HANDBOOK OF SUPPLY CHAIN MANAGEMENT

JAMES B. AYERS

The St. Lucie Press/APICS Series on Resource Management

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by James B. Ayers

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Preface

Supply chains are a hot management topic. Eyes are opening to a more global view of end-to-end material, information, and financial flows. As this introduction is written, two achievements exemplify the trend. Dell Computer has topped the Standard & Poor's 500 index for its 88,918% value gain in the decade of the 1990s. *Forbes* magazine has crowned UPS as the 1999 "company of the year" for its exploding role in e-commerce. Each distinction is a variant on the supply chain theme.

The movement isn't limited to product-making companies. Service businesses of all stripes also have lessons to learn. Intellectual inputs may be as important as physical ones. So the concept of a "supply chain" is broadening to include the intangibles as well as the tangibles. As it is with most good ideas, commercial interest drives much of the supply chain hype. My industry, management consulting, contributes with new buzzwords to stimulate and sustain interest. Substantial contingents of software purveyors also vocalize the concept. Companies investing millions in new systems don't want yesterday's solutions.

"Supply chain thinking," as noted by Riggs and Robbins, is a better characterization.* This term implies a more gradual infusion of new mind-sets and methods into traditional tasks. In many ways, not much has changed. Managers of today have the same concerns as managers had last year, 10 years ago, or 50 years ago. These concerns include products, markets, people and skills, operations, and finance. Supply chain thinking, however, brings change to the tasks managers perform to deal with these issues.

In this book I hope to clarify both the theory and practice of what has come to be called supply chain management, or SCM. The goal of this effort has been to create a handbook for practitioners of supply chain *improvement*. So we emphasize changing supply chains over maintaining supply chains. If we are successful, the reader will keep this reference at the ready. It's hoped it will be the first resource readers turn to for improving supply chains or designing new ones.

The supply chain subject is quite broad. It touches every activity in most companies — and goes beyond company boundaries to boot. To increase the "band width" of this book's coverage of supply chain topics, I've enlisted the assistance of a panel of professionals experienced in the many facets of supply chain improvement. Their contributions are noted throughout the text along with a set of case studies in a separate section. Their backgrounds are not limited to traditional supply chain turf — purchasing, transportation,

* Riggs, David A. and Robbins, Sharon L. *The Executive's Guide to Supply Chain Management: Building Supply Chain Thinking into All Business Processes*, New York, AMACOM, 1998.

and logistics. Their backgrounds include manufacturing and service businesses as well.

I assume that the reader is motivated to improve operations along the supply chain. But the reader may not know exactly what to do or how to do it. I've attempted to collect enough theory and practice to greatly shorten the time it takes to tackle an opportunity for supply chain improvement.

As a consultant, I've always tried to "practice what I preach." That is, the job isn't done until it's successfully implemented. Analysis that's not translated into action is of little use. This philosophy underpins the book. The thought processes and methods recommended here are intended to lower the risk of implementing change. However, it's hard to tinker with a business while you're running it. Someone observed it's like changing the oil in your car at 70 miles per hour on the freeway. So the ideas in the book should make the job more feasible.

The book has four sections, described below.

Section I: Supply Chain Overview (Chapters 1 to 6)

This section traces the evolution of concepts implicit in the supply chain. It seeks to establish the role of SCM in running the business and constantly improving its ability to compete. The section contains descriptions of models for competing, many of which have contributed to today's focus on chains as competitors rather than individual companies. From this work, we develop a model for classifying supply chain improvement projects according to their contribution to improving competitive position.

Use this section to add to your own understanding. Show it to your management team for a quick overview on the importance of supply chain management. Use it also to put together those often too frequent briefings for management and others in the organization on the supply chain management topic.

Section II: The Supply Chain Challenge — Five Tasks for Management (Chapters 7 to 29)

This section describes ways to perform the five SCM tasks better. They cover a variety of management techniques that, while not necessarily new, find fresh application in supply chain improvement. The five tasks and the associated chapters are shown in the following table.

1. Designing supply chains for strategic advantage	Today's success stories show that innovation in chain design is vital to competitive advantage.	Chapters 7 to 9
2. Implementing collaborative relationships	Functional command and control will give way to new structures within the enterprise.	Chapters 10 to 13
3. Forging supply chain partnerships	Working together beats going it alone. The need to partner is real.	Chapters 14 to 20
4. Managing supply chain information	Opportunities to succeed wildly or fail miserably abound.	Chapters 21 to 23
5. Making money from the supply chain	Pricing and cost always matter but ways of measuring money and managing the supply chain efficiently will change.	Chapters 24 to 29

Use this section to find your way around a particular problem. Use it also in planning a supply chain improvement project. It will yield ideas for the structure and tasks of such a program.

Section III: Supply Chain Methodologies (Chapters 30 to 33)

For those looking for more specific direction, I've included a section on performing certain important supply chain improvement tasks. The methodologies include activities needed to create a plan for supply chain improvement plus likely tasks that will be performed during implementation.

Section IV: Supply Chain Case Studies (Chapters 34 to 49)

This section contains case studies drawn from the published papers, presentations, and collective experience of contributors to this book. Each illustrates the application of one or more techniques or principles of SCM. I also attempt to show that supply chain improvement is not confined to product-only supply chains. It also extends to service businesses that must manage physical and intellectual capital.

James B. Ayers

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About the Editor

James B. Ayers is a principal with CGR Management Consultants, Los Angeles, CA (E-mail: jimayers@cgrmc.com). He has consulted in strategy and operations improvement for 29 years. His clients include large and small companies in manufacturing and distribution industries. In addition, he has served clients delivering services in transportation, healthcare, engineering, utility, and financial industries. He has authored numerous articles and has presented workshops on product and process development.

Mr. Ayers holds a B.S. with distinction from the U.S. Naval Academy and M.B.A. and M.S. Industrial Engineering degrees from Stanford University. As a naval officer, he served on nuclear submarines. He is also a member of the Society of Manufacturing Engineers and Council of Logistics Management. He is a Certified Management Consultant (CMC) by the Institute of Management Consultants.

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Undertaking the writing of a book like this one, I found, soon exceeded my capacity for dispensing wisdom about the supply chain. In putting the pieces together, I found I was constantly recalling "bits and pieces" gathered in my associations with clients, other consultants, the news, and a number of publications. Fortunately, material from these sources is plentiful since the supply chain is a widely discussed phenomenon. I view my contribution as interpreting a number of models and viewpoints in a supply chain context. Because I ended up bringing together the insights of many, I have used the plural pronoun "we" instead of "I" throughout the book.

I especially appreciate the insights of Crispin Vincente-Brown, Bernhard Hadeler, Pete Crosby, Keith and Jim Kennedy, Dave Malmberg, Craig Gustin, Mike Aghajanian, Joel Sutherland, and Mark Marcussen for their reviews of my work-in-progress and helpful comments, plus insights gathered over the years. No author can cover all publications but, as the reader will soon discover, much is drawn from *Harvard Business Review*, *The Wall Street Journal*, and *Logistics*. I would also like to thank St. Lucie's Drew Gierman for his support during the project and Christian Kirkpatrick for suggesting it in the first place.

The book also has many chapters dedicated to supply chain improvement methodologies and case studies. These add a "touch of reality" to the frameworks and examples in the earlier chapters. They include both successful and not-so-successful endeavors across the supply chain spectrum. I would like to acknowledge the contributions of the authors of those cases and methodologies here.

To the greatest family on the face of the planet — at least in my humble opinion. Paula, Matt, Kelly, and Alex

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Section I

Supply Chain Overview

We begin with a look backward at the development of supply chain thinking. A primary theme of this book is that supply chain management is not just a tactical discipline. The basis for competition in many industries has shifted from inside to outside the single company. Competitive success will rest in the total enterprise that develops, makes, and delivers both products and services.

Within the field of what we call supply chain management (SCM), there are many "communities." These include the purchasing community, the warehouse and transportation community, the manufacturing community, and the technology community, among others. This section will attempt to address all these in terms of the impact on their functions from changes in supply chain management practice.

Section I describes some early, pertinent models for thinking about strategy. We combine these models into one to which we return several times in describing initiatives to improve the supply chain. Section I covers six chapters. Highlights from each are shown in the following paragraphs.

1. Introduction to the Supply Chain
   - Supply chain definitions.
   - The idea of the "extended product"
2. Supply Chain Paradigms
   - Different views of SCM.
   - Examples of the impact of the supply chain in competing.
3. Supply Chain Potency
   - What it means to have a great supply chain.

4. Evolution of Supply Chain Models
   - Description of models for strategy development and how they affect SCM.
5. Generic Model for Competing Through SCM
   - The supply chain and the product life cycle.
   - Model for classifying supply chain improvement projects.
6. Linking the Supply Chain with the Customer
   - Functional versus Innovative supply chains.
   - Use of the QFD tool for establishing customer requirements.

1

Introduction to the Supply Chain

Manufacturers now compete less on product and quality — which are often comparable – and more on inventory turns and speed to market.

John Kasarda, *Forbes,* October 18, 1999

1.1 Introduction

The above quotation by John Kasarda, a professor of logistics at the University of North Carolina's Kenan-Flagler Business School, supports a principal theme of this book. This is the belief that supply chain management will increasingly be the principal determinant of the ability to compete. We begin by setting the stage with a few basic definitions related to the "supply chain." Any discussion of the supply chain can legitimately be broad or narrow depending on the perspective of the "definer" and the interests of those involved in the conversation. In meetings of the Council of Logistics Management, for example, the discussion turns to distribution systems, transportation, and warehousing. The Society of Manufacturing Engineers may focus on the manufacturing systems that promote "supply chain" effectiveness.

Whatever the forum, the trend is to broaden the definition of the supply chain. One consensus definition holds that the supply chain is all that happens to a product from "dirt to dust." In this view, the supply chain begins with mining ores or growing crops, extracting raw material from Mother Earth. The chain goes on to a multitude of conversion and distribution processes that deliver the product to the end user. It ends with ultimate disposal — presumably back in Mother Earth somewhere.

This book also subscribes to the broad view of the supply chain. We think the supply chain and supply chain management topics deserve that kind of coverage. We'll cover topics ranging from strategies for using the supply chain down to improving supply chain cost effectiveness. For products and services, we also cover the so-called "life cycle" from inception to market maturity to decline. We hope to strike the right balance of theory and practice, of art and science.

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1.2 Defining Supply Chains

Defining terms will help us frame our supply chain discussion. A beginning is a working definition of *supply chain*. The supply chain is more than the physical movement of goods "from earth to earth." It is also information, money movement, and the creation and deployment of intellectual capital, or, as some call it, "knowledge work."

Joel Sutherland of J.B. Hunt Logistics, Inc. has captured the essence of the discussion when he describes the difference between the term "logistics" and "supply chain." Sutherland was an active participant in the deliberations of the Council of Logistics Management and its efforts to build the lexicon of supply chain terminology. He points to three different common views of the supply chain.

1. "Supply chain" is just another term for "logistics."
2. Supply chain includes other functions such as purchasing, engineering, production, finance, marketing, and related control activities in the single company.
3. The supply chain is all the functions in definition #2 plus those in a company's suppliers' suppliers and a company's customers' customers as well — extending far outside the traditional enterprise.[1]

For his part, Sutherland subscribes to definition #3. We would add our two cents' worth with the following definition:

> **Supply chain**: Life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with products and services from multiple linked suppliers.

Let's examine the definition in greater detail. First, the supply chain is made up of *processes*. These cover a broad range including sourcing, manufacturing, transporting, and selling physical products. The definition includes the corresponding activities for a service. *Life cycle* refers to both the market life cycle and the usage life cycle. For many durable goods and services these aren't the same. Many products may be sold in a time window that's relatively short compared with their useful lives. That computer, a product, and that 30-year mortgage, a service, must be supported long after newer products take the place of older ones. For this reason, product support after the sale can be an important — if not the most important — supply chain component. For this reason, the longevity of the seller and its reputation for product support are important factors in the purchasing decision.

Physical, information, and *financial* flows are frequently cited dimensions of the supply chain. The viewpoint of supply chains as only physical distribu-

tion is too limiting. *Information* and *financial* components are as important as *physical* flow in many supply chains. Often omitted from the supply chain discussion is the role of *knowledge* inputs into supply chain processes. A prime example is new-product development. Such knowledge inputs are the stuff of future growth through product innovation. This supply chain process for new products requires close coordination of intellectual input (the design) with physical inputs (components, prototypes, market studies, and the like). Today, added value in the form of intellectual capital is vital to marketing profitable goods and services.

The supply chain should support the satisfaction of *end-user requirements*. These requirements give rise to the fundamental reason for the supply chain in the first place. We also qualify a supply chain as having *multiple linked suppliers.* If we take the point of view of the end-user's view of the chain, we have a supply chain when there are multiple enterprises backing the one from which the user makes his or her purchase. Also, we think a supply chain could be multiple outlets representing a single enterprise. So the neighborhood barber would not constitute a supply chain under our definition. A chain of barbershops would be a supply chain. The farmer selling watermelons from his field by the side of the road would not qualify; the supermarket would.

The supply chain is not limited in terms of flow direction. Many consider supply chains only in terms of flow from suppliers to end-users. For the physical processes, this is largely true. But supply chain design cannot ignore backward flows for product returns, rebates, incentive payments, and so forth. So much of what flows in the supply chain is two-way, including physical product, information, money, and knowledge.

Services also have supply chains. Production planning for the research and development department, which produces designs, not products, can benefit from the same techniques used by product manufacturers. Federal Express and UPS operate service businesses. But they are certainly also complex supply chains. A software company is challenged to constantly improve its product through upgrades, so it too could be considered a supply chain for a knowledge-based product. A new business category, "application service provider" or ASP, is redefining the supply chain for distributing software applications. These examples represent supply chains also.

Through the book, we'll use the term *product* to describe the basic product or service. The *extended product* includes the basic product or service, the supply chain that delivers it, plus other features and factors that go along with the product or service.

In many markets, there may be little difference in the physical products, as we've defined them. Examples include automobiles, personal computers, or cups of coffee. However, there can be great differences in extended products. Examples are the broadened choices we have for buying personal computers like the one used to write this book. We can purchase them in a store, over the Internet, or by telephone. The furniture industry offers another example. We can buy assembled furniture at a neighborhood store or go to a warehouse

operation and buy it unassembled. The prices paid and the "hand-holding" by sales "consultants" is vastly different in the two cases.

Our buying decision likely begins with a need for the basic product or service, but quickly moves to extended product factors such as delivery, service, and reputation. Often, the functionality of the product is taken for granted. Extended product factors rule the buying decision. For many products, the supply chain design is the residence of the most important extended product features.

Figure 1.1 demonstrates the point. It shows some of the factors that might influence us to buy a computer. Once we decide we need a computer, many more decisions must be made. We must decide what kind of computer — factors associated with the physical "base product." Should the computer be a laptop or a desktop? Latest technology or something adequate for our tasks? How much capacity for the hard drive, the memory? What should it cost? How much can we afford to pay? Where can we get the best deal?

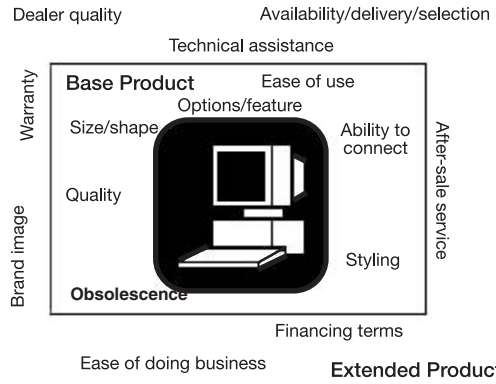


FIGURE 1.1
The extended product.

Once we make these decisions, we still have decisions based on "extended product" features. These tend to be more subtle and intuitive. Figure 1.1 shows some "outside the box" factors one might consider. These include dealer quality, selection, brand image, service, and customer support. The supply chain enters into a number of these extended product factors. Here are a few examples:

- **Dealer quality**: If the sale is through a dealer or retail network, how it operates, its facilities, its reputation are key factors in the buying decision.

- **Availability/delivery and selection**: Having the right model at the right time for the right buyer often means a sale. Supply chain cycle times and information systems improve the chances.
- **After-sale service and warranty**: Many buyers look to this important support network when buying. For many, this service is also very lucrative.
- **Financing**: Except for those who pay cash, the convenience and speed of this closely related service may make or break a deal. Some computer sellers set a monthly price and will keep your PC up to date "forever."
- **Accessibility — ease of doing busines**s: This covers the whole range of contact points between the customer and supply chain. How well is the organization staffed? Are the procedures user friendly? Are responses prompt? Will the organization be around when the need arises?

Many products we buy or contemplate buying have similar customer dynamics. A poorly executed base product will fail in the market. On the other hand, having a well-executed base product doesn't necessarily assure success. When competitors loom, it will be the best basic product along with the best extended product features that will succeed.

1.3 Defining Supply Chain Management

Let's move on to define "supply chain management." This term is gaining currency, implying that there is something different about managing the supply chain. The acronym "SCM" is employed by many as shorthand for the term. Here is our definition of SCM.

> **Supply chain management:** Design, maintenance, and operation of supply chain processes for satisfaction of end user needs.

We feel that SCM is a discipline worthy of a distinct identity. This identity puts it on a level with other disciplines like finance, operations, or marketing. Indeed, many companies now have an executive with just such a title. Our definition reflects the idea that SCM extends to both the supply chain formulation and its subsequent operation and maintenance. This book focuses on both. We discuss SCM in terms of strategic design, getting the most in competitive success from supply chain design. We also discuss options for organizing to sustain the design in operation. Another topic, wringing costs out of the supply chain, strikes at the maintenance and improvement of an existing chain.

SCM creates new challenges for managers. Old missions must be achieved in new ways. This book reports on progress in redefining the manager's work brought on by SCM. In general SCM is broadening the roles of many. We begin in Chapter 2 with a description of the frequently encountered supply chain viewpoints that reside in different organizations.

References

1. Sutherland, Joel, unpublished data, 1999.

2

Supply Chain Management — The "Right" Way

Traffic managers became physical distribution managers, who then turned into logistics managers, and today are morphing into supply chain managers.
Francis J. Quinn, Editor, *Supply Chain Management Review*

2.1 Supply Chain Viewpoints

The quote by Francis Quinn taken from the periodical *Logistics* reflects a common response in companies as they scramble to deal with the challenges of supply chain management.[1] Supply chains and the associated tasks that go with SCM very much depend on the eyes of the beholder. Different companies — and even managers in a single company — have different viewpoints, or paradigms, when it comes to the supply chain. And these paradigms are evolving rapidly. There is no right or wrong supply chain viewpoint. In fact, the view in one company probably should differ from the view in another. This is because their situations are surely different and what works for one won't work for another. We should also recognize that the "right" viewpoint is not static. As time moves on and competitive pressures shift, the need to change viewpoints will surely occur.

Right now, we would say that there are "factions" comprised of managers with a common mindset about the supply chain. Here we describe the generic perspectives we've encountered and attempt to tie them together. We will work "bottom up" from what we judge to be the narrowest of the supply chain interpretations to the broadest.

2.1.1 Functional

The functional supply chain viewpoint exists in most companies today, and should be considered the "base state." When talking to companies about SCM, we assume this is the perspective that exists in the company. Organiza-

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tions that don't think in supply chain terms at all certainly fit the functional paradigm. In this view, companies are a collection of individual departments. In manufacturing companies, examples of dominant functions are Procurement, Operations, Engineering, and Distribution. In the functional organization, each department has, to a large degree, its own agenda. Oversight of links between departments is weak within the company. Between companies in the supply chain, it's practically nonexistent.

Performance evaluation in these companies typically centers on cost. Procurement is measured on the purchase cost of material and material overhead rates. Manufacturing has measures such as direct labor productivity and the cost of quality of delivered products. Distribution effectiveness is measured on the percentage of selling price represented by distribution cost.

In the functional organization, strong department heads sponsor change projects. "Cross-talk" among departments is minimal. Information systems also center on the needs of the departments. Most improvement initiatives are local. They may or may not improve the supply chain as a whole. In fact, a "local optimum" may be injurious to the whole, yet department heads take credit for their "savings." Where the functional viewpoint prevails, the actual impact of improvement projects on the total supply chain isn't measured.

2.1.2 Procurement

Often, the move away from the functional viewpoint begins with efforts to lower the cost of materials. This viewpoint gave rise to the "supply" in "supply chain." In many product-making organizations today, the cost of material is the largest cost component. So, to quote a famous bank robber, management focuses its efforts "where the money is." When you talk of the supply chain, these companies think of suppliers and procurement.

Service organizations also buy many goods and services. Many look for ways to consolidate their demand for support items like office supplies, having realized they spend ample amounts in this category. Also, many service organizations depend on other suppliers. For example, auto insurers have large networks of repair shops and adjusters. Healthcare is another industry of networked "providers." These include physician medical groups, hospitals, and insurers. Seeking long-term relationships to lower costs is important in an era of managed care.

The cost of outside material and services makes this an attractive target for cost reduction. This brings on programs such as sourcing initiatives, supplier reduction programs, and vendor-managed inventory (VMI). Efforts in companies following the procurement viewpoint reach outside the company into the upstream supplier base. Their initiatives include "partnering" with the supplier and shrinking the supplier base. Frequently, especially when the buyer dominates the seller, partnership talk centers on price reductions. Frequently, this shifts profits from one party to another in the chain without fundamental improvement.

In this paradigm, the procurement executive is the most likely candidate to be chosen as the supply chain executive.

2.1.3 Logistics

The idea of companies linked together has roots in the logistics field that includes warehousing and transportation management. Of course, physical movement of products along stages in the supply chain is an important part of most economies. The Council of Logistics Management (CLM) defines "logistics" as follows:

> Logistics is that part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements.

It's notable that CLM includes goods and services, plus related information, in its definition. It also takes note of "customers' requirements" and the need to fulfill these. As we noted in Chapter 1, some practitioners view "logistics" and "supply chain" as equivalent entities.

The logistics view often addresses the outbound downstream side in much the same way as the procurement viewpoint worked with the inbound side. Supply chain improvement focuses on cost reduction aimed at incremental improvements in profit. Typical activities include modeling or automating warehouses, distribution centers, and transportation networks to reduce cost.

In the logistics and transportation paradigm, when companies decide to anoint a supply chain executive, they will likely pick the head of distribution. In place of the "supply chain" term, these companies may use an alternative term, the "demand chain." This reflects attention paid to the outbound, rather than the inbound, or supply side, side of the business. (We won't adopt this convention in this book.)

2.1.4 Information

The information viewpoint seeks to improve the links within both the company and the supply chain by implementing computer applications. New software products plus new ways of moving information around make this an active area. Electronic data interchange (EDI) is an early example of ways to improve communications among companies. A barrier has been the lack of integrated software, both inside and outside the company. Efforts are being made by organizations such as the Supply-Chain Council (described in Chapter 23) to standardize definitions of data elements and processes. This facilitates information sharing along the supply chain.

Dramatic results have come from the use of information to improve supply chain performance. A frequently cited example is Wal-Mart, which moves point-of-sale data back through its system to its suppliers. This reduces the need for forecasting in supply chain decision-making. One shortcoming associated with this perspective is the lack of "process consciousness." Efforts to implement new systems often become all-encompassing, absorbing time, staff, and money resources. The effort drives toward implementation of the technology, not necessarily improvement in underlying processes.

2.1.5 Business Process Reengineering

Business process reengineering (BPR) efforts call for "radical" restructuring of processes to eliminate waste and improve quality. Some commentators have declared the death of BPR. For many, it's associated with downsizing and layoffs. However, the intent of BPR, if not the label, will always be with us. BPR-type efforts take many forms. For example, new computer systems and reengineering are closely linked in many minds. "Six sigma" is a quality initiative that's also a close cousin of BPR. Systems and technology design should follow process design. This is also the intent of BPR. So the underlying process requirements, not the technology itself, are the dominant force behind the change. The technology becomes an "enabler" of an improved process.

Most BPR efforts are confined to one company. But BPR, even if it's not labeled as such, across multiple members of the supply chain will be increasingly common.

2.1.6 Strategic

Some view supply chain design as integral to their strategies for competing. For them, the challenge of competing centers not only on products but also on the operations that make up the "extended product," as described in Chapter 1. These operations deliver the physical and extended products to customers' hands. With this viewpoint, supplier relations, logistics, and information systems support customer satisfaction. This, in turn, leads to increased market share and profit. Costs, while important, are secondary.

We discuss this last view in depth in this book. This is not intended to lessen the importance of the other views. But those views are subordinated to the strategic context in which implementation projects are conducted. All projects to implement a new supply chain or to change an existing one will affect the organization's ability to compete. This impact is better planned than left to chance. We present what we hope are valuable tools for putting the supply chain to work strategically.

2.2 Evidence of the Impact

The business press, plus our own experiences as consumers, reinforces an important message. Supply chains in many industries are changing rapidly. The following paragraphs contain examples — many of which may be familiar to the reader. Many situations reflect how the "extended product" described in Chapter 1 has become a competitive battleground. We then continue to describe the dangers of ignoring changes in the supply chain.

We've observed that different industries and companies view supply chains and supply chain change in different ways. These changes reflect broad undercurrents and may not be seen by participants in the industry. The following examples call attention to these undercurrents in a few selected industries. We do this through the eyes of industry observers and commentators. We term this "buzz." The examples point to the growing importance of supply chain management in coming years. In the examples, we call this "spin." The buzz and the spin anecdotes are pointers that indicate what we see as the future for SCM.

2.2.1 Personal Computers

As this book was written, this was one of the most discussed, most commented-on industries on the face of the planet. It holds lessons for SCM because of its speed of growth and the rapid evolution of supply chains used by competitors in the industry.

2.2.1.1 What Observers Say — The Buzz

The industry began as a high-growth, high-profit business with most sales coming from retail stores. The product itself evolved to where there are now only minor observed differences from one company's product to another's. In fact, much of the product innovation effort centers on producing cheaper and cheaper machines. Introducing ever more sophisticated components such as processors has exhausted its potential for increasing sales dramatically. Consumers have found that lower-performing machines are "good enough." Practical day-to-day use requires much less than what the industry can deliver in terms of technology. So knock-off processors and low-cost machines have penetrated the market.

One response has been the emergence of alternative supply chains that focus on the extended product. Dell sells direct over the telephone or through its Internet site. Dell has lowered overhead and improved cash flow by using supplier capital to finance its business. Existing channels make it hard for other manufacturers to shift their supply chains. They fear alienation of their retail partners if they bypass them and go direct. But the pressure to have a

direct outlet is irresistible. Internet sales are also growing. One software retailer, Egghead, closed its entire retail chain, which focused on software, and started pushing products over the Internet.

2.2.1.2 The Supply Chain Spin

These trends reflect the emerging dominance of supply chain design over product design for this industry — particularly as products reach maturity in their life cycles. Most personal computer components and software are readily available to all producers. Manufacturing is in essence an order-taking and final assembly operation. Extended product activities, which we define here as part of the supply chain, have become the basis for competitive advantage. These features include customer support, the ability to customize to a wide range of configurations, rapid response, and purchasing clout through high-volume operations.

2.2.2 Entertainment

This is an industry where knowledge is the primary input to the product, with the material content in the final product being trivial. A movie is something we bring home from the video store for its entertainment value, not for the tape, the case, and plastic spool that compose its package. The physical form of the product is a minor portion of the price we pay. Over 90% of our dollar is spent on intellectual "components" arising from the creativity of artists, writers, directors, and producers.

2.2.2.1 One Company's Challenge

Rhino Entertainment undertook an overhaul of its supply chain. Rhino's specialty is re-release of popular music in a broad range of genres. Rhino uses the knowledge of its music experts to decide what "packages" will be successful in the market. Rhino then gains permission to publish its selections from license holders, who "own" the intellectual property. The licensers are both large and small music companies. Some of the large ones may even compete with Rhino. Rhino product managers for assigned markets decide how to promote the release in the marketplace.

Only after these steps does the actual physical product take shape. This involves transferring recordings of the tracks (songs) from original sources, design of the package artwork to attract buyers, and arranging production of compact discs and tapes with a contract manufacturer. At Rhino, only a third of those involved in the process actually work on the physical aspects of the product. The remaining employees work with ideas, licensers, and the media. A small portion of the customer's dollar goes to physical product; most goes to the knowledge requirements behind the release.

The Rhino process produces about 15 product releases each month, with about a dozen songs for each release. That works out to about 180 licenses per

month. At the beginning of the redesign of its processes, it took up to two years to produce some releases. An "uncontrollable" in the process was the time needed to obtain approvals from licensers. Although permissions were usually granted, there frequently was considerable delay in responding as requests for licenses queued up. This was considered, with much justification, as an "out of control" factor. Another factor in the extended lead-time was the lack of concurrent processes. Rhino's internal production tasks were serial, with none starting before the previous one was complete.

The old process resulted in a loss of control over the timing of releases. This in turn hobbled financial planning. Often sales were tied to key events in the marketplace. Christmas music for Christmas is an obvious example. A product composed of winning Academy Award tracks timed for released at Oscar time is a less obvious one.

2.2.2.2 The Supply Chain Spin

Rhino is an example of a company whose product is far more knowledge than tangible product. But efficient production requires the same management and coordination one must give to a complex physical product. So the domain of physical and intellectual products aren't widely separated — if they are separated at all. The techniques described throughout this book are meant to have equal application in both cases.

2.2.3 Adding Value Through Brands

Branding reflects the collective view we have of a product. Brands are built on reputations among customers, product functionality, advertising and promotion, and awareness of the company's product among potential buyers. By establishing a brand image, a company's value can greatly exceed its book value. Book value is a calculated measure of company worth determined by accounting rules. These rules recognize tangible value in assets such as brick and mortar and inventory. But the "market cap" or value placed on the company by investors may greatly exceed book value. Much of this added value is due to brand value in an attractive market.

2.2.3.1 The Buzz on Brands

Branding is a vital component in building shareholder value. The brand distinguishes the company and its products from a crowded competitive field. The importance of the brand increases in mature markets. In growth situations, there is often market enough for everyone. Having enough product may be the principal challenge. As capacity catches up with demand, the overall value of the brand becomes more and more important. Brand image evolves from product to extended product features. Brand value increasingly shifts from the physical product to extended product features.

2.2.3.2 The Supply Chain Spin

The supply chain contributes greatly to brand image. Specific supply chain operations that contribute to brand image include the following:

Channels	**Vans.** This California shoe company caters to the youth market with skateboard parks and "hip" gear. It sells through retailers, its own stores, and factory outlets.
Hand-holding	**Solar Turbines.** This San Diego based division of Caterpillar sells on-site power generation equipment. It has disclosed plans to use a "one touch" repair guarantee to assure customers of uninterrupted service.
Give-away	**Free computers.** On-line services have competed for "eyeballs" by giving away or deeply discounting the access tool, a personal computer.
Staying power	**IBM.** In its days of uncontested glory, decision-makers couldn't miss by buying "Big Blue."
Lots of product	**On-line booksellers.** After Amazon's early market success, it and rival Barnes & Noble started competing on how many millions of titles they offer.
Cheap	**"Category killers."** Companies such as Staples and Home Depot use economies of scale to offer low price.
Roll-ups	**U.S. Filter.** This company actively acquired companies providing water equipment and services. When acquired for a premium over its stock exchange price, it was 15 times the size of its nearest competitor.
"Clicks & bricks"	Internet-based businesses are teaming with retail chains. The purpose is to provide the convenience of on-line shopping plus the accessibility of the local Radio Shack or Best Buy.

Each example relies on the supply chain, at least in part, for its competitive edge. Vans uses its alternative channels to boost sales and off-load excess inventory. Solar has targeted a growing market for cogeneration. This market, emerging from electric utility deregulation, involves placing smaller gas turbine generators at local operating sites. Customers in this market aren't

accustomed to maintaining gas turbines. So Solar will provide this service as part of its "extended product."

Giving away computers is like giving away the razor to sell the blades. One can't go on line without the computer. So, the theory goes, give away the computer and gain a captive audience. IBM and the on-line booksellers compete on the breadth of their product. The IBM decision removed risk for buyers for large-ticket systems. Booksellers are looking for product supply breadth as a competitive edge. This is after rivalry among on-line sellers has made the convenience and price no longer a point of differentiation. The category killers and roll-ups have increased purchasing power. Making buys in large volume increases their clout with suppliers.

2.2.4 Healthcare

In the U.S., healthcare is an industry in turmoil. Much of the turmoil is due to the complexity of the supply chain, which includes medical service providers, medical groups, insurance companies, employers, government regulators and, of course, users of healthcare services. Most people don't pay directly for healthcare services. Private companies, through their employee benefit plans, and the government, through Medicare and Medicaid, pay most of the bills.

The industry accounts for 14% of the U.S. economy, but many payers feel they aren't getting their money's worth. Studies point to waste from lack of — or failure in — basic quality-control procedures. There are many anecdotes pointing out that the frequency of use has more to do with the available capacity than medical need. The "disconnect" between the payers and users is often blamed for building wasteful habits into industry management practices.

The industry contains supply chains of several types. There are professional services, including physician and hospital services. There are lucrative patented pharmaceutical products, often developed at great expense. The industry also needs a plethora of support equipment ranging from sophisticated electronic testing equipment to gloves used in patient treatment.

2.2.4.1 What Observers Say — The Buzz

Pressures on the industry have fostered innovation in the design of services and organizations. Most of the innovations have two themes. The first imperative is to get larger. This brings consolidation of individual physician practices and partnering between doctors and hospitals. The second imperative, supported by the first, is cost reduction. This includes many facets already encountered in other industries. Examples are variation reduction, overhauling processes, and upgrading management skills.

2.2.4.2 The Supply Chain Spin

The industry must find some flexible and efficient delivery "enterprise." This enterprise must have substantial capital behind it and be capable of efficient operations. This means effective management of a broad range of processes with diverse measures from medical outcomes to the cost of tissue paper. It is likely a trial and error process requiring persistence and patience. As evidenced by the number of physicians taking M.B.A. courses, it also requires new skills.

One major customer for healthcare services, DaimlerChrysler, has directly intervened with its healthcare providers. This is in the form of supply chain consultants using the tools of manufacturing productivity to improve service and lower cost.

2.3 SCM — Defensive and Offensive Weapon

There are many dangers in ignoring SCM as a discipline. The most serious is the loss of profitable customers. The hypothetical supply chain in Figure 2.1 illustrates the physical movement of products through a traditional network. The flow begins with several suppliers. They send raw material to a factory. Other material that requires no conversion goes directly to warehouses that support customers. The factory outbound shipments supply a distribution center or regional warehouses. The distribution center and warehouses support customer demand.

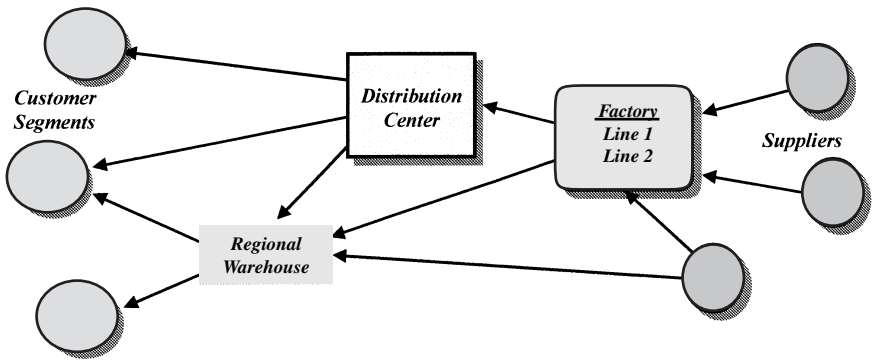


FIGURE 2.1
Hypothetical supply chain.

However, these customers aren't homogeneous. They are likely to be sorted into segments, with each segment having distinct requirements. Perhaps individual customers in each segment also have preferences that have to be addressed. These requirements may arise from differences in how the product is used or features of the extended product, including customer service, information, and technical assistance. Sometimes companies fail to recognize these segments and their distinct requirements. This leads to a "one size fits all" supply chain design that is difficult to change. In effect, the supply chain is a compromise based on the demands of different segments, and no segment is served as well as it could be.

The threat arises when a competitor perceives the service shortfall. That competitor detects an opportunity and structures a focused supply chain based on the needs of an attractive segment. Figure 2.2 illustrates the result.

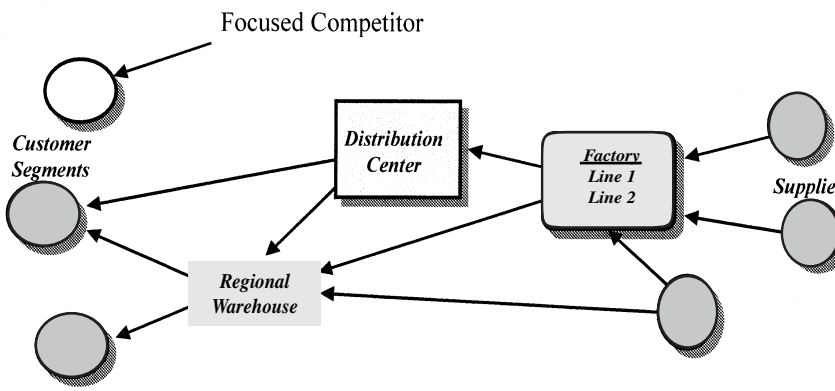


FIGURE 2.2
Impact of focused competitor.

The consequence is loss of a customer segment. Very often this segment is the most profitable. This is because the focused competitor does his homework not only on the supply chain features needed but also on the economics of delivering those features. This process may occur over long periods of time and be seen as erosion of market share. Often, it can be dramatic — executed by an upstart company or start-up outside the industry.

The threat we've discussed is also an opportunity. Supply chain management, SCM, enables one's own enterprise to "pick off" entrenched competitors. So SCM is both a defensive and offensive weapon. We'll describe ways to use SCM tools offensively in future chapters. The next chapter begins this journey by reviewing some of the thinking that has led to where we are today. To do this we ask how well our current supply chain investment strategies contribute to competitiveness.

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3

Supply Chain Potency

Potency, n., power, strength

3.1 The Need for Help

Businesses around the world spend billions every year on better products and processes. Products and services along with the supply chains that deliver them are "on the move." They are constantly changing in new and unexpected ways. Most of the investments made in what we broadly refer to as "product development" or "operations" have at least some, and more often a lot, of impact on the supply chain. These expenditures include product research and development, systems upgrades, capital investments in brick, mortar, and equipment, and even enhancement of employee skills. Managers are faced with a myriad of choices asking, "What should I do next?"

We hope this book will help answer that question. This chapter introduces those that follow. Its purpose is to argue for a framework for analyzing and understanding the potential of supply chain projects for building "potent" supply chains. After all, this book is less about *running* supply chains than it is about *improving* them.

What's the payoff? Managers are fond of measures. We all like to know how we're doing and where we stand: "If you can't measure it, you can't manage it." Some managers are fond of this characterization. However, despite the rigor of most financial systems, many managers often have to accept on faith that a project either proposed or recently completed is worth the effort.

For example a manager or writer will describe some organization, including his or her own, as "world class." This implies an advanced competitive position in world markets, being the benchmark leader others in the industry turn to for ideas. But it's hard to measure "world class" with any great precision. We sort of "know it when we see it."

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Quality measures are another popular yardstick. We see organizations strive for "six sigma" processes. Six sigma is a quality gauge and measures the number of defects in potential occurrences. It stresses execution of internal operations, building quality into each product. Six sigma performance, with a very small frequency of defects, implies perfection in executing processes. Six sigma companies squeeze out unwanted cost brought on by low quality. In recent years six sigma has taken on a broader meaning. It's now a code word for excellence in any process. This includes managerial, administrative, and technical tasks.

The Malcolm Baldrige National Quality Award (MBNQA), presented by the U.S. government, is another example of a quality yardstick. It has a comprehensive checklist that defines "quality" in terms of both internal operations and customer expectations. So it's both externally and internally focused. Companies use the checklist to guide internal evaluations. Some go through the review for an outsider's perspective on their operations. Excellence here doesn't necessarily assure economic success, however; at least one winner went bankrupt.

In measuring supply chain information systems, "integration" is a frequent yardstick. A client once expressed the desire to become an "integrated company." This is consistent with an information systems view of the supply chain as we described it in Chapter 2. We encounter many supply chain improvement projects intended to "integrate the enterprise." According to Hau Lee of Stanford, a company can be more or less integrated based on the following: [1]

- Sharing of information and knowledge along the supply chain.
- Coordination of decision making along links in the supply chain.
- Tight linkage of organizational relationships between companies, with aligned incentives among supply chain partners.

The more information sharing, coordination, and linkage there is, the more integrated — and presumably *better* — the supply chain. We'll return to this topic in our discussion of proactive systems in Chapter 28.

Finally, there are multiple financial measures for improvement projects. Indeed most proposed projects will encounter a capital budgeting process at one time or another on the path to approval and implementation. This process frequently includes a financial justification. There, projects will be subjected to Internal Rates of Return, Net Present Value, or Earned Value types of examination. We'll discuss these in more depth in our chapters on cost reduction in the supply chain.

Of course, the president of a company can point to his or her financial statements as an indicator of performance. After all, most businesses need profits — now or in the future — as a by-product of serving customers. As long as the financial statements are solid, the business must be solid — right? Maybe not. Financial statements are backward looking. The business may be head-

ing for troubled waters, with few signs of problems apparent just by looking at the numbers.

3.2 Potent Supply Chains

We like the term *potency* to describe the effectiveness of initiatives to change the supply chain. How "potent" are these initiatives? How do we measure potency? What is the yardstick? We would define potency as the *power* or *strength* of the initiative in **improving the ability to compete**. We have to look beyond the measures mentioned above. Any of these measures — world class, quality, financial, or integration — are means to an end. And that end is a rosier future based on the ability to compete. Figure 3.1 depicts the relationship.

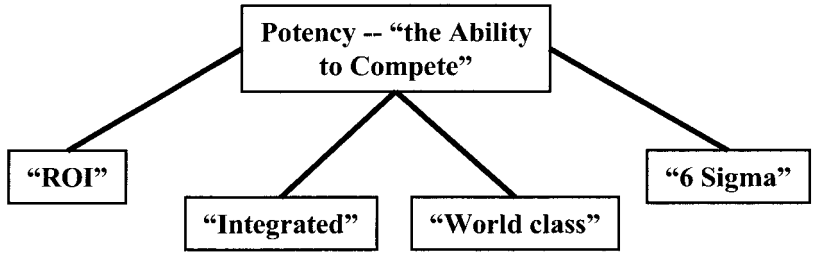


FIGURE 3.1
Interpretations of potency.

Efforts to improve quality and integration or move the organization toward recognition as world class probably contribute to potency. But often it is the integration or the quality level itself that's the objective — regardless of impact on competitive position. You can have quality improvement without improvement in competitive position. While this has benefit as a "rallying cry" or company slogan, it may or may not be potent in the sense we use here.

In the next few chapters and throughout the book, we'll develop a framework for supply chain improvement initiatives in terms of potency. To help us begin, and to gain an understanding of contributions already available to us, we visit recent and not-so-recent thinking on strategy and operations. They offer various approaches to help us in developing our framework. They are also useful in tracing how we've come to this point in our thinking about supply chains. We then offer our version — a synthesis — of these models. We encourage the reader to pick the best approach for his or her own situation.

The models we discuss here are shown in Table 3.1. Note in Table 3.1 that each takes a different approach in interpreting the business environment. This is to be expected at this stage in the development of supply chain thinking. There are often no absolutes in the managerial world. But there are some helpful ways to think about decisions on where to invest to improve competitive position.

TABLE 3.1

Models for Measuring SCM Initiatives for Potency

Model	Originator	Potency Measure
Manufacturing strategy stages	Hayes & Wheelwright[2]	Support of the strategic plan.
Driving force	Robert[3]	Support of the single driving force (of 10 alternatives) in determining the competitiveness of the organization.
Supply chain progression	Poirier[4]	Degree of supply chain cooperation and technology infusion.
Product life cycle grid	Ayers, Gustin, and Stephens[5]	Product position with respect to its competitors and/or life cycle stage.

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4

Evolution of Supply Chain Models

> The assumption that underlies the notion of facilities focus is that a factory or, for that matter, any organizational entity will perform better when assigned a narrower, more clearly defined set of tasks than it would when required to perform a broader, more nebulous set of tasks.
>
> **Robert H. Hayes** and **Steven C. Wheelwright**
> *Restoring Our Competitive Edge, Competing through Manufacturing*

In this chapter we describe several "models" that point to ways product and market strategy can be supported by excellence in operations, especially those operations we associate with the supply chain. The models described here provide needed background in support of the idea that the SCM role should be strategic in nature. If it is, it is potent by our definition in Chapter 3 and improves the ability to compete. The quotation above points to a theme common to many of these models.

4.1 Manufacturing strategy stages

In our first model, we look to earlier efforts to link the strategy implementation with operations. Robert Hayes and Steven Wheelwright have written at length about the opportunity for manufacturing to play a greater role in supporting product and market strategies. In 1984, when they produced their important work on manufacturing strategy, U.S. manufacturers were smarting from perceived and real shortcomings in product development and manufacturing quality. [1]

The authors observed that many companies have a *business strategy* or a *financial strategy* or a *marketing strategy.* But most do not have an explicit *manufacturing strategy.* And many of the competitive shortcomings of the time, low product quality being a key example, could be traced to the shop floor. The authors argued persuasively for a distinct manufacturing strategy that fit with corporate direction. They also characterized ways companies use or don't use operations and manufacturing functions to boost their strategies.

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Their concepts, even though they centered on the manufacturing function, are valuable in discussing supply chains. Fundamentally, Hayes and Wheelwright recognized a linkage between the world of strategy and the world of operations. In our opinion, their observations on *manufacturing* strategy readily apply to *supply chain* strategy.

The authors modeled strategy at three levels, as Figure 4.1 shows.[2] *Corporate* strategy defines the businesses management wants to be in or not be in. It also allocates resources among those businesses. The second level of strategy is the "*strategic business unit*." This is usually a subsidiary, division, or product line. A business unit will have its own strategy. This strategy, according to the authors, links to the corporate strategy and states the basis on which the business unit will achieve and maintain a competitive advantage.

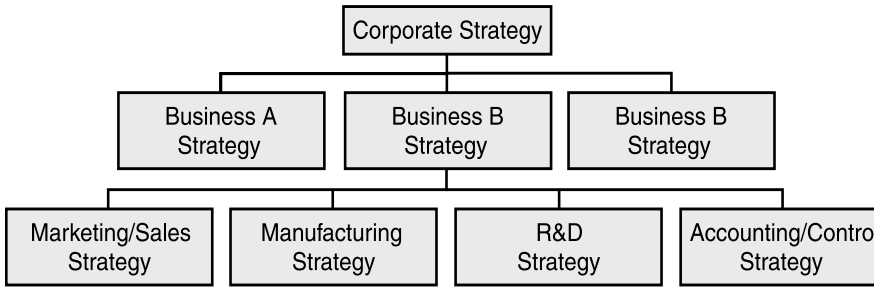


FIGURE 4.1
Strategy at three levels. (From Hayes, Robert H. and Wheelwright, Steven C., *Restoring Our Competitive Edge: Competing Through Manufacturing*, New York, John Wiley & Sons, 1994. Reprinted by permission of John Wiley & Sons, Inc.)

The third level of strategy is *functional*. The business unit strategy should drive the functional area strategies. The four functions shown in the figure are examples. In another business unit, the functions might include distribution or field maintenance or procurement. In this model the supply chain is an anomaly. It's neither a function nor a business unit. It is a cross-functional process that extends beyond the borders of the business unit.

The authors note that most organizations find strategy planning on functional lines (vertically on the organization chart) far easier than along processes that run horizontally on the chart. That rings true today. In companies we've observed, if a strategy exists at all, department heads, such as the manufacturing vice president, write functional strategies that may or may not be well aligned with the business unit strategy. We described this situation in Chapter 2.

However, supply chain processes like product development, launching new products, and customer fulfillment are horizontal processes. The collaboration required makes it hard to write a process-oriented substrategy for the

business unit. A fresh challenge arises in pushing those horizontal processes outside the company, like one must do for the supply chain.

Hayes and Wheelwright define manufacturing strategy as having the eight decision categories shown in Table 4.1.[3] The first four decision categories are "structural" in nature. They are represented by assets such as buildings and equipment, which are difficult to replicate or replace, and are expensive to implement or alter. They likely require capital expenditures to implement and are governed by the capital budgeting process. The last four categories, termed "infrastructure," are more "tactical." They likely are not linked to capital investments. But the infrastructure items can be no less difficult to change and no less important in determining the destiny of the business.

TABLE 4.1

Decision Categories for a Manufacturing Strategy

Capacity	Amount, timing, type
Facilities	Size, location, specialization
Technology	Equipment, automation, linkages
Vertical integration	Direction, extent, balance
Workforce	Skill level, wage policies, employment security
Quality	Defect prevention, monitoring, intervention
Production planning & materials control	Sourcing policies, centralization, decision rules
Organization	Structure, control/reward systems, role of staff groups

Source: Hayes, Robert H. and Wheelwright, Steven C., *Restoring Our Competitive Edge: Competing through Manufacturing*, New York, John Wiley & Sons, 1984. Reprinted by permission of John Wiley & Sons, Inc.

The authors stress that strategies are *patterns of decisions*, not documents. The decision patterns, not what is written in strategy reports, set the real direction of the functional area or business. Therefore, the manufacturing strategy of the business is the pattern of decisions that determine manufacturing structure, infrastructure, and related capabilities.

These thoughts call certain questions to mind with respect to the supply chain. Are not the eight areas applicable as much — if not more so — to a supply chain as they are to any of the manufacturing links? Doesn't the supply chain have to "mesh" with the business unit strategy — even if we have to define the business unit as a chain, not a company?

Hayes and Wheelwright went on to say a manufacturing strategy could play one of four roles in a firm's competitive strategy. They characterized these roles as "stages" in the application of a manufacturing strategy. The stages are progressive, with a firm moving sequentially from one stage to the next. Table 4.2 describes the stages in the evolution of manufacturing's strategic role as envisioned by Hayes and Wheelwright.[4]

The model shown in Table 4.2 has application to supply chain thinking. Applying this model to the idea of potency, Stage 4 manufacturing — or supply chain — strategies would be the most "potent" in terms of supporting

TABLE 4.2

Stages of a Manufacturing Strategy

Stage 1 — Minimize manufacturing's negative potential: "Internally neutral" • Internal management controls are the primary means of measuring performance. • Manufacturing is flexible and reactive to external influences. Common where marketing-oriented companies consider their products "low tech" or in high technology companies that view product design as all-important.
Stage 2 — Achieve parity (neutrality) with competitors: "Externally neutral" • Use capital spending to catch up to competitors. • Follow "industry practice" regarding the workforce, equipment, and capacity additions. Common in many smokestack industries like automobiles, tires, and major appliances. Don't consider manufacturing technically sophisticated and rely on outside sources for innovations.
Stage 3 — Provide credible support to the business strategy: "Internally supportive" • Management screens manufacturing investments for consistency with business strategies. • Changes in business strategy are translated into manufacturing implications. • Longer-term manufacturing developments and trends are systematically addressed. • Characterized by looking at the leading edge of technologies and screening them for application. Common where a dramatic event unmasks deficiencies in manufacturing. Or major new competitors enter the market.
Stage 4 — Pursue a manufacturing-based competitive advantage: "Externally supportive" • Efforts are made to anticipate the potential of new manufacturing practices and technologies. Manufacturing is the peer of other functions. • Manufacturing is centrally involved in major marketing and engineering decisions. • Long-range programs exist to acquire capabilities in advance of needs. Business unit and manufacturing strategies developed in a coordinated fashion. Common in process industries where leaders must maintain manufacturing capabilities to be ahead in competition. Also common as a response to crisis. Stage 4 requires a fundamental shift in the role of manufacturing. Marked by continuous investment in process improvement, internal development of process technology, and attention to the infrastructure element of manufacturing strategy.

Source: Hayes, Robert H. and Wheelwright, Steven C., *Restoring Our Competitive Edge: Competing through Manufacturing*, New York, John Wiley & Sons, 1984. Reprinted by permission of John Wiley & Sons, Inc.

business unit strategies. A problem in applying the model to supply chains, however, is that its reference point is the business unit strategy. Does every business have a coherent strategy? If it exists, is the business unit strategy relevant to manufacturing, much less supply chain, decisions? Are patterns of decision-making within manufacturing and other supply chain functions consistent? Would the best decision for manufacturing be the best for the supply chain?

It's actually relatively easy to have a business unit strategy. Can a supply chain have a strategy? By definition it's a collection of "partners" linked for the common good. What is the "governing authority" at the first tier of strategy making? We will address these questions later. The driving force, which we discuss next, is a model that doesn't necessarily require a business unit strategy for measuring potency.

4.2 The Driving Force

Mike Robert is founder and president of Decision Processes International, Inc., in Westport, Connecticut. His company consults on strategic planning using a distinctive framework. Like Hayes and Wheelwright, he comments on the state of strategic planning. His observation is that, in general, the process is not done at all or, where it is done, is done poorly. As a solution, he proposes a "strategic thinking" process.

Robert categorizes companies in terms of their strategic vision and operations competency. Companies tend to fall, according to the author, into one of the four quadrants shown in Figure 4.2.[5] The strategy dimension of the matrix represents *strategic thinking*. This doesn't include what are often paper exercises at developing strategic plans. The operations dimension refers to the execution of daily tasks, running the business and executing the strategy.

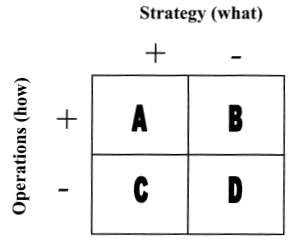


FIGURE 4.2
Strategic thinking matrix. (From Robert, Michel, *Strategy Pure and Simple II*, New York, McGraw-Hill, 1998. Reproduced with the permission of McGraw-Hill Companies)

Quadrant A companies do well at both developing and implementing their strategies. In quadrant B the companies do a good job of managing, but haven't set a business direction. Management churns out good financial results — even for extended times — but can't articulate what the company needs to be in the future. This describes a company where short-run incremental changes are mostly designed to achieve cost reduction rather than strategic level restructuring.

Quadrant C companies do a good job of strategic visioning, but can't implement well. Robert cites early personal computer clone makers as examples. Their vision was clear — to be the best clone maker — but many fell short on execution. Quadrant D is poor in both strategic visioning and execution. Of course, companies in this quadrant are in peril.

While A is the most desirable quadrant, most companies, by the author's reckoning, are in quadrant B. In the U.S., this is due to several factors. First,

leaders tend to come from operating ranks. They haven't acquired strategic skills. Second, U.S. markets are too familiar and homogeneous. A manager in a smaller country, who must operate in multiple, varied markets, will probably have superior strategic skills. Going after new, unfamiliar markets forces deep strategic thinking. Third, there's a tendency to be driven by growth and market share. With these conditions present, there is little motivation to think about strategic direction.

Robert points out that added global capacity has transformed economies from relative scarcity to surplus capacity. He terms these the *push* and the *pull* economies. Paraphrasing Robert, the pull economy with its increased competition will require innovation all along the supply chain. No longer is the producer king; the customer is. Market segmentation has progressed to market fragmentation. Product life cycles are now far shorter than most companies are accustomed to. Striving for efficient manufacturing has given way to the need for flexible manufacturing.[6]

Robert's insight is centered on the idea that there is one single *driving force* or *strategic driver* for any business. He identifies ten possible strategic drivers, which are summarized in Table 4.3.[7] One of these ten, and only one, is central to competitive position, according to Robert. People in the company may not even be aware of the driving force that determines their competitive position. In fact, we find they may believe they are good, or have to be good, at all ten!

According to Robert, underlying factors such as quality, customer service, and profitability are "givens." Any company on the competitive field must perform well at the givens. Competitive advantage centers on managing activities associated with the driving force. Robert refers to these as "areas of excellence."

Within this framework, potency is measured by the contribution to "areas of excellence," not the "givens." For example, a project to automate product configuration at the interface between the customer and company's salesperson could be strategic in one company and not strategic in another. In a company with a technology-driven or a natural resource-driven strategy, for example, it would not be strategic. It might lower costs or improve customer service in the "givens" group. But the same project in a product concept or sales/marketing-driven company would be strategic.

Managers in a company with ongoing projects and with options for new ones could apply Robert's framework to rank the potency of their projects. A simplified categorization might look like that shown below.

Potency Rating	Contribution
High	Supports an area of excellence.
Medium	Supports a "given" area of improvement.
Low	Maintains a basic capability.

Note that this framework doesn't require either an explicit or implicit strategic plan. The company's strategy team has to decide on the driving force.

TABLE 4.3

Robert's Ten Driving Forces

Driving Force	Examples	Areas of Excellence
Product/service concept	General Motors/cars, IBM/computers, Boeing/aircraft	Product development Sales/service
User/customer class	Playboy for men, Johnson & Johnson for doctors, families	User research Customer loyalty
Market type/category	American Hospital Supply for hospitals, Disney for families, Regional markets	Market research Customer loyalty
Production capacity/capability	Capacity: hotels, airlines, paper mills Capability: job shops, specialty printers	Manufacturing efficiency Substitute marketing[a]
Technology/know-how	DuPont in chemicals, 3M, Sony	Technology research Application marketing
Sales/marketing method	Avon for door-to-door selling, QVC Home Shopping Network	Sales recruitment Selling effectiveness
Distribution method	Telephone companies, department stores, food wholesalers, Wal-Mart, Federal Express	System effectiveness System organization
Natural resources	Oil and mining companies	Exploration Conversion
Size/growth	Conglomerates, revenue growth objective	Volume maximization Asset Management
Return/profit	ITT under Harold Geneen, earnings per share objective	Portfolio management Information systems
"Givens":	Quality Low-cost manufacturing Customer service Growth Profit	

[a] Defined in the glossary. Refers to increasing the share of one's own product over substitutes. An example is printed corrugated containers over adhesive labels

Source: Robert, Michel, *Strategy Pure and Simple I*, New York, McGraw-Hill, 1998. Reproduced with the permission of McGraw-Hill Companies.

Of course, this might not be trivial if it requires a decision by inwardly focused department heads!

We can estimate the potential of reengineered supply chain processes on organizations with different driving forces. Table 4.4 attempts to do this, and is offered with the caveat that there will always be exceptions. The objectives in the right-hand column serve as a test for candidate projects. If an existing project fulfills the listed objective, it is likely "potent" in making the company

better at its critical skill. If one has no supply chain project that supports the organization's driving force, management should reconsider the strategy or look for new projects to add to their portfolio.

TABLE 4.4

The Driving Force and the Supply Chain

Driving Force	Supply Chain Improvement Objective
Product/service concept	Assure material support for improvements and service.
User/customer class	Tailor supply chains to bring different products to targeted users.
Market type/category	Tailor chains to deliver product categories to target market.
Production capacity/capability	Find integration and cost reduction opportunities through chain.
Technology/know-how	Design supply chain concurrently with technology development.
Sales/marketing method	Assure the sales department has reliable material supply.
Distribution method	Support sales force and product delivery.
Natural resources	Improve logistics between source and conversion points.
Size/growth	Consolidate and improve resource utilization.
Return/profit	Increase asset/ working capital utilization. Support new services.

Most supply chain literature focuses on the production-driven category. This category calls to mind the manufacturer with its networks of suppliers, distribution, and sales outlets at wholesale and retail levels. As the table indicates, however, there are many ways in which a supply chain project can help companies with other driving forces.

What Robert is saying to the supply chain strategist is that there are many different flavors when it comes to the driving force. Don't assume every company has production as its driving force. Don't uncritically accept solutions intended for a production-driven company when your area of required excellence lies elsewhere.

4.3 Supply Chain Progression

This model follows a paradigm that's common in supply chain literature. Charles Poirier of Computer Science Corp. (CSC) specializes in supply chain consulting. He has published a model of progression in supply chain management similar to the Hayes/Wheelwright model. Table 4.5 shows the progression.[8]

The ten categories are useful in characterizing the potential scope of a supply chain improvement effort. In fact, Poirier's experience is that most companies are in stage 1 or 2 as indicated in Table 4.5. These are internally focused programs. Poirier notes that moving from an internal to an external

TABLE 4.5

Progression of Supply Chain Management Practice

	1. Sourcing and Logistics	2. Internal Excellence	3. Network Construction	4. Industry Leader
Driver	VP-Sourcing (under pressure)	CIO/Supply Chain Leader	Business unit leaders	Management team
Benefits	Leveraged savings, FTE reduction	Prioritized improvement across network	Best-partner performance	Network advantage; profitable revenue
Focus	Inventory; projects; logistics; freight; order fulfillment	Process redesign; systems improvement	Forecasting; planning; customer services; inter-enterprise	Consumer; network
Tools	Teaming, functional excellence	Benchmarks; best practice; activity-based costing	Metrics, database mining, electronic commerce	Intranet; extranet; Internet; virtual information systems
Action Area	Mid-level organization	Expanded levels	Total organization	Full enterprise
Guidance	Cost data; success funding	Process mapping	Advanced cost models; differentiating processes	Demand/supply linkage
Reach	Major cost (local) categories	Business unit	Enterprise	Global interface
Model	None	Supply chain-intra-enterprise	Inter-enterprise	Global market
Alliances	Supplier consolidation	Best partner	Partial alliances	Joint ventures
Training	Team	Leadership	Partnering	Holistic processing

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focus between stages 2 and 3 is an especially significant barrier. The systems and people are just not in place, and the required behavior is counterintuitive. Very few enterprises have reached stage 4; he cites Wal-Mart, Proctor & Gamble, and Dell Computer as examples of companies that have. Success requires imagination, determination, and technology. Poirier is emphatic about the technology issue, stating, "Without heavy doses of network technology, there is little chance of assuming real supply chain leadership."

The model of supply chain stage progression doesn't address the issue of potency in terms of competitive improvement. It implies that stage 4 companies will be potent competitors. However, we can envision that a stage 4 company could be only at parity competitively if its products are behind in the marketplace or if no distinctive competence has been developed.

In the next chapter we examine a final model. It's based on the product and ties the supply chain strategy to the product's position in its life cycle.

4.4 What Does It Mean?

These three models are only a few of several theories that help guide strategy development. The first two, the Hayes/Wheelwright and Robert approaches, have value in terms of supply chain strategy because each emphasizes the role of operations in supporting competitive strategies. Poirier provides dimensions along which a supply chain might evolve. In the next chapter we'll attempt to synthesize these approaches into a general model for understanding how supply chain improvement projects should support strategies for competing.

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5

Model for Competing through SCM

> In fact, as a strategic weapon, time is the equivalent of money, productivity, quality, even innovation.[2]
>
> **George Stalk, Jr.**, Boston Consulting Group

5.1 Product Life Cycle Grid

In the last chapter, we examined three frameworks, or models, that offer different ways to think about supply chain strategy. The model described in this chapter uses the "product life cycle" to define the product's position in its competitive market. The model helps us understand the relative importance of *supply chain* features, as distinct from *product* features, to long-term product success. It also brings into play the notion of time-criticality in supply chain innovation. As George Stalk noted in his article, time can be the dominant element in a strategy.

The supply chain features, as we noted in Chapters 1 and 2, are part of what we have called the "extended" product. Competitor imitation or lapses of patents eventually enable competitors to imitate the physical features of the product itself. Extended product and supply chain features, in turn, often become the principal basis for competing.

To the extent the threat of base product imitation exists, there is a premium on excellence in the supply chain. The competitive field in most markets requires well-designed products. But at the margin, other factors govern the buying decision. For example, most airlines offer clean, modern aircraft and maintain good safety records. This is the price of entry to the club — a "given" in other words. If an airline didn't qualify, we wouldn't go near it. Satisfaction with a particular airline likely depends on flight frequency, the ability to upgrade, employee courtesy, prices, frequent flier programs, or the coffee served on flights. Supply chain thinking has untapped potential for maintaining a competitive position or moving a company from an unfavorable to a more advantageous position.

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As we have in prior chapters, we describe a *product* as its physical features or functionality. The extended product includes the supply chain, which encompasses the processes that put the product in the hands of end users. This includes numerous transactions involving physical movement, exchange of information, and the flow of money. The grid in Figure 5.1, published in an earlier work, illustrates the concepts involved.[2]

Companies with many products are likely to have some in each category in Figure 5.1. The *Product Excellence* dimension rates the product against competitive products in its chosen market. This evaluation is focused on the physical product itself. The *best in class* will rank highest in terms of functionality, reliability, and value for price.

The *Supply Chain* dimension includes not only the distribution of the physical product but also the many activities that compose delivery of the extended product as well. Examples include accompanying services such as technical support, financing, and distribution. The *best in class* often have great service reputations, if not exceptional products. The *also ran* companies are ones we avoid if possible.

The grid is helpful in applying the product life cycle to supply chain strategic planning. The product life cycle is a common business model applied by marketers and strategists. The curved arrow represents four phases of the product life cycle faced by the product. These correspond to the quadrants on the grid in Figure 4.1.

C	Inception	Producers compete in a start-up mode. The products are new and markets are forming. Supply chains are taking shape. No dominant supply chain mode has emerged.
A	Growth	The market expands. The winners have been sorted out based primarily on product and, to a lesser extent, on supply chain features.
B	Maturity	Demand stops growing. Supply chain features dominate over product features. Product features are common among competitors. Niche strategies appear, with competitors focusing on particular market segments, using supply chain design as a strategy.
D	Decline	Demand falls and the industry consolidates. Some attempt rejuvenation of product or supply chain. Competitors quit the market.

In the grid, "A" products are on top of the world. Products and supply chain processes are the best in class; demand is ample for all but the worst competitors. In the new-product situation, this is the highest growth phase of the market cycle. The company's product has survived the shakeout that

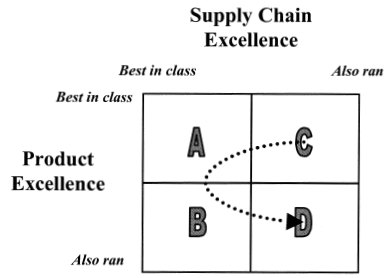


FIGURE 5.1
Market positions of products. (Reprinted with permission of CRC Press, LLC.)

comes after product introduction. Makers of these products "own" their markets as demand outstrips supply.

Microsoft is an example of a company that has enjoyed a long tenure in the A quadrant. Its Windows and Office software have been an "automatic" addition to a new PC, assuring widespread distribution. No software developer would ignore either in developing a new application, further locking in its dominance.

Most products we buy day to day are in the B category of the grid. The high-growth days are probably behind. Some laggards from the A quadrant fail to see the change from growth to maturity. They fall behind if they haven't innovated their supply chains. Competition is intense because there is little difference among physical products, so success requires supply chain innovation for the extended product.

B products may be former A products whose early success attracted competitive offerings. While their efficient supply chains remain intact, they are no longer the standard for product excellence. McDonald's has a widespread store network. It opens new outlets with precise, efficient procedures built on long experience. But its products are, to many, dated and low quality — even for the relatively low prices charged.

Wonderful products supported by sloppy operations populate the "C" category. Xerox, when it invented copier technology, was in a C situation. Companies with completely new products often occupy this quadrant. Such companies are vulnerable to copycat competitors, just as Xerox was in time. For new products, competitors strive for the best product design. Leaders will have great product features and may do well at supply chain design. If they do, they'll move up to the A quadrant.

"D" products are hanging on for dear life. Unless they move to another quadrant by rejuvenating their product or supply chain, they won't survive. So getting to A or B is not an option. Crown Books, an early discounter, lost market share to Barnes & Noble and Borders, which sell the same books but with more amenities. In another turn, Internet marketer Amazon.com has challenged their "brick and mortar" model.

One's supply chain strategy will depend on grid placement. Table 5.1, also published earlier,[3] has examples of how supply chain thinking can apply to define a general strategy that fits each box. High-potency projects are those that will help the company accomplish the intent shown in the table.

TABLE 5.1

Applying Supply Chain Thinking

Competitive Position	Supply Chain Strategy
A. Excellent product and supply chain	High-potency projects will continuously improve both product and supply chain to deter competitors. If there are any flanking, breakthrough innovations in product or supply chain design to be made, make them yourself. Don't let someone else.
B. Excellent supply chain, "commodity" product	Maintain parity in product design. Design projects to test innovative concepts for supply chain design.
C. Excellent product, unexceptional supply chain	Your technology lead won't last. Plan supply chain innovations while you enjoy an advantage. The best supply chain will produce a lead for the growth phase of the life cycle.
D. Poor product and supply chain	Go after the long hanging fruit. In the time you have (if any), innovate toward one of the other quadrants. If product innovations will take too long or are unavailable (a move to A or C quadrants), redesign your supply chain (a move to quadrant B).

Table 5.1 provides a screen for evaluating a project's contribution to strategy. We believe marrying the life-cycle concept to the grid has particular value. It should help managers focus on the next quadrant and do things today to be competitive tomorrow.

5.2 Achieving Potency in Supply Chain Redesign

In this section, we meld these perspectives together. This includes the product life-cycle grid that we described in this chapter and the models from Chapter 4. The purpose is to guide the thinking of those charged with developing and approving projects to improve the supply chain. With this tool, they can help their organizations by finding the "right" projects.

5.2.1 Strategic or Not Strategic?

The models we've discussed characterize supply chain projects in two ways. The first way has to do with strategic "fit." This idea of fit means there's a

match between the supply chain project and what it takes to be successful in the marketplace. The project fit can be measured against an explicit strategy or implicit strategy for competing. It asks the question, *Does the project change the basis for competition?*

If it does, then it's strategic in nature. If it doesn't, it may sustain the enterprise, but at best it only maintains, not improves, a competitive position. For our model, we would adopt this "binary" screen for assessing supply chain projects. This can be summarized by the answer to the above question. A "yes" answer makes the project strategic. A "no" means it's maintenance — that is, it could be important to stay in the game, but not sufficient for improving. How do we decide if the answer is "yes" or no"? Our discussion of models in this chapter and Chapter 4 provides four ways to make this judgment: strategy support from Hayes and Wheelwright, the driving force for Robert, and the product grid.

Hayes and Wheelwright would define supply chain projects as strategic if they support an explicit business unit strategy. Robert would define them as strategic if they enhanced the driving force behind competitive position. Poirier would define a strategic product as one that moved the organization along the supply chain progression. The grid approach in this chapter defines projects as strategic if they improve competitive position as defined by a product's grid position. Table 5.1 provides a guide for screening projects.

Figure 5.2 further illustrates the difference between strategic and nonstrategic projects. It shows two companies and their progress over time. In any marketplace, there is a "quality threshold" that's constantly rising. Staying abreast of this rising threshold produces the "given" types of projects. These are necessary, but not sufficient, for achieving competitive improvement.

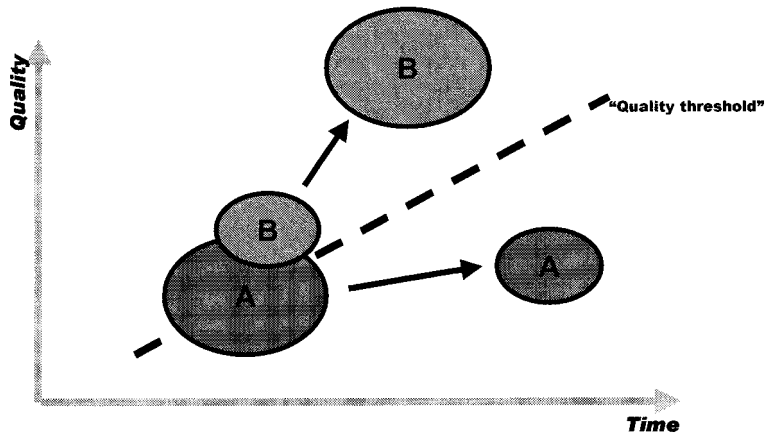


FIGURE 5.2
Improving competitive position.

In the figure, Company B starts out small, while Company A is much larger. However, through strategic projects, Company B is able to grow at the expense of Company A. In fact Company A falls below the quality threshold and shrinks as a result. A classic example is the case of Wal-Mart and KMart. In this case, Wal-Mart is represented by Company B; KMart by Company A. Strategic projects, then, will not just maintain a competitive position. They will improve it, achieving growth at the expense of the competition.

5.2.2 Level of Impact

The second way to classify supply chain projects recognizes that improvements move beyond the department or the business unit into the extended enterprise. In an earlier article by Jim Ayers, Craig Gustin, and Scott Stephens,[4] we envisioned three stages for supply chain reengineering efforts. These corresponded to their scope in terms of effect on levels of the supply chain. Three stages are appropriate.

Stage 1 – department-level focused

Stage 2 – business-unit-level focused

Stage 3 – supply-chain-level focused

This three-level approach adds one level to Poirier's framework. He recognizes "internal" and "external" levels. Our experience is that department boundaries often present a significant barrier to supply chain innovation — even more than those encountered going outside the company. These barriers are often referred as "silos," parochial functions that resist change. If these demons exist in your company, they need to be dealt with either before or while extending projects to the supply chain. Our composite model would retain these three levels. The result is shown in Figure 5.3.

The labeling in Figure 5.3 supports six categories of supply chain projects. It recognizes that strategic supply chain projects may occur at the function, business unit, and supply chain levels. It also observes that, just because a project extends beyond the immediate company, it need not be strategic. It could be "catch up" to reach parity with a more aggressive competitor or of little relevance to competitive position. So venturing outside the company to do a supply chain project alone is not a prerequisite for a strategic project.

Too few projects undertaken by companies would qualify as strategic projects, even though they require large sums of money and major effort to implement. Most will keep the organization "in the game" and are "given" types as described by Robert. Table 5.2 gives some examples and how the model might classify them.

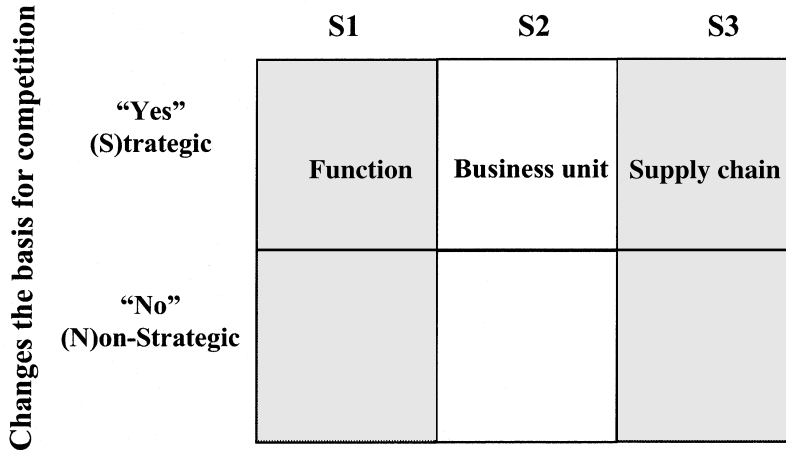


FIGURE 5.3
Model for competing through SCM.

TABLE 5.2
Applying the Model

Changes Competition	S1: Function	S2: Business Unit	S3: Supply Chain
Yes	Proprietary factory floor process.	New product introduction process.	Taking over maintenance in the field from customers.
No	Skills training for sales force.	A 10% across the board budget cut.	Direct marketing over the internet.

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5.3 Why Bother?

We have talked about "potency" in terms of supply chain projects. Potent supply chain projects will change the basis for competing in the marketplace. Most improvement projects we encounter aren't "potent" in this sense. They may help the company stay even with the competition, but may not help them get ahead. We'll use Figure 5.3 throughout the book as a reference for classifying supply chain improvement projects.

The purpose of this discussion has been to help the reader move in the right direction. The supply chain approach requires new ways of thinking about what's important and what's not. That ERP project you're about to undertake may bring a lot of new technology and may be a necessity if your legacy systems are breaking down. But it may do little for you strategically.

Most of this book describes tools for developing or overhauling supply chains. As important as the execution step is the project selection step. The models and processes recommended here should yield a more effective portfolio of supply chain projects to implement. It should also avoid the problem of falling into impotent dead-end efforts.

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6

Linking the Supply Chain with the Customer

The raw parts of a BMW 540i are worth approximately 50% more than those in a similarly sized and equipped Honda Accord. The difference in weight is 30%. Yet the Bimmer sells for 100% more.

Rich Karlgaard, Publisher, *Forbes*, October 19, 1998

There are many techniques to design supply chains for more competitive potency. Rich Karlgaard points to three in explaining the price spread between the BMW and the Honda. These are ideas and craftsmanship, the ability to reproduce the car at a consistent level of quality, and the "mystique" that makes the buyer willing to pay so much.

This chapter addresses the use of market and customer requirements to drive supply chain design. Answering these requirements offers the potential to produce value-enhancing qualities that bring premium prices. The first part describes a model for matching the supply chain design with the product/market type. The second describes Quality Function Deployment (QFD) for developing specifications for the supply chain that are linked to customer requirements. We start by advocating that supply chain design shouldn't be left to happenstance. It requires a specification just as one might prepare if one is building a house or designing a new product.

6.1 Specifying Supply Chain Design

The design of an automobile or a computer or a house begins with a specification by the designer, often — but not always — acting in concert with the user. The housing tract developer will design a product that appeals to a targeted market segment. This means putting cheap houses where the market wants cheap houses, and expensive ones where the market demands expensive houses. The result is often three or four models that can be customized to each buyer's taste. Customization options include carpet, paint, tile, curtains, and other features.

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A contractor building a custom house will work closely with the owner and his or her architect. Within the constraints determined by the building site and local codes, almost anything is possible in the floor plan.

As customers, if we are going to buy something, we must first decide what we want from our purchase. How many bedrooms should we have in that new house? Do we want a big car or a small one? How will we use a new computer? For routine tasks will we require a low-end computer, or will we run programs like graphics design that require a high-end machine?

The producers of these products have to "guess" or make assumptions about what we want in the way of houses, cars, and computers. Unfortunately, we often start our search with an "I'll know when I see it" attitude. So no amount of market research can assure a successful product.

Likewise, supply chains often develop without the benefit of conscious design. All too often they are built over time, and decisions are made without an overall blueprint. This chapter describes ways to avoid this situation.

6.2 Effective Supply Chains

Marshall Fisher prescribes a framework for assuring that supply chain design is appropriate for a product.[1] Fisher points out that supply chain design depends on the nature of the product demand. He divides products into *functional* and *innovative* categories. Functional products, as the name implies, are the staples of life — toothpaste, groceries, and commodities of all kinds. Competition is fierce for these products, and margins are relatively thin.

Innovative products, on the other hand, are differentiated in the market. They have advanced technological features or styling. They carry higher margins — but demand is uncertain. Examples include this year's latest fashions and automobiles with novel features. The first minivans and sport utility vehicles fit this category.

For those who aren't certain which products fall into which category, Fisher offers a guide, shown in Table 6.1. Uncertain demand and higher profit margins define innovative products. Functional products are also equivalent to categories B and D on our product position grid introduced in Chapter 5 and repeated here as Figure 6.1 for reference. The C quadrant will likely be almost exclusively innovative products. Many products in the A quadrant will also likely be innovative.

For many, the costs of the supply chain are those we typically think of as "logistics" costs. Components include the cost of inventory, packaging, warehousing, transportation, and the associated labor. These are connected with the physical movement of goods from supplier to customer. Many consultants in logistics focus on reducing these costs. Distribution executives often have jobs that depend on keeping these costs within bounds. A frequently

TABLE 6.1

Functional Versus Innovative Products: Differences in Demand

	Functional (Predictable Demand)	Innovative (Unpredictable Demand)
Product life cycle	> 2 years	3 months to 1 year
Contribution margin	5–20%	10–60%
Product variety	Low (10–20 variants per category)	High (often million of variants per category)
Average margin of error in forecast at time production is committee	10%	40–100%
Average stockout rate	1–2%	10–40%
Average forced end-of-season markdown as percentage of full price	0%	10–25%
Lead time required for made-to-order products	6 months to 1 year	1 day to 2 weeks

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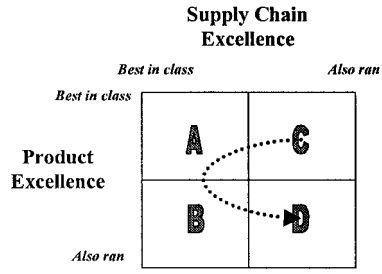


FIGURE 6.1
Market position of products.

encountered measure of distribution executive performance is "supply chain cost per dollar of sales." This line of thinking, Fisher argues, is dangerous if the type of product — functional or innovative — isn't considered.

Fisher recommends fundamentally different supply chains for functional and innovative products. For innovative products, Fisher considers what he refers to as "market mediation" costs in designing the supply chain. Market mediation costs arise from mismatches in demand and supply. These occur because forecasting demand for innovative products is especially difficult. If there is *too much* product, it must be marked down. This market mediation cost is the product of the markdown discount times the number of units marked down. If there is *too little* product, the company incurs another type of market mediation cost — that of lost sales. This cost is equal to the unit contribution margin multiplied by the volume of lost sales.

An example illustrates the potential impact of market mediation cost on supply chain design. We'll use a hypothetical "widget" manufacturer and distributor for our illustration. The widget is a new product, and its product plan embodies management expectations for the first year's sales and profits. Figure 6.2 illustrates the case of the product with expected sales and costs for a "widget" product as shown below:

Widget Sales Price	$100
Gross Margin (excluding distribution cost)	$40
Unit Distribution Cost (transportation, warehousing, transportation)	$10
Widget Sales Forecast	100,000

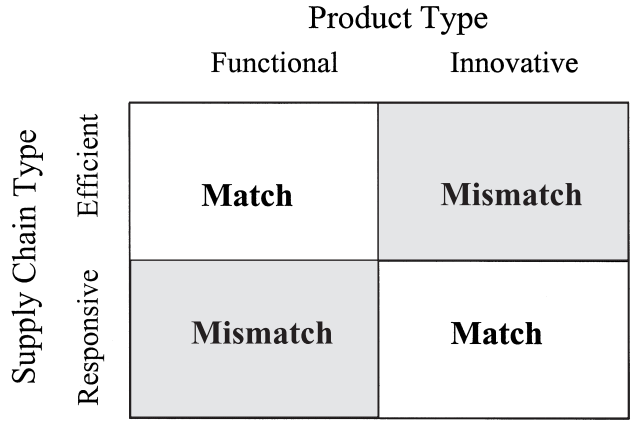


FIGURE 6.2
Hidden supply chain costs.

The plan calls for a sales price of $100 with an attractive gross margin before distribution costs of $40. Distribution costs are expected to add $10 per unit to cost. It's likely that the supply chain manager is measured on whether the costs of distribution meet the $10 expectation. The first-year sales forecast calls for 100,000 units, producing revenues of $10 million. However, this is an innovative product, so actual demand is likely to be uncertain. Demand, in the case of the widget, may in fact be significantly more or less than the forecast of 100,000 units.

Let's assume that our widget manufacturer has little flexibility in its supply chain. Commitment to a production volume must be made at the beginning of the year. So the plan becomes very important as a determinant of the widget's success. In cases like that of the widget, one of three outcomes is likely if the supply chain manager produces the 100,000 units called for by the plan:

1. The plan is accurate. 100,000 units are sold, and the product result closely matches the plan. The supply chain manager is a hero.
2. Sales falter; only 70,000 units are sold. The widget maker must dump 30,000 units of inventory. The inventory must be sold at discount prices. The product manager is a goat; the supply chain manager is okay, since distribution costs are within budget.
3. Demand exceeds the plan; 130,000 units could have been sold. Customers are disappointed, and sales are lost. The supply chain manager is fired; the product manager gets a promotion.

Figure 6.2 uses numbers to illustrate these outcomes. We see that the actual sales range extends from 70,000 to 130,000. When sales fall below the expected 100,000 level, discounts must be employed to move the merchandise. In this case, a 70,000-unit sales level brings a markdown of $50. The resulting profit if only 70,000 units are sold is $1.8 million instead of the standard profit of $2.1 million for 70,000 units, a "cost" of an unresponsive supply chain of $300,000.

When sales go above expected levels, the company is at risk for lost profits. If actual sales are 130,000, for example, the profit potential is $3.9 million instead of the budgeted $3 million, a market mediation cost of $900,000. Notice that, when market mediation costs are taken into account, the added cost of a poorly designed supply chain can be substantial compared with the distribution costs of getting the product to market. Most measurement systems ignore this reality.

The important message is that supply chain cost under uncertain demand has two components. The first is the traditional cost associated with physical distribution, shown in Figure 6.2 as "Distribution Cost." But distribution cost doesn't fully capture the economic impact of supply chain design decisions. One should also consider the effect of price markdowns and lost profit opportunities.

As the widget example illustrates, a problem for a company is having a mismatch between the supply chain design and the nature of product demand.[2] The grid in Figure 6.3 is Fisher's summary of the four states in which a company might find its products and supply chains. The product type and the supply chain are either matched or mismatched. It's rare for a company to have a mismatch in the lower left quadrant of Figure 6.3. This is because most companies focus on cost reductions, so their efforts may already have produced a low-cost supply chain. Or they only market functional products and have supply chains designed for efficiency to deliver those products.

It isn't rare, however, to have a mismatch in the upper right quadrant. Companies in this quadrant commit a common error. That error is to manage the supply chain to achieve the efficiency appropriate for a functional product — when the product is essentially innovative. In fact, a successful executive who has managed the supply chain for a company with functional

		Forecast:			
		Sales Revenue:	$ 10,000,000		
		Unit Price:	$ 100		
		Unit Distribution Costs:	$ 10		
		Unit Gross Margin:	$ 40		
	Actual Unit Sales:	70,000	100,000		130,000
	Unit Price Mark Down:	$ 50	$ -	$	-
	Revenue Before Mark Down	$ 7,000,000	$ 10,000,000	$	10,000,000
	Revenue From Marked Down Units	$ 1,500,000	$ -	$	-
	Cost of Production:	$ 6,000,000	$ 6,000,000	$	6,000,000
	Distribution Cost (based on undiscounted sales):	$ 700,000	$ 1,000,000	$	1,000,000
	Total Supply Chain Cost (production & distribution):	$ 6,700,000	$ 7,000,000	$	7,000,000
	Pretax Profit:	$ 1,800.000	$ 3,000,000	$	3,000,000
	Added Profit if Unexpected Demand Filled:	-	-	$	900,000
	"Cost" of Inflexible Supply Chain:	$ 300,000	$ -	$	900,000

FIGURE 6.3
Matching supply chains with products. (Reprinted by permission of *Harvard Business Review.* Exhibit from "What is the Right Supply Chain for Your Product" by Marshall Fisher, March-April, 1997. Copyright © 1997 by the President and Fellows of Harvard College; all rights reserved.)

products may not recognize the differences in the products of a new company. As we mentioned earlier, it's not uncommon to measure performance for a logistics or supply chain manager by the percent of gross revenues spent on the supply chain. Such a person may mistakenly apply the "efficiencies" to a new company with innovative products — and earn a bonus for doing so! A more appropriate measurement would include market mediation costs in the calculation.

For many products like automobiles, there are both functional and innovative supply chains. Fisher notes that a "functional" car like a Taurus should use a functional supply chain with as much cost squeezed out as possible. But a high margin convertible could earn more profit with an innovative supply chain.

So making money out of the supply chain, applying Fisher's model, has two branches. For the functional product, it means innovations to reduce the supply chain cost associated with distribution. For the innovative product, it means reducing total costs, including market mediation. This is a more complex equation as we demonstrate in the widget example. It involves not only the traditional costs but also those associated with mismatches in demand and supply. Companies like our widget-maker have to decide if the extra

profit to be gained from a flexible, responsive supply chain is worth the cost of putting it in place.

Fisher describes some of the differences in design criteria for the two types of supply chain.[3] Table 6.2 lists those criteria. In a later section on costs and the supply chain, we describe techniques that recognize these differences in product demand.

TABLE 6.2

Physically Efficient vs. Market-Responsive Supply Chains

	Physically Efficient Process	**Market-Responsive Process**
Primary purpose	Supply predictable demand efficiently at the lowest possible cost	Respond quickly to unpredictable demand in order to minimize stockouts, forced markdowns, and obsolete inventory
Manufacturing focus	Maintain high average utilization rate	Deploy excess buffer capacity
Inventory strategy	Generate high turns and minimize inventory throughout the chain	Deploy significant buffer stocks of parts or finished goods
Lead-time focus	Shorten lead time as long as it doesn't increase cost	Invest aggressively in ways to reduce lead time
Approach to choosing suppliers	Select primarily for cost and quality	Select primarily for speed, flexibility, and quality
Product-design strategy	Maximize performance and minimize cost	Use modular design in order to postpone product differentiation for as long as possible

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6.3 Quality Function Deployment

Quality Function Deployment (QFD) is a technique to translate requirements — defined by customers — into specifications for a product or service. QFD also has application for management processes that affect the supply chain, including design of the chain itself and development of supply chain features for a new product. QFD "forces" supply chain designers to consider a number of factors important in design. This lowers the risk of leaving something out. The tool disciplines the process of collecting data and making decisions about design features.

The methodology begins with customer requirements. These can be developed by survey or by assumptions made in the absence of research. The latter is particularly appropriate in the case of very new products. In these situations, customers may not have a frame of reference from which to express their requirements.

At the center of the QFD approach is the "house of quality." It encapsulates what is known about customer requirements, their importance, and the design supply chain features needed to meet those requirements. Figure 6.4 is a picture of the "house" and its components.

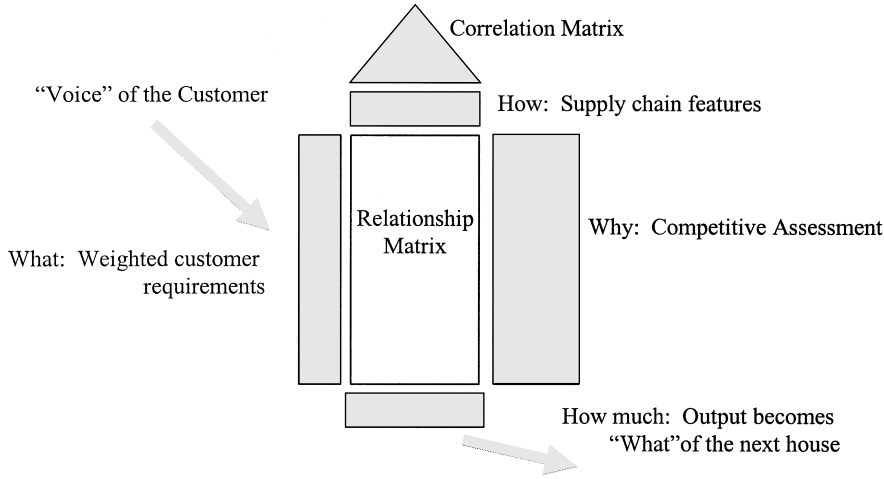


FIGURE 6.4
QFD house of quality.

Outside research or design team assumptions form the "voice" of the customer. These are the areas in which the supply chain must excel. Examples might include requirements for lead time, technical support, packaging, and pricing. These requirements become the "what" of the house. That is, the characteristics that the supply chain must consider in order to satisfy the customer. Examples are speed, variety, and product assistance.

An example used in some training sessions is a cup of coffee. The "whats" for a cup of coffee can include both product and "supply chain" features. Product features include the size of cup, the temperature of the coffee, the insulating wrap around the cup, and the type of beans used to make it. The supply chain features include options on serving size, promptness of service, and ambiance of the location. Starbucks is an often-cited example of using ambiance to turn a very functional product into an innovative one.

The team should also weigh the requirements in order of importance. The conventional approach is to assign percentages to each factor, with the total of all factors adding to 100. So, as an example, the most important feature

might have a "30" weight, the second a "20" weight, and so on. An important contribution of this exercise is that it forces the team to define its customers. These can include multiple segments, each with vastly different requirements. This will almost certainly be true if the company has both functional and innovative products.

In the case of coffee, market research might find the customer weighs both product and supply chain features. For example, type of coffee might be the most important quality earning, for example, a 40% weight, and ambiance second with 20%. Complexity is added when considering the requirements of different customer segments.

The "why" is a competitive assessment. It evaluates the company against competitors on each customer requirement. The information should show the company's product and supply chain position in terms of the features most wanted by customers. The *why* display shows the relative positions of major competitors and the degree of difference between them. This can help identify areas to turn a functional product into an innovative one. For example, the type of coffee served is an easily duplicated feature. But ambiance is not, and is a better opportunity to be "different."

The "how" is a list of supply chain features. If QFD is to measure the current supply chain, then these could represent the existing (as-is) supply chain. In the design process, the *hows* can be what we refer to as the "to-be" supply chain. This will help assure that the new supply chain has all the features needed to satisfy the customer. A "how" in the coffee business might include product variety and the interior design of the stores.

The relationship matrix links the customer requirements (the whats) with the design features (the hows). Interior design will contribute strongly to ambiance in the case of the coffeehouse. In the case of responsiveness in product delivery, a customer requirement for "4-hour turnaround" might correlate with a design feature "local stocking points" for the short notice replenishment.

In the relationship matrix, these design features are evaluated in terms of their contribution to the customer requirement. So, a supply chain design feature that contributes significantly gets a higher weight than one that contributes, but to a lesser degree.

The correlation matrix indicates reinforcing or conflicting supply chain features. An example might be the conflict between costly inventories to provide short turnarounds in a responsive supply chain and the need for cost reduction in an efficient supply chain.

The output of the house is the "how much." This quantifies what needs to be done. For example, the need for local replenishment may lead to the requirement for 100 advanced stocking points. This might give the team an incentive to rethink the design feature. The coffeehouse may need to add varieties to its product lines and more easy chairs to its lounging area. In Chapter 8, we apply QFD to a case example.

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Section II

The Supply Chain Challenge — Five Tasks for Management

Many technologies and tools are available to improve the way supply chains work. These range from technology implementation to finding new ways to structure organizations — from hardware technology "nuts and bolts" to software to methods for organizing and motivating staff — the "soft side." Many of these techniques described in Section II may be familiar to the reader. If this is the case, we hope we've added both context and content in terms of their application to supply chain management. We expect that most readers will be expert at one or more of the areas we describe. However, we feel there is too little understanding of the broader implications of supply chain management. So we think every reader should find material that will enhance his or her own capabilities.

We believe there is a fundamental shift underway in the way managers manage. This is brought on by awareness that the basis for competition has shifted from the individual company to the supply chain. It's the supply chain that poses a fundamentally new "challenge" to management. The skills and tools we need to manage in this environment will have to change.

For convenience as well as structural purposes, we've separated the challenge into five tasks for management. Although the five tasks overlap somewhat, our techniques and tools are organized along those five tasks. We direct the attention of the reader to related topics as often as possible. Mastery of effective supply chain management will require competency in all five tasks. Figure 1 shows the five tasks.

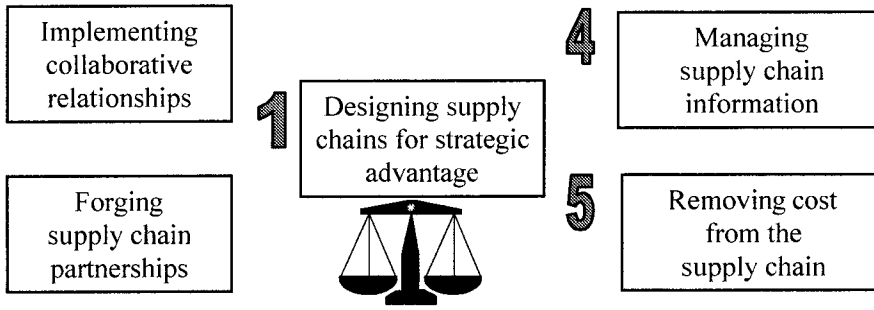


FIGURE 1
Five tasks for supply chain management.

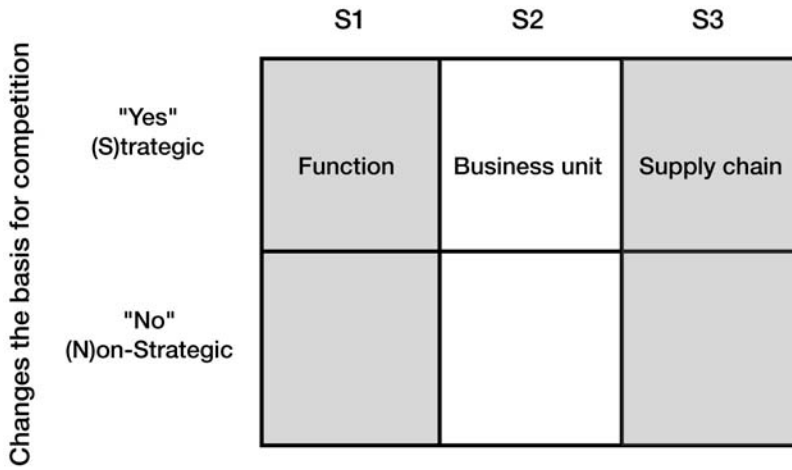


FIGURE 2
Model for competing through SCM.

We've placed the strategic design of supply chains (Task 1) at the center. The other tasks should take their lead from strategic requirements. We see the other four management tasks as "pushed" by the need to improve competitive position. The strategy task sets the agenda for the other tasks. Implementation requires judgment in balancing the tasks on the left, which are essentially "right-brained," requiring more art than science, with those on the right, which are arguably more science than art. The scale is symbolic of the need for balance in pursuing these tasks.

In Section I we described ways of determining what is strategic and what is not when it comes to supply chain planning. We've developed a framework for classifying these projects, repeated here as Figure 2. The figure

serves as a "refresher" on that framework, showing the basic types of supply chain project classified by their scope and strategic contribution.

Our discussion of Task 1 describes how one might go about designing a strategy that defines what supply chain projects you should pursue. The discussions of the remaining four tasks more or less assume that one has a charter that requires knowledge in each particular area. And that charter arises from the need to implement a supply chain-related project. This project may be either strategic or nonstrategic and have a scope of any of the three types — functional, business unit, or supply chain.

The following sections provide an overview of the five tasks.

Task 1: Designing Supply Chains For Strategic Advantage (Chapters 7–9)

The section discusses ways to embody strategic choices and customer requirements into supply chain design. The scope covers existing products and services as well as new products or customer segments. It is based on the notion of the "extended product" that includes the supply chain. This concept maintains that, in the longer term, physical product features will be insufficient for competitiveness. "Amenities" associated with the supply chain will determine competitiveness.

Specific topics covered include the following:

1. A framework for building sustainable advantage based on a unique set of well-linked activities.
2. Matching supply chains to product types — recognizing that supply chains should be designed with different objectives based on the products they support.
3. Techniques for coordinating new-product development and supply chain management. The approaches cover both existing and new-product pipelines.
4. Application of an analysis tool, Quality Function Deployment (QFD), to supply chain design.

Task 2. Implementing Collaborative Relationships (Chapters 10–13)

This section refers to the type of collaboration needed within the organization. The task "forging supply chain relationships" refers to collaboration

outside the organization. Any change in the supply chain must be accomplished through people. People in the organization must live with the consequences of any changes. Our experience is that change fails to be effective due to rejection of the change by people in the organization. So we begin this section with a description of the functions that must support different facets of the supply chain change process.

The task also addresses garnering top management involvement (dubbed *tmi*), implementation project structures, and organization of both the change effort and the ongoing management of supply chain functions.

Specific topics include

1. Organizing the change effort and functional roles in supply chain transformation
2. Participative process for redesigning supply chains
3. Performance measures and their role
4. Placing the supply chain management function within the organization

TASK 3. Forging Supply Chain Partnerships (Chapters 14–20)

The supply chain paradigm demands effective partnering outside the enterprise. In some ways this is easier than working only internally; in some ways it's harder. It's easier because these partners are probably suppliers and customers with a common stake in your success. Clients also tell us it's sometimes easier because they can side-step internal priorities and politics. It's often harder because relationships with outsiders have traditionally been at arm's length. Whatever the case, as the basis for competition shifts to the supply chain, there will be an increase in partnering arrangements of all kinds.

Topics include

1. Core competency — what does it mean in terms of supply chain management?
2. Motivations for partnerships
3. Partnership structures
4. Stage 3 supply chain management
5. DaimlerChrysler as an example of partnership management

TASK 4. Managing Supply Chain Information (Chapters 21–23)

The role of information systems in altering supply chains shouldn't be underestimated. This section will describe roles technology will play in supply chain change. It argues that systems changes should support process changes that, in turn, support enterprise strategies. This perspective is a management, not a technical, one. The possible components of a fully functioning supply chain information system are described along with the alternatives for their implementation.

The section covers the following topics:

1. Elements of a supply chain system
2. Technology innovations
3. Software solutions
4. Implementation barriers

TASK 5. Removing Cost from the Supply Chain (Chapters 24–29)

Costs will always be a focus of supply chain improvement efforts. These efforts will be for both strategic and tactical advantage. This section describes some common and not-so-common approaches. It is organized around the root causes for unnecessary supply chain cost. In the section, we address six root causes:

1. Lack of clarity regarding what is happening in the supply chain
2. Variability in operations from both external and internal factors
3. Shortcomings in product design
4. Inadequate information for decision making
5. Weak links between partners in the supply chain
6. Unintended circumstances arising from traditional mindsets

7

Supply Chains as Activity Systems

"Different"

Dodge automobile advertising slogan.

7.1 Structuring the Supply Chain

In this chapter we describe and apply a framework for structuring a supply chain. A theme will be creating something that's "different" from the competitive field. In keeping with our theme that supply chains should offer competitive advantage, this framework follows a methodology that will produce a different supply chain that will stand out from competitors. Many organizations pursue supply chain designs with the sole intent of reducing cost. Chapter 6 described the situation of the "functional" product where cost can be the overriding objective. Here we describe a way to apply market segmentation and customer specifications to supply chain design. Rather than simply trying to beat costs out of the supply chain, we can deploy chains that improve the competitive position.

A supply chain is a collection of activities and processes. In a manufacturing company, these include manufacturing, distribution, customer service, and selling functions. In many organizations and supply chains, these activities and processes may be little more than independent "entities." There is little integration and consistency of purpose from one process or activity to another.

Michael Porter, Harvard Business School professor and a thought leader on strategy, maintains that *linked* activities and processes are especially resistant to competitive pressures.[1] He refers to these linked activities as "activity systems." We believe the concept of activity systems has valuable application in SCM. This is because a well-linked supply chain *is* one type of activity system.

Porter also emphasizes that in any market, operations effectiveness, usually measured by cost reductions, can only go so far. This philosophy is also consistent with the observation that "you can't save your way to success." In

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fact, operations effectiveness in most markets is a "given." This is consistent with the earlier description of the quality threshold, which is ever rising in any marketplace. Improvements of this nature are not strategic, since they offer no sustainable competitive advantage. Competitors can easily copy innovations that only produce cost savings. Also, while product technology and supply chain imitators can duplicate an isolated activity, linked activities are difficult to duplicate. So competitive advantage must be built on being "different" as Dodge automobile commercials note. This uniqueness leads to invulnerability.

Both Fisher's (Chapter 6) and Porter's frameworks support the idea that the supply chain is fundamental to competitive success. Certainly, products with superior features and design contribute greatly. But innovation in the supply chain dimension is likely on the same level as product design as a determinant of long-term success. So supply chain design has the power to extend the profitable life of the product.

7.2 Case Study — Applying the Frameworks

A case study for a company we'll refer to as "Acme" illustrates how to construct an activity system for "innovative" and "functional" products. The case was also described in a previous publication.[2] Acme had long manufactured a widely used line of aircraft fasteners, a product field in which Acme was a pioneer and technical leader. Many of Acme's competitors were licensees of its technology.

Fasteners are the "glue" that holds the aircraft together — so they are essential components, even though they represent only about 2% of the aircraft sales price. Acme's products also included the tools aircraft manufacturers use to install the fasteners. So the fastener/tooling combination represented a fastener "system." Design of the tooling — along with the product design — determined the cost of fastener installation. Customers respected Acme for the quality of its product, but usually based their purchase decision on supply chain criteria like price and availability. All suppliers of Acme's technology were certified to quality standards. Unlike other fastener companies, Acme maintained technical services to support its technologies. But quality and technical services — while desirable — seemed to carry little weight in most purchasing decisions.

Acme's profit had languished in a cyclical downturn in the commercial aircraft market. A recent boom in business brought profitless prosperity. Boeing, a price-driven buyer, dominated this market. Many licensees enjoyed lower costs and greater market share, including sales to Boeing.

Most producers and customers like Boeing believed fasteners to be functional products. This was partially due to the long life of the airframes that used fasteners and the difficulty of certifying any variation in the way the air-

craft were put together. So there was an inherent obstacle to replacing existing products that were specified in the initial design.

However, there was some innovation in the industry in both fastener design and the tools for their installation. The purpose of this development was to reduce the total cost of installation. This total cost included not only the price of the fastener but also the labor associated with installing it. Surveyed aircraft companies reckoned this additional labor to be several times the cost of the fastener itself.

The supply chain for fasteners was also in a state of flux. Many non-Boeing customers were also turning to distributors for fasteners — rather than buy fasteners directly from producers like Acme. This displaced manufacturers from dealing directly with the aircraft manufacturers that were the end-users of fasteners. For these users, buying from distributors brought lower inventory, just-in-time delivery to assembly lines, and reduced purchasing overhead. Customers also imposed strict service standards for replenishing stocks on distributors.

Despite these changes in industry supply chains, Acme maintained a one-size-fits-all supply chain approach based on its historic direct-sales channel from Acme to the aircraft manufacturer. There were no accommodations for emerging industry segments. Lack of innovative products and ignoring new supply chains caused most of Acme's products to fall into the D quadrant of the product grid (refer to Figure 6.1). Particularly vexing to customers in a time of tight supply were long lead times for Acme's products.

The following sections illustrate how a supply chain redesign, using the conceptual frameworks of Porter and Fisher (described in Chapter 6), might improve Acme's competitive position. The next sections step through the Porter framework for constructing an activity system using Acme as an example.

7.2.1 Select Strategic Themes to Underpin Your Strategy

Porter's framework begins with strategic *themes*. Strategic themes are the cornerstones of the activity system. Porter observes that the themes require clear choices regarding how to compete. This is a difficult but necessary step not to be taken lightly. Too often, companies try to be all things to all people. Failure to choose how one will compete implies there's no strategy at all.

The choices for Acme centered on the four themes listed in the left-hand column of Table 7.1. The table shows the "as-is" choice implicit in the way Acme operated. These positions had evolved historically and were not the result of conscious strategy decisions along the way. The last two columns illustrate the range of options from the high to the low end. Various competitors had chosen to compete along the spectrum from high to low. Most successful competitors had made conscience choices.

Acme had choices in each of these areas. A possible set of choices could include those shown in Table 7.2 and depicted in Figure 7.1.

TABLE 7.1

Themes for Acme's Strategy

Theme	Acme "As-Is"	High End	Low End
1. Technical leadership	Provide a variety of resources — engineers, laboratories, etc.	Cutting edge	Copy cat
2. Flexible production	Inflexible scheduling. First in, first out.	Excess capacity, short lead times	Take a number. Get it when it's ready. Production designed to fill Boeing orders.
3. Customized service options	No customization for segments. Services designed around direct sales to OEMs.	Tailored approaches to all segments.	Narrow choices directed at niches — at low prices
4. High contribution focus	Not managed, poorly measured.	Plush, service driven	Narrow, price driven

TABLE 7.2

Strategic Choices for Strategy

Theme	Strategic Choice
Technical leadership	Maintain technical leadership position. Find ways to more fully exploit the advantage from laboratories and engineering department.
Flexible production	Deploy production capability to match service levels.
Customized service options	Develop different levels of service for each customer segment.
High contribution focus	Price products and services to meet profitability goals.

Figure 7.1 displays an Acme decision to maintain its technical leadership position (theme 1) while adding flexibility to its production and customer service systems (themes 2 and 3). Profitable operations require a new financial approach (theme 4). So pursuit of measures to assure that prices and costs align became a choice to be made.

Deceptively simple in concept, the four boxes represent real choices for Acme. As an example, Acme could choose to forgo its technical leadership position. That would produce a dramatically different company and supply chain. Gone would be laboratories, the engineering department, and a technically adept sales force capable of troubleshooting customer problems. It would treat all its products as "functional," choosing to compete on price alone. It would operate as a "no frills" company, delivering little more than plain "vanilla" product. And several successful competitors did just that.

The flexible production and customer service themes (2 and 3) required major changes in the way Acme managed its capital resources and scheduled its oper-

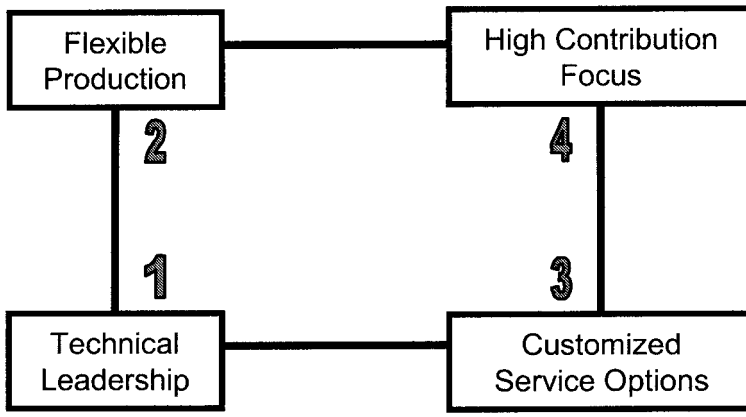


FIGURE 7.1
Acme's four strategic themes. (Reprinted with permission of CRC Press, LLC.)

ations. These changes reflect focused strategies aimed at the emerging role of distributors in the supply chain. For Acme, this could mean three strategies:

- A Boeing-specific strategy
- A strategy for other aircraft makers
- A distributor strategy

Each segment had different needs. For example, distributors want fast delivery of a variety of products. Price is secondary. Boeing wants long production runs and low cost.

With the complexity introduced by this strategy comes the need for better accounting. So pursuit of *contribution* could be a theme. Note this isn't *contribution margin*. The goal of increased contribution allows for both high- and low-margin business. To qualify, a low-margin business with high volume would be desirable. The choice of margin would require Acme to do a better job of measuring and managing prices and costs. Acme had tended to view high-margin business as desirable without regard to the volume.

7.2.2 Define Unique Activities to Support These Streams

With strategic themes in place, Acme had to develop supporting activities and processes that implemented those themes. Figure 7.2 shows some of the activities Acme might have pursued to implement the strategic themes.

A renewed investment in product R&D supports the theme of technical leadership. Also, product R&D and consulting support the technical leadership theme. Acme reckoned its technical position was unique in the industry. That capability would have value to customers needing new solutions and

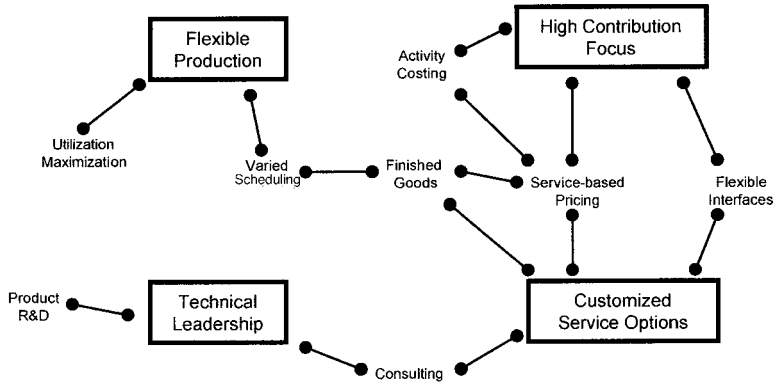


FIGURE 7.2
Supporting activities for Acme's strategy. (Reprinted with permission of CRC Press, LLC.)

advice on the use of the product. But it ought to "pay its way" instead of being given away. Acme faced the choice of many software firms. This choice was to support paying customers through the product "break in" period and then charge for services thereafter.

Because demand had increased dramatically, Acme needed to use all the plant and equipment capacity available. The utilization maximization activity supports this goal. It includes a number of measures like improved maintenance, reduced set up, and cellular manufacturing to get more from scarce machine and personnel capacity. This activity was also important to help Acme get ahead of its backlog and reduce its lead times.

Varied scheduling and finished goods support flexible production and customized service options themes. Acme had a policy not to carry finished goods inventory and build only to order. But this added to the long lead times for all its products. By selecting products for inventory, Acme could satisfy at least a portion of its customers' requirements quickly. The products would be what Fisher refers to as functional products. These are the products whose market demand is certain. Introducing varied scheduling would add predictability to production schedules and enable better management of production priorities.

In an environment of scarcity, offering different levels of availability is a strategic application of supply chain thinking. It recognizes that immediate availability has a value over delivery in 6 months. A supply chain providing product today at a higher price would solve some customers' needs. Other customers could choose to wait their turns in the queue. Of course, the premium for short-term response will vary with the ebb and flow of market demand. At peaks in demand, the availability brings a premium price. At low points, it's an edge in a more competitive marketplace.

Flexible interfaces between Acme and its customers broadened the contracting and transaction options available to customer segments. On-line ordering and production tracking are examples. The existing Acme customer interface system formed over time when end-users placed direct orders. These options would especially accommodate the needs of the growing distributor channel in the supply chain. Each distributor had a unique customer base with varying demands for product and replenishment. Acme could "tune" its production system to these needs with more options.

Activity costing would help Acme understand which sales are "profitable." Profitability would be measured here in terms of total contribution. Acme served many customers with a wide product range. But Acme had little left in the way of profit, despite resurgent demand. Activity costs would point to the profitable and unprofitable businesses. Activity costs would also support service-based pricing. Service-based pricing would mean more services should cost more. It maintains that non-product supply chain services have value. A customer drawing heavily on readily available finished goods inventory and technical support, for example, should pay more.

7.2.3 Make Sure the Activities Fit Together

As we indicated at the beginning of this chapter, Porter maintains that sustainable advantage comes from "fit" between activities. In adapting this idea to supply chains, we can describe three flavors of fit:

- **First order: fit between the activity and strategic theme.** In the activity map, activity costing fits the notion of measuring contribution on different pieces of the business. Its application is as an internal control to evaluate product and customer profitability. Product R&D is another example of first-order fit. The product R&D activity supports the technical leadership theme alone.

- **Second order: reinforcing activities.** This type of fit is between activities where one activity supports another. For example, activity costing also reinforces another activity, service-based pricing. Activity costs provide the data to set prices. Changing the way scheduling is done (varied scheduling activity) will enable maintenance of finished goods inventory (finished goods activity).

- **Third order: optimization of effort across the activities and with suppliers and distribution channels.** Third-order fit includes the elements often referred to as "supply chain integration." Flexible production and finished goods provide options for distributor customers competing with just-in-time contracts. Flexible interfaces increase the ability to link up with the supply chains of Acme's customers — notably distributors.

It is "fit" that provides sustainable competitive advantage, according to Porter. Competitors can usually imitate the individual activities of successful companies. But they ignore the impact of second- and third-order fit — the greatest contributors to competitive position. To dislodge their successful adversary they must copy not just one, but multiple, activities and link them effectively. This is many times more difficult than imitating a single activity.

7.3 Conclusion

Thinking in terms of supply chains instead of individual operations or departments leads to more competitive strategies. These strategies, in turn, have fallout throughout the operation. In the case of Acme, the addition of new linked activities would bring the need for new thinking, a shifting of organization roles, and new information systems.

If we view the levels of project from our classification framework (introduced as Figure 5.3), we might assign the projects to the levels shown in Figure 7.3. All three levels are represented, and all projects are "strategic" as each is needed to implement Acme's strategy.

Function	Business unit	Supply chain
Varied Scheduling	Finished Goods	Flexible Interfaces
Utilization Maximization	Activity Costing	Service-based Pricing
		Product R&D
		Consulting

FIGURE 7.3
Classifying Acme's strategic initiatives.

Acme's product line had both functional and innovative elements. End users were looking to reduce their costs. This opened the opportunity for Acme to innovate, particularly in addressing the total system cost of installing its fasteners. Pure cost reductions placed it in direct competition with more efficient competitors. This is a battle Acme would be unlikely to win.

Developing the strategy is a vital first step to improvement, and perhaps the easiest. The implementation phase shifts from a "right brain" to a "left

brain" exercise. There is an unprecedented need for cross-functional cooperation. Implementing Acme's new activity system would draw on skills from marketing, engineering, production, and finance. The devil lies in the details. Later sections in the book are designed around implementation tasks. Acme would need to draw on these approaches to be successful.

References

1. Porter, Michael E., What is strategy? *Harvard Business Review*, (74/6), pp. 61-78, November-December 1996.
2. Ayers, James B., Supply chain strategies, *Information Strategy: The Executive's Journal*, (15/2), pp. 2–10, Winter 1999.

8

QFD Case Study

> It (QFD) will give you a better product, service or process than you would have achieved otherwise.
>
> ***QFD Handbook***

8.1 Applying QFD at Acme

We agree with the above quotation. QFD has much to recommend it as a tool for design. This chapter builds on our example company, Acme, as a situation where QFD can play a role in supply chain development. As described in retrospect in Chapter 7, it may be difficult to understand how Acme overlooked the shifts in its markets. But Acme's situation is more the common case than it is the exception. The crush of day-to-day running the business puts the trees in the way of the forest.

QFD, as introduced in Chapter 6, could assist Acme in its supply chain planning. Acme had a one-size-fits-all supply chain. How might it use QFD in its planning? What contributions would it make to the construction of its strategy? If there's to be a strategic restructuring of Acme's supply chain, what form should it take? We have described one possible solution in Chapter 6.

To illustrate QFD application, we can reconstruct the decisions needed to arrive at the supply chain strategy.

- What segments does Acme serve?
- What do customers in each segment want?
- How can Acme satisfy those requirements?

This chapter describes how Acme might use a customer survey to clarify its direction. The decision to use QFD would rest on the realization that supply chains were shifting. The trend from direct purchases by aircraft manufacturer customers to distribution is evidence. This increases industry complexity and brings the need for restructuring to cater to different segments. The survey can help sort out possible directions for that restructuring.

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Such a survey should provide insights into the following:

- *Product/customer grouping.* Differing needs by group.
- *Performance factors.* Factors valued by the segment and their relative importance.
- *Ideal supplier.* What are the characteristics of such a supplier and how does the fastener industry stack up?
- *Acme's performance.* The performance of Acme relative to the rest of the industry.
- *Competitor comparison.* Acme rankings in specific areas relative to specific competitors.
- *Trends.* Customer concerns that could affect Acme.
- *Added value.* Potential areas for Acme to increase its contributions to customers.

The following sections describe how a survey might contribute to constructing a supply chain. The description refers to a questionnaire structure shown as Table 8.1. It contains the type of data that can be converted to the QFD format, which in turn supports collective decision making for supply chain design.

TABLE 8.1

Outline of Acme's Questionnaire

Introduction to the questionnaire	• Background and purpose • Directions
Respondent Profile	• Supplier Strategy section respondent • Transaction section respondent
General Information	• Expected mix of direct and distributor purchases • Current suppliers including distributors and directly purchased items
Supplier Strategy Section	• Definition of an ideal supplier • Direction of fastener technology • Cost of installing a fastener • Information technology trends
Transaction Section	• Relative performance with respect to lead time • Relative performance with respect to lead time reliability • Relative performance with respect to price • Relative performance with respect to technical support • Relative performance with respect to field sales force support • Relative performance with respect to product quality • Relative performance with respect to inside sales support • Relative performance with respect to overall ease of doing business with the company

8.1.1 Customer/Product Groups

Different customer groups necessitate multiple questionnaires. This needs to be considered in survey design. For example, Acme's requirements might lead to questionnaires for both its fasteners and its installation tooling. Within each of those product lines there are both manufacturers and distributors. In all probability, a separate survey instrument should be tailored to each group.

Responses to a general information section of the questionnaire may point to other "slices" or segments in the market. These might be determined by the buying patterns of the respondent. Examples are the suppliers they have or, in the case of distributors, their customers. Another common segmentation basis is the volume of purchases made. Yet another is buyer behavior. One group may deal with only a few suppliers in longer-term relationships. Another group might be opportunistic, seeking the best price and terms each time a need arises.

8.1.2 Performance Factors

The "Supplier Strategy" section seeks to gain a broad understanding of the respondent's decision-making process. A list of supply chain-related performance factors is at the center of this response. These are typical measures by which a buyer evaluates its suppliers. Responses to the list may also serve to segment customers by their priorities. This is valuable in sorting buyers into "functional" and "innovative" categories. A functional buyer would value "unit price" over "problem solving" categories. An innovative buyer would place higher value on these.

8.1.3 Ideal Supplier

This is a concept that allows respondents to define what they like best in suppliers. The ideal supplier is the supplier respondents would like all suppliers to be. Obviously, all suppliers are not ideal. It is also possible that no one supplier reaches that level of performance, and the ideal is in fact a composite. By assigning priorities to each performance factor, Acme will have the information needed to fill the "what" portion of the QFD matrix. This represents the priorities for performance from suppliers. The questionnaire responses will allow Acme to rank performance factors.

So an aircraft manufacturer will have suppliers in many categories. The individual preparing the response should have a broad enough view to understand the relative performance of various supplier groups. In the case of Acme, this probably won't be the fastener buyer for the aircraft manufacturer or distributor.

The questionnaire asks the respondent to compare the fastener industry to this ideal. With the ideal supplier representing the first quartile of suppliers,

the respondent places the fastener industry in the appropriate quartile. The purpose is to gauge the industry's overall position. In QFD terms, it "centers" industry performance for measurement of Acme's performance.

8.2 Acme's performance

The next response asks for Acme's performance relative to the ideal supplier. Of course, the respondent must buy from Acme. This information will assist in filling the "why" portion of the QFD matrix. Table 8.2 shows possible interpretations arising from the application of the ideal supplier concept with performance measures for the industry and Acme.

TABLE 8.2

Application of QFD to Acme's Strategic Direction

Ideal Quartile	Industry Quartile	Acme Quartile	Implication
1	2	4	Indicates the need for urgent performance improvement.
1	2	1	Company excels in this measure. Should assure that any changes don't reduce performance. If the area is of high value to the customer, Acme should publicize its relative performance.
1	3	1	Distinct advantage for exploitation. Could direct advantage at innovative segments.

8.2.1 Competitor Comparison

In what is called the "Transaction Section," the questionnaire seeks detailed comparisons with competitors on various aspects of the relationship. Also, since Acme serves end-customers through distributors, it seeks information on their effectiveness. The data refines the industry-level evaluations in the Strategic Section. It moves from an overall industry perspective down to the level of individual competitors. So it should provide Acme with a good idea of the most effective competitors. The mechanics of using a quartile approach are similar to those in the Strategic Section.

8.2.2 Trends

The Strategic Section requests information on trends from the customers' perspective. The questionnaire asks for a response in the areas of product technology and information systems. There is also a question regarding the total cost of installing a fastener. It is not expected that every manufacturer will

have this data, but responses can help put the customer costs of using one's product into perspective. In the case of Acme, it is a measure of the cost to the end-user of running the fastener "system."

This is particularly applicable when one supplies such a system. This was the case with Acme, which provided both the fasteners and the tooling to install them. Good analogies are the proverbial razor and blades or cell phones and calling time. Producers, in many cases, can afford to give away the initial product to gain the income stream from the user.

8.2.3 Added Value

The information can support decision making in multiple ways. If Acme performs below industry standards in areas important to customers, it could be falling below the competitive threshold. There's no alternative but to reach the industry standard.

Of greater value is the ability to discover strategic supply chain opportunities. The questionnaire will not tell "how" but can point to the "what." These could be needs that no current supplier does a good job of satisfying. The strategic initiatives described in Chapter 7 are examples of responses to needs like these. In many cases the strategic projects may also reinforce needs to improve in customer-critical performance measures as well.

9

The Supply Chain and New Products

Technology has a genius for becoming invisible — or, when not invisible, perfectly ordinary.

Frederick Allen, Editor,
The American Heritage of Invention & Technology, Winter 2000

Supply chain management practices can help improve strategic position by getting more from new products. The impact of supply chain management on new products is often ignored. The discussion in most supply chain forums focuses on existing, rather than new, products and existing, rather than new, supply chains. The quotation supports the idea that the inherent technology in new products becomes, in time, "ordinary." This leaves the heavy lifting in terms of maintaining long-term competitive position to extended product design and supply chain management.

From a supply chain standpoint, the introduction of a new product is both an opportunity and a threat. It's an opportunity to the extent that the new product will increase sales and vitalize a company's offerings. It's a threat if the introduction somehow misses the mark with prospective customers, rendering the investment in its development worthless. The supply chain may have a lot to do with success or failure. Supply chain management techniques cannot guarantee that a product will be a hit with customers. But a properly designed supply chain will assure that the product is introduced with the right kind of supply chain and that the economics of the supply chain are figured into the product development process.

There are as many new-product processes as there are companies that produce new products. Some companies depend on a constant flow of new products. An example is Rhino Records, which "rereleases" past hit music. This process produces about 15 releases a month. These add to an already significant catalog of prior releases. Au Bon Pain is a sandwich shop with locations in major metropolitan areas. Its customers may grab lunches at Au Bon Pain several times a month, so the menu can't be static. A flow of new menu items adds variety to customers' diets.

Both Rhino and Au Bon Pain rely on a "fixed" supply chain into which they launch new products. The supply chain processes for each product introduction are common, but each new product will have some variation that must

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be addressed in the introduction procedure. For Rhino, the promotion budgets and expected sales volume will vary widely from one release to another. Timing is also critical if the release is to take advantage of external events. For example, Rhino heavily promoted a release of Oscar-winning tracks at Oscar award time. Au Bon Pain can run a special on a new sandwich to draw customers into its stores. Or it might introduce sandwiches regionally that cater to local preferences.

For Rhino and Au Bon Pain, the supply chain is a central, vital process. However, it is likely to be stable — not changing much fundamentally but susceptible to continuous improvement modifications. Individual new products don't vary significantly from item to item. Each Rhino CD or tape and each Au Bon Pain sandwich has a lot of common with those that preceded it. But speed and efficiency in the process that produces them continues to be quite important.

At the other extreme are new products that require new-product technology, production processes, partners, and supply chains. These product introductions are anything but routine. Often, these projects represent "bet your company" investments. In the middle of these extremes are many, many products that are neither routine nor radical. And often, the likely conclusion is that existing supply chains and production facilities will suffice to produce market success.

In Chapter 6, we described the differences between innovative and functional products. One observation is that similar products, like automobiles, may be different. Our example was a Taurus being a functional product while a new convertible is an innovative one. The supply chains for these products should be different. The differences may not be so much in the physical flow, but in the decisions regarding inventory and availability of product. The products cater to different segments; they are likely to carry different margins and inventory economics.

We've also noted that new products are moving more and more rapidly through the quadrants of the product position grid (refer to Figure 5.1). This is reflected in the shortened product life cycles common in newer products. So we believe it will be even more important than ever to plan the supply chain along with the product's movement across this grid. As the product moves from one quadrant to another, the supply chains need to change.

We feel there needs to be greater awareness of the need for supply chain thinking early in a product's development. This will require management interventions in that process. Here we describe ways to improve the effectiveness of this important activity.

It's useful to have an understanding of the types of new products or new processes that might compose a company's portfolio of product or process development projects. One such classification is provided by Kim Clark and Steven Wheelwright.[1] The authors' model, with four types of product/process change, encompasses innovation in both products and processes. Table 9.1 is an adaptation and shows their classification.

TABLE 9.1

Types of Product/Process Development Projects

Type	Examples	Extent of Product Change	Extent of Process Change
A	Enhancements to existing products Derivative products Variations on similar products	Products have minor improvement Modifications include different content but same basic form Minimal supply chain change	Tuning, incremental changes Confined to one department Could produce supply chain change
B	Next-generation product New platform	Next-generation product Probable supply chain impact	Next-generation process Multiple departments involved Likely supply chain impact
C	Radical breakthrough	New core product May require a new supply chain	New core process Likely to require a new supply chain
D	Research/advanced development	Designed to lead to a new core product Could/could not require a new supply chain	Designed to lead to a new core process Likely to require a new supply chain
E	Partnership projects	Likely to require a new supply chain if product is new	Supply chain change is likely

Clark and Wheelwright described types A through D. Type E is our addition to recognize the "partnership" project, which can produce its own set of issues. The table recognizes that any particular project can vary in terms of the product and process change involved. For example, an A-type project involves minor changes in both product and process dimensions. Type A products are like Rhino's releases or new menu items at Au Bon Pain. Changes of the A type could be either product- or process-directed, or both.

Type B projects are more ambitious. They often involve the "next generation" of a base product. The continual upgrading in personal computers provides a good example. A project in the B category could produce the same effect on the process dimension. The C project is the "breakthrough" in either product or process. In retailing, the growth of Internet sales is an example of a C project on the process side. Type D projects represent the "fuzzy front end" of product and process development. Managers have a choice about how much supply chain planning should be done in advance.

The E projects are joint efforts with multi-company participation. We address the issues surrounding alliance and partnering projects in our discussion of partnerships beginning in Chapter 14. Chapter 27 also describes some techniques for coordinating supply chain change during the product

development process. The discussions in these chapters can apply to all five types of projects shown in Table 9.1.

The classifications are useful. In each category, we describe the likely impact on the supply chain from either new products or new processes. A "next-generation process" resulting from a B effort can happen even if there's not a great deal of change in the product itself. Likewise a next-generation product may require only incremental process or supply chain changes.

Manufacturing companies use the term "concurrent engineering," often called "CE," to describe efforts to develop the manufacturing process while designing a product. Manufacturers find that CE speeds up product introduction. It is the opposite of the "over-the-wall" approach of handing down product designs from the engineering department to the production department. CE is a cultural breakthrough if done well. In too many organizations, engineering and manufacturing under-communicate, so many products are introduced with a sequential rather than simultaneous processes.

The need to consider the supply chain adds another dimension to the CE concept. Now it's not just tooling and material that have to be considered but also the distribution channels, inventory policy, and other supply chain issues. CE for the entire supply chain particularly fits in the case of B, C, and E products in the table. In these cases, a new product is more likely to be accompanied by a new supply chain. These are probably major projects involving a great number of unknowns about the market and the likelihood of commercial success.

References

1. Wheelwright, Steven C. and Clark, Kim B., *Revolutionizing Product Development*, New York, Free Press, p. 49, 1992.

10

Foundation for Supply Chain Change

> Supply-chain improvements will come faster when every manager, whatever his or her functional title, becomes a supply-chain manager.
>
> **Peter Bradley**, Editor-in-Chief, *Logistics*

This chapter is the first of four that address our second supply chain task, *Implementing Collaborative Relationships.* This task encompasses the roles of players *within* the organization in improving supply chain functions. A subsequent section (Chapters 14–20) covers approaches for partnering with companies across the supply chain.

Supply chain change is very much a cross-functional effort involving all levels. The opening quotation hints at broad participation. We believe the changes brought on by supply chain management require *collaborative* relationships throughout the organization. Often the largest barrier a single organization has to overcome comes from within. New supply chain relationships will test traditional ways of working that change in many ways over the course of a program that brings supply chain innovation.

Some readers may view these few chapters as "reruns" that describe programs such as TQM. Indeed, the TQM philosophy and tool set are relevant to implementing supply chain change. We noted in Chapter 7 that our case-study company, Acme, had only begun its journey to supply chain improvement with the development of necessary tasks. Too many organizations make excellent plans but fail in execution. So we give the subject of implementation its due here.

The foundation for collaborative relationships has several dimensions. The table below lists four and the section topics related to their implementation. The section progresses from overall direction to management of projects to institutionalizing or "locking in" changes into everyday operations.

If any of these elements is missing, effective supply chain change is unlikely. Here we include both the methodology and participation for putting the foundations in place. They encompass planning, execution of change programs, and ongoing operations. Much of this section reflects basic project management. But the lessons bear repeating. We also hope to give these approaches a supply chain "flavor." Skillfully applied, these techniques will improve communication and make working together more pleasant and effective.

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Foundation Topic	Coverage	Chapters
1. A philosophy that promotes change.	• Shewhart cycle • Top management involvement	10
2. Structured implementation programs.	• Functional participation • Initiatives and projects • Sponsorship • Teams at three levels	11–12
3. Participative methodologies.	• Methodology for project execution	12
4. Institutionalized changes.	• Organization structures • Measurement	13

10.1 Promoting Change

Implementing supply chain changes is not unlike other change programs that have either been used in the past or are current today. Earlier, we mentioned that TQM "technology" offers effective tools for the change process. The Shewhart cycle of Plan–Do–Check–Act, taught by W. Edwards Deming in Japan, provides a durable and effective model.[1] The cycle has four steps that repeat — hence the term "cycle" — to continuously upgrade a process. Figure 10.1 shows the Shewhart cycle. We describe them here in the context of supply chain improvement. After each step in the cycle, we list the tasks involved in completing that step.

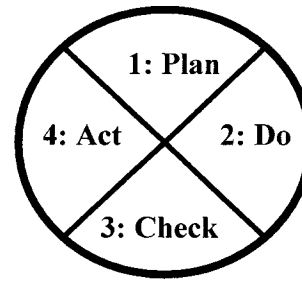


FIGURE 10.1
The Shewhart (or Deming) cycle.

10.1.1 Step 1: Plan

Set an overall strategy for the organization. In addition to supply chain considerations, this should include a vision, financial objectives, expected mergers and acquisitions, product development plans, and operations improvement.

Identify the ways a reconstituted supply chain should support the strategy. Set a high level specification, or vision, for the new supply chain. Divide the supply chain into processes. The Supply-Chain Council offers a standard process reference model, described in further detail in Chapter 23. Examples

include order fulfillment, payments, inbound material, physical distribution, production control, and new-product introduction. Determine the changes to these processes needed to meet strategic requirements.

Develop a portfolio of supply chain-related initiatives and projects organized by process (discussed later). Classify the projects using one of the strategy frameworks described in this book or a local adaptation that better fits the organization. Organize teams to execute the projects. We recommend team structures and participation later in Chapter 12.

10.1.2 Step 2: Do

Write the project action plans. Apply a methodology to evaluate and change the process. Such a methodology also appears in Chapter 12, where we discuss the "do" phase in considerable detail. Test solutions in pilot testing. Implement the organization structure and measurements needed for full-scale implementation.

Use appropriate technology to support the redesigned processes.

10.1.3 Step 3: Check

Observe the results. Change the solution based on those results.

10.1.4 Step 4: Act

Evaluate the change. Learn from the result. Begin the planning cycle again. Extend the application as appropriate.

10.2 Top Management Involvement

Top management has special roles to play in the process we've just described. We refer to this role as "tmi," shorthand for "top management involvement." Any manager who has had to implement a project will probably raise the need for tmi. It's considered, practically universally, a prerequisite for success in any program for change. With it, projects sail along with the wind at their backs. Without it, it's an uphill battle for resources and results. When examining the cause of success or failure, it will often appear on a list of project management factors such as the following:

Project manager skills

Team member numbers and skills

Strong system integrators and software suppliers

Cooperation of users

Money and time

Project control

Top management involvement (tmi)

The call for tmi is seldom accompanied by sound advice about how and how much tmi is needed or even what it is. It is probably the hardest item on the list to describe, yet it could be the most important.

Since we agree that tmi is required for success, we devote space to solidifying the concept. Abstract terms don't help. So here are some prescriptions for active management of the supply chain improvement cycle by top management. We begin with a clearer definition of just who is top management.

10.2.1 Who is Top Management?

Earlier, we described the types of supply chain projects an organization might undertake. In our model, there were six categories depending on strategic contribution and scope. Figure 10.2 below repeats the six categories.

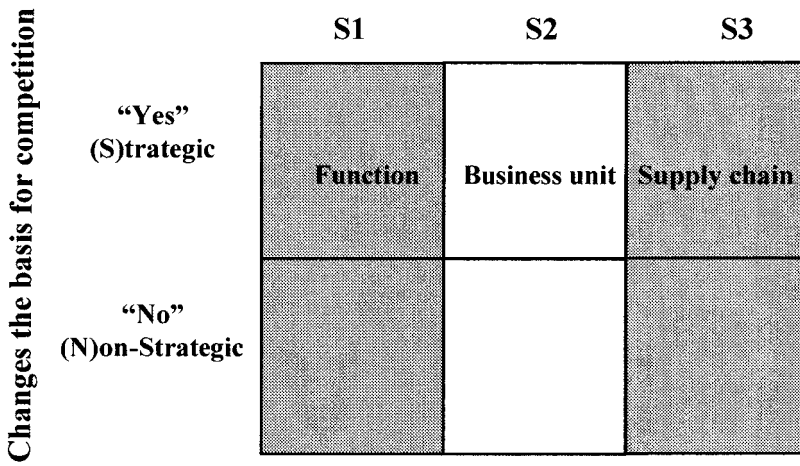


FIGURE 10.2
Model for competing through SCM.

We suggest that the definition of "top" management depends on the type of project. All projects for change should have some level of top management "attention." The practical reality is that top managers will necessarily ration time and energy based on the importance of each project. The shading in the figure suggests that those projects that fall in the upper-right-hand corner

should have the most attention and involvement. These are also the projects that require senior level sponsorship, as we'll describe later.

If we are talking about an autonomous business unit, this would be the president or general manager and his or her direct reports. A functional project (S1) — whether strategic or nonstrategic — might fall under a department head with less frequent intervention by peers or the business unit president.

Later in this section, we suggest that a steering committee guide the destiny of each project. The senior member should represent the appropriate organizational level. In strategic projects at the business unit and supply chain levels, that person should be the business unit chief executive.

10.2.2 Keepers of the Strategy

Few would deny that strategy is a top management function, and one that can't be delegated. Too often, however, existing projects will constitute a *de facto* strategy. An ERP project, for example, will consume every available spare resource. Moving a manufacturing plant will also capture everyone's attention for an extended period. Rather than being a planned strategy, these often result from collective actions taken over time as part of capital budgeting or ongoing planning projects. There is little in the way of "top-down" direction to create new priorities and reevaluate ongoing projects. Top management has failed to play an active role in project definition with a strategic framework in place.

Strategic direction comes from a vision of where the organization needs to go. The vision provides a yardstick to determine what is strategic and what is not. In fact, we often find that many projects form out of a haphazard process, have no strategic contribution at all, and should be discontinued. Robert expands on this need.[2]

A surprising example of this is Microsoft. Microsoft found itself without a vision. Bob Herbold, the chief operating officer at that time, is quoted in company advertising as realizing, "My gosh, we don't have a clear statement of what Microsoft is." The response was to predict the future for attributes that were likely to stay relevant and attractive. For Microsoft, the resulting branding or vision, what the company refers to as a "sacred" statement, was *Microsoft leads the way in providing access to a new world of thinking and communicating.*

Microsoft's situation is not uncommon. In Figure 10.2 we define several ways to qualify a project as "strategic" or not strategic. In general, a strategic project will implement the vision and alter in some way the competitive landscape. This is different from projects that keep the company "in the game" but don't affect the competitive balance. From Figure 10.2, projects can be any of three levels: supply chain, business unit, or functional area. It's the job of senior management to sort out which projects are strategic and which only maintain a position.

In general, we find that too few projects are strategic in nature. A typical example is a large program for upgrading systems by implementing new

software. The project is huge in terms of money, time, and distraction. Budgets may be measured in the tens of millions. But the new system will seldom deliver anything distinctive in the way of competitive position. In fact, to hold down cost and reduce time, managers and company advisors may discourage customization of the system. So the same solution proliferates through the industry.

10.2.3 Capability-Building/Strategy Shifts

Most companies have to face a fast-changing market place. No vision, strategy, or portfolio of projects will apply for long. So it's the job of senior management to change with the times. This requires what Hayes and Pisano call *strategic flexibility*.[3] The essence of this concept, according to the authors, is the shift of focus from the mechanics of implementation to their contribution in terms of an intended direction. The lesson is that the supply chain strategy must be flexible enough to change in the face of changing strategies. An example would be a shift from stressing rapid product development to producing low cost products quickly and cheaply.

Strategic project selection, according to Hayes and Pisano, should depend on the skills that the company needs to cultivate. They cite the choice of improving production flows and reducing lead-time. If this is a strategic goal, the organization will have choices of the path to its achievement. A JIT (just in time) system with a "pull" discipline for production decisions is one direction the company might pursue. Implementing a systems-based approach that includes advanced planning software is another.

The two approaches will hone different skills. JIT will develop one type of capability, software solutions another. Both may reach the same end-point eventually in terms of lead times and production flow. However, the skills developed as a result of the choice will be different, so the choice is critical with respect to the ability to compete in the future.

10.2.4 Portfolio Management

We use the term "*portfolio*" to refer to the body of projects underway or proposed for implementation. The goal of portfolio management is to design and authorize the best set of projects to implement one's strategy. Other sections talk about strategy design. So, for this discussion, we'll talk about general frameworks for project review and authorization.

For this discussion, we assume that management has many options for deciding which supply chain improvement projects should be in the portfolio. Supply chain projects of all types may be proposed in any given period — frequently in conjunction with the annual budgeting cycle. But the management team has to pick the "best" ones. An important responsibility of management is to approve, deny, or put these proposals on hold. The rise of supply chain issues brings fresh challenges to project selection.

A common practice is to use financial criteria for project approval. For example, if a project requires capital, it faces the capital budgeting process. Unfortunately, especially if the business unit is part of a larger organization, many capital budgeting processes rest on financial criteria. These methods use discounted cash flow (DCF) techniques to compute *net present value* (NPV) or *return on investment* (ROI). The latest wrinkle on this theme is *earned value*. All three approaches weigh improvement in cash flow against the capital investment required. An unfortunate consequence of this approach is that, once one has learned the game, the numbers will follow. All too often there is little chance of an audit of actual outcomes. So creative accounting becomes the norm. Numbers are produced that meet known "hurdle" rates.

Another justification approach arises from the compulsion to follow industry leaders. Afraid of being left behind, management pursues buzzword programs that are "sweeping" the industry. "I've got to have one too," becomes the justification.

We believe a mix of these approaches is the best practice. Our recommendation rests on matching the project type with the appropriate justification method. This avoids the problems of a one-size-fits-all approach to justification. Table 10.1 illustrates the approach.

TABLE 10.1

Justification Approaches for Different Kinds of Projects

Classification	Description	• Justification Method
"S" projects	Strategic projects at the supply chain, business unit, or functional levels	• Identified in strategy, or • Develops strategic capability, or • Supports "driving force"
"N" projects that emulate industry norms	Projects that implement common industry practices. "Stay-in-the game" projects.	• Responds to a deficiency, or • Incorporates common new technology expected of industry participants
Financially motivated "N" projects	Optional projects that reduce cost or increase revenues.	• Financial discounted cash flow methods (ROI, NPV)

Currently, most decisions are either intuitive or are treated like "financial" projects. This method calls on top management for a more disciplined approach. This increases the complexity of the screening job, but should produce a portfolio that makes the best use of scarce resources. Chapter 25 contains a discussion of financial tools for better SCM.

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1. Walton, Mary, *The Deming Management Method*, Putnam, New York, pp. 86–89, 1986.
2. Robert, pp. 22–30.
3. Hayes, Robert H. and Pisano, Gary P., Beyond world-class: the new manufacturing strategy, *Harvard Business Review*, pp. 77–85, January–February 1994.

11

Functional Roles in Supply Chain Change

If the only tool you have is a hammer, every problem looks like a nail.

11.1 Introduction

In Chapter 10 we discussed the Plan–Do–Check–Act approach to implementing supply chain projects. We also described at some length the role of top management in implementation. However, the reality is that the "doers" who implement new supply chain processes will come from one or more functional departments. So an important part of the task under current discussion, *Implementing Collaborative Relationships*, is marshalling these resources. A major obstacle is that improvement team must learn new skills to be effective. In addition to hammers, they must become proficient with saws, wrenches, and other tools of the trade. This chapter provides a guide to participation in our five supply chain implementation tasks:

1. Designing supply chains for strategic advantage.
2. Implementing collaborative relationships. (This task is the subject of this chapter.)
3. Forging supply chain relationships.
4. Managing supply chain information
5. Removing cost from the supply chain.

The five tasks will draw on an organization's resources in new ways. However, as a practical matter, most companies operate along the lines of traditional functions, organized into separate departments. Examples in a manufacturing company are procurement, engineering, manufacturing, and distribution. People in these functions naturally become the "experts." Too infrequently, people move from one function to another. Over time they know more and more about the business of the department and less and less

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about company-wide or supply chain issues. So, to appreciate the "big picture," one must assemble teams for problem solving.

One reengineering consultant has said that the existence of walls between the functions is the primary reason for the consulting industry. Indeed, consultants derive much of their revenue from improving communications, integrating information flows, or mediating across these man-made boundaries. DaimlerChrysler, in a case described in Chapter 13, provides an example how a large company dealt with what the company refers to as "battleship" departments.

The five tasks include both planning and operations elements. Strategy setting is certainly heavy on planning; removing cost requires an understanding of what works in the "real world" of operations. Too often, supply chain topics are relegated to procurement, distribution, or information technology managers. This is often the result of narrow viewpoints of SCM that take root in organizations. In our experience, the critical factor in determining the time to implement change is governed by the need to communicate direction to various functional groups. Their involvement from the outset can cut implementation time significantly.

When one thinks of the supply chain for a manufacturer, the shop floor, procurement, and distribution are departments that come to mind. But, as we have discussed, supply chain management is also the purview of marketing, sales, engineering, and finance. For example, a manufacturer of complex aircraft components turned their supply chain problems over to procurement. They viewed, with some justification, that the high cost of material made this the appropriate choice. In most food companies, distribution is a large chunk of what customers pay for when they shop at the grocery store. So the temptation is to drop responsibility for supply chain management on the distribution department. We would discourage this. All levels and functions should play a role in supply chain management.

Another obstacle is a reluctance to go beyond the organization's boundaries for input about supply chain design. The appropriateness of this will vary from company to company. However, as a general principle, the input of both customers and suppliers will increase the return on the improvement effort.

In planning participation in the improvement process, one should at least have a checklist to aid in assembling the skills needed for the effort. This checklist provides a starting point for assigning representatives to supply chain improvement projects. Table 11.1 performs such a role. It shows how typical functional areas might, depending on the situation, participate in each of the tasks. The form of the participation in terms of organization and reporting structure is the subject of discussion in Chapter 12.

Table 11.1 identifies three roles. The *Primary Responsibility* role includes championing the changes, specifying the end results, and overseeing progress. The *Support* role provides guidance in design to the specifications of the sponsors. The *Collaboration/test* role involves less involvement during

design, but extensive participation as users when the design takes shape. Both staff and line functions need to be involved.

TABLE 11.1.

Functional Roles in Supply Chain Change

Functions	Tasks 1	2	3	4	5
Senior Management	**P**	**P**	**P**	**S**	**S**
Finance/Legal	**S**		**S**	**S**	**S**
Marketing & Sales	**P**		**P**	**P**	**S**
R&D/Product Development	**P**		**P**	**P**	**P**
Human Resources		**S**			
Information Systems		**S**		**S**	**S**
Process Design	**S**	**S**	**S**	**S**	**S**
Operations	**C**	**P**		**PC**	**PC**
Materials Procurement	**C**		**P**		**PC**
Production Control				**PC**	**C**
Distribution	**C**		**P**	**PC**	**PC**
Suppliers	**C**		**SC**	**C**	**C**
Customers	**C**		**SC**	**C**	**C**

Note: ***P***=Primary roles for supply chain design; ***S***=Support roles in design and implementation; ***C***=Collaboration/test through design and implementation. The first seven areas are typically "staff" functions. The rest are "line" functions.

No doubt, readers can think of sound alternatives to these assignments. Use the assignments here as a starting point to form the list best fitted to individual circumstances.

Note that the table identifies Process Design as a separate function. This function can include industrial or manufacturing engineers, information technology specialists, assigned cross-functional teams from several functions, or outside consultants. Or it can be a combination of many resources, including all of these. It can also be full-time or part-time.

The discussions of each task will acquaint the reader with nature of the task and how it might be performed in the future. The next section contains a brief overview for each task and an explanation of the roles to be played.

11.2 Designing Supply Chains For Strategic Advantage

Supply chain design begins with the customer. So we show primary responsibility resting with Marketing & Sales and Product Development. Senior Management provides direction throughout design. The Process Design function can design solutions, and other functions shown can provide input and test those solutions. The Finance/Legal function should set constraints and review progress. Suppliers and customers should provide direct personal participation or provide inputs through conferences, surveys, or interviews.

11.3 Implementing Collaborative Relationships (This Task)

By collaborative relationships, we refer to interactions within the enterprise. We are looking at organization structures, empowerment, and other measures that will speed information and gain the most from every employee. Also, measurement and reward structures have a major effect, and this task would remove obstacles to improvement due to measures.

Ultimately all internal functions will participate. We identify Senior Management and Operations as the "drivers." Process Design should have a role in the design. Information Systems should also participate to the extent information systems will enable changes.

11.4 Forging Supply Chain Partnerships

Partnerships come in many forms all along the supply chain, so many functions can participate by working with outside organizations. The table shows many potential champions. Senior Management should always be involved. Marketing and Sales, and Product Development can be sponsors if the changes will lead to improving the positioning of a product. Materials Procurement can sponsor partnering agreements with suppliers on the upstream side. Distribution can do the same on the downstream side.

Partnerships may take many forms, from traditionally structured buy–sell relationships to outright acquisitions, so many support functions may have to make the partnership work. John Harbison and Peter Pekar point out that many attempted alliances fail for lack of "institutionalized" procedures.[1] It is these procedures that will execute the intent of the partnership. Without them, success is at risk.

11.5 Managing Supply Chain Information

Like partnerships, information systems requirements also spring from many sources. We define the supply chain in terms of both physical movement and information movement. That information may be "back office" transaction data or, increasingly, "front office" market and sales applications and shop floor decision support.

The former is likely to spring from Finance, Operations, and Distribution. The latter may originate with Production Control, Marketing and Sales, and

Product Development. The discussion of this task will list the rapidly changing options for applications and how they mesh with the supply chain. We also examine justification processes and the role of systems in process improvement.

11.6 Making Money from the Supply Chain

"Making more money should be everybody's job," said one client. And efforts from TQM to reengineering have sought savings out of operations. The problem is that *everybody's* job is *nobody's* job. We show sponsorship here from Product Development for taking cost out of new products or new versions of existing products. We also include functions that cover areas of high cost — Operations, Procurement, and Distribution.

What's new about supply chain management is the idea that it's a *chain* of multiple companies that deliver products and services, not chains of individual *departments*. To avoid one department reducing its own costs at the expense of another, it's particularly important that cost reduction be a cross-functional initiative.

This discipline also addresses the way numbers are collected, allocated, and reported. Therefore, Finance is likely to be an important contributor to the task.

References

1. Harbison, John R. and Pekar, Peter, *Smart Alliances: A Practical Guide to Repeatable Success*, San Francisco, Jossey-Bass, p. 128, 1998.

12

Supply Chain Design — A Team Framework

> While concurrent engineering has sought to establish well-defined organizational and team structure along with well-structured business processes for product realization, collaborative engineering goes above and beyond this to create the necessary infrastructures and encourage the best environments for highly effective team collaboration.
>
> **C. Anthony Mills**, *CASA/SME Blue Book Series*

The above quotation, from a paper on product development, hints at the need for collaborative processes in any complex endeavor.[1] In this chapter, we present techniques that lower the risk that goes along with change. This includes a methodology for what to do next, after the foundations for supply chain change described in Chapters 10 and 11 are in place. Here, we describe ways to organize the overall change program, lending coherence to the efforts. These measures will better assure the linkage between ongoing programs for change and the strategic intent that leads to their formulation.

12.1 Initiatives and Projects

When TQM (total quality management) programs were in vogue, some companies measured progress by the number of team projects that were under way. The assumption was that dozens or even hundreds of teams working on local problems was bound to produce some dramatic results. Captaining this effort would be the TQM coordinator responsible for training teams and riding herd on the effort. In many efforts, there was an emphasis on quantity over quality.

There may be cases where multiple projects make a lot of sense. There are probably an equal number of cases where fewer would also be better. To help organize a change program, we recommend a three-level construct from the *strategy* to the *initiative* to the *project* or *action plan* that implements the strategy.

Figure 12.1 illustrates the relationship between the strategy, the initiatives, and the projects. The strategy sets overall direction. It is not confined to sup-

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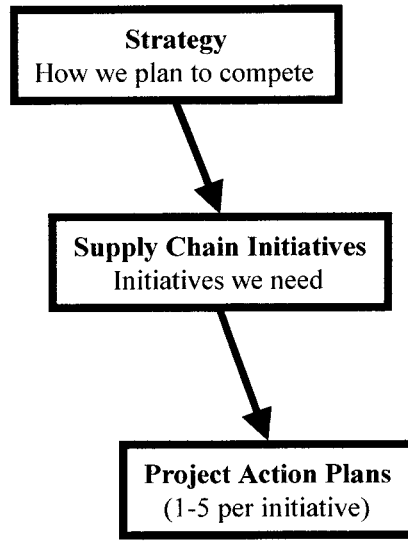


FIGURE 12.1
Strategies, initiatives, and action plans.

ply chain issues but also includes other elements such as product development, acquisitions, and financial plans. The initiatives related to the supply chain portion are gleaned from the strategy. There might be four to six in a representative company.

Initiatives form the link between the strategy and the projects. Often, most companies that have strategies will also have action projects. But the linkage between the two is missing. The initiative is an ongoing endeavor that serves as a category for multiple related projects. While the initiative may last years, the projects done under the banner of that initiative will come and go. Projects are budgeted with the intent that they "go out of business" when the defined work is done. Hopefully, that will be on time with the funds provided. Initiatives have no budget or time limit. They delineate a category of project for organization and communications purposes.

The organization has latitude when it comes to defining initiatives. For example, there might be one for each major supply chain process. In the case of the SCOR model from the Supply-Chain Council (refer to Chapter 23), this would be *plan, source, make, and deliver*.

They could also be organized by solution type. Examples would be systems, production technology, or organization development and skills enhancement. Another alternative for sorting is by end result. Examples include cost reduction, cycle time reduction, quality improvement, or revenue enhancement. A "six sigma" program is an example of an end result approach. Another alternative set of initiatives might be our five tasks for SCM.

The method we like uses strategic "themes," as described in Chapter 7, as a basis for developing initiatives. This provides the greatest "connection" between the strategy and its implementation. In the case of Acme, the strategic themes, as shown in Figure 7.1, were

1. Flexible Production
2. Technical Leadership
3. High Contribution Focus
4. Customized Service Options

In structuring initiatives, the emphasis should be on finding a method of sorting that best fits the company. It's fine also to mix the methods just described.

Project definition should include the elements shown in Table 12.1 below. This "action plan" should guide the implementation effort.

TABLE 12.1

Contents of an Action Plan

What To Do	Why Do It	How to Do It	When/Who/ Where
Description, Business Reason, Needs Addressed	Qualitative, Quantitative	Technology, Work plan, Training, Communication	Resources, Schedule, Logistics

There may be several, just one, or no projects under way in an initiative at any time. Projects, as we have said, should start and stop according to their own schedules. A project that's too big and too ill-defined may become an initiative. The pieces then can be projects that are "trackable." This may make very good sense when implementing systems.

12.1.1 Sponsorship

The discussion of functional participation in Chapter 11 raised the issue of sponsorship for supply chain improvement projects. The individual sponsor appointment will depend on the nature of the initiative or project, the scope, and the motivation (strategic, catch-up, or financial). Needless to say, the sponsor should have a personal stake in project success.

Since supply chain improvement is very much process-oriented, the idea of the "process owner" may make sense. This individual is the focus point for issues affecting his or her process. The owner need not be a line manager responsible for the process or part of it. It could be a senior executive with a stake in the process' success. For example, the marketing executive could be the owner of "order fulfillment." A close cousin to the process owner is an

"initiative owner." This person would fill a similar role to the process owner for the projects conducted under his or her initiative.

We view the sponsor as a logical head for the project Steering Committee in an organization like that shown in Figure 12.2. The sponsor should not be on what we refer as the "design team." The sponsor should be designated during the "Plan" phase of the PDCA cycle and have the assignments shown in Table 12.2.

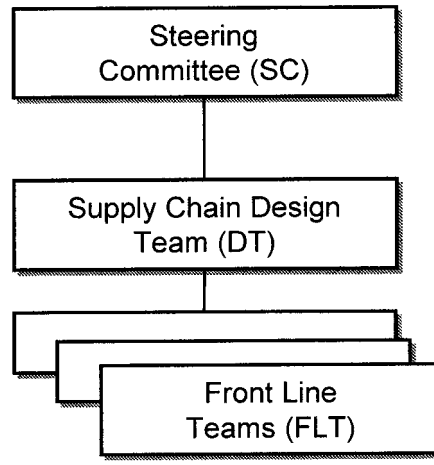


FIGURE 12.2
Project organization chart.

TABLE 12.2

Roles of Sponsors

Project Phase	Sponsor Tasks
Plan	Set boundaries and issues
	Justify project
	Prepare budget/schedule
	Assign team members
	Define success
	Charter of the effort
Do	Monitor progress
Check	Measure and report results
Act	Evaluate progress
	Prepare for the next round of change

Of particular importance is selecting a project manager, team members, and outside consultants, if any. The next sections describe project phasing and team selection. We now explore issues in executing the project. This includes the overall "flow" of the project and the teams needed to implement.

12.1.2 Project Phasing

Regardless of their size as measured by time and budget, supply chain projects tend to have three phases. The first is intensively analytical. It involves a review of the current situation and preparation of a conceptual design for change. The second phase adds detail to the design and begins implementation through pilot testing. The third is full-scale implementation, including systems changes. The project plan should define the phases. Figure 12.3 is a profile of the three phases.

The feedback arrows in Figure 12.3 illustrate internal "check–act" activity throughout the project. We find that the "stage-gate" process discussed in Chapter 27 in relation to new-product development is also of value in supply chain improvement projects. With multiple projects under way, gates in the flow shown in Figure 12.3 assure timely completion of deliverables. A section later in this chapter will focus in how to perform Phase 1. But first, we recommend a project structure for participation.

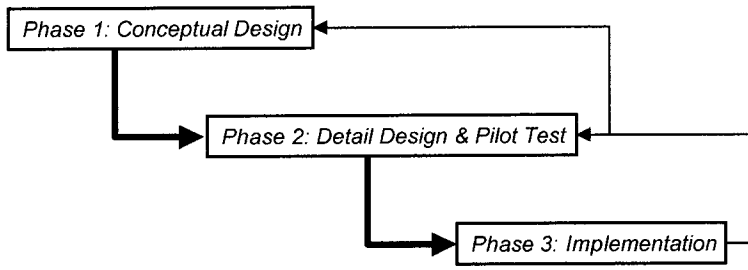


FIGURE 12.3
Three-phase implementation.

12.1.3 Teams at Three Levels

Getting work done requires participation from many. These include executive, technical, and user levels. The functional areas from which participants are drawn will depend on the project. Teams should operate at three levels. The terminology is shown in the project organization chart, Figure 12.3. The Steering Committee (SC) includes the project sponsor and other managers. It's important that the SC be able to make decisions regarding the course of the project.

The Design Team (DT) includes those who work in the process or area under study. The DT can also include consultants, suppliers, customers, and other stakeholders in the improvement. Chapter 11 described recommended participation in different types of projects. The Front Line Team (FLT) represents users of the supply chain process under review. They are available to test solutions and offer "sanity checks" on questions of design. The FLT may

not be needed until Phase 2 when elements of the conceptual design are put to the test in everyday use.

Bensaou and Earl describe the appropriate mind-set for implementing information technology.[2] They recommend, and our experience supports their findings, that changing processes, not technology, should be the driver behind changes. The structure above, particularly with the FLT feature, reduces the risk that "solutions" don't run amok. We suggest that Phase 2 in Figure 12.3 be completed within the current systems environment. This will produce better specifications for system-related changes. In some cases, objectives may be achieved without any system changes at all.

12.2 A Methodology for Conceptual Design

We've mentioned that Phase 1 of the supply chain improvement project is analytical. We call it conceptual design because it provides a broad-brush view of the new way of working, but can be absent thorny detail. In fact, the design should be at a level sufficient to "sell" the next phase to the SC. If the SC requires greater detail, the phase will be longer. If it requires less, it will be correspondingly shorter. The process for Phase 1 we've found successful in redesigning supply chains is shown in Figure 12.4.

The DT is the chief agent in executing the Phase 1 methodology. The following sections describe each of the five steps shown in Figure 12.4. We leave the description of analytical tools to other parts of the book. But experience reinforces the notion that the process followed is of equal or more importance as a determinant of success than the use of any particular analysis tool. The important point is that this is a participative process. It must engage those who work in the process throughout the design. It offers an opportunity to balance aggressive, sweeping change with the reality of limited resources in terms of money and time.

Some clients may say they prefer a directed approach — "tell us what we should do." In our experience, this seldom works. Buy-in comes through participation, not in being directed, particularly by a consultant, to take a new direction.

12.2.1 Task 1: Describe the As-Is situation

At the outset of the project, the SC and DT should establish the "boundaries and issues" related to the project. Boundaries establish the area of study. If this is a process, then boundaries can be a list of functions and organizations covered. The process can be confined to a single function such as manufacturing, procurement, or distribution, or across a business unit, or across a multi-company supply chain.

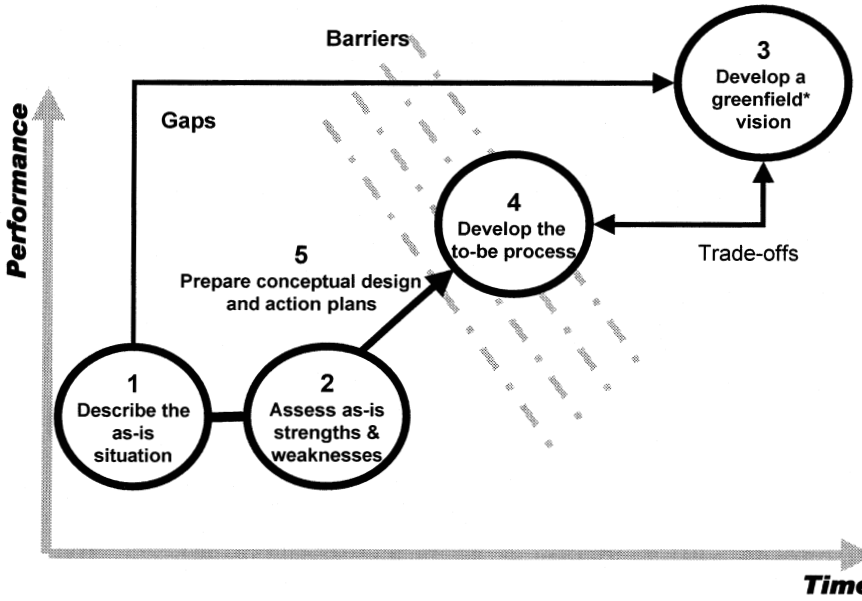


FIGURE 12.4
Phase 1 analysis and commitment.

A list of issues to address will also guide the project. Issues can be questions that the steering committee would like answered. What causes delay? What's our quality level? How do we compare with the best? How do we compare with our competitors? By the time we complete Phase 1, the questions should be answered.

Another precursor to the project should be an understanding of strategic direction. This includes the organization's intended method of competing. From this understanding of strategic direction should be drawn a list of constraints on the project. These include limits on capital and an understanding of areas that might be addressed by other efforts.

Documenting a process includes, but isn't limited to, the following:

1. *Catalog* of activities or steps in the process. Comprises decisions required, steps, skills, and who performs the activity.
2. Definition of *metrics* that characterize the process. This should include volumes, elapsed time, work time, and costs.
3. Customers for the process. Group customers into segments including both internal and external users.
4. *Issues* raised in the process of fact gathering. Include areas for possible benchmarking. Identify "critical" steps in the process. List

suggestions for improvement from interviews and other data collection.

Task 1 should be purely *descriptive*. It's not intended to *evaluate* the process. That comes in Task 2.

12.2.2 Task 2: Assess As-Is Strengths and Weaknesses

At this stage the design team shifts from collecting information about the as-is situation to evaluating it. There are many techniques for evaluation. These include the following:

- Develop quality measures.
- Benchmark other operations.
- Compare to design principles/best practices.
- Evaluate value added to customers.
- Interview/survey customers/users.
- Identify bottlenecks.
- Apply analytical tools like Quality Function Deployment (QFD) (described in Chapter 8).
- Perform a SWOT (strengths, weaknesses, opportunities, and threats) analysis.

With the evaluation complete, the DT should prepare a *specification* for the new process. This is a vital step. The specification incorporates measures to gain a strategic advantage from the process as well as actions to update and streamline the process. It's a terrific opportunity to gain relief from long-running aggravations. This will serve as design guidance for the "greenfield vision."

12.2.3 Task 3: Develop a Greenfield Vision

The greenfield vision is so named because it encourages an "out of the box" perspective. Too often, we are confined to conventional thinking and only propose what we think is "feasible" in terms of acceptability from approvers. We should adopt the attitude that we have it in our power to totally reinvent the process, the company, the organization, the facilities, and the systems. In the longer run, we can do all these things. Too often, we figure we are constrained by the realities of sunk investments, company politics, and conventional attitudes. But we shouldn't let this thinking deter us from a "start-from-scratch" approach. Over time, experience with the current system has provided many lessons about what works and what doesn't, so why not apply that experience?

If the DT is using a consultant, we recommend that the consultant develop the greenfield vision. The DT should make the consultant or team members satisfy each specification. If they cannot, they should assure all the others that they have exhausted every possibility. The greenfield package should include the following:

- A revised process flow
- Organization structure to support it
- Required systems changes
- Other infrastructure support (facilities, equipment)
- Measures for the redesigned process
- First cut costs and benefits
- A report on specification fulfillment
- Proposed steps for detailed design

Together the DT and FLT should identify the "realities" that are barriers to implementation of the greenfield. These can include all the factors we mentioned previously. The purpose is not to discourage the free-thinking process but to set the stage for making the appropriate trade-off between the greenfield and the to-be process.

12.2.4 Task 4: Develop the To-Be Process

This task consists of a series of facilitated meetings with all teams participating. They usually involve three steps: presentation of the greenfield, several discussion sessions, and a final decision on the "to-be." The SC should approve the to-be. It will incorporate the tradeoffs to create a plan that the organization is prepared to implement. "Organization" in this context is at the appropriate level — function, business unit, or supply chain.

The to-be version may be close to the greenfield if the teams find few obstacles to its implementation. This occurs in the "trade-off" phase. The team must balance the cost of each change represented by the greenfield against the benefits provided. In some cases, the to-be version will be closer to the as-is. This implies slow going in approaching the greenfield.

Once this process has been completed, has the greenfield vision exhausted its usefulness? We believe the greenfield vision should continue to provide direction for change. Its analogy is a guiding star in the sky that sets direction for the organization and its change efforts. As progress is made, it should be updated periodically — pushing further out to higher levels of performance in response to new circumstances, fresh applications of emerging technology, and progress in implementing change.

12.2.5 Task 5: Prepare Conceptual Design and Action Plans

At this point, the teams should prepare to move to Phase 2. The preparation will depend on the needs of the individual project. They will have to be sufficient to receive SC and executive approval. This will depend on company policy, the size of project, and the risks involved.

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13

Institutionalizing Supply Chain Changes

> Most people who lead and manage organizations got there through the operational ranks. They did not spend much time thinking about, or charting, the direction of the company.
>
> **Michel Robert**, *Strategy Pure and Simple II*

Once the change process is nearing completion, the need arises to assure that the changes will "stick." This is often referred to as "institutionalizing" new processes. Organizations are like rubber bands — they return to their original, natural state once the pressure for change diminishes. The same is true of organizations besieged by change initiatives. Once the wave passes business-as-usual returns. As the opening quotation notes, many managers are incapable of making long-term change stick in their companies.[1]

The supply chain change we envision as necessary in most organizations is no exception. For example, in earlier chapters we described how we believe supply chain change will rely on focused supply chain processes designed to the needs of specific customer segments. Almost surely this will require new organization structures as well as new procedures and systems. Often, making these changes, particularly the organization changes, "stick" is the largest barrier.

This section describes ways by which changes can be locked in — through organization structure and performance measures. These can be either the biggest boost to change or the biggest obstacle. Meaningful change cannot occur without considering them.

13.1 The Supply Chain Function in the Organization

The traditional organization structure, and the one that exists in most organizations today, divides people according to their function. So, when it comes to the supply chain in a manufacturing company, we have the procurement department, the manufacturing department, and the distribution depart-

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ment. In some situations, this arrangement makes sense. But these situations are fewer and fewer. So the process of change should bring a review of the organization and proposed alternatives when the existing organization is lacking in effectiveness.

13.1.1 Should There be a Supply Chain Function?

Supply chain organizations evolve with the company. We refer again to our growth cycle repeated as Figure 13.1. A start-up business unit in the C quadrant may have a great product and a growing market. The product developers and marketing types probably rule the roost. Supply chain issues are likely to take a back seat to product development and marketing. The chief supply chain challenge is dealing with product changes and meeting demand. For many technology products, a particular supply chain challenge is lining up partners to supply critical components.

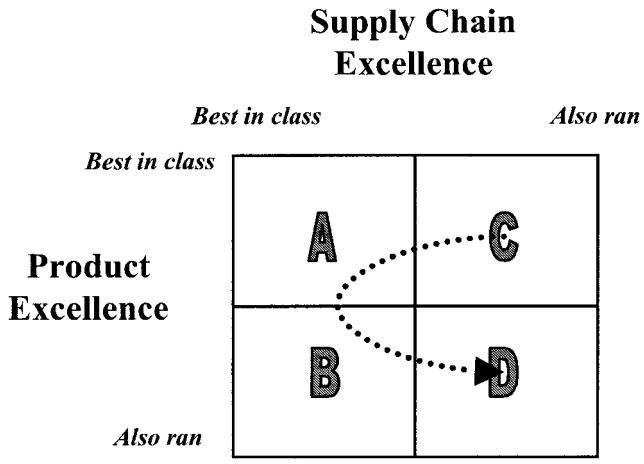


FIGURE 13.1
Market position of products.

As the enterprise's product or products move to quadrant A, the organization becomes such a size that greater formality is necessary. At this point, the traditional functional structure starts to take shape. Profits are still plush in the growth market, driven by the novelty of the product. The principal supply chain mission is to assure that demand is met. To this end, the temptation is to "specialize" throughout the organization. This promotes the growth of the traditional functional structure.

In quadrant B, competition stiffens; growth slows. Cost becomes a dominant consideration. Perhaps new products have been introduced along the way, and the company markets a broad product line to multiple markets.

Responsibility for customer care is delegated to the functional organizations. Competitive initiatives increasingly center on cost reduction across the supply chain. Innovations in the supply chain — more than in the product itself — may represent the fastest path to competitive advantage. The product that has moved to quadrant D has become "commoditized." It faces extinction if nothing is done to reinvigorate it.

The aging organization may manage products in all the quadrants through a supporting functional supply chain organization. In effect it likely has a single supply chain not particularly suited to producing or delivering products and services in any of the quadrants. At this point the organization is vulnerable to competitors with distinctly focused supply chains or to break up into divisions or "spin-offs" of parts of the business into separate companies. If the company is publicly traded, these pieces may have greater value than the whole.

13.1.2 Basic Alternatives

Better management of the evolution of the supply chain, we believe, can sustain a product's profitability and shorten reaction time to competitive moves. This is particularly applicable to quadrant A and quadrant B companies. Table 13.1 depicts the generic alternatives to supply chain organization, in what we will refer to as Baker Corp.

TABLE 13.1

Baker's Product/Market Mix

	Segment 2	**Segment 2**	**Segment 3**
Product line A	$$$	$$	
Product line B			$
Product line C		$$$$$	
Product line D	$$		

Table 13.1 represents a company with three customer segments and four product lines. The "$" represent the profit earned in each segment by the product line. For example, Baker's product line C is the most profitable when selling into segment 2. B products produce the lowest profits. Segment 3 is the least profitable.

If it is typical, Baker is likely to have a functional organization. Its procedures dictate that each product line be sourced, produced, and distributed the same way. Traditional functional departments make this happen. So, if it's typical, Baker is likely to be a company with a "one-size-fits-all" supply chain.

Baker has two basic alternatives to the existing functional supply chain:

- *Product-centric*. Form tailored supply chains according to products. This might result in one or more product lines having a distinct supply chain.
- *Customer-centric*. Form tailored supply chains according to market segments. There could be one or more supply chains organized around segments.

In selecting an alternative, several market factors should be considered. These are shown in Table 13.2.

TABLE 13.2

Alternative Organization Forms

Type of Supply Chain	When Preferred	When Not Preferred
Functional	Narrow product line. Small organization. Mature business	Diverse product/customer base Speed is important in adjusting to changing conditions
Product-centric	Multiple products with differing production technologies Cost-driven business Homogeneous customer base. Capital-intensive production technology	Varied customer base with differing requirements Relative low-cost production technology Cost secondary to service in production decision
Customer-centric	When strategy calls for targeting attractive segments Style-driven business requiring fast response Heterogeneous customer base/many segments	Too many segments to serve Lack of scale could cause loss of focus. Price-sensitive market

So Baker's selection will depend on a reading of these factors. It isn't uncommon to mix these basic models. For example, generic commodity items are increasingly sourced centrally and bought locally. This means a central group finds the best "deal" for items commonly used throughout the company. When the local operation has a requirement, they order from this source. This makes sense for copier toner, paper, forms, and so forth. These items have little effect on competitive position, and purchasing them in greater quantities may yield savings. Without such an effort, many larger organizations will overpay, losing the benefit of large volume purchases.

A single product line may also use two different supply chains tailored to different customer segments. In the case of Baker, product line A might be a candidate for customer-centric supply chains. It is making modest profits in two segments. Perhaps designing supply chains for each could increase this.

In the case of Acme, the fastener manufacturer we described in Chapter 7, the same products went to two markets: cost-driven Boeing and to less price-

sensitive repair and overhaul markets. The latter market was less concerned with price than with the availability of product when it's needed. Customers in this market often are willing to pay premiums for fast delivery.

Baker's product line B contributes little to profit. Assuming its production facilities are not intertwined with other products, it could be separated into a product-focused supply chain. A decision might rest B's market position in the grid in Figure 13.1. If the product is in quadrant D of our grid, it should probably be dropped. On the other hand, if it is in the C quadrant, it could be an exciting growth prospect. A decision-maker might consider developing a tailored supply chain for segment 3.

13.1.3 Timing Organization Change

An aggressive supply chain transformation will shake up an organization. It's difficult to run the business and change it at the same time. The issue of coordinating organization and process changes often arises. Situations include shifting from one supply chain focus to another, whether it's functional to a product-centric focused organization or functional to a customer-centric focused organization.

In an ideal situation, we suggest that it take place between Phases 1, Conceptual Design, and 2, Detailed Design, as described in Chapter 12. The resulting sequence is shown in Figure 13.2. The Phase 1 (shaded) activity produces the process design. This, in turn, produces an organization design to support the new process. Upon reaching Phase 2, the Steering Committee should implement at least a portion of the organization to proceed with the detailed design. In this way, those responsible for the new process will have a hand in its design.

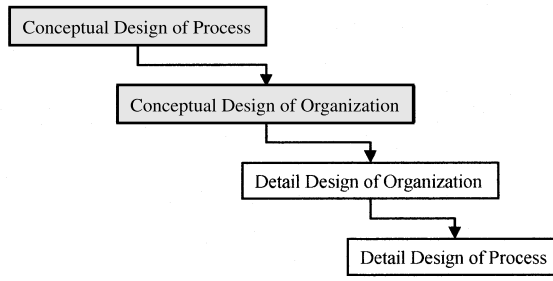


FIGURE 13.2
Sequence for implementing organization and process change.

13.2 Staying on Track — Performance Measures/structure

Unless the strategy and process designs include the appropriate measures, changes won't last. Any new measures may challenge decades of precedent. Also, if the financial management decisions don't stay consistent with the new direction, the ongoing changes may lag for want of funding. This section describes examples of ways to lock in change with measures and structure.

13.2.1 Measurement

An important tool for measurement was introduced by Kaplan and Norton.[2] The authors refer to their tool as the "balanced scorecard." Their technique has found wide application in many companies. The balanced scorecard also has value in locking in supply chain changes. Use of concepts behind the balanced scorecard approach will help evaluate whether supply chain changes are having the desired affect.

The approach takes broad corporate-wide goals and cascades them down into meaningful measures for departments, groups, or individuals. The "balance" in the balance scorecard approach comes from the breadth of the measures. Rather than following the common practice of limiting measurement to financial information, the balance is provided by four perspectives:

1. Financial perspective. The traditional viewpoint, including owner value.
2. Customer perspective. How the organization measures up in the opinion of customer expectations.
3. Internal business perspective. What the organization must excel at to be successful.
4. Innovation and learning perspective. How the organization can improve and create value.

All four areas are susceptible to enhancement through supply chain innovations. Table 13.3 contains examples in each of the four categories.

The authors recommend developing lower-level measures to match strategies. For example, if lead-time reduction is a supply chain initiative, then specific goals for each element of lead-time should be set for the appropriate group or department assigned the job of making the goal a reality. Figure 13.3 shows how a typical supply chain goal at Baker can "peel" down into lower level objectives.

The figure shows that Baker Corp. wants to reduce lead times for one or all of its products. This is one of many goals as indicated by the band of "Corporate Level Goals." The Manufacturing Department has four goals accompa-

TABLE 13.3

Supply Chain Measures Using the Balanced Scorecard

Balanced Scorecard Measures	Supply Chain Examples
Financial perspective	Supply chain changes can improve balance sheets and cash flow. Profits can increase from providing targeted premium services.
Customer perspective	Changes in the supply chain can reduce the time it takes to serve customers.
Internal business perspective	Restructuring the supply chain produces fundamentally different ways of doing business.
Innovation and learning perspective	Shifting to product- or customer-centric supply chains offers the chance to learn new skills.

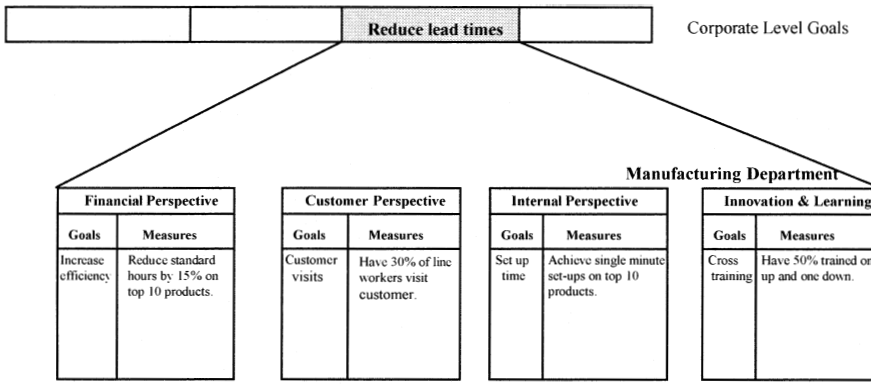


FIGURE 13.3
Balanced scorecard example — supply chain application.

nied by measures to support lead-time reduction. A strength of the Balanced Scorecard is that it measures performance in all four areas that support the goal. It is common practice that a goal like lead-time reduction will not include the measures for each perspective. Little consideration is given to all the factors that may contribute to longer lead times. Measures of this type should be considered "unbalanced."

Baker recognizes that set-up times are a principal contributor to longer lead times. They want to shorten these to make smaller runs more feasible from an operating point of view. They also believe cross training would be beneficial to increase worker flexibility. So they set a goal to train workers on upstream and downstream jobs. This will add flexibility in the light of fluctuating demand.

Baker assesses that an understanding of where products are used by customers will increase awareness of the importance of response time. So they plan visits by front line workers to customer operating sites. Since the measures should decrease costs, they also set a goal to remove hours from budgeted labor levels.

13.2.2 Platform Teams at DaimlerChrysler

Robert Lutz describes the motivation of "platform" teams at Chrysler Corp. before a merger made it DaimlerChrysler. The formation of these teams is often cited as the centerpiece of a Chrysler turnaround from a weak to a strong competitive position. The business success that followed made Chrysler an attractive candidate for merger with Daimler, the German producer of the Mercedes Benz.

In the automotive business, *platform* refers to a family of related products or principal components. These are sold under well-known brand names like Jeep, Chrysler, Dodge, and the soon-to-be-discontinued Plymouth line. At DaimlerChrysler there are platforms for several product categories plus one platform oriented to a major component system. Table 13.4 lists the DaimlerChrysler platforms.

TABLE 13.4

DaimlerChrysler Platforms and Products

Platform	Some Product Names
Large car	Chrysler Concorde
Small car	Chrysler Sebring
	Convertible Dodge Neon
Jeep	Grand Cherokee
	Wrangler
Truck	Dodge Ram
	Dodge Durango
Minivan	Chrysler Town & Country
	Voyager
Power train	Multi-platform systems

Development of platforms at DaimlerChrysler was a response to a late-1980s turndown in business. It had become apparent that Chrysler's traditional structure wasn't speedy enough in producing new products for fast-changing automobile markets. In the traditional structure, each function made decisions for the entire platform line. The functions include those shown in Table 13.5.

TABLE 13.5

Product Development Functions at DaimlerChrysler

Function	Role
Styling	Decides what features the car will have.
Engineering	Designs the components.
Procurement & Supply (P&S)	Provides the components.
Manufacturing	Assembles the components.
Sales	Sells the cars.

In the old structure, the same functional departments presided over all the platforms. The result was queues all along the process for introducing product innovations into the marketplace. This occurs principally on the model-year product introductions. In the summer and early fall, DaimlerChrysler "launches" its latest model-year product. In some years, there are only minor changes to the vehicle; in other years, the changes are far more significant.

The launch is the culmination of extensive design and testing of components. It also involves validation of production capability at principal suppliers. (This topic is discussed further in Chapter 20.)

Platform teams rose because competitors were winning the race to market with new and fresh designs. The old Chrysler had a one-size-fits-all process. How innovative could one department be in trying to serve a diverse range of brand names, each with its own goals and identity? Lutz, as President of Chrysler, led the effort to break down the monolithic departments. His approach was to split them into platform-oriented teams, equivalent to moving from a functional to a product-centric focus. This created a central large organization with small appendages for each platform.

In his book, Lutz likens the resulting large departments to battleships and the platform teams to "tugs" pushing the battleship along. But this didn't solve the basic problem of slow product development. So, once the tugs were in place, Chrysler "sank" the battleships to avoid backsliding into old ways. Torpedoing the battleships left the tugs in place, which created much angst in the organization. But now most DaimlerChrysler employees identify with their platforms, not their functions.

This wrenching example illustrates what we believe will become more common as the pace of product development and supply chain change quickens. Managers will have to keep a constant eye on their product portfolios, customer segments, measurements and incentives, and supply chains to maintain competitive positions.

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14

Motivations for Partnerships

> We have roughly 30,000 employees now, and $26 billion in revenue this year. If we were vertically integrated, I don't know how many employees we'd have, but it would be some huge number.
>
> **Michael Dell**, Dell Computers

The previous chapters addressed our second supply chain task for creating collaborative relationships inside the organization. Internal improvement efforts require one type of collaboration — getting departments on board for supply chain change. This section reaches outside to relationships between companies along the chain. This requires another type of collaboration, and we describe the building blocks for partnerships in this and subsequent chapters (Chapters 15 to 19).

The term *supply chain* implies an increase in external partnerships as companies seek to better link their operations. A single enterprise that delivers a product or service will have a supply chain for the raw material it needs and for distribution of its product. However, it doesn't necessarily need to have "partnerships" with other enterprises. These partnerships are "above and beyond" traditional commercial, arm's-length relationships. Well-executed partnerships offer significant opportunities in most chains to quicken the pace of innovation. Poorly executed efforts, on the other hand, may have the opposite effect.

In today's competitive environment, it's not uncommon for suppliers to approach existing and prospective customers offering to "partner" with them. Is this a sugar-coated sales pitch or a new business relationship? Is it any different from just selling them stuff? Is there any substance behind the words? Often the pitches are shallow, pointed only at the next sale.

However, many organizations are putting new efforts behind improving their ability to enter creative supply chain partnerships. As they go about it, the issues encountered are many. What are our goals for partnerships? Do we even need a partner? What kind of partners should we be looking for? What things do we want a partner to do? How can we assure a smooth working relationship? What structure should we have for the partnership? Where are the best places in the supply chain to partner?

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Certainly partnerships are not new; there are many examples. Partnerships between companies include not only product development but also supply chain development where they find new applications. Many electronic commerce companies ("clicks") are teaming with retail chains ("bricks") to cover holes in their supply chains.

Another prominent example is partnering between manufacturers and third-party logistics providers, or 3PLs. The third-party providers leverage their expertise and infrastructure to fill what have been internal roles in material management. An example is the consolidation center described in a case study in a later chapter. Forging supply chain partnerships, we believe, is indispensable in improving supply chain operations and competitive position.

There are a few widely recognized models for partnerships in industry. Wal-Mart is recognized in the retail industry for building processes and information systems that distribute nearly instant information on actual sales throughout the supply chain. Dell Computer Corp. has a similar reputation for pioneering direct sales channels for personal computers. Dell's methods are now widely copied in both the personal computer industry and, increasingly, elsewhere.

Michael Dell described some of the underpinnings of the Dell supply chain for the *Wall Street Journal*.[1] His message was directed at the automobile industry, which he believes would benefit by a Dell-type supply chain. We believe his recommendations can be extended as general advice to many other industries, including service businesses. His comments, plus those of the reporters, include the points listed below.

- Use the Internet for communicating with both suppliers and customers. Dell suggests there is more control on the supplier side for initial efforts. Experiment with the Internet to see what customers value in terms of information posted there.
- Use partners for any operation that isn't central to your business. He credits partners for Dell's rapid growth. Outsiders minimized the need for capital and have enabled Dell to achieve sales of $26 billion with 30,000 employees — almost $900,000 per employee.
- Dell's build-to-order system produces a 160% return on capital and a stock market valuation to match.
- Actively manage a few suppliers. Dell has 25 suppliers for 85% of its needs. They are actively involved in their suppliers' operations and seek to understand their environments and the issues faced. They rank suppliers relentlessly and post scores on a limited access Internet connection.
- Accelerate change implementation and condition employees to accept the pace.

In our model of the market position of products (Figure 5.1), we would place both Wal-Mart and Dell squarely in quadrant B — mature products with great supply chains. Their products lines are surely available in many other places, but no others in their industries have done as good a job in supply chain design.

14.1 Types of Partnerships

In work with clients in creating and seeking partnerships, we have often seen the need for more-formal processes for identifying partnership opportunities and establishing the partnership. This is particularly true of the more mature business for whom partnering is a novelty. Dell had the "start from scratch" advantage. Many have muddled along for years doing everything themselves and, in many cases, cultivating a "not invented here" syndrome. Here we'll build a framework for thinking about different types of partnerships.

14.1.1 The Vertical Partnership

We view supply chain partnership initiatives as being of two fundamental types. The first is joining forces with another that has complementary, nonoverlapping skills. Both parties are relatively equal in terms of their contribution to the effort. It's like a marriage where "two live better than one" or "the whole is worth more than the sum of its parts." The direction for this type of partnership is "vertical" with respect to the flow of goods and services along the supply chain. Two companies combining research and development resources to develop a new product is an example. For example, one may develop a basic material; the other may develop products made of the material.

A partnership initiative could be positioning oneself to be a better vertical partner to customers and suppliers. This type of effort is usually part of a strategy to expand market share. It recognizes that partnering will grow in the supply chains of your customers. If you aren't prepared, you will lose out to better-prepared competitors. An example is the joining of a third-party logistics service provider and a manufacturer. Through the consolidation center, the logistics service provider consolidates incoming materials and sends them to the manufacturer's assembly lines. The logistics service provider has built special competencies needed to perform this service. Our Chapter 7 case study of Acme also described a strategy built on the need to be a better partner in multiple market channels. This puts you in the position of preferred provider as a customer or supplier. The direction is "vertical" along the supply chain. In these situations, you seek unique attractive

offerings to entice new customers or expand your business with existing customers.

14.1.2 The Horizontal Partnership

The horizontal partner is one that does have overlapping capabilities. The combination of two telecommunications providers, one focused on wireless and one on long distance, is an example. "Clicks and bricks" combines two retail channels. Such partnerships may be motivated by a number of factors. Examples include the need for greater geographic coverage or to provide the critical mass to be competitive. As industries consolidate into mature industries with lower profit margins, for example, only the largest can afford to maintain the systems and infrastructure to stay in the race. Industry roll-ups are also a form of horizontal partnering. In roll-ups, a dominant partner will buy smaller companies, usually for stock. The rationale is that the larger entity will enjoy economies of scale. The financial market awards a high value to the stock. So the acquisitions are priced at attractive levels — at least on paper.

A special situation with respect to supply chain partnerships is the "virtual enterprise." These emerging organizations, like Dell, use partnerships for as many functions as possible. Virtual enterprises usually focus on technology development, originating new products or integrating existing technology. For these companies, the fastest and least costly path to the marketplace is using partners' capabilities rather than developing them from scratch. When several contribute to the effort, the direction is often both horizontal *and* vertical. Virtual enterprises and related derivatives will increase, driven by an increased pace of product introductions and the need to share risk.

With reference to our model of supply chain projects shown in Figure 14.1, partnering projects are almost always likely to be strategic. The highlighted category shows its placement in the strategic category. It is what we refer to as "stage 3" SCM with stage 3 being the supply chain level. The figure reminds us of the important place partnership initiatives will have in portfolios of supply chain projects.

John Harbison and Peter Pekar categorize many linkage types, or "alliances" between firms.[2] The variations depend on (1) the commitment in terms of expected duration and (2) the nature of sharing between companies. For example, an outright acquisition is one extreme. It is a takeover of ownership and a permanent commitment. At the other extreme, a purchase order based on quoted price and delivery is a routine transaction. No permanent relationship is intended; the next order will likely go to the lowest quoted price and lead-time. Supply chain outsourcing arrangements, like those with third-party logistics providers, probably fall in the middle. They will be relatively long term — perhaps 1 to 5 years — and may or may not involve a corporate combination of the firms.

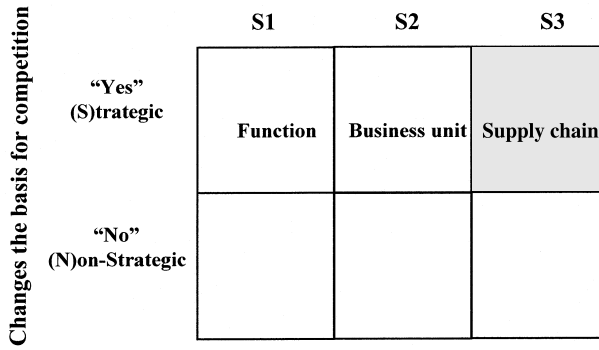


FIGURE 14.1
Model for competing through SCM..

The authors mention that alliances differ from mergers in an important way. Mergers focus on financial terms. Alliances have many more operational issues to negotiate. The authors' research shows that failure to address these operational issues is a principal cause of problems in alliances. In other words, "the devil is in the details." In a following chapter, we describe a methodology to lessen the risk of such occurrences.

14.2 Motivations for Supply Chain Partnerships

Two drivers are at work in spurring supply chain partnerships. The first, and the more obvious tactical one, is cost. For many companies, purchased goods and services are their largest cost. It is common for these costs to exceed other categories such as labor, interest, and capital-related costs. Outside material includes not only material items used in products but also office supplies and services like accounting and information services development.

Turning to partners can bring the benefits of "one-stop shopping." A larger volume of business awarded to a single supplier is bargaining leverage for discounts. In recent times, companies have produced excellent results with "sourcing" projects directed at reducing cost.

14.2.1 Core Competency and the Supply Chain

The second driver for partnerships, and a deeper strategic one, is the focus on "core competence." Assumptions about core competence underlie many decisions about partnerships. A decision to perform or not perform an activity or produce or not produce some component is a strategic determination. It entails deciding which capabilities to retain and cultivate. It also affects the

type of supply chain needed to be successful. Unlike Dell Computer, too often other companies have no road map to guide these decisions.

The concept of core competencies was introduced by Gary Hamel and C. K. Prahalad.[3] It holds that competitive success requires the nurturing of distinctive skills, or "competencies." Other activity contributes little to competitive position. In the worst case, "non-core" activity diverts management attention from activities that create real value. Hamel and Prahalad define competitiveness on three levels. These are (1) core competence, (2) core products, and (3) end products. Their analogy is a tree, as shown in Figure 14.2, with core competencies as the roots and end products as leaves.

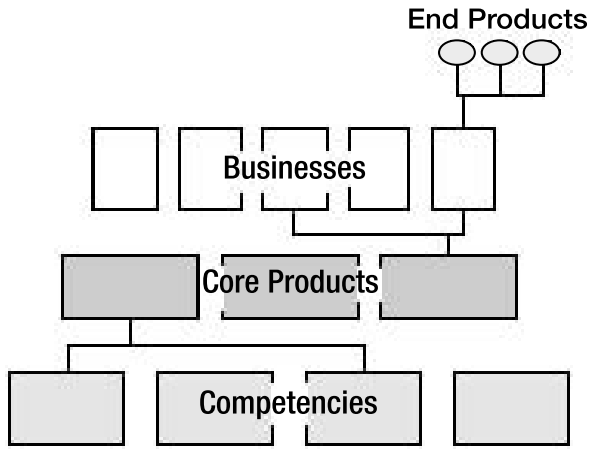


FIGURE 14.2
Competencies: the roots of competitiveness. (Reprinted by permission of *Harvard Business Review.* Exhibit from "The Core Competency of the Corporation" by Gary Hamel and C. K. Prahalad, May-June, 1990. Copyright ©1990 by the President and Fellows of Harvard College; all rights reserved.)

One or more competencies support a "core product." These core products are the heart of many products that go to market. The core products feed the "end product" offerings of various businesses. So Honda's core products, engines, and power trains produce multiple motorized products. The strategic business unit, or SBU, markets and sells end products that have their roots as core products based on core competencies.

The authors illustrate the point with Canon, a manufacturer of a range of high-technology products. Canon has three core competencies: in precision mechanics, fine optics, and microelectronics. They apply combinations of these to a score of products ranging from cameras to copiers. Note that the tree diagram is not an organization chart. Core competence may be nurtured by many mechanisms like teams from departments across the organization.

It also doesn't, for example, necessarily imply the need for a corporate director for each particular competence.

In their article, the Hamel and Prahalad point to the important role of partnerships in nurturing core competencies. They believe partnerships are a relatively inexpensive way to advance a competence. They also decry the tendency of many companies to organize around SBUs at the business level. SBU measures are immediate, focusing on profits generated from the sale of end products. Unfortunately, no single SBU is likely to be the custodian of core competencies or core products. The focus at the SBU level is on end products, or "leaves" on the tree. The "roots" or competencies, which should be nurtured across SBU boundaries, may wither for lack of attention.

We believe that, since core products will probably rely on multiple competencies, a competence can also be integration of diverse technologies. This integration requires movement of technology across SBUs and partnership companies. Another competency might also be found in building alliances. Harbison and Pekar note that skill in alliance building improves with practice.[2] If alliances become vital to success in the business, it's not unreasonable, in our opinion, to treat partnership-building skills as "competencies."

The notion of identifying core competencies can be carried to an extreme. One client walked through his manufacturing plant and identified about half of his operations as "non-core." This means they were not, in his opinion, a basic competence. His criterion was the existence of a cheaper alternative from an outside supplier. The implication was that, if someone could do an operation better, or equally well, elsewhere, it probably should go.

One problem with this framework is that it ignores the value of the "activity system" we described in Chapter 7. These are integrated activities designed to meet the needs of important customer segments. It could be that these mundane operations were important to their activity system and, by implication, to their supply chains. In fact, Prahalad and Hamel maintain that many managers are ignorant of the deeper competencies at work in the development and delivery of their products and services to the marketplace.

The concept of core competence is important to supply chain management. We'll return to the topic after describing trends in supply chain structures. Traditional views of roles in the supply chain are giving way to new views. The following section describes the traditional view. Chapter 15 describes the emerging model for supply chain partnerships. The traditional and emerging models reflect the impact of both cost reduction and competence building in the evolution of supply chain partnerships.

14.2.2 Traditional Model

Figure 14.3 models the traditional relationship between suppliers and their customers. It reflects a transaction-based relationship, with the buyer–seller linkage driven by price and other terms like delivery. A single company, on the right, represents the ultimate "customer." This ultimate customer has

many suppliers; these suppliers in turn have their own suppliers. In logistics circles, these levels of the supply chain are sometimes called *echelons*. We also use the term here.

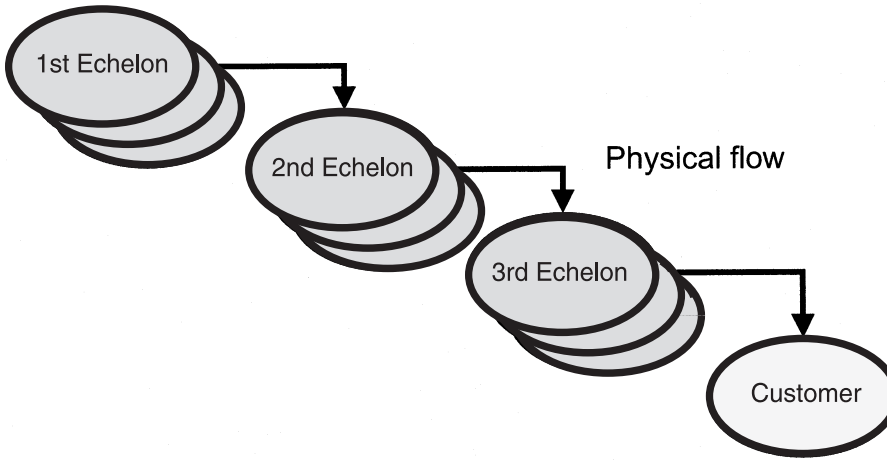


FIGURE 14.3
Traditional partnership model.

Procurement policies and practices perpetuate the traditional model by requiring several suppliers for each material category. In fact, our "customer" company, although there is only one, may face similar requirements from its customers. The figure also shows spaces between the players, reflecting the arm's-length nature of the relationships. There is little sharing in terms of technology, data, capital spending, or facilities.

Many managers find comfort in this arrangement. Having multiple suppliers, they feel, provides the "best," often the lowest, price. Decisions over source selection are simplified. Multiple suppliers also are perceived as assuring a reliable supply. If one vendor has a problem, another will step in to cover the shortfall. Managers also equate low price with the most cost-effective solution. Indeed, their performance measures often support that supposition.

The conduit between each level in the chain passes through each company's procurement department. Training and performance measures for procurement departments preserve the traditional way of doing business. In most cases there is a "closed-book" approach to sharing information. This includes forecasts, costs and operating data — even the progress of an order through the supplier's pipeline.

In most cases, the procurement department acts to process the transactions necessary to buy and stock needed material. Most procurement functions have skill levels appropriate to this task. There is little talent available for

strategic thinking and to manage partnerships. The lack of skill and unwillingness to change is a bottleneck for partnering in supply chains. In the next chapter, we'll explore some of the changes to the traditional model.

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15

Emerging Partnership Model

> By partnering with a logistics provider, we've taken a quantum leap in improving our distribution process and customer service.
>
> **Bill Bundy**, Miller SQA

15.1 Introduction

The pressures of cost reduction and focus on core competencies are driving many toward a new model for supply chain relationships. Figure 15.1 highlights the changes brought on by the emerging model. The model has distinct differences from the traditional one shown in Figure 14.3. First, there are fewer players in the supply chain. As shown in Figure 15.1, there may be only one company, not several, at each echelon. In the emerging model, the size of the participants has also expanded, and the number of echelons, or supply chain levels, has diminished. The expanded role of remaining participants encompass new capabilities. These are often the result of horizontal and vertical partnerships described in Chapter 14. By implication, several former members of the chain have exited, and perhaps have gone out of business completely.

An example of an expanded role is having the second-echelon partner manage procurement and inventory for the ultimate customer, a role now conducted by third-party logistics service providers. This is a not a role or service normally associated with the traditional model. In fact, the cost of these activities may not even be measured in evaluating links in the supply chain. Such a service can be an example of an "extended product" service described in Chapter 1 and an opportunity to reduce capital investment and decrease supply chain cycle time. Another example of partners working closer together is collaborative planning, forecasting, and replenishment (CPFR) in the retail industry. This cooperative effort is described in Chapter 29.

Supply chain participants find partnership arrangements to be mutually advantageous. With fewer competitors, surviving suppliers have greater

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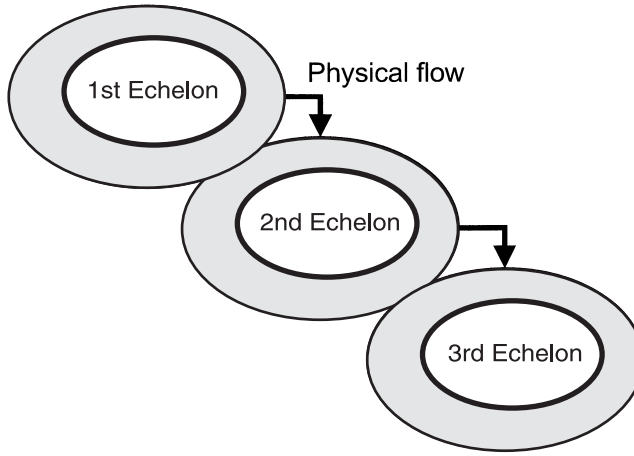


FIGURE 15.1
Emerging partnership model.

market share. With the larger base of business, they are likely to gain production economies to share throughout the chain. An example is the investment now needed to maintain state-of-the-art systems. Single companies often can't muster the funds or talents needed to keep supply chain systems up to date. A larger critical mass may also justify extended product services based on distinct competencies not feasible with a smaller business base. Fewer participants can also benefit customers. Communication through the chain is easier, speeding product to market and facilitating product innovation.

Companies at each echelon, by virtue of their expanded roles, have found new "space" in the chain. Creating the space establishes unique capabilities that no rival can match, reordering roles and closing gaps in the chain. It requires a commitment to finding new ways to partner with others. Kim and Mauborgne describe ways to identify empty "space" for introducing new products and services.[1] More-recent examples related to the supply chain include the following:

- Internet marketing
- Distributors moving into product assembly, providing subsystems rather than components
- Modular assembly of automobiles with the assembler inside the customer's final assembly plant
- Manufacturers' distribution centers shipping smaller orders direct to retail customer stores, rather than customer-distribution centers
- Joint technology or product development

- Carrying inventory and preparing kits or modules for final assembly at customer plants
- Using point of sale information to manage a customer's inventory
- Tailored outsourcing arrangements including information services and logistics functions

15.2 New Roles For Procurement

In the emerging model, procurement departments must act more strategically. We described their traditional role in Chapter 14. The procurement function is often the interface between supply chain partners, and partnerships will make new demands on the function. Dave Malmberg of CGR Management Consultants has defined four stages marking the evolution of the procurement function's role.

1. "Building infrastructure." This stage is characterized by improving the efficiency of transaction processing. Inventory is segmented to develop targeted procedures depending on value and volume.
2. "Working smarter." This level sees greater use of electronic transaction tools plus more sophisticated decision support and management by exception practices. Often, the Stage 2 procurement function will undertake work simplification efforts to reduce manually processed transactions. There are attempts to better balance the requirements of suppliers and customer service, with procurement playing a central role.
3. "Leveraging relationships." Most routine transactions are automated. There is increased exchange of information between customers and suppliers. Problem items get special treatment for management and handling. Extended product services tailored to specific customers emerge.
4. "Strategic role." The procurement staff is almost totally dedicated to improving interfaces with suppliers and customers. The emerging model in Figure 15.1 takes root. The staff works with cross-functional teams including suppliers and customers to reduce cost and improve performance. Many non-production procurement items are handled by outside firms.

With most procurement departments operating at the Stage 1 or Stage 2 level, the transition will be a tough one. This is an important barrier to implementing effective partnerships. For many reasons, partnering is an "unnatural" act. However, the pressures are irresistible, so more managers must face the music at some point and open the door to partnerships. We also expect

that much more will be written about partnerships and the obstacles involved. There are many surface problems facing partnerships. Examples include the following:

- Partners pursue their own, not mutual, goals. Corporate measures are at odds. Information isn't shared. No agreement on splitting the "bounty" between partners can be reached. Good intentions evolve to a traditional relationship, or worse.
- The partner selection process is poor. There are no criteria for selecting the partner. Screening is superficial. The company ends up with a misfit. Or, a company is reluctant to break off from a long-established relationship. Mediocre performance is tolerated.
- In restructuring to be a better partner, the needs of potential partners are poorly understood. The traditional attitude continues. Alternatively, the effort is a marketing ploy between buyers and sellers, with no real commitment to fundamental change.
- Partners provide insufficient resources to support the partnership. For example, key project staff members are unavailable. Schedules are missed; "team members" are unavailable, one side has an inordinate workload.
- Partners are "blind-sided" by some unseen circumstance. Examples are incompatible systems and a missing capability that was assumed to be present.
- One partner goes through a merger or acquisition. Relationships and policies change sharply.

15.3 Fundamental Barriers

We believe fundamental barriers lie at two levels. The first occurs before partners are even approached. This is the point where the need for partnerships is established. The second is in execution of the partnership. This is the point at which two parties have committed to working together. Here we amplify on the nature of the barriers and solutions to evade the inherent pitfalls.

Too often, partnerships develop opportunistically. This occurs when a proposal arises from an outside candidate partner or is generated internally — often by a functional manager. The proposal may be sound, but the strategic reasons for pursuing it are murky. So the company moves into a partnership with fuzzy goals. Another pitfall is one of omission, not considering partnerships at all. A strategy comes into existence, but partnering to achieve strategic ends is not considered.

Ideally, we would like to see a vision for the supply chain, including the activity system the organization needs to carry out its strategy (Chapters 7 and 8). Out of this vision will come a "template" for partnerships. This will define what types of partners are sought and what they should contribute to fulfilling the vision.

The dialog needed to produce this result requires a vocabulary for defining partnership types. We propose such a vocabulary in the next chapter. It provides a good beginning for translating strategic needs into partner selection. It says in effect, "the hole is round." Let's not select a "square" partner.

The next challenge is averting attempts to insert a square peg into the round hole. The type of the partnership will differ for different supply chains — even if those supply chains are in the same organization. In companies serving multiple markets, supply chain design isn't a one-size-fits-all affair, so segmenting the supply chain along market or product lines makes good sense. Our approach describes methods to accomplish this. We also include an example translating an activity system, developed in strategic planning, into partnership requirements.

Once a partner is selected, the hard work of implementation begins. We provide two tools for deployment at this stage. These are described in the next chapter. Together, they address many root causes for partnership failures. The first tool addresses the scope of partnership issues. Effective planning for partnership operations begins with a mutual understanding of the issues faced. Joint identification and resolution keep the partnership focused on common goals.

The second tool is a structure for decision making and keeping partnership operations on track. This is the intercompany version of the organization and task structure for internal project completion.

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16

Planning for Partnerships

> Designing a winning business is also a tall order. But the blueprint starts with customer segmentation.
>
> **James Champy**, *Forbes,* March 8, 1999

Thinking in supply chain terms brings the need for new ways to describe partnerships. In Chapters 14 and 15, we described different motivations for partnerships and different types. For the company considering partnerships, we have developed a classification methodology for defining what we want to accomplish with partnerships and what kind of partnership will produce that result. This approach will reduce the risk of going to the altar with the wrong partner. Classifying partnership types also furnishes a vocabulary for discussing the need for partnerships and weighing the viability of candidate partners.

16.1 A Partnership Vocabulary

The classification we recommend has three dimensions. These are *purpose, direction,* and *choice.* We discuss each in the following sections. If you understand your need for a partner in each of these dimensions, you are well along in making the right choice of partners.

16.1.1 Purpose

This classification category relates to the fundamental reason for the partnership. The most important factor is whether you are trying to build new "space" as described in Chapter 15 and how you intend to do it. The classification method describes whether the new space is created or not and whether you are going it alone or bringing on a partner to help you. Of course, creating new space is a more complex process than refining an existing role. Our view is that most partnerships are intended to refine current positions with lower cost or better service rather than to define new space. In many cases,

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the potential to define new space is not even considered in the partnership decision.

Figure 16.1 shows the choices for defining the purpose of the partnership. The shaded square (IV) represents the existing situation — the as-is with respect to partnering and the roles of each link in the supply chain. The figure reflects two levels of decision. The first-level decision is whether to create new space in the supply chain. Moves from IV to I or II positions on the grid represent this decision. At the second decision level, a company can do this on its own (II) or it can choose to partner (I).

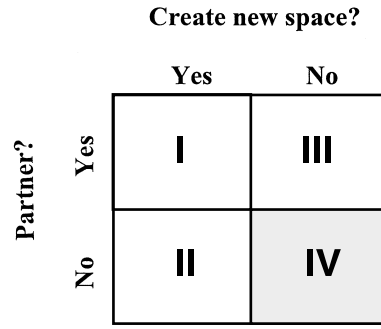


FIGURE 16.1
Potential for new supply chain space.

A company may want only to expand by refining its existing position. We have said that most attempts to partner are moves of this category. This is position III on the grid, reflecting the help of a partner in increasing profits from its business.

Table 16.1 summarizes the options for classifying the purpose of the partnership. The matching grid position is in the left column. A company that is considering a move from the corner (quadrant IV) needs to evaluate options for the best path. This involves understanding the business reasons for the effort, the resources available internally, and the likelihood of recruiting an external partner.

TABLE 16.1

Alternative Partnership Strategies

	Purpose	Description	Application
III	Growth in the current chain	Partners seek a better competitive position without creating new "space" in the supply chain.	Includes geographic expansion or partnering with immediate upstream or downstream companies.
II	Single company/ new space	Your company undertakes, on its own, an initiative to create new space in the supply chain.	Viable option if the company has the resources to undertake this alone. Acme, our case study (Chapter 7), is an example.
I	Partners create new space	The partnership forms with an explicit goal of creating new space.	A manufacturer teams with a distributor to offer an integrated just-in-time service.

16.1.2 Direction

Direction, the second dimension of our classification method, is the term we give to the relative positions of the partnering companies along the supply chain. Table 16.2 shows different directions.

TABLE 16.2

Partnership Directions

Direction	Description
Horizontal	Partners are at the same echelon in the supply chain.
Vertical	Partners are at different echelons, probably adjoining, of the supply chain.
Combined	Expansion of capability occurs both horizontally and vertically.

A "horizontal" combination, as we described in Chapter 14, means each partner is at the same echelon. Partner capabilities will overlap. An example is two wholesale distributors partnering to offer increased geographical coverage. Partners in different echelons whose capabilities don't overlap represent a "vertical" combination. An example is Wal-Mart, a retailer, providing point-of-sale information to McKesson, a pharmaceutical distributor. McKesson, upstream in the supply chain, is then able to provide timely delivery direct to Wal-Mart stores.

Figure 16.2 illustrates horizontal and vertical partnerships. Vertical partnerships reflect the trend toward consolidation in many supply chains. The evolving model of the supply chain we described previously forecasts more growth of partnerships in the vertical direction. In these cases, fewer players perform more supply chain functions, capturing a greater share of supply chain value.

16.1.3 Choice

This category captures the relative strength of each partner. It's called "choice" because it reflects the availability of options for partnering. More-competitive situations provide more options when selecting partners. We rely on a data management paradigm here that reflects the relationship between partners. Table 16.3 explains the relationships.

In the relationship characterization in column one, your company is first. The options you have are second. In commercial aerospace, Boeing would be a "one to many" company. It is the largest customer for most of the products it buys. Presumably, Boeing would have many partners from which to choose. Likewise, a supplier to Boeing would be a "many to one" if there were many competitors. A company in a "many to one" situation may have a tough time standing out from the crowd. However, we noted in Chapter 14

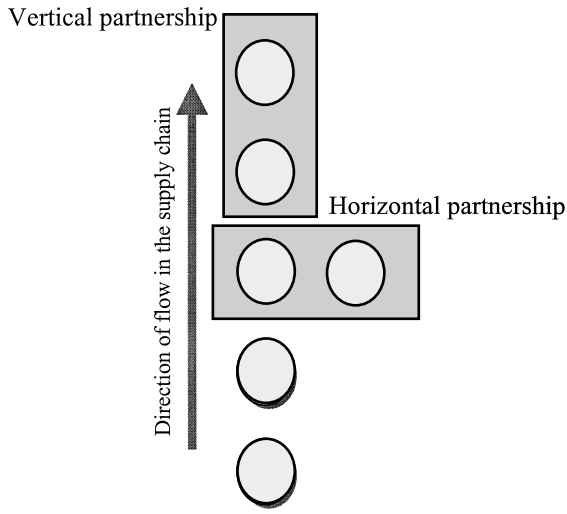


FIGURE 16.2
Partnership directions.

that structuring oneself to be a viable partner is a strategic option. The rewards could be worth it. Having a distinctive ability could enable a leader to consolidate an industry, thus acquiring its former competitors, or gain market from those less ready to make needed changes.

16.2 Using the Vocabulary

The classification framework finds use in formulating options for partnerships. Table 16.4 shows examples from applying the framework. In example 1 from Table 16.4, the companies will make a substantial investment to their mutual gain. The manufacturer gains a product line. The operator has a new business. Either could have chosen a "one to many" partnership if they could have gone it alone. The manufacturer could have sold the product to multiple operators, if feasible. The operator, in turn, might have managed the production itself, contracting with numerous suppliers.

Examples 2 and 3 are our company Acme from Chapter 7. We have used Acme as an example of how to develop activity systems. Acme is one of several companies supplying Boeing, a dominating customer, and distributors with aerospace fasteners. Its strategy is to build multiple supply chains focused on individual markets. Boeing is "many to one" case — with Acme being one of several options for dominant buyer Boeing. Serving distributors

TABLE 16.3

Partnership Relationships

Relationship	Description	Application
Many to many	Your company, one of many serving your market, has many partner candidates from which to choose. Neither partner is currently a dominant company.	Two companies form a partnership to separate themselves from the crowd. They may do so to target a particular segment neither could approach alone. An industry "roll up" is an example. Here a company, usually with stock, buys others offering similar services in a market.
One to many	Your company is large and you have many options for selecting partners.	You select the "best of the breed" for partnering or, working alone, you develop capabilities appealing to many customers. DaimlerChrysler, a case described in Chapter 20, is an example. Dell, described in Chapter 14, is another example.
Many to one	Your company has a low market share and must compete with others for the business of the strong partner.	You develop strategies for distinguishing yourself so you become the chosen one. You may ignore other segments to focus on the needs of the targeted strong partner. Acme is an example in catering to Boeing.
One to one	This is a peer arrangement with dominant partners on each side. There is little choice in partner selection.	Due to the size of the market and the scale of operations required, there is little choice. The merger of Daimler and Chrysler is an example.

is a "many to many" example — where the number of manufacturers is roughly equal to the number of distributors.

In example 4, no market space is created. It is an example of industry consolidation for increased competitive mass. This often occurs in mature industries and in industries where the investment needed to maintain an edge becomes prohibitive.

TABLE 16.4

Applying the Partnership Framework

#	Purpose	Direction	Choice	Example of Application
1	I	Vertical	One to one	Two large companies devise a new transportation service. One partner covers product development and manufacturing for the needed technology, the other invests in infrastructure and operational capabilities.
2	II	Vertical	Many to one	A small company supplying Boeing (our Acme case) carries stock to provide same day delivery of selected line items.
3	II	Vertical	Many to many	Acme builds a supply chain tailored to the needs of its distributor customers.
4	III	Horizontal	Many to many	Two distributors in a large market combine for better geographic coverage to capture large accounts.

17

Core Competence and Partnerships

> European and Asian executives find that their U.S. counterparts lag in the critical skills of planning integration and implementation. They are too quick to think the job is completed when the negotiations are finalized.
>
> *Smart Alliances*

In Chapter 15 we described the transformation to the emerging partnership model — shrinking participants and fewer echelons. This has begun or continues at an accelerating pace in many industries. It should be considered a wake-up call that the path to success will lie in developing partnerships. As the quotation notes, many have much to learn about this process.[1] To the extent the trend is at work in a particular industry, companies in that industry face imperatives if they are to survive. These imperatives include the following:

- Assess the industry environment. Understand where you stand. Develop strategies to deal with the consolidation of competitors. Visualize the industry's structure in three to five years. Define the space (Chapter 14) you want to fill.
- Develop needed extended product services to fill the space between supply chain levels. An *activity system* like Acme's (Chapter 7) is an excellent approach for accomplishing this task. Define your partnership needs using the framework in Chapter 16.
- Be the kind of company a supplier or a customer will want as a partner. This requires each company to implement required systems, sharpen its operating performance and its "compatibility quotient."

All of this requires an understanding of what core competencies are required to be competitive in the future. Our forecast is that SCM will, in many companies, be seen as a required core competency on a par with product technology competencies. Examples where it already is include our examples, Wal-Mart and Dell Computer. Figure 17.1 shows how an SCM competency will fit with product technology competencies.

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What form does a competency in SCM take? Prahalad and Hamel point to three criteria for a core competence.[2] These are the following:

1. Provides access to a wide variety of markets.
2. Contributes to perceived customer benefits.
3. Is difficult to imitate.

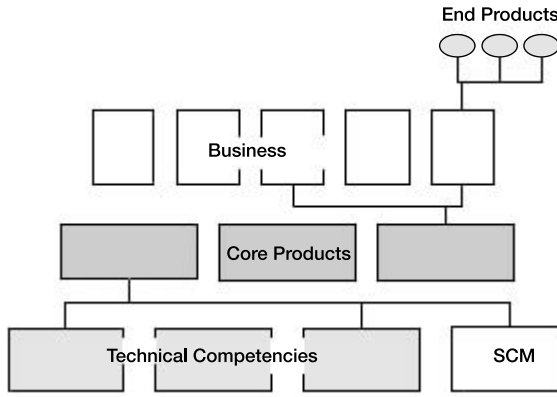


FIGURE 17.1
SCM as a core competency.

These criteria closely match Acme's objectives in developing its activity system. To expand sales, Acme wanted to tailor its delivery system to the needs of multiple segments. It designed its systems around customer requirements. Finally, Acme sought a "system," not just individual activities, that would be hard to imitate. The following section describes how to make the transition from activity system design to a strategy for adding partners in the supply chain.

We can illustrate how a partnership strategy could possibly evolve from an activity system using Acme as our example. Acme's strategy called for a restructuring of its supply chain along the lines of a newly developed activity system. These activities "fit" together to form a supply chain to better serve its customers.

For Acme, there were four strategic themes (shown in boxes in Figure 17.2). These are supported by the six listed activities (also shown in Figure 17.2) that need to be developed. The strategy presents two challenges for Acme with respect to partnerships. The first is to examine each activity and decide whether a partner is needed to implement the activity. The second challenge arises because the strategy, in essence, creates "space" for Acme to become a better partner for its customers. This need exists because Acme's markets are segmenting into groupings with different requirements. For these reasons

Acme is likely to have more partners in its future — one set of partners will consist of customers, another of peers and suppliers.

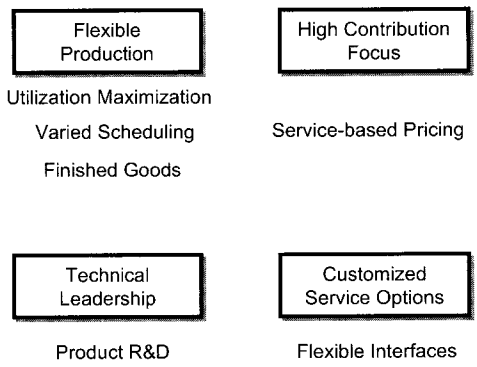


FIGURE 17.2
Acme's activity system.

Table 17.1 shows potential partnership solutions for implementing the strategy. The column "Candidate Partnerships" contains options for developing the activity jointly with partners. "Partnership Type" describes ways in which the activity will help Acme become a better partner to its customers. The table uses our characterization system from Chapter 16 to identify the type of partnership required to implement the activity.

TABLE 17.1

Acme's Partnership Choices

Activity	Candidate Partnerships	Partnership Type
Utilization maximization	A manufacturer partner could provide extra capacity in peak production times.	III — horizontal — many to many
Varied scheduling	A contract manufacturer could provide a capability for certain products Acme needs to supplement its line.	III — horizontal — many to many
Finished goods	Distributors could share risk by carrying inventory.	I — vertical — many to many
Product R&D	Joint development with customers.	I — vertical -- many to one
Service-based pricing	Work with suppliers to lower cost and assure the supply of incoming material.	III — vertical — many to one
Flexible interfaces	Work with customers and distributors to design custom product/ service offerings.	I — vertical — many to many

The decision to take on a partner depends on Acme's own evaluation of its needs for support. However, as Table 17.1 shows, there are many options for expanding the use of partnerships in Acme's case.

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1. Harbison, John R. and Pekar, Peter, Jr., *Smart Alliances: A Practical Guide to Repeatable Success*, San Francisco, Jossey-Bass Publishers, p. 100, 1998.
2. Hamel, Gary and Prahalad, C. K., The core competency of the corporation, *Harvard Business Review*, (68/3), pp. 79–90, May–June 1990.

18

Organizing Improvement Efforts

Partition: division into parts

That a company like Acme will have multiple partnership options, as listed in Chapter 17, is not unusual. When a company reaches a certain size, it will face complexity in deciding where to focus its improvement efforts. This chapter points to ways to "partition" the various supply chain "threads" into manageable parts. We include this discussion in our partnership task because we believe it is a prerequisite to devising sound partnership strategies.

We believe the path to partnerships will have three distinct steps, as shown in Figure 18.1. In many cases, an organization's supply chain is complex. The complexity is brought on by the need to serve multiple markets with several product lines. This complexity leads to the need to divide the supply chain into manageable "chunks" for building strategies. Each chunk would have its own supply chain strategy, including a role for partnerships. This strategy should include an activity system to improve competitive position.

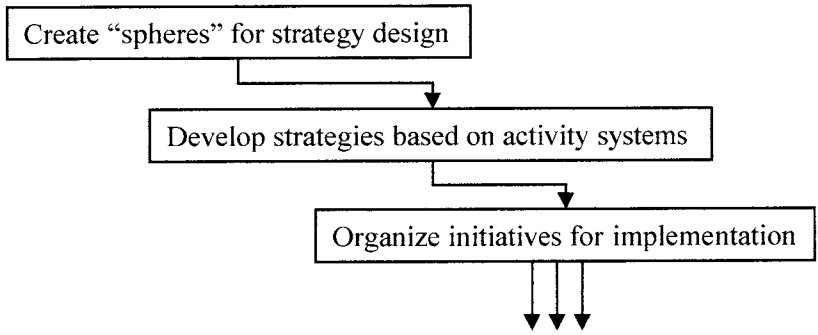


FIGURE 18.1
Process for organizing the improvement effort.

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18.1 Using Spheres to Segment the Supply Chain

A number of factors contribute to complexity in larger organizations. Most companies have a "supply" side with incoming material as well as a "demand" side governing product or service distribution. Within the company walls are internal operations — another dimension. A further complication is handling different product and market combinations. Despite the movement toward European unification, the product sold in France may require a different approach from what it would in Germany. Also, a product may be sold under a company label in one market but under another's label in others. This could necessitate different approaches as well.

The following sections describe two approaches for breaking the supply chain into manageable pieces. The first approach centers on the structure of the supply chain itself — namely the products, markets, and operations involved. This approach breaks the supply chain into the chunks, which we call "spheres," mentioned above. With this foundation, the second approach focuses on the initiatives to be implemented. Each initiative represents a grouping of related activities.

18.2 Defining "Spheres"

The term "sphere" is a convenient descriptor for dividing a complex supply chain. The sphere analogy reflects the three-dimensional nature of supply chains as shown in Figure 18.2. It is similar to the idea of "threads" proposed by the Supply-Chain Council (refer to Chapter 23). Each dimension defines the boundary of a portion of the supply chain. We define the dimensions as the following:

- **Products.** This includes goods and services, including the sourcing of materials and their distribution.
- **Markets.** These are the segments for the goods or services. They can be end users or downstream links in the supply chain.
- **Operations.** These are the facilities, organizations, and supplier networks required to deliver the product or service.

What's important is that each sphere be compatible with a common supply chain design. The sphere needn't be an "end-to-end" supply chain. That is, multiple products could have a common sourcing and production sphere but separate spheres for distribution into various markets. Each sphere should lend itself to having specific improvement goals for redesign

or upgrade. Table 18.1 contains a few examples of ways to define spheres for each dimension.

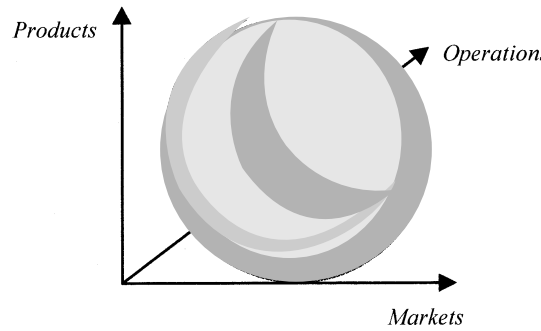


FIGURE 18.2
Dimensions covered by spheres.

TABLE 18.1

Ways to Select Spheres for Supply Chain Development

Dimension	Ways to Create Spheres
Products	Core competencies/core products
	End products sold by business units
	Common manufacturing processes
	Material sources
Markets	User groups
	Regions/countries in which sold
	Market demographics
	Downstream customers (distributor/OEM)
Operations	Production facilities (plant sites or cells)
	Supplier groups
	Materials used
	Distribution channels

We can illustrate this approach through the types of issues faced by a diversified manufacturer like Samsung Electronics (SEC). SEC sells a variety of household products in markets around the world, including vacuum cleaners, microwave ovens, refrigerators, washing machines, and air conditioners. They are distributed under the Samsung label as well as the labels of others. They are also manufactured in multiple facilities. For SEC, like many others, there is no single supply chain design to match the diversity in its market/product mix. Likewise, there is probably no single partnership solution that will meet its needs. The following examples show how a company with the complexity of an SEC might create spheres out of its diverse business lines.

Figure 18.3 shows two dimensions of our spheres —products and markets. In this example, the products are the appliances sold while countries represent the markets in which the products are sold. The table is an example only and isn't intended to represent SEC's actual distribution of these products.

An alternative listing of products could have been core product components. For example, a potential choice is all the products that use motors. Motors, in fact, may be a "core product" with proprietary technology based on core competencies. User groups rather than countries could also have defined the markets.

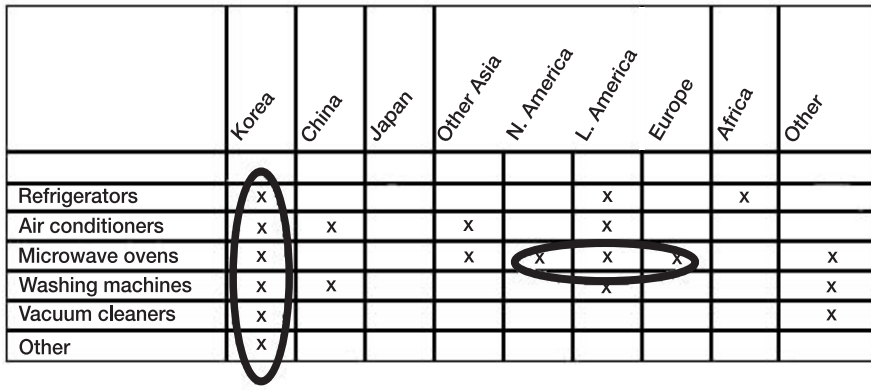


FIGURE 18.3
Example layout of business for selection spheres.

A choice of spheres is represented by two ovals, as shown in Figure 18.3. The first covers all the products sold in the Korean market. The second shows one sphere for microwave ovens sold in North America, Latin America, and Europe. One sphere is product-centric; another is market-centric. The other dimension, operations, would also need to be defined. For our Korean sphere, it would presumably include all local production facilities that support the market. For the microwave-oven market, it would encompass the existing source for those markets.

Other example spheres might include those shown in Table 18.2.

TABLE 18.2

Spheres for SEC

Product	Market	Operations
Refrigerators	OEM market in North America	No supply or production operations
Refrigerators	All markets	All inbound and manufacturing operations
All appliances	Korea	No production operations
Air conditioners and vacuum cleaners	Other Asian markets	All supply and manufacturing operations

Note that it's not necessary to use all three dimensions to define a sphere. In these cases, the omitted dimension will have an assumed "as-is" condition. That is, that dimension is outside the scope of the current planning

effort. It's also not necessary to define spheres for the whole network of products, markets and operations. One only needs to apply the process for the high-priority spheres of immediate concern.

To illustrate that selecting spheres for strategy development is as much art as science, we provide some illustrations in Figures 18.4, 18.5, and 18.6. The three figures show some conceptual alternatives for spheres in a single supply chain.

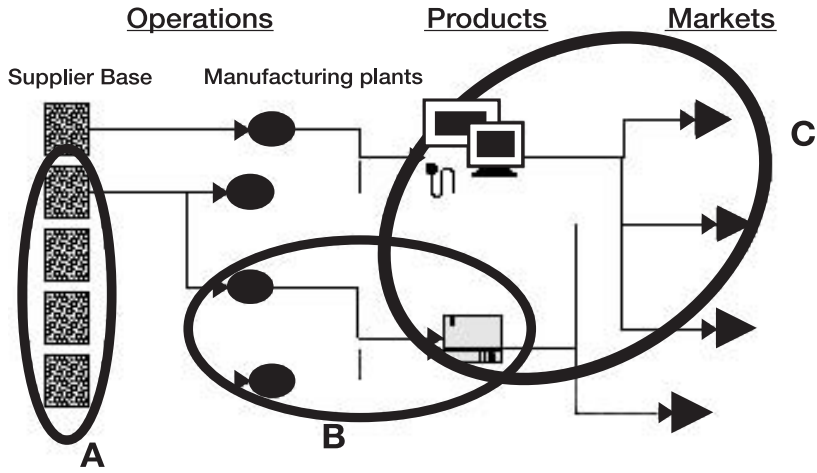


FIGURE 18.4
First example for selection of spheres.

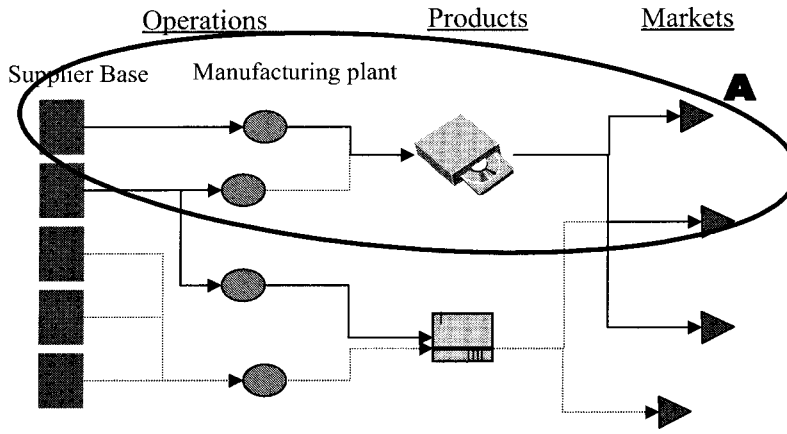


FIGURE 18.5
Second example for sphere selection.

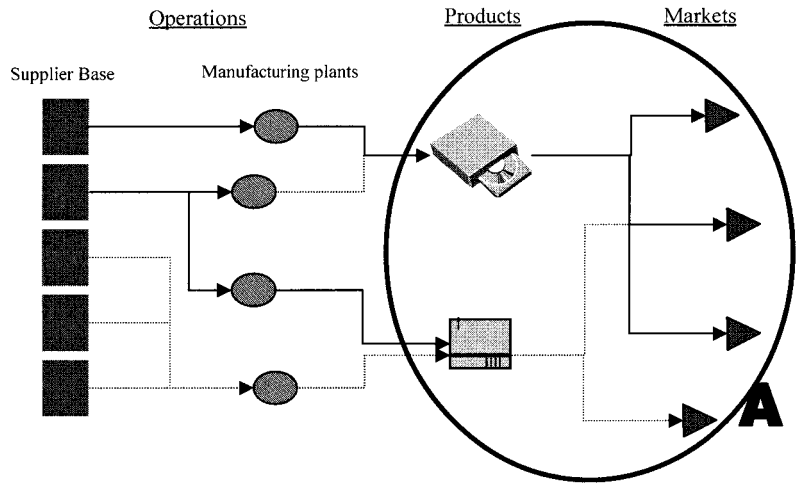


FIGURE 18.6
Third example for sphere selection.

In Figure 18.4, there are three spheres. The first is a sourcing-oriented sphere (A). It includes material sources for both of the product lines from four suppliers. Many current supply chain efforts start and end with this type of project, often referred to as a "sourcing" project. The focus may be reduction of the supplier base or partnering for cooperative efforts for incoming material delivery. The types of partnerships sought could be characterized as *I* or *II* types (create new space) with *vertical* direction and choice as *one to many.* The choice reflects the greater power of the buyer with regard to suppliers and assumes there are alternative sources for the material covered. A fifth supplier (at the top of the supplier base in the figure) serves only one plant and product line and is not included in the effort.

A second sphere (B) encompasses the manufacturing plants and distribution channels for one of the products. This product could be seen to have considerable potential for improvement. Improvement efforts in the sphere would focus on operations in the production and distribution system. The sphere would be *single product — all markets — production/distribution operations.* Partnerships would focus on distribution methods and effectively linking distributors with manufacturing plants.

A third sphere (C) focuses on two of the market segments and includes both products, as they are both sold into the markets. A plausible reason for this selection is that the markets have good growth potential, or market share gains can be made at the expense of competitors. Perhaps there's a way to cross-sell into these markets. This effort would target downstream distribution to cater to the needs of these attractive markets. Its characterization is *all products — selected markets — distribution operations.*

Figure 18.5 presents another scenario. In this case, a sphere (A) has been created that has end-to-end coverage centered on one of the products. This arrangement calls for potential partnerships along the supply chain from suppliers to the manufacturing operations to end-users. Partnerships would be expected to be vertical in nature.

A third scenario might be that shown in Figure 18.6. This sphere is focused on the distribution channels for both products. Its scope includes all the customer segments. Its characterization is *all products — all markets — distribution operations.* Like the earlier example, partnership opportunities also lie in the distribution network, but on an expanded scale.

From the options described above, one should conclude that selecting spheres is an art form that requires considerable management judgment. It also depends on management priorities for business direction. It may also seem counter-intuitive to divide the supply chain. After all, SCM is an end-to-end concept. Can one really attack a part and leave other parts untouched? Many times, it will make sense to "eat the whole elephant" like the middle example above. But, practically, most supply chains in larger companies are complex and involve many operations. So focus on significant pieces may assure that the highest-priority efforts achieve implementation. Our next section describes a way to divide the implementation effort into initiatives.

18.3 Spheres and Activity Systems

In Chapter 7, we described activity systems that constitute supply chains. In Chapter 12, we described how companies could organize improvement projects under the headings of "initiatives." Here we use Acme to tie these two concepts together.

Figure 18.7 shows Acme's activity map. It contains the four strategic themes as corner posts for the strategy. Supporting each theme are one or more activities that must be refined or developed from scratch. The circles in the diagram cluster the activities into three initiatives for implementing the supply chain design. Each is fundamentally different in terms of the implementation work needed.

Initiative A is operational in nature. The job here is to improve production capabilities to support new methods of production scheduling and the finished goods inventory. Partnering can include, as we observed earlier, horizontal relationships to assure capacity and vertical relationships for inventory management. Initiative B focuses on technical leadership. From a partnership perspective, it includes vertical links with end users to develop new fasteners and installation tooling. Initiative C covers pricing and customer interface activities. Partnerships take the form of vertical linkages with partners leading to custom features.

The process outlined in Figure 18.1 is intended to lend coherence to the implementation of a supply chain strategy. This can be a major challenge, particularly when the supply chain sprawls over multiple diverse markets, products, and operations. The tools described in this chapter should add visibility and accountability to the implementation effort.

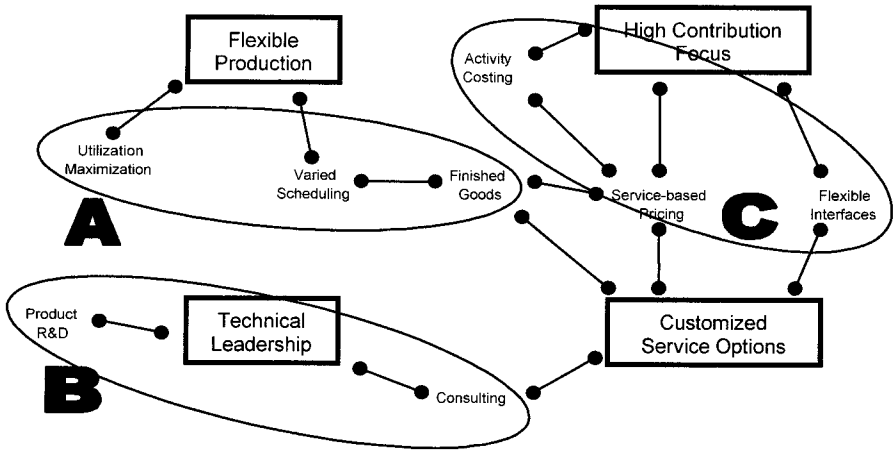


FIGURE 18.7
Acme's sphere selection.

19

Stage 3 Supply Chain Structure

> Organization of a company's logistics activities, therefore, must be dynamic, continually adjusting to these changing forces.
>
> **William C. Capacino**, Andersen Consulting

Bill Capacino's prediction, first made in 1994, is proving to be correct.[1] Overseeing what can be a complicated effort requires new ways to organize and control the effort. A previous article describes what we refer to as "Stage 3" supply chain management.[2] Stage 3 refers to the interorganizational nature of the effort. Stage 1 is department level; Stage 2 is the business unit, or company, level. New Stage 3 practices will produce a cooperative effort, including partners in supply chain improvement. We believe the following features will characterize Stage 3 supply chain improvement.

- A focused goal for the effort with objectives like strategic positioning, market share increase, and financial improvement. These will center on the partnership as an enterprise, rather than individual partners. If multiple spheres are involved, as we describe in Chapter 18, each sphere effort can have its own goals.
- Multi-company staffing and funding of the effort. Joint projects reflect a commitment to effective supply chain design. Such participation will shorten implementation lead-time. A challenge will be to balance contributions among partners.
- A third-party "honest broker" to facilitate the effort and provide an outside perspective. At times the outside participation will keep a project moving. The third party can be a team member or consultant jointly funded by the partners. Such a presence is particularly appropriate in striking the right "balance of power" in the partnership.
- A CEO steering committee with representatives from partner firms. This body should make major decisions, including those involving funding. The steering committee would meet frequently while establishing the partnership and as necessary during its operation.

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- Multi-year projects with self-funding short-term wins. This allows the program to be sustained by its own cash flow benefits. Targeting immediate benefits satisfies the need of many managers for tangible results.
- Contracting among partners that distributes cost and rewards based on achieving measures of performance. We describe ways to accomplish this in later chapters. Sharing of benefits will build trust and support for the effort. The honest-broker role may help in determining what these shares should be.
- Process integration. This means deployment of appropriate technology solutions. A plan for systems to share information should accompany the design of partnership processes.

We see the initiative for supply chain improvement coming from a *sponsor* firm. The sponsor firm may be a dominant player in the supply chain or one with a major stake in the project's success. It should have completed the preparation steps we described earlier in this section. It will likely be somewhere in the process of developing and implementing its supply chain strategy. Indeed, it may have already completed internal restructuring tasks.

We envision that the sponsor firm will invite key partners among suppliers and end users to participate. Together, they will form a "supply chain working group" (SCWG). The SCWG will decide what spheres need to be isolated for supply chain redesign. It will also mobilize design teams to undertake improvement efforts in the spheres. Implementation will occur locally — that is, within the designated spheres. But the SCWG will monitor the overall effort to assure consistency with goals.

Once formed, a good next step for the SCWG is to develop the supply chain issues to be addressed. Presumably, there will be multiple companies and in-company divisions represented. This is a characteristic of Stage 3 supply chain improvement. It will be difficult getting everyone "on the same page." A way to do this is through a three-step process: (1) development of issues, (2) establishing requirements, and then (3) structuring the effort.

19.1 Step 1: List the Issues

The process begins with the SCWG defining issues that need to be addressed. There can be in excess of 100 of these, so it helps to divide them into categories. Issues are often presented in the form of a question. An example of potential categories used in product planning appears in the Figure 19.1.

The diagram shows that decision categories needn't be limited to supply chain or pure logistics issues. At this point in the effort, it's important to have an overall business context for structuring the supply chain effort.

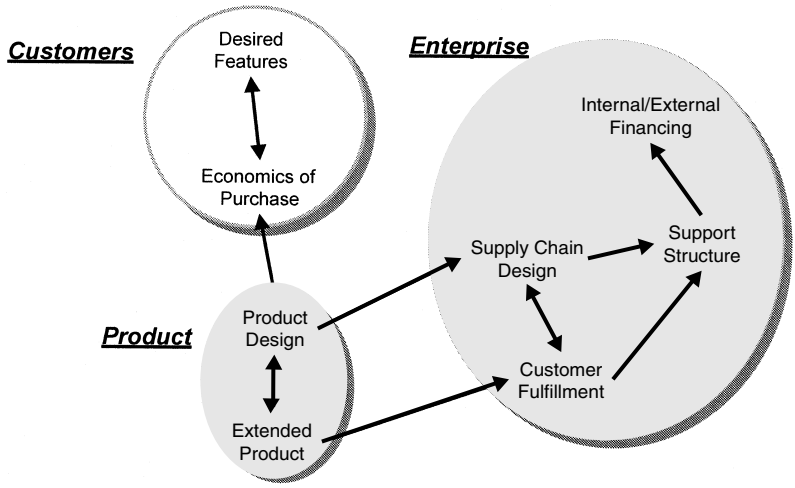


FIGURE 19.1
Categories for partner collaboration.

This includes an understanding of customer requirements and how they link to product and supply chain design. The SCWG should develop and maintain the issue questions.

Table 19.1 provides examples of the broader issues to be resolved. The examples are from a multi-company development team with seven members. They sought to commercialize a high-technology electronics product for the airline industry. The excerpts provide a flavor of the issues faced by that team.

19.2 Step 2: Define Requirements

In step 2, each listed issue is considered by the SCWG. Where possible, decisions regarding issues are made by consensus of SCWG members. In many cases, an issue resolution isn't known. If its priority is high, it then becomes a requirement to address quickly in an improvement effort. Out of these requirements evolves an agenda for the project. This agenda is expressed in terms of issues to address and priorities for the issues. Table 19.2 illustrates a methodology for making decisions around these issues.

The methodology requires "status quo" documentation of progress on resolving each issue. The SCWG must judge both *importance* and *urgency.* Next, there is a decision regarding the current state of knowledge (*Know, Think, Don't Know*) for the issue. Finally, the SCWG must decide if an answer to the issue is needed right away. Figure 19.2 provides some examples. The first item, by virtue of its rankings, should be addressed immediately. The

TABLE 19.1

Examples of Partnership Issues.

Category	Example issues
Desired features	What is the scope of the market — domestic, international? Are there differences in the characteristics of these markets?
Economics of ownership	What is the manufacturing cost of "representative" products, including all factory overheads?
Product design	Is any engineering duplicative? Is the wheel being reinvented? Are design resources deployed to maximize commercial potential?
Extended product design	What non-monetary benefits do we offer? Time to market? Avoided investment? Areas of expertise?
Supply chain design	Are existing facilities suitable to handle this volume? Do they have sufficient equipment and appropriate technology?
Customer fulfillment	What field service capabilities are needed? Repair centers, spare parts distribution, maintenance capability? Will this be internal or external?
Support structure	What structural alternatives are there for participating in the enterprise? Participation includes suppliers, technology development, or financing.
Financing	What will the enterprise look like financially? Pro forma financial statement available? How much cash will be required to continue after initial funding ends?

TABLE 19.2

Setting Issue Priorities

	High/Low	High/Low	Check One			Yes/No
Type	Importance	Urgency	Know	Think	Don't Know	Need to Know
A	H	H			X	Y
B	H	H	X			Y
C	H	L		X		Y
D	L	L			X	N

Note: A: An issue with a need to gather information and put into the plan now. B: An issue that should go into the initial plan. C: An issue requiring further research to be placed into the plan later. D: No action needed on this issue. Monitor the situation for future developments.

second deserves resolution, but there is time, as indicated by the low urgency. The third issue has no known answer. But the importance and urgency of the issue mean that it can be deferred.

Concurrent with issue development, the SCWG should collect basic information about the supply chain. To the extent possible, the SCWG should associate specific issues with its position in flowcharts of supply chain processes.

19.3 Step 3: Structure the Effort

From this information, the SCWG should recommend a program structure to the CEO steering committee. The structure should include the following:

1. **Master plan for program.** The plan would govern the overall effort. It would include schedules, priorities, financial flows, and a vision for successful completion.
2. **Plan for spheres.** This would include definition of the spheres and design team assignments based on the challenges of making changes in each one.
3. **Design Team charters.** The charters should include the goals and objectives, resources, schedules, and issues that should be addressed.

There are many ways to use partnerships to improve supply chain performance. Examples include the following:

- Sourcing efforts to rationalize procurement across the organization. This type of project often produces immediate savings in the bill for outside goods and services. It requires mobilizing internal teams as well as partnering with outside suppliers.
- Demand-driven supply chains. Most aggressive partnership programs focus on cycle time reduction, building a "just-in-time" capability all along the supply chain. Partnerships will work to remove wasteful cycle time at all stages.
- Third-party logistics providers. Using logistics specialists to fulfill basic supply chain functions will enable companies to focus on core competencies.

Illustrations of these and other examples appear in our chapters on cost reduction in the supply chain and the case studies. Regardless of the solution, the steps listed in this section will improve chances for success.

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20

The Extended Enterprise™ at DaimlerChrysler

Follow the "Forever" Requirements.
Be a team player.
Pay attention to details and follow up.
DaimlerChrysler, from "Making the Extended Enterprise Work"

20.1 Description of the Extended Enterprise

In Chapter 13, we described how DaimlerChrysler deployed platform teams in its U.S.-based Chrysler business. According to then-president Robert Lutz,[1] Chrysler was on the ropes in the late 1980s. Platform teams were a response to high cost, long lead times for product development, and outmoded products. Platform teams encouraged new lines of communication *within* the organization, and we discuss this aspect of platform teams under the appropriate task in Chapter 13.

No less impressive was the parallel development of the "extended enterprise" to complement the platform teams. *Extended Enterprise* is a trademarked term applied by DaimlerChrysler to describe its partnership with suppliers. The underlying philosophy behind the Extended Enterprise fundamentally changes the relationship between DaimlerChrysler and those *outside* the organization essential to its success. It is an example of the type of relationships that we've discussed in this section. We predict that many features of the Extended Enterprise will find their way into partnerships in other industries.

The Extended Enterprise has also drawn the attention of the business press in an article authored by Jeffrey Dyer.[2] It is offered as a case study of transferring the respected Japanese supplier-relationship model, referred to as *keiretsu*, to the U.S. Dyer describes the motivations and the impact of the Extended Enterprise partnership philosophy on product cost and development cycle time.

Like many "revolutionary" changes, the Extended Enterprise was born of necessity, not design. According to Lutz, Chrysler may have vanished with-

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out the support its suppliers provided in reducing cost and aiding the development of new products. We describe in subsequent paragraphs some of the principal features of the Extended Enterprise. Figure 20.1, which shows features of the Extended Enterprise, will help get our bearings.

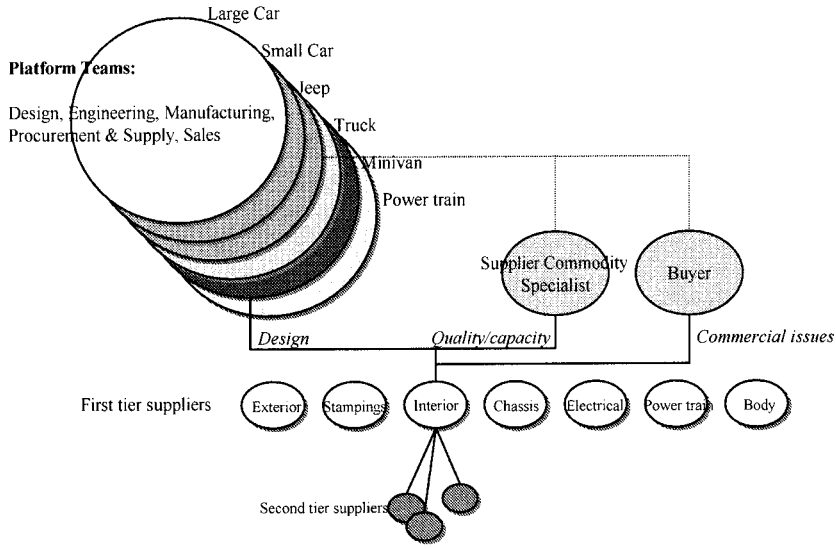


FIGURE 20.1
DaimlerChrysler's Extended Enterprise.

If the Extended Enterprise diagram in Figure 20.1 seems complicated, that's because it is! It doesn't suggest the ordered structure of a traditional organization chart, with clearly defined functions, hierarchy, and lines of communication. At any time, an individual in the "network" may have multiple supplier–customer relationships with others in the Extended Enterprise. While this situation can lead to unclear goals and accountability, it does have the effect of moving decision making down into the organization to those closest to the problem.

At the upper left are the platform teams described in the Chapter 13. At DaimlerChrysler there are six of these. For example, a platform such as *minivan* will be responsible for products with familiar brand names like the Chrysler Town & Country, Voyager, and Dodge Caravan. Each platform contains representatives from traditional functions such as manufacturing, engineering, and procurement.

A supplier making, say, radiators could serve several masters at DaimlerChrysler, depending on how many platforms its product is on. However, a single supplier will have some constant faces in DaimlerChrysler. Such faces are provided by supplier quality specialists (SQS) and buyers. The

SQS and the buyers are part of a central Procurement & Supply (P&S) organization. The SQS monitors product quality and assures that suppliers have sufficient capacity to meet assembly line demands. The buyer looks after the "commercial" aspects of the supplier/DaimlerChrysler relationship. The design engineers and assembly plant engineers represent the platform organizations.

The supplier base is grouped by commodity type. The SQS organization reflects these commodity groupings. So one group looks after electrical/electronics, another interiors, and so forth. The following paragraphs describe key features of Extended Enterprise operations.

In the automotive industry, protecting the assembly line from delays due to missing or nonconforming parts is a paramount concern. The economics of the assembly line are compelling. Car company nonproduct costs in areas such as corporate overhead, technical staff, and marketing efforts are wasted if an assembly line can't produce a revenue-generating automobile. So downtime on assembly lines is expensive. Reworking assembled automobiles to replace defective parts is also expensive. Warranty costs are worse: these correct problems found by customers after the sale. Repair is costly in terms of both out-of-pocket cost and customer good will.

Avoiding these costs and preserving customer loyalty are the purpose of the Extended Enterprise. The sections that follow describe some features of the Extended Enterprise we expect to become commonplace in many industries.

20.2 Presourced Components Through a Supplier Strategy

Most suppliers in the Extended Enterprise are "guaranteed" their continuing relationship with DaimlerChrysler. Of course, that guarantee is contingent on their providing quality parts on schedule. Those that don't will likely see less and less DaimlerChrysler business. When it's decided that a part will change or be replaced, the platform engineer will create the design with or without the help of the supplier. As the design is developed, the supplier is selected from an approved list of suppliers for that type of part. Guidance for this selection is provided by a sourcing strategy. Normally, there are only one or two suppliers for any part. In the case of modified parts, the choice will likely be the incumbent supplier.

Presourcing enables an expanded supplier role. This includes the design changes required plus setting a target component cost. During the component's life cycle, the supplier may propose savings opportunities to the buyer under the SCORE program. SCORE stands for Supplier Cost Reduction Effort. Its purpose is to draw suppliers into the fight against waste. This is especially important for a company such as DaimlerChrysler, whose reliance on suppliers is relatively high compared with other U.S. automobile manufacturers.

Once the design is developed, the part is "disclosed" to the SQS. This kicks off a process lasting 2 to 3 years to assure that the redesigned parts are available to the assembly line and that they meet quality standards. The SQS, the engineer, and the supplier form a product team that works toward this goal. The documented processes described in the next section cover the scope of their activity.

20.3 Documented Processes

DaimlerChrysler requires that its suppliers be certified to the automobile industry's quality standard, called QS-9000. That standard defines the internal quality processes that suppliers must use. An independent registrar must certify compliance with these processes. They cover continuous improvement, defect prevention, and reduction in variation. QS-9000 provides a foundation of basic requirements for any supplier wanting to serve any of the major automobile companies.

DaimlerChrysler supplements these requirements with its own procedure for new-product introduction. DaimlerChrysler characterizes its quality efforts two ways — advance and current. DaimlerChrysler refers to efforts to anticipate problems as "Advance Quality Planning" (or AQP). As the name implies, the hope is to head off problems before they happen. Current quality efforts focus mostly on problems in assembly plants. They also address continuous improvement after a component is in production. Suppliers are continuously graded on their performance, and low performers are subject to corrective action, even if the parts they provide are "carryover" parts that have no design changes.

AQP measures to assure quality and quantity of the component come into play when a component design must be originated or modified. It's the job of the product team described above to comply with the process. Documentation, describing the Product Assurance Planning (PAP) process, lays out what is expected of suppliers in terms of management practices that assure quality. This standard includes elements developed by International Standards Organization (ISO), the AIAG (Automotive Industry Action Group), and used by other major manufacturers, such as Boeing.

20.4 Risk Assessment

The AQP process begins with a "risk assessment." This is a triage event sorting new or modified components into low-, medium-, or high-risk categories. The type of risk determines how advance quality assurance will be handled

during component design modifications, testing, and manufacture. The criteria for setting the risk level consider part characteristics, whether the supplier has made the part before, or whether the process for making the part is new. Those components with low-risk assessments can manage their advance quality process without intervention from DaimlerChrysler.

For medium-risk components, the supplier will manage the quality process just as it would for a low-risk component. However, DaimlerChrysler will perform a formal Product Sign-Off (PSO) for the component. The PSO is explained in more detail later.

In the case of high-risk parts, DaimlerChrysler will "lead" the entire process. This includes both the quality assurance phase and the PSO. This is a 2-year time frame at least, tied to the launch date for the vehicle. It involves frequent meetings between the product team from DaimlerChrysler and the supplier and a "final exam" — the PSO.

20.5 Product Sign-Off (PSO)

The PSO essentially affirms the supplier's production process. It takes the form of an on-site visit to witness the production of components by the supplier. The visit also verifies that the elements of the quality plan are in place. The PSO also tests whether the supplier production process has sufficient capacity to feed DaimlerChrysler's assembly lines.

Table 20.1 describes elements checked during DaimlerChrysler's PSO process. In a later section on cost reduction techniques, we'll explore selected items further. We forecast that, as quality practices advance, most industries will move to quality standards similar to those described here. The PSO model used by DaimlerChrysler is likely to be replicated in one form or another. This is particularly true where dominant organizations such as Boeing in aircraft and the Big Three automakers have the clout of the one-to-many relationship with their suppliers.

One can also foresee the time when third-party logistics companies will be asked to comply with standards such as these by their customers. Many companies are not prepared; they will not likely survive in the more demanding environment.

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TABLE 20.1

DaimlerChrysler Product Sign-Off (PSO)

PSO Element	Description
Process flow diagram/manufacturing floor plan	This document shows the manufacturing process including loops, operations, operators required, and locations in the factory.
Design and process failure mode effects analysis (DFMEA and PFMEA)	DFMEA addresses design of the component itself. PFMEA addresses the production process. Both try to anticipate what could go wrong so that the item itself or the process may be changed to prevent the problem.
Error and mistake proofing	By product or process design changes, error proofing eliminates the possibility of producing a defect. Mistake proofing includes ways to spot errors that do occur so they can be corrected before a defective product is sent to DaimlerChrysler.
Problem solving methods	This component looks for the application of quality-related problem solving techniques like cause–effect diagrams and design of experiments.
Incoming/outgoing material qualification/certification plan	The supplier must show how it controls the quality of incoming and outgoing material. Examples include inspection of incoming material, receiving/shipping reports, and supplier certifications
Parts packaging and shipping specifications	Logistics between the supplier and DaimlerChrysler are important. This element checks the way this movement occurs. Coverage includes labeling, containers, and laboratory results.
Parts handling plan	The handling plan defines how parts will move between operations in the process internal to the supplier plant.
Engineering standards	Standards describe materials, processes, and quality elements for a material, process, part, or system.
Preventive maintenance	A plan should describe how preventive maintenance would proceed for equipment and tooling used in the process.
Product quality plan	This plan shows the schedule, status, and coverage needed to make sure lower tier suppliers also comply with quality standards.
Gage and test equipment evaluation	Customers want to assure that quality checks are both "repeatable" and "reproducible," referred to as *R&R*. Repeatability assures that a single person would produce the same result in multiple samplings. Reproducibility assures that multiple checkers would produce the same results.
Tooling, equipment, and gage identification	This element lists the requirements for the process.
Specific product and process characteristics identified	Certain features of the component will affect performance more than other features. Called "key" characteristics, these are the focus of quality assurance efforts.
Control plan	This plan shows the controls needed at each step of the process. These are points where measurement of the process occurs. The measures will cover the key characteristics that affect performance.
Process monitoring and operating instructions	Instructions must be located by the workstation for the process they cover. They must be visible and legible to the operators.

Line speed demonstration & first time capability (FTC)	The supplier must demonstrate that the capacity of the process meets DaimlerChrysler's requirements. This includes measuring first-pass yield at various steps of the process.
Initial process study	Parts produced by the process must meet statistical standards for variation. Passing this test is necessary for payment of tooling costs by DaimlerChrysler.
BSR/NVH	BSR means "buzz, squeak, and rattle." NVH stands for noise, vibration, and harshness. This step examines the interaction of the component with others in the system.

21

SCM and Information Technology

Is ERP the same as supply chain management?

This question came from an executive deeply involved in implementing an Enterprise Resource Planning (ERP) system. The session was an introductory meeting on the topic of supply chain management. The questioner hoped the answer would be "yes." As the theme of this book suggests, however, ERP is not synonymous with supply chain management. ERP, at best, is only a partial SCM solution. In fact, it may be no solution at all if it doesn't improve competitive position.

However, information systems — by virtue of the effort, time, and expense involved in their implementation — are often a prominent feature in supply chain improvement. The question above reflects confusion about the interaction between information systems and SCM. Like our questioner, many executives wrongly equate the two. We hope to clarify the distinction in this section on information technology (Chapters 21 through 23).

We tackle the job in two parts. The next chapter (Chapter 22) summarizes categories of supply chain applications. Along the way we describe why these categories might fit a particular situation and some of the pitfalls one might encounter in implementation. In Chapter 23, we profile the work of the Supply-Chain Council (SCC). The SCC is a non-profit organization formed by industry to promote supply chain integration. Since much of its work is directed toward the integration of information along the supply chain, we describe it at this point in the book. Later, in Chapter 28, we describe ways to put information systems to work to lower costs and increase velocity in the supply chain.

This discussion is decidedly oriented to the manufacturing and distribution of products. Most supply chain systems have their roots in these industries. However, we believe there are parallel systems in the service sector and that the lessons learned for manufactured goods are transferable.

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21.1 The Landscape

Innovation in the supply chain puts new demands on information systems and the people who develop and manage them. Making information systems work to improve supply chains is an important SCM skill. But, putting technology ahead of strategic design and operational requirements is a frequent shortcoming. Consequently, much effort is wasted or even counterproductive.

Systems issues present some monumental challenges to senior managers in particular. The reasons are many. Senior managers "may not have a clue" about their needs for systems, the capabilities of information technologies, or how to implement the technology. They have only a hazy awareness of how computers work and what infrastructure capability, such as networking, they provide. Consequently, these managers are often at the mercy of their technical departments and software marketers. Or their lack of knowledge leads to indecision.

Another factor is the constant barrage of stories of computer projects run amok. Many war stories recount foul-ups costing tens of millions. In fact, some companies implement high-cost systems only to "unplug" them when they don't work. The *Wall Street Journal* recounted a flurry of such horror stories brought to light through lawsuits and visible corporate miscues.[1] Among the incidents reported in a single article were the following:

- Whirlpool, the appliance maker, had troubles shipping product due to high demand and conversion to SAP software.
- W. L. Gore & Associates, the water-resistant-fabric maker, sued Peoplesoft, Deloitte Consulting, and others over a botched installation of new systems.
- A quickly implemented SAP ERP system kept candymaker Hershey from delivering its products to meet the peak Halloween demand — despite having plenty of inventory.
- Allied Waste Management, a service company, pulled the plug after spending $45 million on a $250 million SAP system.

Of course, many organizations have completed large systems projects with better success than that described above. And often the fault is as much that of the craftsmen as it is of the tools.

The above examples cite the application category called ERP. ERP systems automate "back office" operations. The back office consists of the many transactions fundamental to the business. Examples are personnel records, booking sales, and ordering materials. In the late 1990s, the need to address "Y2K" risks motivated many of these efforts. Older "legacy" systems built around the needs of individual departments were not ready for the new millennium.

Now that the problems of Y2K are behind, we predict the next "drivers" for systems improvements will be getting strategic value out of systems to improve the supply chain. Those who have implemented new systems will look for ways to capitalize on their investments and exploit technology for competitive reasons. Frequently cited examples include e-commerce capability, electronic links along the supply chain, reducing inventory, exploiting databases for customer information, and otherwise increasing the role of technology in customer interfaces.

This section describes the wide and fragmented supply chain information landscape. We do it lightly, acknowledging that there are multiple sources for more-detailed information. This is also a landscape with "blurry" boundaries between categories of applications. Hardly a week passes when we don't hear about a new acronym or "revolutionary" tool in the domain of supply chain systems. Unless one closely follows the technology, one can be excused for being confused. Describing each and every application category would require more space than we have available. So we'll confine our descriptions to what we believe are the major categories.

21.2 Supply Chain Applications

The Council of Logistics Management (CLM), in conjunction with Andersen Consulting, maintains an "inventory" of supply chain applications. Its list of software in a CD format describes over 1200 application packages.[2] To find the right fit for his or her business, the user can select from the many categories shown in Table 21.1.

TABLE 21.1

CLM Software Categories

• Order processing	• Stock/pallet location	• Vehicle maintenance
• Inventory control	• Labor performance	• Physical distribution system modeling
• Inventory planning and forecasting	• Material handling	• Electronic data interchange
• Distribution requirements planning	• Transportation analysis	• Warehouse management
• Materials requirements planning	• Traffic routing and scheduling	• Promotions and deals
• Purchasing	• Freight rate maintenance and audit	• Other functions

Typically, any listed package will include several of the functions shown in Table 21.1. Indeed, some packages claim to have them all. Herein lies a problem. Users have to decide which features are most important to their businesses. They then have to decide how well each candidate package supports

the need. Packages will undoubtedly be stronger or weaker in any area. If you need a great traffic routing and scheduling capability, for example, you will have to look closely at each candidate package that provides this function. Some claiming to possess the functionality may in fact have it, but do it poorly.

When presented with a "short list" of candidate packages for implementation, we find that some clients — knowing there is an abundance of options — are uneasy with only a few alternatives. They realize that a software package selection could be a commitment for a decade or more. There's a suspicion that there might be a better solution out there beyond the short list presented. If the project doesn't go well, the selection team will shoulder the blame. To cover one's risk, they may believe that one must rummage through all 1200, or at least several hundred, to make sure the "right" choice is made. Of course, evaluating a single package is a time-consuming job taking from 1 to 3 weeks for a diligent review. Imagine doing this for hundreds.

When it comes to the supply chain, this list — as comprehensive as it seems to be — is far from complete. Additional categories used by software suppliers, many of which have coalesced with the rise of SCM, include SCM itself (Supply Chain Management), ERP (Enterprise Resource Planning), CRM (Customer Relationship Management), PDM (Product Data Management), CRP (Capacity Requirements Planning), MES (Manufacturing Execution Systems) and APS (Advanced Planning & Scheduling).

Also, one must consider the possibility of what are called "bolt-ons." These are combinations of packages to cover a user's requirements. They are often developed when two cooperating package purveyors "integrate" their offerings. For example, the Hershey example above included ERP (by SAP AG of Germany), APS (by Manugistics, Inc., of the U.S.), and CRM (by Siebel Systems of the U.S.) applications. Another party, IBM, managed the effort. A trend is the consolidation of bolt-on package functionality — in the Hershey case, the CRM and APS — into core ERP systems.

In addition to applications, supply chain systems include the means of communicating among partners. Many supply chain partners, for example, use electronic data interchange, or EDI. The Internet is the emerging technology of choice, and packages are in varying states of "Internet-readiness." Another application category of software is EAI (Enterprise Application Integration) or "middleware." This category enables different applications to "talk to each other." This can be important both inside an organization and in managing a supply chain. Deploying middleware can bypass or delay investments in new applications.

We've indicated that understanding the benefits and risks of technology is a challenge for many. One would hope that system marketers would be helpful in this regard. Unfortunately, so-called "solution providers" seldom emphasize clarity in their communications. Table 21.2 contains examples of sales-related press releases, brochures, and information articles from software companies and systems consultants.

TABLE 21.2

Claims by Information Technology Providers

	Source	Excerpt
A	ERP system marketer	"[Company] offers integrated Flow Manufacturing that enables dramatic benefits such as a 90 per cent reduction in cycle time, 50–90 per cent reduction in inventory and a dollar for dollar increase in working capital. These are all available with a low risk transition strategy."
B	Two software companies	"[Company 1] and [Company 2] have extended their relationship to offer customers a closed loop supply chain solution."
C	E-commerce provider	"[Company] is the leading provider of electronic commerce solutions that dynamically link buying and supplying organizations into real-time trading communities."
D	Supply chain software provider	"[Company] unveiled [product name], a new approach for demand-driven fulfillment that enables companies to anticipate and meet customer delivery expectations the first time, every time."
E	System integrator	"[Company] is a leader in industrial strength, e-business solutions for system and application response performance."
F	ERP systems provider	"[Product name] allows people to harness the power of the Internet to work smarter, better and faster by optimizing supply chains, managing strategic relationships, reducing time to market, sharing virtual information, and increasing productivity and shareholder value."
G	Consulting firm	"[Company's] insight into the global consumer products complex from consumer to retailer to supplier, helps companies develop and implement winning strategies. The firm's thought leadership among retailers and consumer products companies has led to the transformation of entire industry sectors."
H	IT consulting firm	"[Company] is one of the most successful and fastest-growing IT consulting firms nationwide. [Company] is differentiated by its tradition of unsurpassed technology expertise; its strong track record of delivering; and its experienced, enthusiastic people — the best in the business."

Readers might be excused if they concluded that this industry tends toward hyperbole. These companies have a large investment in product development, and each sale increases the return on that investment. So claims are often extraordinary. Descriptions of the results are vaguely worded superlatives replete with fuzzy multisyllable terms such as "transformation" or "integration."

However, there is no doubt that systems solve real problems. The claims made by Company A in Table 21.2 are very similar to those made for TQM and JIT just a few years ago. In fact, the changes needed to achieve the benefits probably require both the software and nonsoftware disciplines to gain the most from the system. Often, the preparation for the system is as important as the system itself. Cleaning up the data is a necessary prerequisite to successful system use. Company B reflects a trend among many software suppliers — that of combining forces to offer a "new" product from two or

more old ones. Some computer publications caution that many of these alliances are marketing ploys; buyers beware![3]

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22

Topography of Supply Chain Applications

> When designing and implementing a system, remember that system effectiveness is inversely proportional to the complexity.
>
> **George Plossl,** as quoted in *ERP: Tools, Techniques, and Applications*

George Plossl offers sound advice for those contemplating the implementation of any major software tool.[1] In this chapter, we describe the major software categories that fit into the supply chain domain. We mentioned in Chapter 21 that the boundaries of these categories are fuzzy. A particular package may be classified or marketed under multiple categories. The types themselves also change over time. This can be the result of package providers joining forces, or industry providers seeking new "space" in the marketplace. The joining of two or more providers usually involves the building of software links between packages. In this fashion, they become "integrated" and offer a "single solution." Other companies, working alone, will build new versions of their packages with additional capabilities.

A "map" of the supply chain information terrain will aid our discussion. Figure 22.1 is such a map; we'll use it as a reference to place different categories in the chain.

Figure 22.1 shows three enterprises that compose a "supply chain." The central shaded figure could be our own organization. The enterprise to the left represents our supplier base. Our customer base would be on the right. All three enterprises have separate functions, or departments, as noted by the vertical lines, or "silos," in each enterprise in the chain. Across the top is the "enterprise level." This consists of corporate functions or processes that cross department boundaries within the organization. Between organizations the figure shows linkages of two types — information and physical flow. The information flow is two-way, while the physical flow is one-way from raw material to delivered goods. We recognize that product also flows backward due to transactions such as returns. Also, there are financial flows in supply chains.

Early systems were generally developed under functional sponsorship and had minimal integration between departments. This was the problem addressed by ERP. Once data is entered into the ERP system, it is available for all departments. Faxes, mail, EDI, the Internet, or proprietary networks pro-

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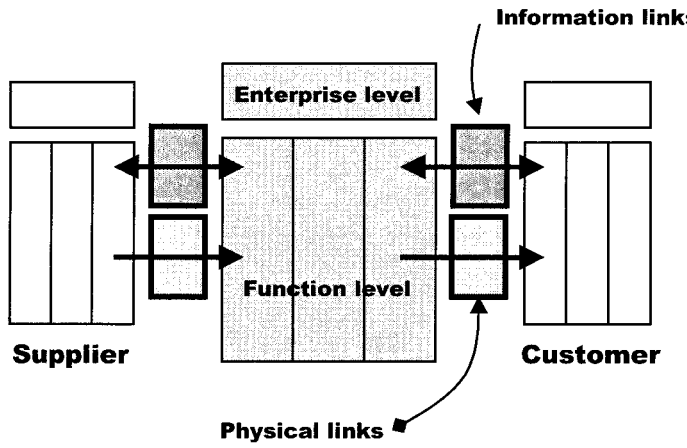


FIGURE 22.1
Map of supply chain information terrain.

vide pipelines for the information links. As indicated above, the Internet is becoming standard.

An understanding of what different categories of systems will and will not do is important to effective management of the supply chain. We hope these descriptions will be helpful in sorting what one might need. As we proceed, we'll return to Figure 22.1.

22.1 MRP and ERP

By far most of the money, time, and effort expended recently on supply chain systems have gone to this category. "MRP" stands for *materials requirements planning*. "ERP" stands for *enterprise resource planning*. We consider MRP and ERP together, since the newer incarnation, ERP, has its roots in MRP. Carol Ptak and Eli Schragenheim have traced the evolution of MRP to ERP.[1] Figure 22.2 shows their MRP to ERP evolution. They liken each phase to "ERP growth rings." Each generation, like the rings on a tree, has added to the capability of this category of application.

According to Ptak and Schragenheim, at least three drivers are behind this growth. The first is the expanding capability of technology. The declining cost and increasing capability of computers brings with it hardware for handling more transactions faster. The second driver is increasing expectations in the supply chain for fast response. The result has been greater reliance on "just in time," or JIT, practices. Under JIT, long lead times are out; speed is in. In the JIT environment, materials must be managed with much more rigor.

The third driver is the shift from labor-intensive to material-intensive business models. This has come from improvements in worker productivity and

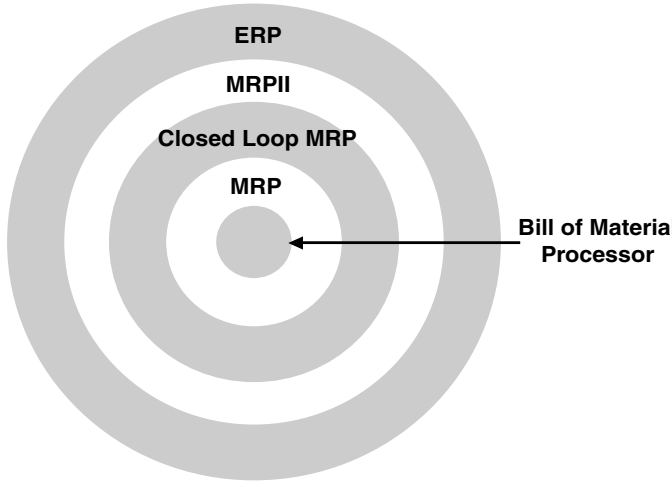


FIGURE 22.2
ERP growth rings. (Reprinted with permission of CRC Press, LLC.)

a growing propensity to buy, rather than make, components. So ever-improving methods of managing material are welcome and downright necessary to stay competitive. Successful companies work on lean inventories and strive to have the right material available at the right time.

The bill of material processors, shown as the first growth ring, documented what material went into what product. This was a major step in matching the material purchased with the products being sold. It became feasible with the coming of age of computers in the early 1960s. MRP added visibility and took advantage of increasing calculating power. In MRP, the forecast need — represented by the master production schedule — could be compared with on-hand and on-order amounts. Orders could then be placed to fill the gap.

MRP schedules have two logical flaws that, according to critics, limit their effectiveness. The first is that MRP requirements are based on forecasts. With cloudy crystal balls, MRP causes overstocking of items that don't sell and understocking of those that do. The second flaw is the assumption of infinite capacity. Associated with this is the use of fixed lead times. As a result, forecasts may make impossible demands on the production process. Actual lead times vary with the workload. When backlogs go up, lead times are likely to go up as well. (Refer to the "3C" alternative to MRP in Chapter 29 for an approach that addresses these two shortcomings.)

Relieving the capacity planning problem led to "closed-loop MRP." In closed-loop MRP, the computer calculates the effect of the production plan on work centers. One now knows which centers have the most demand and can take action. Examples of this action can include rescheduling, adding capacity, or contracting out production. Closed-loop MRP requires the organization to fully document manufacturing processes, particularly the bottlenecks.

In manufacturing processes, this usually includes capacity expressed by the time required to produce a part, the set-up required, and lead times.

Producing this documentation adds considerable cost and time to implementing MRP or ERP. This cost is commonly expressed as a multiple of the software cost. Multiples of five or six times or more are not uncommon. The documentation and training also strain the project management capabilities of many companies and their system integrators, which are usually consulting firms hired to get the systems installed and running. It is likely that the failures cited in Chapter 21 are not the result of deficient software logic. They are probably due to shortcomings in the integration of packaging, training, or managing needed organization changes.

When MRP evolved to MRPII, available computing power made it possible to track financial as well as material requirements in the same application package. According to Ptak and Schragenheim, MRPII produced an integrated business system that

- provided visibility of the requirements of material and capacity driven from a desired operations plan
- allowed input of detailed activities
- translated all this activity to a financial statement
- suggested actions to address those items that were not in balance with the desired plan[1]

This means that MRP, established to manage material for production, had leapt departmental boundaries, spreading from the manufacturing floor to financial and planning processes, and in the process improving communications among multiple functions.

ERP extends MRPII even further. As defined by the ERP/Supply Chain Research Center, this includes "modeling and automating many of the basic processes with the goal of integrating information across the company." The huge advantage is getting every department on the same page when it comes to data. No longer is it necessary to reenter employee data or orders or sales forecasts into multiple department-level systems. The scope of ERP can now include product development, capacity planning, and marketing. ERP has found eager customers in many industries beyond manufacturing.

Table 22.1 is a list of common modules in a typical ERP system for manufacturers and distributors. A claim by many ERP providers is that their system incorporates what they refer to as "best practices." One package claims to have over 800 predefined business processes that can be tailored to suit an individual user's case. This is valuable if the company is willing to change. It can cramp the style of some implementers, however. An electronics distributor insisted on making each report in the new ERP system match the equivalent report in its legacy systems. The purpose was avoidance of any change that would require adjustments by employees. The result was a very rough implementation that, due to the customizing necessary, ran far over budget.

TABLE 22.1

Functionality of ERP Applications

• Capacity Requirements	• Cost Management
• Engineering/Product Definition	• Financials and Accounting
• Human Resource Management	• Manufacturing Processes
• Material Bills and Routings	• Order Management
• Real Time Planning and Scheduling (often with bolt-on software)	• Purchasing and Inventory

Another note of caution is in order. First, ERP systems are sometimes "rejected" because the inherent best practice method isn't accepted by the organization. If the organization tries to modify the software to fit its processes, it will likely end up with a "one of" system — and a costly one at that. Every upgrade to the base software may necessitate extensive modification.

Another caution lies in fitting ERP to a supply chain strategy. We have said that strategy depends on uniqueness. While adopting standard processes for nonstrategic activities is certainly acceptable, one must understand which processes have to be different for strategic reasons.

In Figure 22.3, we return to our supply chain map to trace the expansion of functionality in these systems. The original MRP was principally a *supply* function, confined to a single department as we show in the figure. So it occupies a space on the incoming side of the enterprise where material acquisition is planned and processed. There is little effect on other functions. Closed-loop MRP has an impact beyond the supply function. Production processes have to be documented. Forecast requirements are bounced against the capacity to deliver them. So multiple departments in the enterprise are affected.

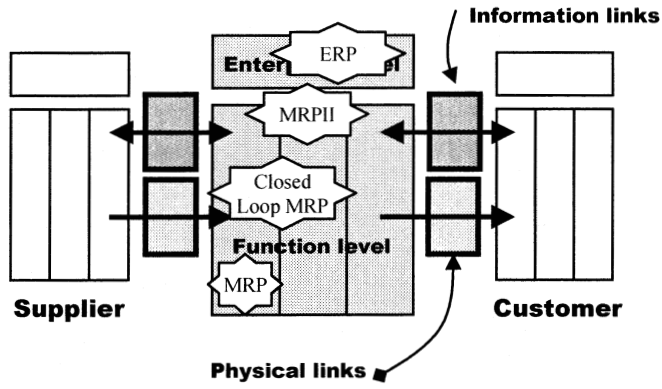


FIGURE 22.3
Progression from MRP to ERP in the supply chain.

MRPII involves financial functions and becomes the centerpiece of corporate systems in manufacturing companies. ERP extends that reach even fur-

ther. But, as Ptak and Schragenheim point out, the heartbeat of most ERP systems remains the basic MRP module.

22.2 Specialized Applications for SCM

ERP isn't the end of the systems journey for most companies. And to some, like the manager making the statement at the beginning of Chapter 21, this is a surprise and a disappointment. They may find important shortcomings inherent in ERP's role as a transaction system. The shortcomings lie in planning and scheduling important processes in the organization. Examples include incoming materials, production processes, and the warehouse.

In the dynamic software environment, many ERP providers are scrambling to add this functionality to their own systems or are building linkages with special application packages. However, for most, these additions must come through bolt-on packages. Here we briefly describe a few of these specialized applications and what they do.

22.2.1 SCM and APS

This category is the vanguard of what is referred to as *supply chain management* or *advanced planning and scheduling* software. In our discussion of MRP and ERP we described what some believe are the weaknesses of MRP and ERP. The lack of features is particularly dangerous when supply chain partners are closely coordinating their production and the supply chain is running close to capacity.

A response has been the growth of applications in the SCM and APS category. We'll use the term "APS" here since it's a more descriptive term of the software functionality. Applications in this category are likely to displace the scheduling and planning roles of ERP systems. Dave Turbide, editor of *APS Magazine*, has listed the MRP and ERP shortfalls addressed by APS systems.[2] Table 22.2 compares the two categories.

Turbide reports that many APS applications are moving beyond single companies to supply chain solutions. These extend the capabilities described above beyond the immediate enterprise. Suppliers of APS applications emphasize the *planning* capability of their products. Typical modules include both *supply planning* and *demand planning,* providing forecasts of expected production. These are shared up and down the supply chain. An important benefit in multicompany planning is having a common forecast. A frequently cited shortcoming of noncooperating supply chains is that each link must make an independent forecast.

Demand fulfillment, another APS feature, helps the organization respond to demand as it actually unfolds. This includes the ability to look forward and

TABLE 22.2

Comparing MRP/ERP to APS

MRP/ERP	APS
MRP is a batch process. It's not run in "real time." Often run outside normal hours.	Uses technology that allows for fast turnaround of results.
No priorities for customers, products, and materials. All requirements treated the same.	Can optimize solutions using business rules.
Uses the infinite capacity assumption.	Recognizes capacity constraints.
Lead times are fixed and known.	Lead times are a result of many dynamics in the schedule and should reflect business rules and procedures.
Calculates in a one-pass sequential process working backward from due dates.	Solves material and capacity availability simultaneously, assuring both are present for scheduled production.
Weak decision support/simulation capability.	Fast turnaround allows for multiple "what if" scenario analysis and fast response to inquiries.

test alternatives for supply chain production. An APS may operate over a wide time frame, providing both short-range and long-range decision support. The system may also have to make delivery commitments on a minute-by-minute basis. It does this by quickly reassessing capacity and due dates based on the latest orders. This is possible because the data is in the core memory during computation, speeding the process. On the other hand, it's also a tool for long-term capacity planning with time horizons measured in years.

22.2.2 MES

Another "bolt-on" application category is *manufacturing execution systems* (MES). MES also sprang from the inability of traditional MRP systems to plan in dynamic shop floor environments. This category automates much of the scheduling activity needed to run work centers on the shop floor. The time horizon is short, ranging from minutes up to days. It is described by some as a bridge between the MRP/ERP or APS plan and the machine-level controllers on the plant floor. An MES solution will likely perform some or all the following:

- Resource allocation and monitoring.
- Operations scheduling recognizing capacity constraints. Dispatching. Maintenance management.
- Data collection on labor, quality, and work completion.
- Manufacturing/process engineering tools including simulation, process planning for parts, and design for manufacture (DFM) analysis.

- Quality management including inspection and testing, laboratory results, and statistical process control.

An MES package is suited to complicated production settings where fast execution of orders is important, and operations must be rescheduled frequently.

22.2.3 Warehouse Management Systems (WMS)

What APS and MES do for the factory, a warehouse management system will do for the distribution center or warehouse. More sophisticated operations require specialized applications designed to their needs. WMS applications fill this gap. On the outbound side, it is particularly important in coordinating shipments with customers — a process referred to as *fulfillment*.

WMS functionality can cover a broad range including internal operations, shipping, and transportation, and management functions such as payroll and inventory management. The systems also incorporate automation like barcode reading and the use of radio frequency hand-held terminals to communicate in the facility. These provide real-time updates of inventory status. Other functions include those listed in Table 22.3.

TABLE 22.3

Functionality of Warehouse Management Systems

• Labor control and planning	• Order entry through EDI and e-commerce methods
• Inventory tracking including cycle counting and locations	• Planning of picking routes for improved productivity
• Transportation planning and routing	• Yard management
• Decision support for planning	• Shipping transaction processing
• Capability for random slotting to increase storage density	• Receiving processes to improve accuracy
• Directed put-away	• Batch picking

22.2.4 Customer Relationship Management (CRM)

ERP is largely known as a "back office" transaction processing application. This has left a vacuum in the "front office." The front office covers the activities that bring the business into contact with customers. This category, while certainly important to the supply chain, is not included in lists like those produced by CLM, which focuses on distribution-related applications. Like other categories, CRM suppliers are building bolt-on links with back office ERP systems.

The CRM category includes a large number of functions for both e-commerce and traditional interfaces between customers and product suppliers. Examples include those shown in Table 22.4. CRM is likely, in our opinion, to be an important enabler of supply chain strategy execution. Once a customer

demand enters the supply chain through a CRM application, it can be dispersed rapidly throughout the chain. Rule-based decisions can then support both planning and execution systems in response. We describe this approach in Chapter 28.

TABLE 22.4

Functionality of CRM Applications

• Contact management	• Customer history tracking
• Account/territory management	• Field sales
• Customer service systems	• Order entry
• Data "mining" to understand customer trends	• Decision support for sales campaigns, market segmentation, and so forth

22.2.5 Product Data Management (PDM)

While many have focused on ERP implementation, some companies — particularly those with technical products — appreciate the need for PDM applications to improve their supply chains. As time to market requirements for new products increases in importance, so will this category. PDM has long been the domain of individual company engineering departments. One of the hallmarks of SCM is the increased role of partners, and sharing product information becomes more necessary. A particularly important example is electronics. Increasingly, producers in this fast-moving industry rely on contract manufacturers to produce their designs. PDM fills the need for standardized ways of exchanging product information.

Many companies maintain product-related information in separate applications. Examples include the CAD (computer-aided design) system for engineering drawings and a word processing file for product descriptions or technical manuals. This makes mixing and matching files a difficult job. In this environment, steps in the process are likely to be done in sequential fashion. Conceptual design, detailed design, drafting, testing, and so forth proceed at a slow pace in series. If a downstream change occurs, the design process may have to be repeated. PDM is seen as an enabler of "concurrent engineering," which has the potential to shortcut the design process. With concurrent engineering, design activities proceed in parallel.

Effective use of PDM will likely be a "make or break" factor in competing in many markets. This includes both new-product introduction and management of product design change orders. Roy Schulte of the Gartner Group, which monitors information technology trends, describes the need for "zero latency." This term implies "instantaneous" left-hand/right-hand communication. As soon as a new design is ready or a change in design occurs, it is published up and down the chain. Slow communication of product design information increases cost and wastes time.

Another practice that is supported by PDM is referred to as "design for supply chain." In this case, a supply chain partner, perhaps a large distributor, reviews a bill of material as the design is near completion. The review may surface opportunities for substitution of a functionally identical part. The alternate part carries a lower cost due to the distributor's contracts with suppliers.

Within the PDM category, we would also include recording the "rationale" for important design decisions. This is the "why" of the design. It will provide those with whom one must collaborate now and in the future the rationale for a design decision. Separate tools are available for this purpose.

A collaborative PDM system requires the capability not only for defining product components but also for sharing those designs along the supply chain. It must also be dynamic in terms of tracking product configurations, referred to as "configuration management." Separate applications are available for this purpose. Cutting-edge applications in this category allow buyers to order customized products from suppliers. Accessing the supplier's design library with Internet-compatible links does this. Such links support purchasing, manufacturing, and life-cycle maintenance requirements.

Typical components of PDM include those shown in Table 22.5.

TABLE 22.5

Functionality of PDM Applications

• A product database	• Non-proprietary interfaces for access to the database
• Configuration control	• Rationale for design decisions
• Messaging system	• Integration of PDM tools

22.3 Meeting Improvement Objectives for Systems

There is much written on why systems efforts fail. We described some problem cases earlier. Systems have a lot to offer, but the systems solutions are seldom easy or cheap. In understanding why systems fail, one must understand why the efforts were undertaken in the first place. Much recent activity has centered on the kingpin of systems project — the new ERP system. Deloitte Consulting and Benchmarking Partners reported the results of a survey of companies undertaking ERP implementations plus their own experience with technology implementations.[3]

There were a number of technological reasons that necessitated the projects. Factors, listed in order of importance, were

1. Systems not Y2K compliant
2. Disparate systems

3. Poor quality/visibility of information
4. Business processes or systems not integrated
5. Difficult to integrate acquisitions
6. Obsolete systems
7. Unable to support growth

Since the survey was conducted before 2000, many companies were facing the Y2K deadline. So that need has receded. In the future, motivators will likely include one or more of the remaining factors. The survey also measured ERP expected against actual benefits. Table 22.6 lists the areas identified as benefits and indicates whether the benefits exceeded or disappointed expectations.

TABLE 22.6

Fulfillment of Expectations for System Implementation

Benefits Exceeded Expectations	Benefit Level Disappointing
Productivity improvements	Inventory
Procurement	Personnel reductions
Order management/cycle time	IT cost reduction
Financial close cycle	Cash management
Transportation/logistics	Revenue/profit
On-time delivery	Maintenance
	Supplier management

There are many commonly mentioned root causes for project failings. Here is our summary.

22.3.1 Strategic Plan

Too little thought goes into matching systems design with strategic needs. To date, most systems efforts fulfill "back office" requirements. This is generally the day-to-day transactions needed to run the business. Most companies that have been in business for any amount of time have built systems around departmental needs. Often these are added to gradually without benefit of an overall plan. There is never a concerted effort to look at the whole, including enterprise and supply chain processes. This includes ways in which the organization will interact with its supply chain partners. With Y2K pressure behind us, we expect better linking of systems efforts with other strategic implementation initiatives.

22.3.2 Documentation Shortcomings

Systems depend on accurate data to produce high-quality outputs. For example, the schedule for a poorly documented manufacturing process will have

minimal value. Implementers of systems often overlook the need for creating and maintaining this documentation. The result is a "brittle" system where underlying data inaccuracy makes the system all but useless.

22.3.3 Modularizing the Job

We would agree with others that a systems effort should be subdivided into distinct projects. This will be even more important as users look for more value-adding solutions beyond back office operations. The systems effort must be part of an overall initiative that includes supply chain design and experimentation with alternative ways to create information links.

22.3.4 The "Simpler Way"

In any supply chain effort, the "best" systems solution may not require a computer at all. Going into an effort with a preconceived idea that the solution requires a computer application is a mistake. This is particularly true in the case of many SCM applications. There are alternatives to consider either as a final or interim solution on the way to new systems. One such method, called the 3C alternative to MRP, is described in Chapter 29.

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23

Supply-Chain Council

Process reference models integrate the well-known concepts of business process reengineering, benchmarking, and process measurement into a cross-functional framework.

Bill Helming, Pittiglio Rabin Todd & McGrath

23.1 SCOR Model

In this chapter, we describe the Supply-Chain Council (SCC) and the Supply-Chain Operations-Reference (SCOR™) model. The opening quotation explains the purpose of the reference model.

Unlike engineering disciplines, SCM has lacked a common vocabulary and framework for building supply chains. Communications across companies and even within companies has been hindered by this missing element. In 1997 Pittiglio Rabin Todd & McGrath (PRTM), a consulting firm focused on technology companies, and Advanced Manufacturing Research (AMR) a research firm, developed SCOR to address the problem.

To validate the model and encourage its adoption, PRTM and AMR assembled a 69-company advisory group. The advisory group found value in the model in terms of its potential to lift supply-chain performance to a new level. The Supply-Chain Council was then launched to advance use of the model. Case studies later in this chapter provide examples of SCOR application.

The model assumes that supply chains will have common characteristics, which include the following elements:

- Standard process descriptions
- Relationship framework between the standard processes
- Standardized metrics for performance measurement
- Best-in-class management practices
- Standards for aligning software features and functionality

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Such modeling is a proven tool for defining processes and understanding the information needs to make those processes work effectively. The SCOR model is structured in a "top-down" fashion. This structure has increasing levels of detail as one proceeds deeper into the operation. SCOR includes four top-level management processes — *Plan, Source, Make,* and *Deliver.* Figure 23.1 shows the relationship between these processes and partners in the supply chain.

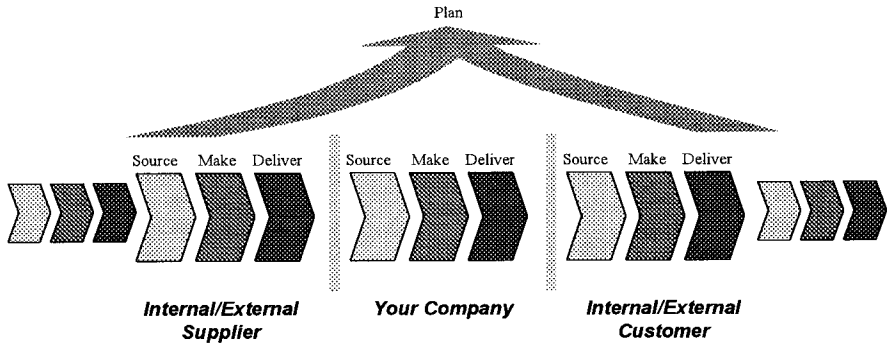


FIGURE 23.1
SCOR model structure. (Printed with permission of the Supply-Chain Council.)

The *Plan* process covers the boundaries of the supply chain under consideration. As shown in Figure 23.1, this is presumed to be a multicompany affair. Each supply chain component can have *Source, Make,* and *Deliver* processes. These may be more or less important from partner to partner. For example, one partner may be a distribution company. Its *Make* component could be minor or nonexistent. Of course, a "make" capability could be significant as part of a postponement strategy. With postponement, also described in Chapter 26, the supplier commits to the final configuration late in the process — often in response to actual customer orders.

The four first-level processes contain a diverse number of activities. Table 23.1provides a flavor of their scope. Level 1 SCOR planning defines the model's scope and content. It also sets "basis of competition" targets for improving supply chain performance. These are translated into improvement goals.

The second level of SCOR model development contains toolkits for supply chain design. These are matched to the supply chain environment being modeled. For example, there are models for make-to-stock, make-to-order, and engineer-to-order links in the supply chain. Several of these models may exist in a single supply chain. For example, an end product produced by one partner at the end of the supply chain could follow a make-to-order model. The distributors supplying the operation could be working in a more traditional make-to-stock environment.

TABLE 23.1

Scope of SCOR Model Process Components

Management Process	Supply Chain Processes
Plan — covers the other three processes. Seeks to balance demand and supply.	Suppliers. Rough cut capacity, make/buy. New/replacement product plans. Physical, systems infrastructure. Decision-making processes.
Source — procures goods and services to meet demand.	Material acquisition, processing, and storage. Vendor relationships including certification. Component engineering. Contracting, financing of suppliers.
Make — transforms goods into a finished state.	Fabrication, assembly, and test. Scheduling/sequencing. Quality assurance. Tracking of progress.
Deliver — provides finished goods and services in response to demand.	Customer interfaces. Fulfillment. Warehouse, transportation, and installation. Inventory management. Customization.

Source: Printed with permission of the Supply-Chain Council.

The SCC recommends applying SCOR to "threads." These are supply chain segments similar to the "spheres" described in Chapter 18. SCC observes that there are likely several threads in larger enterprises, each with its distinct supply chain needs.

At Level 3 in SCOR development, the model consists of standard process documentation for each of the Level 2 environments. The documentation includes process definition, metrics, best practices, required systems capabilities, and system tools by vendor. Level 4 is implementation; each supply chain or individual company is seen to implement tailored actions based on the goals of the effort and the performance gaps they have to fill.

Level 1 and 2 information can be particularly helpful in setting implementation priorities and quickly strategizing needs like new systems, facilities, and outside support. Beyond Level 3, company practices are likely to be unique — in fact they should be, lest they create copycat supply chains. In applying the SCOR model to other frameworks covered in this book, Levels 1 and 2 are also the appropriate levels for designing the unique activity systems using the process described in Chapter 7. Levels 3 and 4 would determine the tools and structure for implementing the activity system.

23.2 SCOR Application Cases

Two case studies — one from AT&T Wireless Services and one from Meade Johnson Nutritionals (MJN), a division of Bristol-Myers Squibb, illustrate early applications of the SCOR model.[1,2] The descriptions are summaries from presentations made by company managers at an SCC conference. Each

company was under pressure to improve its operations — but for different reasons. In the AT&T case, the business of making and distributing wireless products to customers was losing money and in danger of being closed. In the case of MJN, the issue was dealing with prosperity rather than adversity. The supply chain was seen as incapable of handling the growth required by the parent company as well as the requirement for continual cost reduction. Part of the problem was lack of a management function with the charge to oversee and manage supply chain development across multiple functions and business units. It's also notable that both examples address the role of new products in their redesigned supply chains.

23.2.1 AT&T Wireless Services

This division of AT&T began life as McCaw Cellular Communications, Inc. AT&T acquired McCaw in 1994 after McCaw had established a substantial market position for cellular services around the world. The business changed its name to AT&T Wireless Services in 1995. By then, it had a number-one position in North America in additional to its global presence. Wireless Services purchased or manufactured and then distributed wireless technology hardware for its customers. It had also established a "core competence" in manufacturing and a reputation for performance excellence in the marketplace.

However, problems related to the supply chain for wireless equipment threatened the future of the business. These included the following:

- Financial losses running 20% of revenues.
- A global presence that was wide but not deep with less than 10% of revenue coming from the international markets.
- An unfocused product line. Over half the products were designed by others, despite AT&T's formidable design capability.
- Not only were the products designed by others, more than 70% of products were produced by a large network of outside manufacturers (OEMs) despite an internal manufacturing capability.
- The company was caught in a transition from a business-to-business to a consumer-product model. It was difficult to have the right product available at the right time for these markets.
- Leadership and strategic direction were in constant flux, including executive turnover and "flavor of the month" approaches to planning.

Wireless Services decided to employ the SCOR methodology in attacking its supply chain problems. The following sections describe that activity at each level of the SCOR development process.

23.2.1.1 SCOR Level 1: Basis of Competition

In SCOR model application, this level is intended to define process types and priorities for improvement. At Wireless Services, it focused on the "value proposition" the company was promoting. The philosophy employed by SCOR uses competitive comparisons to establish what is considered the "basis for competition" or *BOC*. At Wireless Services, senior management examined each product line against supply chain performance attributes and decided on objectives for performance related to competition. Figure 23.2 shows the format of the product line BOC structure.

Performance Attribute	Performance vs. Competition					
	Product Line 1	Product Line 2	Product Line 3	Product Line 4	Product Line 5	Product Line 6
Reliability / Quality	◎	◎	◎	◎	◎	◎
Flexibility/ Responsiveness	◎	◎	◎	◎	◎	◎
Supply chain costs	●	●	●	●	○	○
Asset Utilization	○	○	○	○	○	○

Best in class ● Advantage ◎ Parity ○

FIGURE 23.2
Product line BOC at AT&T Wireless Services.

The figure depicts a methodology for setting supply chain performance targets. These, of course, should reflect corporate goals for competing effectively that recognize the differences from product to product. One can question if competitors represent an adequate benchmark, particularly if the industry is one that lags "best practice" as implemented in other industries. Selection of priorities should also depend on whether the product is "functional" or "innovative" as defined in Chapter 6. In the innovative supply chain, for example, flexibility and responsiveness will dominate cost categories. The opposite might occur in the case of the functional supply chain.

The next step at Level 1 was to benchmark performance in the performance areas against the industry. This includes the metrics shown in Table 23.2.

From benchmarking, Wireless Services management assessed that each of the performance metrics was either a "major opportunity" or a "disadvantage" in terms of competitive position. This created a large gap that had to be closed by supply chain redesign.

Figure 23.3 shows each performance attribute and the needed "distance" to reach the desired BOC level of performance. Such an analysis is the foundation for devising supply chain solutions. As Wireless Services put it in their presentation, the exercise "defined the business problem."

TABLE 23.2

Level 1 metrics for AT&T Wireless Services

Performance Attribute	Level 1 Metric
Reliability	Delivery performance to request (percent)
	Order fulfillment lead-time (days)
	Fill rate (percent)
	Perfect order fulfillment (percent)
Flexibility and responsiveness	Supply chain response time (days)
	Upside production flexibility (days)
Supply chain costs	Supply chain management cost (percent)
	Warranty cost as percent of revenue (percent)
	Value added per employee ($)
Assets/utilization	Total inventory days of supply (days)
	Cash-to-cash cycle time (days)
	Net asset turns (turns)

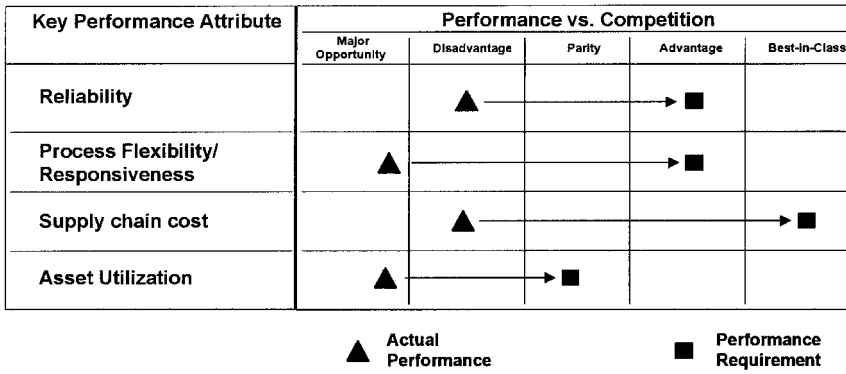


FIGURE 23.3
Wireless Services' need for supply chain improvement.

23.2.1.2 SCOR Level 2: Operations Analysis and Model

With a business objective, Wireless Services could turn its attention to a structured analysis of its supply chain. The supply chain at the time was typical of supply chains that grow without benefit of conscious design. Most products were produced by outside Pacific Rim companies — and there were many of these. These, in turn, were supplied by several hundred component suppliers, also in Pacific Rim countries. Products and raw materials entered the U.S. and were shipped to AT&T manufacturing plants in Mexico. From there, finished products went to distribution centers in the U.S. These distribution centers then shipped product to retailers and other OEMs who used Wireless Services' products.

Long sourcing lead times — over 200 days for some products — necessitated that Wireless Services forecast its needs, rather than build to actual demand. In fact, conformance to forecast production requirements was high.

Manufacturing was able to closely follow the scheduled product set for it by forecasts. However, with forecast errors running from 40 to 80% for different products, such performance was deemed "precise but not relevant" because the forecasts were so inaccurate.

From these findings, Wireless Services prepared a supply chain vision with the following elements:

- A demand-driven supply chain where product is built to order rather than forecast. This required shorter lead times and a simplified supply chain network.
- Product "platforms" using architectures based on common components. The proliferation of products from varied manufacturers with little overlap in "modules" caused inventory to proliferate and lead times to extend. The company's wireless products lent themselves to common modules for handsets, bases, radio modules, user interfaces, speakerphones, and power supplies.
- Combined manufacturing and distribution operations located in Mexico.
- Greatly reduced supplier base, strengthened partnerships with the chosen few that were selected, and the bringing in of final assembly into AT&T facilities.

With the building blocks of the new supply chain vision in place, Wireless Services could begin implementation.

23.2.1.3 SCOR Level 3: Performance Levels, Practices, and Systems Selection

Level 3 activity involved selection of enabling systems technology to achieve the goals of the supply chain reengineering project. Principal features called upon several of the applications, along with the corresponding process improvement, described in Chapter 22. The list below provides a summary.

- Real time available-to-promise (ATP) logic: Required integration with scheduling and inventory management processes and systems.
- Electronic order handling: Required integrated demand/deployment planning. Desired point of sale visibility and tracking of product movement along the supply chain.
- Ship complete orders: Treated each order line item as a separate order. Integrated each line item with inventory source and inventory status. Real time visibility over inventory status required.
- Handle 90% of orders on a first-in first-out basis: Systems needed for advanced planning and scheduling logic. The logic would consider supply chain constraints on costs and resources.

23.2.1.4 SCOR Level 4: Implementation

Implementation required a cross-functional effort. This was particularly true because effectiveness depended on redesign of products, not just improvement in physical flow. For this reason, a reengineering structure with broad representation was put in place. Figure 23.4 shows the eight initiatives addressed by the organization. Three were directed at product development; four were associated with the product production processes, and one integrated financial considerations.

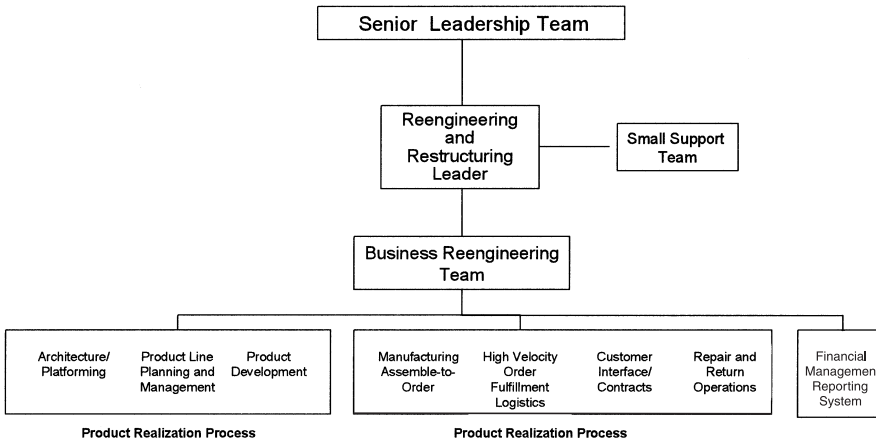


FIGURE 23.4
Organization Wireless Services' improvement effort.

Wireless Services enjoyed a 50% improvement in gross margins by the second year of implementation. This was accompanied by corresponding improvement in delivery performance, inventory reduction, and cash flow. Lessons learned by Wireless Services in their reengineering effort included the need for fact-based analysis, identification of strategic performance advantages, and involvement by senior management (what we refer to as *tmi* in Chapter 10). Another lesson is to work constantly at updating the value proposition, making benchmark measures, and refining the supply chain. This reduces the risk of being forced to repeat "massive" catch-up reengineering.

23.2.2 Mead Johnson Nutritionals (MJN)

MJN is almost 100 years old and sells nutritional products to infant, consumer, and medical markets. Brands include Enfamil, Pablum, Boost, and Sustacal. The company is the market leader in global infant formula market share, and has annual sales of about $2 billion. In 1967, the Bristol-Myers Squibb (BMS) Co. acquired the company.

BMS requires 15% annual growth and 5% productivity improvements annually. It was MJN's strategy to achieve its growth target through geographic expansion and new products. This required a supply chain design that could expand in step with sales. Achieving the productivity improvement target had become difficult as "low hanging fruit" was picked. Supply chain redesign was also seen as a path to achieving the productivity goal.

A survey of the supply chain at MJN led to the following conclusions:

- The supply chain pipeline was overloaded and unlikely to handle growth targets.
- There was no formal decision making or priority setting mechanism with regard to supply chain design.
- Metrics for supply chain performance were lacking.
- The supply chain was not viewed or managed as a process.

Findings like these are common in many companies, particularly those who have a traditional, functional point of view toward their operations. These findings led to three top-level recommendations addressing organization and measurements as part of an effort to improve the supply chain. The first was a "project approval committee" or PAC, as shown in Figure 23.5.

The PAC was responsible for coordinated projects for new-product development and supply chain improvement. Figure 23.5 reflects MJN's solution to the problem of organizing for supply chain improvement broached in Chapters 10 and 11. To aid growth objectives, supply chain and product-development initiatives were under common leadership. This structure makes SCM a company-wide rather than a functional effort.

The second recommendation was to use SCOR metrics to measure and manage global supply chain performance. In addition to those shown in Table 23.2, MJN tracked returns as a percentage of sales, product quality, and product cost. Another structure was established to report progress to the PAC.

The third recommendation was to treat SCM as a key cross-functional process. The organization and metrics established through the first two recommendation made this possible. Like AT&T Wireless Services, MJN used the BOC and benchmarking to assess where it stood with regard to current and desired performance. MJN also calculated the value of closing the gaps, an amount that approached $70 million.

The effort has helped assure that priority projects receive the resources needed for their implementation. The company is looking for both near- and longer-term improvements in their operations. They continue to stress the importance of senior-management support and persistence in pursuing improvements.

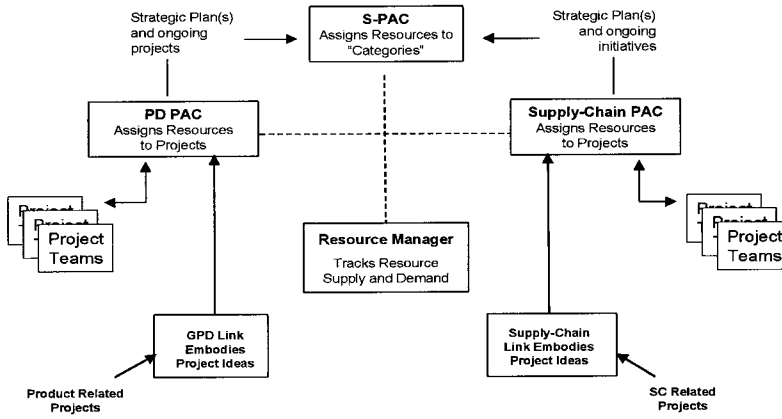


FIGURE 23.5
MJN project approval committee.

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24

Cost and the Supply Chain

Cost is a consequence.

Crispin Vincente-Brown, The Bourton Group

24.1 The Allure of Cost Reduction

Cost reduction never goes out of style. At the so-called "end of the day," cost savings sell projects to improve supply chains. As consultants, we point out the "soft" benefits of our solutions. But it's seldom that our clients won't want to know how much money they're going to save. Hardly any businessman or consumer doesn't want the "best bang for the buck." If there is any fault in this, it is that saving money often becomes the primary focus, pushing aside hard-to-measure benefits from strategic improvement. However, one reality is likely to remain. That is that the single best way to sell supply chain initiatives is to forecast positive cash flow from either operating expense reduction or increases in sales. Whether one achieves those forecasts is another point.

The harsh reality is that, if and when the results of supply chain initiatives are compared with their forecasts, many supply chain projects fall far short of objectives. In fact, some projects may even add cost. In this section — Chapters 24 through 29, we'll seek a better understanding of why this happens and what can be done to prevent it. These chapters address our last SCM skill task, "Removing cost from the supply chain."

This section highlights both "tried and true" and more recent models and concepts centered on reducing costs in the supply chain. Active company practitioners and consultants promote and practice many of the approaches described here, so these will probably be familiar to readers of this book. Often overlooked, however, is the emergence of supply chain management and the added "twist" it brings. Our revisiting of these techniques will add a supply chain context. We expect that many approaches will gain new life or be done in different ways as competition between supply chains heats up.

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There are many cost reduction approaches that management jumps to when looking for improvement in the bottom line. A popular target is cost-cutting leading to reduced head counts, or "full-time equivalents." Another is extracting short-term concessions from suppliers. Others try to improve performance by filling their factories to absorb overhead. Always popular are perennial efforts to slash inventory, or similar campaigns for quick-hit returns based on a target cost category. We want to discuss ways to make operations *both* more cost effective and strategically valuable. Broad benefits should include two or more of the following:

- The traditional target of cost reduction: reducing resources in terms of staff, capital requirements in the form of working capital or fixed assets, or material cost
- Getting more production from existing resources, effectively boosting output and lowering per unit cost
- Reducing the time, not just the cost, to produce a product or service
- Building processes that support strategic plans

We have asserted that constant improvement along all these dimensions is the price of staying in business. There are few companies exempt from the imperative to lower costs. If you are dealing in markets where buyers are totally price driven, any expense reduction keeps you competitive, even if your innovations are rapidly copied.

We return to our model of supply chain projects, repeated here as Figure 24.1. The model contains categories for projects at the function, or department, level, the business unit level, and the supply chain level. Projects are either strategic or nonstrategic, depending on whether they will change the basis for competing. A project that merely keeps you even with respect to competitors is not, in our view, strategic.

Most cost reduction efforts lie in the lower left-hand box that is shaded in Figure 24.1. That is, the supply chain projects are conducted at the local level for purely tactical reasons. Sorting strategic and nonstrategic cost reduction projects when they are proposed will yield more from scarce resources expended in implementing improvements. Any manager faced with a choice of improvement projects should understand the potential for strategic enhancements. This is an important SCM skill. In this chapter, we describe methods for making this evaluation.

24.2 Are Cost Reductions Strategic?

This is an important question. It's another way of asking, "Can a company save its way to prosperity?" There are differences among strategic thinkers

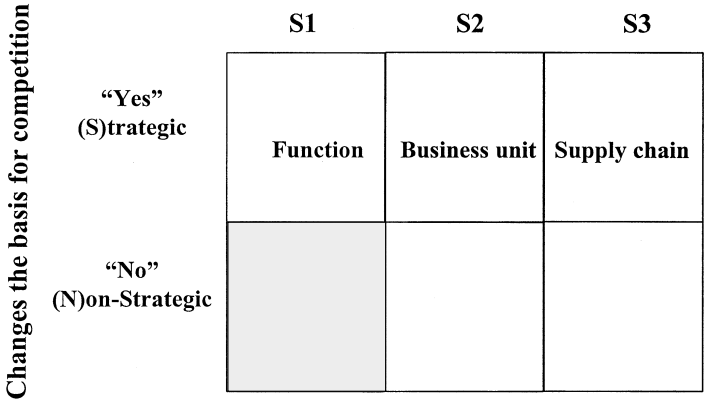


FIGURE 24.1
Model for competing through SCM.

on this issue. One side views cost reduction as "necessary but not sufficient" in achieving strategic advantage. In this view, word of successful cost reduction technology spreads fast, abetted by consultants, software developers and integrators, and other purveyors of the solution.

In this view, competitive position depends on product innovation and being distinctive in the competitive field, in some ways different from — not like — everybody else. We asserted earlier that the supply chain has become an important opportunity to establish that difference. Other models contend that being the low-cost producer equates to market leadership. The next section summarizes the opposing viewpoints.

24.2.1 Conflicting Viewpoints

Michael Porter maintains that "operating effectiveness," which he shortens to *OE,* will not lead to a sustainable competitive position. [1] Porter believes many companies have lost sight of the need for strategies through their pursuit of operating improvement and cost reduction. He backs the view that operating efficiencies are easily transported across company boundaries. His assertion is that "activity systems," which are hard to duplicate, are the root of competitive advantage. Our case of Acme in Chapter 7 illustrates this approach.

Our earlier reference to Robert in Chapter 4 supports Porter's perspective.[2] Continuous improvement and cost cutting, according to Robert, is a necessity. Companies must brutally lower their costs and improve their quality all the time. But he supports the Porter view that long-lasting competitiveness builds on somehow being different.

Other views support the case for cost reduction. In the 1970s, the Boston Consulting Group (BCG) encouraged its clients to lower their costs through the "experience curve." This framework was based on "learning curves" experienced in manufacturing. It was observed that production costs for products like aircraft and electronic components declined as accumulated production volume rose. Thus, the competitor with the greatest market share will have the greatest accumulated volume, hence the most "experience." It will have the lowest cost because it can put its experience to work to achieve economies.

Therefore, BCG advised, a strategic goal should be high market share leading to volume production leading to cost reduction. This, of course, assumes that the company can apply lessons learned from its accumulated experience wisely. The model is seen by some to have under-recognized the growth of market segmentation, with tailored products and different ways of thinking about and measuring market share.

Earlier in Chapter 6 we also discussed the differences between functional and innovative products.[3] Fisher contends that the supply chains for functional products have to be *efficient*. So cost is a dominant feature and determinant of supply chain design. On the other hand, supply chains for innovative products have to be *responsive*. The emphasis is on making high-profit products available to the market.

From this framework, one could conclude that cost reductions for the innovative supply chain are not necessarily strategic, while those for functional products are. Fisher points out, in fact, that hacking cost and inventory from a supply chain full of innovative products can be counter-productive. We also believe that an innovative supply chain can make a functional product innovative. Starbucks and Dell Computer are examples.

24.2.2 Strategic or Not Strategic?

Despite the differences noted above, no one argues that well-designed and -executed cost-reduction projects are not good for business. However, in making choices of which projects to pursue, strategic contribution should be kept in mind. Too often, we judge projects that reduce costs solely on the cost reductions they might achieve. In these cases, the most critical question asked is, "Will it help me make my budget?" The decision is driven by financial measures every manager in a key position must meet.

This is often unfortunate. The decision-maker should formally consider strategic contributions from any cost-reduction project. This judgment should determine whether the project is "above the line" in our model shown as Figure 24.1 — that is, strategic — or below the line — nonstrategic.

An example will illustrate the point. Our fastener company introduced in Chapter 7, Acme, has designed three cost-reduction projects. The projects coded "A," "B," and "C," have been presented for funding review. However, staffing and money limits dictate that only one of the projects can go forward.

Each project has been analyzed in some detail, per Acme's procedure. Acme managers have prepared short profiles for each project.

The analysis covers the pre-tax cash flows and return on investment (ROI) from each project. Policy dictates that projects exceed a 15% "hurdle" rate, Acme's "cost of capital." The corporate finance department calculates the hurdle rate using a weighted average of the cost of financing Acme's business.

Although it has never been required in the past, Acme's president has asked for an assessment of strategic contribution from each project. The manufacturing director has prepared the analysis of project A. The engineering director prepared the project B analysis. The marketing manager prepared the analysis of project C. A notation in the description of each project categorizes them. Table 24.1 summarizes the result.

TABLE 24.1

Acme's Cost Reduction Projects

	Description	Financial	Strategic Contribution
A	Numerical Control (NC) machine (S1 project))	Investment: $600,000 Eliminates two operators for direct labor savings of $300,000 including overhead. 40% pre-tax ROI for five-year life.	None identified. Similar machines are in wide use in the industry.
B	Prototyping line (S2 project)	Investment: $400,000 Saves time of engineers desiring test runs of new products. Estimated savings: $100,000 of indirect salary expense. 10% pre-tax ROI for a five-year life.	Not quantified. Could help get products to market faster.
C	Rapid response center for distributor channel (S3 project)	Investment: $1,500,000 Negative ROI. Adds inventory and requires capital investment. Minimal savings — perhaps $50,000 from the use of new equipment.	Hard to estimate. Could increase market share in fast-growing segment. May be able to increase prices in exchange for fast turnaround.

Note that, as one progresses from project to project, the three proposed investment projects get vaguer in terms of the risks and rewards for both financial and strategic impact. The attractive return promised by project A looks pretty good when compared with projects B and C. It also seems to be the best supported and therefore less risky in case of an audit after implementation. Apparently, it also meets Alpha's ROI threshold of 15%.

Mapping the three projects in terms of strategic contribution will clarify their contributions. Figure 24.2 maps Acme's projects to our competition model. "A" has the largest return on investment (ROI) of the three — at least as it's depicted in the profile above. However, the project's impact is limited to a single function, so it appears in the S1 category. According to the profile, it is deemed to offer little in the way of strategic advantage.

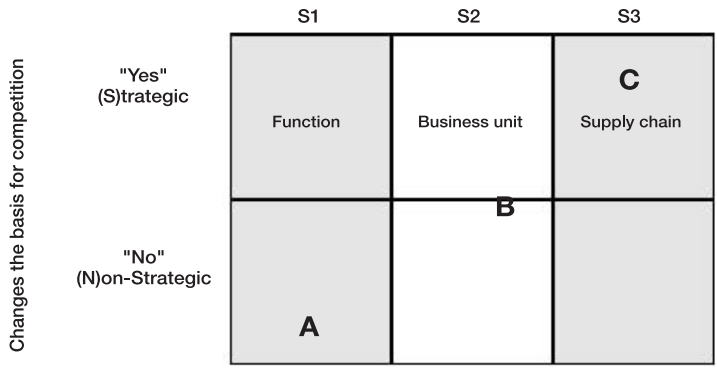


FIGURE 24.2
Mapping Acme's projects to competition model.

Project B is a cost-reduction effort directed at several departments, so it's an S2 project. The departments include engineering, manufacturing, and procurement. Project B offers some strategic advantages but not enough to be classified as a strategic project by Acme's management. Its ROI pencils out far less than A's. In fact, at 10%, it's below Acme's hurdle rate required for approval.

Project "C" is a supply chain project (S3) and is considered strategic. However, it doesn't offer the ROI that either A or B offers. In fact, Acme has difficulty forecasting the financial benefits from Project C. Acme management feels it will be hard to explain to its board of directors, which must approve the request. If these Acme approvers reject hard-to-measure savings, project "C" is doomed.

In many companies, project A would be the overwhelming choice. No doubt, it has a strong functional advocate in the manufacturing director. It requires less coordination, so it will be easier to implement — making fewer demands on top management. As an added incentive, the machine tool manufacturer, looking to make a large sale, is offering all forms of "free" assistance in implementing the technology.

Project B, on the other hand, must be orchestrated between departments, and one department or the other might bog down in the implementation of the project. This can increase the effort required by senior managers. Project A must be orchestrated along the supply chain, and some distributors may not participate or see value in the program. So there is more real implementation hassle and risk.

A number of factors will enter into situations like Alpha's. The conditions we just described are common. Instead of focusing entirely on the cost-reduction benefit, an equivalent amount of time should be spent on strategic con-

tributions. This avoids the trap we described at the beginning of this chapter — having all cost-reduction projects settle into the lower left-hand corner, as shown in Figure 24.1. Such an analysis might also point to additional areas for financial benefits.

For too many companies, a traditional discounted cash flow (DCF) procedure guides investment decisions. "Strategic thinking" doesn't enter in. The DCF approach has had its place — particularly in evaluating single-function, relatively isolated projects. But supply chains make this approach less viable as the only basis for capital budgeting. The need exists to find benefits at higher and more abstract levels, particularly those that will improve the competitive position of the chain. Often, costs at this level will not be apparent. To uncover these areas of hidden cost, we begin by listing what we believe to be the root causes for waste and unnecessary cost in the supply chain.

24.3 Root Causes for Cost

What does SCM demand of the art and science of cost management that doesn't already exist? The first, and most obvious change, is that cost reduction in SCM has moved beyond the single department or company. It's no longer good business to limit oneself to one's own company for cost-saving opportunities. It is also, in all probability, relatively ineffective. Models like DaimlerChrysler's Extended Enterprise (Chapter 20) will become more common.

Usually, the cost in one company is influenced as much by others in the supply chain as it is by its own operations. Crispin Vincenti-Brown of The Bourton Group represents the situation well when he states "cost is a consequence." In other words, look at costs as a signal of a root cause, not a root cause in themselves. When it comes to costs in the supply chain, ask "why" several times. That process leads to one of several root causes that stand in the way of controlling or reducing supply chain costs.

Our experience shows that root causes for excessive costs likely lie in one of the five categories described in the following sections. Subsequent chapters will address each.

24.3.1 Lack of Clarity

Over time, mature operations evolve without benefit of conscience redesign. The form taken is one of narrow, functional departments each with its own set of priorities, projects, and habits. Cost-accounting systems, supposedly designed to elucidate what's going on, contribute to the confusion. Rather than providing insights into operating health, they are designed around requirements for financial reporting. Departments become "cost centers" to

be measured and managed. The proverbial "trees" obscure the "forest." Managers held accountable for these budgets lose sight of the big picture.

The problem compounds in the face of the supply chain challenge. Whoever heard of a P&L for a supply chain? Isn't it logical that supply chain management will shift attention from the individual enterprise to the supply chain, a multicompany enterprise? How will this evolve? How much detail is needed? Management deals with what it can see. Often this includes only budget figures or the prices paid for material to keep things running, so department budgets come under scrutiny, with ever tightening goals for "improvement."

Suppliers in turn are on the hook for continuous cost reductions. In some large companies, this takes the form of an annual ritual. Each year, the buyer hands the supplier account manager a slip of paper. On the paper is a number — the percentage of reduction in price required to do business for another year. At most, these are incremental steps, amounting — if one is lucky — to a few percentage points improvement a year. This is sufficient to keep everyone happy. For supply chains to work effectively, this method of operating must change radically.

Another cause for cost obscurity is the nature of different types of cost. Increasingly, our organizations are built on knowledge, rather than direct, physical outputs. Nowhere is this truer than in the service organization where there is almost no physical output at all. In the era of high technology, even the manufacturer's product is as much knowledge, in the form of design and technical content, as it is physical product. The need for clarity is especially important in reducing the costs of production support, administrative, technical, and professional work groups.

To effectively control costs in most supply chains, we must raise the visibility of costs. Alternative forms of accounting and reporting are needed. We'll cover this topic in Chapter 25 from two viewpoints. The first is presentation of costs in a way that illuminates rather than obscures. The second is matching the cost type and the appropriate solution for gaining reductions.

24.3.2 Variability

Variability comes in many forms. It includes fluctuations in the amount of work and inconsistency in performing individual operations. An operation that becomes subject to extreme workload changes will likely have poor execution of individual operations from a variety of causes. An example is the need to do things in a hurry and having to throw untrained staff at the task. Having to deal with volume fluctuation also adds extra operating expense, capacity investment, and inventory.

Companies no longer can afford this habit if they want to compete effectively in the supply chain world. What if supply chain partners have different production cycles? Will they whipsaw each other? Will one partner pass on his stop-and-go behavior to others — amplifying the swings all along the

chain? Sound management calls for ironing out fluctuations, at least those of a self-imposed nature. Later, in Chapter 26, we'll discuss ways this can be done in the supply chain.

Variability in processes is targeted by measures to assure "process capability." Our DaimlerChrysler example (Chapter 20) describes how a major automotive company addresses this source of variability. We'll expand on that example in Chapter 26 to describe the need for processes capable of consistent output at any level of production volume.

24.3.3 Product Design

It's no secret that product designers heavily influence life-cycle costs for their products. The ability to control cost declines sharply once the design has taken shape. However, management processes in many companies ignore this simple fact of life. In the rush to market, they fall short in considering product cost and material availability in advance of introduction. This is especially important in new technology products or products requiring infrastructure investment in the form of new plants and production equipment.

An extreme example has been the U.S. defense industry. Product functionality has traditionally reigned supreme over the cost of the weapon system. As one might expect, this has led to highly capable, but very costly, weaponry. Because new weapon programs have been governed by "cost plus" contracts, there has been little discipline over this process. In fact, the way profits are calculated, higher cost means higher profits in many cases.

In an attempt to deal with this irony, the Department of Defense introduced "cost-as-an-independent-variable" (CAIV). This mouthful, developed by the "math-centric" defense engineering community, means cost is a design criterion on a par with technical capability. Under CAIV, a high-performing, but over-cost, system no longer meets the specification.

More and more companies team in developing new products. Several companies provide important components. If any falters, the entire development project is subject to delays. Such delays may mean a competitor blazes the trail into the market and months, or even years, of profitable sales are lost. Many a new product has been held up or rendered unmarketable by excessive costs or absence of key components. Even if recovery is feasible, nothing can drive up cost as much as a hurried push to acquire vital components.

In Chapter 27, we'll describe techniques for both product or process development that reduce cost and pain once the technology is introduced.

24.3.4 Information Sharing

Information barriers abound both within any one company and along the supply chain. There are a variety of causes ranging from incompatible systems to no systems at all. We addressed systems and information management from a more technical viewpoint in Chapters 21 through 23. The lack of

supporting procedures and systems creates "friction" that slows movement through the supply chain, leading to unnecessary transaction and coordination costs. These are seldom visible and can have many causes that can be resolved with better planning and process design.

In Chapter 28, we describe approaches that use technology to reduce costs through better information sharing. The technology needed for that sharing, for the purpose of this section, is secondary. In fact, much of the software and hardware needed may be in place already.

24.3.5 Weak Links

The term *supply chain* means there are links between companies adding value to a common end product. No two links will be equally capable of performing their roles in the chain. Nor should they be. But the chain needs to protect itself from its "weak links." This doesn't necessarily mean eliminating the link. It does mean, however, managing the risk to protect supply chain partners from the consequences of weak-link shortcomings and outright failures. Weak links can include any of the supply chain components: physical, information, monetary, or knowledge flow. It can be a failure in the quality of the item or its means of passing from one partner to another. The source of weakness can be confined to one partner or be spread across the chain.

A good example is the impact just-in-time supply chains have on a production system. Automotive assembly lines can grind to a halt if even a minor supplier has a production interruption. The situation is not confined to just-in-time situations. It's not uncommon for top-level operations managers to patrol their storerooms with shortage lists in hand — even with several months' inventory in the warehouse! They are the victims of weak links either in their supplier base, their ability to stay in touch with that supplier base, or in their own abilities to understand and cover their needs.

Such failures from weak links won't always announce themselves in dramatic fashion so they are immediately obvious. Small changes like late deliveries and stock outs may signal a slowly evolving breakdown somewhere. What is only irritating today can lead to greater problems tomorrow. Without preventive measures, all in the chain will suffer.

Innovations in information systems have brought ever more sophisticated ways to establish links within our organizations. A contradiction arises when managing a supply chain. *Sophisticated* may not be the right approach; *simpler* may in fact be better. Many supply chains are ponderous "beasts" that, while strong competitors overall, aren't agile enough to be fine tuned. Therefore, we need to have simpler ways to maintain communications along the supply chain.

24.3.6 Unintended Consequences

There are a number of traps in this category called "unintended consequences." These refer to well-intentioned, but misguided, efforts at cost reduction and other forms of operations improvement. An example is "flavor of the month" initiatives. For example, when total quality management (TQM) was topical, training programs and TQM teams flourished. Some organizations used the number of teams in action as the measure of TQM effectiveness.

One area where unintended consequences proliferate is in purchasing. We spoke in an earlier section on partnerships about the "purchasing mentality." This paradigm looks to price as the cornerstone of supplier selection. It's hard to argue, at least on the surface, with using price to make decisions on suppliers. However, having to compete and share business with others, paradoxically, adds uncertainty and reduces incentives to work hard at lowering cost. One has to balance the need for *lowest price* against the need for *lowest cost*. The difference is that *lowest price* as bid against others may not result in the *lowest cost*, because the low bid comes with unseen costs like quality and delivery problems — and an unwillingness to work to lower overall costs.

The consequence is higher cost in many forms. Table 24.2 lists examples of unintended consequences. They show how both buying and selling companies are affected.

TABLE 24.2

Examples of Unintended Consequences

In the Buying Company	In the Selling Company
Increased purchasing overhead	Unwillingness to make capital investments.
Added complexity to systems and procedures, unnecessary transactions	Reduced customer service
Difficulty in isolating problems	Lower priority in production planning

The principal effect on the buying company is added administration for every dollar purchased. This is incurred in the belief that it reduces the cost of material itself. On the other side, the selling company will hesitate to make the commitments needed for long-term market success. We don't think that "sole source" is the right path for every material requirement. But companies should have some method to make the trade-offs necessary to find the right mix.

Another unintended consequence is illustrated by Alpha's choice of investment projects. Alpha, by virtue of its project selection process, is likely to pick project "A." That project shows a good return on investment, has a strong advocacy, and represents the "path of least resistance" for management. But it has the risk of providing only minor improvement — in spite of all the safeguards put in place to protect the corporate pocketbook.

A more insidious consequence comes from a lack of understanding of so-called "solutions" promoted to improve the supply chain. Examples are big-

ticket ERP applications and investments in production technologies like Alpha's project "A." These misunderstandings take the form of "disconnects" between the root cause of the cost and underlying solution. So management "mis-invests" in a solution that doesn't fit the problem. A good example of this comes from the "theory of constraints" framework described later. This framework states that bottlenecks govern the capacity of the factory, or by extension, the supply chain. Investment in non-bottleneck operations, according to the theory, is wasted. Yet few consider this when contemplating investments.

A supply chain can protect itself from the consequences of unintended circumstances by the way it manages its portfolio of improvement initiatives. This list of root causes says that saving money has less to do with accounting or work ethic in the work force or budgeting and more about the issues we've listed. Most, if not all, are in the purview of management. Doing a better job at supply chain tasks will address these causes. We'll explain how in this section, starting with our first root cause, that of the need for clarity.

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25

Root Cause — Clarity

> Activity-based costing is a form of language that has been developed to describe certain laws of nature: the laws of nature that relate to cost behavior. If the language becomes obsolete, the laws of nature will not change.
>
> **Douglas T. Hicks**

25.1 Introduction

This chapter addresses "clarity" as a root cause for under-performing supply chains. By clarity, we are principally talking about costs and related measures of performance. Measuring costs in complex organizations has become a challenge for many. When it comes to the supply chain, problems only compound. The obscurity of costs that exists at the company level only worsens when gauging how costs are spread among supply chain partners. This chapter describes the role we see for applying the principles of activity-based costing in supply chains. As Doug Hicks notes, ABC is our best choice for capturing the "laws of nature."

Also, long standing habits that demand hard negotiations are likely to persist. So openness is not necessarily the norm. However, understanding costs and the limitations of current ways of reporting them is an important SCM skill. In this chapter, we explore potential solutions and how they apply to supply chains. Decisions might include some of the following:

- Measuring the cost of a new product that's jointly developed by several companies.
- Performing "make or buy" decisions to determine functions that might be outsourced.
- Deciding fair transfer prices for products and services along the chain.
- Assuring that profits cover capital investments

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We begin with descriptions of cost concepts that examine the ways organizations track "costs." Surprisingly, the idea of a "cost" is not so straightforward as it first appears. To an accountant it is rather black and white. A cost is what you pay for something. The accounting system does a pretty good job of capturing what we pay for things, often in considerable detail. A company focused on cost gains a reputation for running its business "by the numbers." This implies a simple, and often naïve, approach lacking in a basic understanding of the root causes of costs. The result is often the unintended consequences described at the end of Chapter 24.

One needs to understand how a set of numbers has originated. So we dedicate space here to a review of the basics. The understanding includes not only the timing of the numbers and its effect on our ability to take effective action but also knowing what's behind the numbers and what we can learn from them about root causes of cost in the supply chain. This chapter describes tools for using cost information to uncover these root causes.

We also provide a case study involving a cost-driven research and development effort that addresses cost accounting in multi-company environment. This is in the belief that such an approach will be increasingly important to partners "marrying up" in supply chains.

Because it's easy to get lost, we've prepared a map, Figure 25.1, which extends from where we are now to where we need to be in terms of SCM cost management. A group of companies needing visibility over supply chain costs is likely to make a full or partial trip along this progression. If they begin in the lower left corner, ideally they'll finish in the upper right — by one path or another.

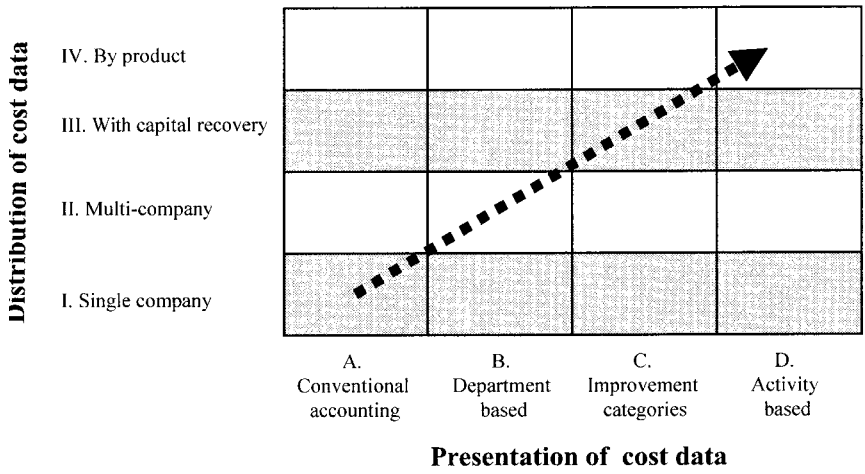


FIGURE 25.1
Pathway to effective supply chain cost measurement.

The x-dimension along the bottom of Figure 25.1 traces the evolution we would like to see in terms of the presentation of financial data. From conventional accounting at the company level, it can next be broken down by departments. This is probably not difficult, since the company information is often aggregated from department budgets. We suggest the progression in cost presentation move next to what we will describe later as "improvement categories." Conventional accounting formats are sterile with regard to categorization of costs with an eye to reducing them. Finally, activity-based costs provide a process view of costs.

The y-dimension in Figure 25.1 reflects different levels of information distribution along the supply chain. Single-company data (level I) becomes multi-company (level II) when two or more partners decide it's in their best interest to share data. At level III, these companies adopt common policies regarding capital costs and their recovery. For reasons explained later, capital recovery can be a vexing issue. Despite the complexities involved, many boards of directors now focus on what has been a neglected area. At the final stage, cost drivers are applied to activity-based costs to develop supply chain product costs. These costs can now be applied all along the supply chain to make strategic product line decisions.

Most companies will begin in the lower left-hand corner of Figure 25.1 (position IA). They use their financial reporting system to make decisions about supply chain improvements. That information is confined to the company. All that's known about supply chain costs is what the company pays for the things it buys or the prices it gets for its products. Detailed cost information is not shared among supply chain "partners." In fact, partnering is primitive and can usually be characterized as conventional arm's-length contracting. From here, we'll describe how this progression might occur by describing some of the techniques of cost management and pitfalls in collecting and using cost data.

25.2 Company Cost Structures

To aid this discussion, we'll call on three manufacturing companies that compose a supply chain and that have very different cost structures. The companies' names are *Old Line, High Tech, and Process.* We'll look at them first as individual companies and later as a supply chain.

25.2.1 The Starting Point (A)

The base state in our framework for stages of cost management begins in the lower left-hand corner. A traditional income statement designed for financial reporting is likely to use categories like those shown in Table 25.1. This financial statement is usually collected at the "business unit" level. This is where accountability for the "bottom line" rests in the organization. Most of the organization is composed of cost centers, which are budgeted

annually. Within the income statement, many costs are allocated. As such, they are no longer associated with processes. Accounting standards allow discretion in reporting, so policies on cost measurement vary from organization to organization.

TABLE 25.1

Traditional Cost Accounting Categories

	Net sales	The revenue of the company adjusted for bad debt, returns, and so forth.
Less:	**Cost of goods sold**	Costs of those sales including employees, materials, depreciation, other overhead, and fixed costs. (This cost is passed on to inventory.)
Equals:	**Gross profit (or margin)**	The money made on the primary line of business.
Less:	**Selling and administrative**	Support functions required to oversee the business.
Less:	**Research & development**	Expenditures on new products or processes.
Less:	**Interest expense**	The cost of debt to finance the business.
Equals:	**Earnings before income taxes**	The money made before taxes.
Less:	**Taxes**	Taxes paid.
Equals:	**Net earnings**	The money made after taxes are deducted. Also, the return on shareholders' investment.

While useful for evaluating financial performance, this format is wanting when it comes to supply chain management. SCM will require a more operational way to account for costs. The purpose is twofold. The first is to provide "comparability" among supply chain partners as data is collected at different levels. The second purpose is to direct the attention of managers to improvement opportunities. With this said, there is no "right" way to achieve these ends. However, we do see that there will be a progression like that shown in Figure 25.1.

25.2.2 Department Costs (B)

An appropriate next step is to separate and display costs according to departments or cost centers. We refer to this level as the "department" level (Column B) in Figure 25.1. This serves two purposes. First, it enables one to discard data that doesn't apply to the supply chain. For example, the cost of the legal department may have little bearing on supply chain operations. If so, it would probably fall outside the scope of SCM. It can be dropped from further consideration — at least in the context of supply chain improvement.

The second purpose is to remove the "allocations." An allocation occurs when the cost of one department is assigned to another. Accountants also say these costs are "absorbed" when they are allocated. This process roughly assigns overhead, or *indirect*, costs to users in *direct* functions, the operations that add value to the product. In a manufacturing company, for example, the cost of toolmakers may be allocated to a direct cost production department where the tools are used. In a bank, information services costs may be allocated to user departments like the operations departments at branches and the loan-making units. Clarity, as we're defining it here, is lost when allocations are made. We want as many raw numbers as we can get without accounting shortcuts and assigned costs. In this way, we can better see what we are paying for each supply chain activity.

25.2.3 Improvement Categories (C)

Having generated department-level numbers, we gain added insights. However, if we are out to improve an existing supply chain or build a new one, there is an additional step that will be helpful. It involves establishing categories for costs and assigning department level costs to these categories (column C in Figure 25.1). Table 25.2 shows one categorization we've found helpful. Its principal utility is as an aid in matching cost-reduction solutions to the nature of the cost. For example, solutions for direct factory labor are different from those applied to technical and professional groups.

TABLE 25.2

Improvement Categories

Work force costs:	
Factory direct labor	Labor that "touches" the product. Usually has assigned work measurement standards.
Factory indirect labor	Labor that doesn't have a work measurement standard but supports the direct labor component.
Clerical/administrative/sales	Secretaries, accounting staff, receptionists, clerks, and sales administration.
Technical/professional	Design engineers, system engineers, procurement staff, "white collar" functions.
Fixed costs	Annualized costs of capacity — generally plant and equipment. Other fixed expenses.
Purchased item costs:	
Services	Accounting, consulting, and engineering support.
Subcontracted material	Material made to the company's specification. This category is normally susceptible to cost reduction.
Commodity material	Material bought by many companies. There is normally a "market" price for commodity material. Not considered susceptible to cost reduction.

We can illustrate this with an example. Table 25.3 shows the percentage of cost in the eight categories for our three case study companies, *Old Line, High*

Tech, and *Process*. Table 25.3 shows the result of assigning costs to categories for our three example companies. Department managers, assisted by observations and data collection, can often divide costs into these categories without too much effort. When they have to be made, estimates are adequate for our purposes.

TABLE 25.3

Cost Categories in Supply Chain Companies

	Process	Old Line	High Tech
Work force costs:			
Factory direct labor	5	25	5
Factory indirect labor	5	15	5
Clerical/administrative/sales	10	15	15
Technical/professional	10	5	20
Fixed costs	40	10	10
Total internal costs:	70	70	55
Purchased item costs:			
Services	0	0	5
Subcontracted material	0	10	30
Commodity material	30	20	10

We'll refer to these definitions and these three companies in the sections that follow. Another useful step at this time is determining if costs are fixed or variable. The next section describes the importance of making this distinction.

25.2.4 Allocated Costs — Roadblock to Clarity

The use of allocations was one reason the conventional accounting statement was wanting. Accounting systems use allocations as shortcuts to assure that the costs of production are fully "absorbed." Most of the allocated costs fall into the category of *indirect* cost and become part of the "cost of goods sold" as shown in Table 25.2. *Direct* costs are those that, in a manufacturing company, are part of the bill of material and are based on standards for labor and material. These direct costs are the "base" for the allocation, and the indirect costs are assigned in proportion to the base.

The arbitrariness of this practice wasn't always as great as it is today. In the early years of the 20th century, when current methods of cost accounting took shape, direct labor contributed heavily to manufacturing costs. There was little in the way of overhead to support these functions. The result was far less distortion from allocations. Today, factories are much less dependent on direct labor. So much more of a company's cost is allocated using these rules.

We can illustrate the effect of cost allocation with the case of *Old Line.* Refer to Table 25.4. If this company is typical, factory direct labor is the base for allocating other internal costs. This could include factory indirect, much of

the clerical cost, some of the technical/professional category, and all the fixed cost. For this example, we'll assume all are allocated as overhead costs.

TABLE 25.4

Old Line's Cost Structure

	Old Line
Work force costs:	
Factory direct labor	25
Factory indirect labor	15
Clerical/administrative/sales	15
Technical/professional	5
Fixed costs	10
Purchased item costs:	
Services	0
Subcontracted material	10
Commodity material	20

Accounting procedure takes these costs, amounting to 45% of all costs, and divides them by direct labor to produce an *overhead rate*. In this case, the overhead rate is (45/25) x 100% = 180%. Thus, for each direct labor dollar incurred, an additional $1.80 would be charged, for a total of $2.80. This illustrates *absorption* accounting. This is because the direct cost in the form of labor has "absorbed" the indirect cost.

Absorbed cost was the figure Acme used to justify its project "A" in our example Chapter 24. In that case, their direct labor cost for estimating savings was "burdened" with the accounting-assigned overhead. Acme estimated project A would generate $300,000 in annual savings. But this figure had overhead attached. The actual savings could have been closer to the direct labor at the base — perhaps as little as $100,000. We see this frequently in companies when they invest in sophisticated, automated technology. The result is that savings in direct labor are overestimated while additional unseen overhead costs to maintain the technology actually aren't included at all.

This process of calculating costs gets companies into trouble in implementing supply chain improvements. Like Acme, they'll base the feasibility of a labor-saving project in the factory or warehouse on $2.80, not $1.00, of savings. This could be in error by a factor of almost three! In *High Tech* and *Process,* the situation is more extreme. *Process* is capital-intensive; *High Tech* is information-intensive. There, each $1 of direct labor could absorb up to $5 of overhead. In these companies, direct labor costs $6 with the cost allocations we described for *Old Line* in place. And this is not an unusual situation.

This method of accounting contributes to the fact that many companies have tended to concentrate cost-reduction efforts on direct labor. Accounting procedures lead them to believe "that's where the money is." The result is cost-cutting departments like industrial engineering troll for savings on the shop floor with little corresponding effort in capital asset utilization, support, administrative, and technical functions. This is one example that shows why

we find the recommended categories shown in Table 25.2 are helpful in reducing supply chain costs.

25.2.5 Direct Cost versus Absorption Accounting

The fact that absorption accounting distorts financial decision-making has long been known. For this reason, many managers advocate a *direct costing* approach. Another term, perhaps more descriptive, is *variable* costing. In direct costing, variable components of assigned costs are separated from fixed components. That is, those costs that vary directly with sales should be recognized as sales occur. Those that are fixed should be period costs, charged during the accounting period, and not put into inventory. In absorption costing, these fixed costs are placed into inventory at the time of production, deferring the charge. For reasons we describe later, this can cause unintended consequences in the supply chain. We again rely on *Old Line* to illustrate.

From Table 25.5, we see that direct costing brings a dramatic change to *Old Line's* books. Under absorption accounting, all the internal costs are transferred to inventory when products are manufactured (70%) along with the cost of direct material. There is no immediate penalty for producing unneeded products; the costs that are transferred aren't costs any more but "assets." This encourages managers to build unsold inventory to absorb costs.

TABLE 25.5

Separation of Old Line's Costs into Variable and Fixed Components

	Old Line	Variable	Fixed
Work force costs:			
Factory direct labor	25	20	5
Factory indirect labor	15	5	10
Clerical/administrative/sales	15	0	15
Technical/professional	5	0	5
Fixed costs:	10	0	10
Total internal costs:	**70**	**25**	**45**
Purchased item costs:			
Services	0	0	0
Subcontracted material	10	10	
Commodity material	20	15	5
Total	**100**	**50**	**50**

Under direct costing, only about a third would be placed in inventory (25%). The fixed costs are charged to the income statement immediately (45%). Note that making an item for inventory requires the company to lay out cold, hard cash for direct material (25%). This expenditure is at risk if

demand for the production doesn't materialize. If production is deferred, the direct material is "saved" until it is actually needed by the market.

Direct costs also approximate the "marginal" cost incurred by producing one more unit. This has important implications for decisions regarding pricing. A case illustrates the point. The general manager of a housewares company, a former accountant, was faced with a dilemma. His best customer at the time, Sears, had offered a deal that made him uncomfortable. Sears wanted to buy a large quantity of his highest-volume product, a step stool useful for cleaning high shelves and changing overhead light bulbs. But his accounting system was telling him he would lose money if he took the deal. Here are the numbers he faced:

Fully absorbed cost	$10
Sears' offer	$8
Marginal cost	$5

Since the step stool was the highest-volume product in the plant, the organization had become quite proficient in producing it. But the overhead rate was full of costs for inefficiencies from making lower-volume products. In effect, the efficient step stool production subsidized the inefficient products. Actual variable costs for the step stool were $5. With fully absorbed costs, the client would seem to lose $2 on every unit. In direct costing, he would put $3 in his pocket. He refused Sears'offer.

No company, or supply chain for that matter, will stay in business if it just covers direct costs. They must recover fixed costs as well. But awareness of direct costing and its impact on behavior is important to supply chain decisions on pricing and investments. A decision to participate as a supply chain partner should consider direct costs and contribution to profit. In our Acme case study (Chapter 7), the company chose to focus on high contribution, as opposed to high contribution margin, business as part of its strategy. If our housewares executive had followed the same path, the company would have taken the Sears offer.

Absorption costing is a contributing factor to packing work into production schedules near the end of accounting periods. If management believes they'll be short of their goals, they may make more "stuff," betting that it can be sold at some point. Fixed costs will be absorbed, and reported profit will improve for that period. They can worry later if the stuff they make doesn't sell. We point this out for an important reason. If a link in the supply chain is prone to this behavior, particularly if it's in a leading role, a dysfunctional supply chain will result. Each supply chain member will have to determine whether it is willing to be ruled by what is best for the long-term benefit of the supply chain. We'll return to this topic in our discussion of variability as a root cause for supply chain cost in Chapter 26.

25.3 Activity-Based Cost

An important tool in supply chain design and measurement will be activity-based costing, or ABC for short. This is located in column D on our progression grid in Figure 25.1. Another term applied to this approach is activity-based management (ABM). The emphasis added by "ABM" is a focus on using activity cost for process improvement through reengineering and quality measures. In this discussion, we'll retain the original acronym, *ABC*. We devote considerable space here to the importance of ABC in SCM.

ABC's emphasis on cross-functional processes is the reason for its growing importance in single-company application. Its potential rises when we talk about supply chains. In the supply chain world, any one company's operations are part of a flow from incoming, or upstream, partners to outgoing, or downstream, partners. Activities in a company and the way we account for them should no longer be viewed as stand-alone and isolated but as part of the chain that extends beyond the company. ABC is a way to reinforce this view.

If a company is even modestly successful as a supply chain partner, there will be traces of several chains present. Each chain should be "tuned" to the needs of a different customer segment and will therefore make different demands on each activity. A simple illustration is marking outbound product to individual customer specifications. This increasingly occurs in both factories and warehouses. One customer wants black ink; another wants blue. One wants custom-corrugated cartons; another is satisfied with stick-on labels on standard cartons. One wants its products shipped to its captive distribution center; another wants direct shipment to retail stores. In service businesses, the focus on individual customer segments can mean dedicated "cells" offering customized services for major customers. ABC will enable understanding of what resources are dedicated to what chain.

As we talk about ABC, we should be aware of an ongoing discussion among ABC practitioners. Douglas Hicks, who contributed our opening quotation, describes the situation well.[1] Hicks reports that there are large companies who use ABC for ongoing tracking of performance at a detail level. These companies need an "*ABC* system" (capital letters). This system will continuously track costs at great detail down to each work unit. Such systems are expensive to implement and maintain. The analogy is running a movie of your operations for continuous viewing.

Hicks advocates "*abc*" (small letters) to represent the application of activity-based costing to planning and strategic decision-making. This form requires far less set-up and maintenance. Its analogy is the snapshot, rather than the movie. With abc, one can go into as much detail as needed to make planning decisions or assess improvement potential. It is also far less expen-

sive to develop and maintain. Table 25.6 shows Hicks' comparison of the two approaches.

TABLE 25.6

Comparison of Approaches to Activity Based Costing

ABC	abc
Computations	Business insight
Software	Brainware
System	Model
Complex and costly	Powerful and practical
Minute detail	Pareto analysis
Training	Education
Absorption accounting	Absorption and incremental

The abc version is also the philosophy we recommend for supply chain management — at least in the initial stages of multi-company cooperation. Not every company is ready to invest in developing and maintaining what could be expensive and intrusive financial systems. To explain abc by example, we call again on our three companies. Suppose our companies are linked, as shown in Figure 25.2, in a supply chain. *Process* and *Old Line* are suppliers to *High Tech*, which sells to end-users. *Process* makes an important, but relatively inexpensive product, which we call a "widget."

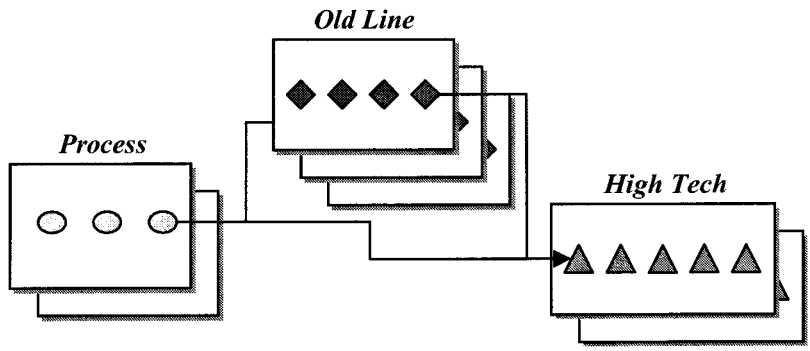


FIGURE 25.2
Three-company supply chain.

Both *Old Line* and *High Tech* use the widget. The widget made by *Process* accounts for 5% of the final costs of *High Tech*. *Old Line* fabricates components for *High Tech*, and its share of final product cost is 15%. *High Tech's* is 80%. These companies partner in the supply chain and are mutually dependent on each other. Their capabilities are complementary, and they produce the best-quality products in their respective industries. Figure 25.2 shows multiple "layers" for each partner. These represent different supply chains acting in

parallel. These could be "threads" in the language of the Supply-Chain Council or "spheres" in the vocabulary of this book.

Table 25.7 shows each partner's cost structure and the composite supply chain cost structure. The composite is based on the percentage of total cost each partner contributes. Such a presentation is an example of Level II (multicompany) accounting on the vertical axis of our progression map (Figure 25.1). To gain a product cost, the composite must be adjusted for transfers among the supply chain companies. An example of this adjustment using this data is presented later.

TABLE 25.7

Supply Chain Partner Cost Structure and Composite (Available in Chapter 25 Spreadsheets)

		Process	Old Line	High Tech	Supply chain
Work force					
	Factory labor	5	25	5	9
	Factory indirect	5	15	5	7
	Clerical/administrative	10	15	15	15
	Technical/professional	10	5	20	17
Fixed		40	10	10	12
Purchased					
	Services	0	0	5	4
	Subcontracted material	0	10	30	25
	Commodity material	30	20	10	13
					100

The Level II composite displays interesting information about costs in our supply chain. Note that the direct labor category is only 9% of all costs. The largest labor component is in the technical/professional category. The ranking categories — even accounting for transfers — are outside material purchases. We'll return to this line of thought later when we discuss picking improvement projects.

This case sets the stage for describing and applying ABC in this supply chain. The topics we cover include the following:

1. How ABC advances from a department focus to an activity focus. This references the D column in Figure 25.1.
2. Special issues related to capital recovery and ABC. Moving from level II to III in Figure 25.1.
3. Transforming activity costs to product costs. Moving from level III to IV in Figure 25.1.

25.3.1 From Departments to Activities

In ABC, cost accounting shifts from the chart of accounts set up around departments to activities within those departments. The supply chain diagram in Figure 25.2 applies this idea in our three-company supply chain. Each supply chain company has multiple products. Each "stacked" box depicts a separate product line. Shaped symbols (oval for *Process,* diamond for *Old Line*, and triangle for *High Tech*) represent activities in the process. Each product requires at least one activity in each company.

Departments, in turn, have budgets to operate the activity or activities under their purview. Any project proposed to improve the function of that department will likely be an S1 functional effort, using our framework for improvement project categories (Figure 25.3). It will benefit to some extent all the products that pass through the department. The project will also likely be justified on savings achieved within that department; there will be little thought addressing the impact on the products. Acme's project A from Chapter 24 is an example.

Figure 25.3 illustrates the relationship between departments, activities, and products. This is the case of *Old Line*. *Old Line* has three products — A, B, and C. It is product B that supports the supply chain with *High Tech* and *Process*. Products A and C are sold elsewhere. *Old Line* has two departments. Department 1 has three activities; Department 2 has one. Three of them — 1, 3, and 4 — are part of Product B's supply chain. Product B doesn't require Activity 2. *Old Line* budgets by department. So managers in each department use sales forecasts for all three products to estimate the resources they'll need.

There are a number of traps in this process, a few of which we've already mentioned. Because *Old Line* has a plant-wide overhead rate, each department absorbs overhead based on the direct labor incurred in its department. The problem arises when overhead items are unevenly distributed among the departments. It happens that Activity 2 is a heat-treat operation supported by a large investment in equipment. Activity 2 also consumes large amounts of energy. In *Old Line's* case, depreciation on the equipment, interest on debt taken on to finance the equipment, and the energy costs are all overhead items. *Old Line* allocates them over all the departments. But Product B doesn't use the facility. So it will be penalized to the extent heat-treat costs in Activity 2 are transferred to Activities 1, 3, and 4 through overhead rates.

Table 25.8 with *Old Line's* internal costs illustrates how the misallocation occurs. It also illustrates the fundamental reason for the growth of activity-based costing as a management tool. Table 25.8 contains both conventional- and activity-accounting versions of cost in each department. The activity costs are derived by splitting department budget items and assigning them to cost-reduction categories. This is the process employed to move from the B to C column on our progression map.

Table 25.8 shows that Activity 1, for example, is a heavy user of clerical and administrative resources. Activity 2, as we have observed, is capital intensive. It consumes the lion's share of both fixed asset and working capital

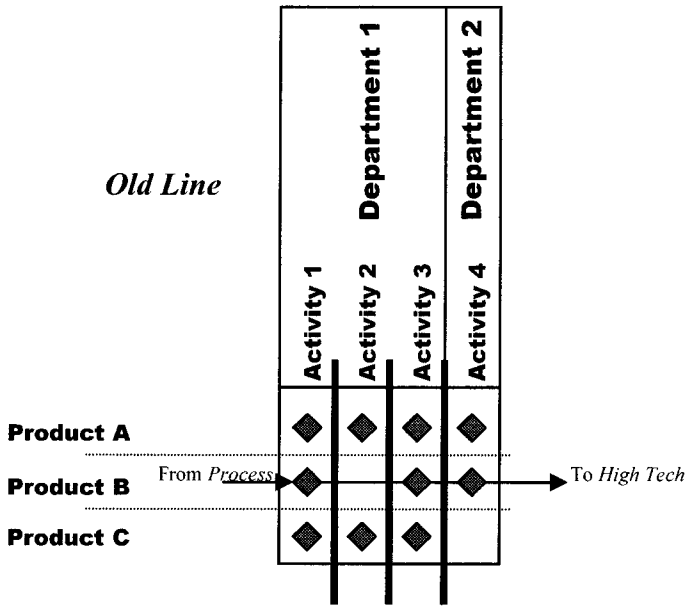


FIGURE 25.3
Old Line's Product/Cost Structure.

TABLE 25.8

Old Line's Costs by Department

Activities		ALL	1	2	3	4
Work force						
	Factory direct labor	25	5	5	10	5
	Factory indirect	15	4	4	3	4
	Clerical/administrative	15	10	2	2	1
	Technical/professional	5		5		
Fixed		10	1	7	1	1
	Total overhead	45				
	Total activity cost	70	20	23	16	11
	Overhead rate:	180%				
	Conventional cost:		14	14	28	14

investment. The technical demands of the process also use the time of technical and professional support staff.

Activity 3 is labor intensive, and it has the largest share of direct labor at *Old Line*. Since direct labor is the base for allocation under conventional accounting, Activity 3 appears to be the costliest department (28%), using a

conventional accounting approach. By contrast, the ABC approach shows that Activity 2 actually has the highest cost (23%).

The resulting "overcharge" to Product B leaves *Old Line* vulnerable to competitors wanting to do business with *High Tech*. A focused competitor that does a better job of accounting — without even being more efficient — can target *High Tech's* business. ABC is an important tool in identifying these situations. Even if there's no competition, *Old Line* may believe its work for *High Tech* isn't as profitable as it really is.

Managers will increasingly turn to ABC as supply chain partnerships form. The best partnership candidates will be willing to share financial data with an eye to lowering total supply chain costs. A current example of this is the distribution industry. Distributors are being asked to perform more and more services for their customers. These include marking products, light assembly, and direct shipment to stores around customer distribution centers. Indeed, development of these capabilities is an important part of many distributors' strategies.

25.3.2 Capital Recovery (Level III)

When we first introduced our definitions of cost categories, we promised to return to the subject of fixed costs. We believe issues around accounting for fixed costs are important enough to have a place on our progression map in Figure 25.1. So we discuss issues having to do with capital recovery as level III on the progression.

Companies, particularly public ones, are naturally aware of and concerned about their perception in capital markets. These markets provide the money that put them in business, entrusting investor resources to the hands of management. There's an increasing perception that conventional accounting shortchanges many investors because of its influence on company decision-makers.

Again, the shortcomings of conventional accounting play a role. Also, the growth of supply chains will demand more of partners in the way they manage and track the costs of investments. How capital recovery is managed is likely to play a key role in assuring success in any supply chain. Here, we describe some ways to assure a fair distribution of the cost and risk arising from capital investment in the supply chain.

25.3.2.1 Addressing Capital Recovery — The Need

In our cases, *Old Line* and *High Tech* have fixed costs at 10% of total cost (refer to Table 25.3). On the other hand, *Process* has a structure with 40% fixed cost — most of which is capital investment. These fixed costs can also include expense items. However, for the purpose of illustration, we'll consider them all capital recovery items for both working capital (example: inventory) and fixed asset investments (examples: land, plant, and equipment).

One can readily spot the importance of capital recovery in a company like *Process* where fixed costs are high. Even *High Tech* has 10% of its total and almost 20% of its internal cost in the fixed category. With traditional accounting, capital costs reside in overhead accounts like depreciation, interest, and lease payments. How well does this represent the actual cost of capital in a supply chain process? Too frequently, the answer is "not very well." Among problems cited are the following:

- Numbers, particularly depreciation, include no "cost" of capital. We define this as the return expected by investors above depreciation. Shareholders expect a higher stock price; and banks require interest. The interest paid on debt, if there is any, may also be too low to represent the cost of capital. Also, the interest is generally reported at the company level and is probably disconnected from the investment itself and certainly from the process that draws on the resource.
- Depreciation lifetimes required by tax and accounting practices often don't match "economic lifetimes." Economic lifetimes will vary from process to process and by type of asset. What if an asset is fully depreciated? Does that mean it's now free? Is the mandated 30-year life for a particular asset even relevant? Is the economic life in a fast-changing market more like 5 years or even 3 years?
- Conventional fixed-cost accounting distorts product pricing and profitability decisions. Not matching capital costs to product-producing activities in the supply chain has harmful consequences like undercharging for the product or selling into unprofitable segments.
- The conventional approach also shortchanges shareholders. For public companies, current practice results in anemic earnings that erode market capitalization, or "market cap" for short. Market cap is the total stock market valuation. It is found by multiplying the market price by the number of outstanding shares.
- Supply chain companies frequently use different methods to account for fixed costs. Can partners agree on a common method? What happens when one partner invests more than another does? Will the nature of the supply chain require a common method for accounting for capital?

The last point is directly applicable to this book. And we would respond with a resounding "Yes!" to that question. Meaningful partnerships require investments in both physical assets and systems. So an agreement on accounting for these is mandatory if partners are to move beyond arm's-length relationships. Another important driver is the point about "market cap." Studies of share prices and their correlation with earnings conclude that markets value a stock more the more it earns beyond the "certain" return of

a government bond. But few companies have the means in place to assure that threshold is reached.

25.3.2.2 Capital Has a Cost

The idea of combining capital recovery into measurement of current financial performance isn't new. A method called "residual income" has been practiced for decades. Residual income subtracts the cost of capital employed from the income statement. For example, Acme's $600,000 NC machine, introduced in Chapter 24, would be charged a capital cost of ownership of $90,000 (15% x $600,000) against the expected benefits. This is because Alpha's hurdle rate is 15%. Because interest is deductible for tax purposes, many adjust the cost of capital to include the impact of taxes and asset life.

More companies, particularly those traded on stock markets, now report "Economic Value Added," or EVA'.* In EVA application, assets required to run the business are charged to operating earnings at the cost of capital. The cost of capital is commonly a weighted "interest rate" based on the sources of selected categories of finance — equity (stock) and debt financing (corporate bonds, bank credits, leases, and so forth).

EVA measures the ability of a company to achieve returns above the cost of capital. If returns including capital charges don't exceed the cost of capital, a negative EVA results. EVA is one response to bad habits such as inventory building as a way to boost earnings. As inventory builds, capital needed for the business also goes up, creating a financial penalty for the cost of that capital. With EVA, the capital cost of the inventory is charged against the manager who made the decision to increase inventory. In conventional measurement, there is no such penalty.

The Stewart firm defines EVA as Net Operating Profit After Tax (NOPAT) less the cost of capital employed in the business. Capital cost may be computed through an analysis of the firm's capital structure, a hurdle rate, or a figure based on the judgment of management. EVA encourages behavior likely to create shareholder wealth. Firms such as Herman Miller employed EVA in designing supply chains. Chapter 48 describes one such effort at its Miller SQA subsidiary. Recognition of EVA caused the Miller SQA design team to look for shortcuts to reduce inventory and speed product through the chain. An approach to combining EVA with ABC is also provided by Narcyz Roztocki and Kim LaScola Needy from the University of Pittsburgh.[2]

25.3.2.3 Recommended Approach

We believe a modified approach based on one of the traditional tools is the best fit for capital cost accounting in SCM. Because an organization with its own financial statement may serve many supply chains, SCM demands more detail in accounting for capital costs than an approach like EVA. As our example at *Old Line* shows, we must be able to associate costs for the use of capital

* EVA is a term trademarked by Stern Stewart

with the process steps needed to make a specific product. The supply chain is also a multicompany environment where individual income statements and balance sheets are less relevant. So our primary audience for financial information isn't shareholders, but executives responsible for making supply chains work and work efficiently.

A sound approach is to use capital recovery factors from the "engineering economy" discipline as practiced by industrial engineers. The approach is used to evaluate the cash flow implications of potential investments in operations improvements. As described here, this approach should also assure that supply chain partners relying on EVA would produce acceptable numbers. This is because decisions made at the individual process level will be consistent with building shareholder value as measured by EVA.

In engineering economy, *capital recovery factors* translate the initial cost, adjusted for salvage value, into a "equivalent uniform annual cost" or EUAC. This is like a mortgage. A house financed for 20 years with a $100,000 mortgage requires a monthly payment of $850. The payment includes both principal and interest. Using EUAC as a capital charge allows variation by type of asset employed and life of the project. In some cases, a higher interest is appropriate for longer projects. For example, equal investments of $100,000 with 5-year and 10-year lives will have different capital charges.

To illustrate, we go back to our example of Acme's investment in Project A described in Chapter 24. Recall that the NC machine would cost $600,000 and have a 5-year life. We can use this information to compare the capital charge under varying assumptions. For simplicity, let's assume the machine has no value at the end of the 5-year period. Acme's cost of capital is 15%.

A table of capital recovery factors enables us to calculate the equivalent uniform annual cost (EUAC) is shown in Table 25.9. The $120,000 figure is our base (#1 in Table 25.9). In conventional accounting, this would likely determine the capital charge the department manager would see on the income statement if the company used straight-line depreciation. It represents only depreciation of the asset. Using a 15% cost of capital adds 50% to the charge (#2 in Table 25.9). The amount is higher because it includes both the cost of money and the recapture of the principal amount. If management felt that the economic life of the project was shorter than 5 years, say 3 years, then the resulting charge is over twice that produced by conventional accounting (#3 in Table 25.9).

The capital charge is less sensitive to the cost of capital. A 20% rate produces only a 10% change over a 15% rate (#4 in Table 25.9). A 10% rate produces 14% reduction (#5 in Table 25.9). One might conclude that economic life is a much more important factor than the firm's cost of capital. No matter what assumptions are used, it's apparent that conventional accounting significantly understates the cost of capitalized assets whether they are equipment or inventory.

We should point out that the cost of capital might appear on the income statement in other ways. If the company borrows to finance purchase of the machine, then the interest will be charged. If the asset is leased, the lease cost

TABLE 25.9

Comparison of the Effect of Different Capital Recovery Factors

	Situation	Capital Charge
1	Conventional accounting, Straight-line depreciation. 5-year life	$120,000
2	5-year life, 15% cost of capital	$180,000
3	Above with 3-year life	$264,000
4	5-year life with 20% cost of capital	$198,000
5	5-year life with 10% cost of capital	$156,000

may be charged to the work center where the machine is installed. The use of EUAC is neutral with regard to financing source. The fact that different companies use different financing mechanisms is one more reason supply chain partners should adopt a common method of recognizing investments.

25.3.3 Product Costing with ABC (IV-D)

We reach the final position, the upper right hand corner of Figure 25.1, in our progression map by applying ABC to product costing. Combining these concepts, as we have said, has been our goal. What's new about the supply chain is that we go beyond the immediate boundaries of the company. Applying ABC in product costing moves the process squarely into strategy. The insights gained to date are quite useful in operations improvement, but they are internally focused. Having a tool for supply chain managers to jointly assess their products' profitability and create new products is critical to a successful supply chain.

ABC requires definition of supply chain activities, including a "cost driver" for each. The cost driver is the principal variable associated with the activity. The next sections are brief descriptions of how this might be done in the supply chain context.

25.3.3.1 Defining Activities

Part of the "art" in defining activities for ABC is to balance the potential for improvement with the materiality of the activity. For example, if this is a new supply chain, then partners may want to focus on the activities most likely to put the venture at risk. This can involve a technology innovation in supply chain processes or products or assumptions about market penetration and the channels needed to maximize sales.

For a supply chain that's been in operation for a while, the focus may be on cost. A natural response is to focus on the most expensive activities. An alternative is examining not only the most expensive but also the most "improvable" activities. This can be accomplished with a "top-down" approach. That

means starting with a view of the supply chain as a separate enterprise and expanding downward into detailed activities as long as it makes sense.

A technique called a "node tree" borrowed from a systems analysis tool called $IDEF_0$ is useful. $IDEF_0$ is widely used in analyzing activities in processes. An alternative, or even supplemental approach, is to use the SCOR model developed by the Supply-Chain Council (refer to Chapter 23).

In Figure 25.4, we illustrate the approach with a node tree from our three-company supply chain. The activity architecture resembles an organization chart. The lead company, *High Tech*, performs the activities in clear boxes. Other shading indicates the roles for *Process* and *Old Line*. This is characteristic of the top-down viewpoint and supports the practical application of what we referred to earlier as abc. One can extend the chart as far down as one wishes, depending on the nature of the activity. For example, *A231 Fabricate components* can break down into a multitude of manufacturing processes needed to produce final product components.

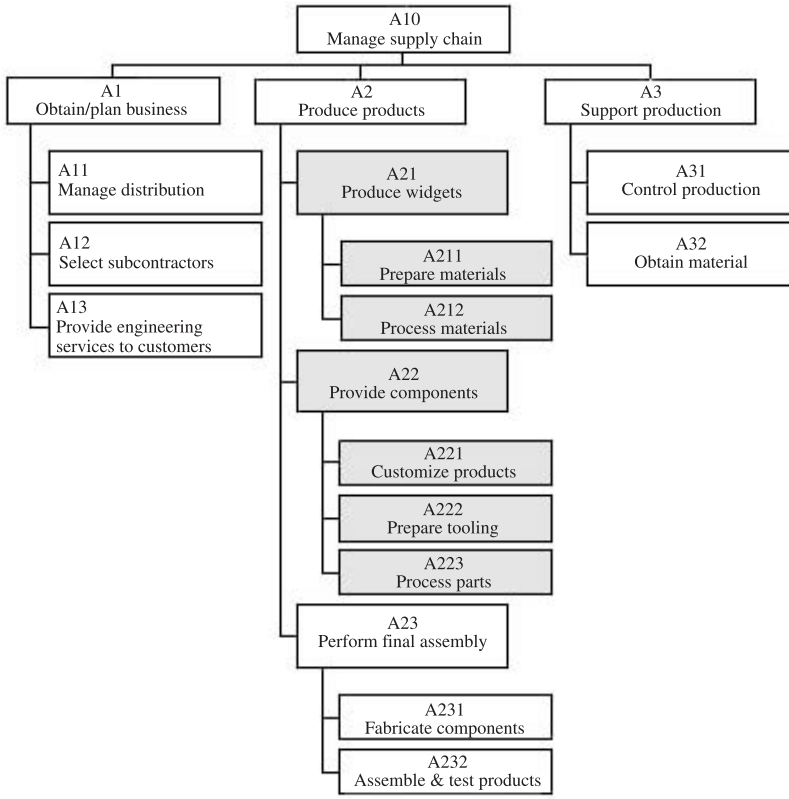


FIGURE 25.4
Node tree representation of a supply chain.

Another feature is the existence of production, decision making, and planning activities. The decision making and planning functions may not be costly in terms of direct expense, but they heavily influence costs in other activities. An activity like A31 Control Production can have a profound effect on the efficiency of the supply chain, affecting capital investment in plant and equipment, inventory, and productivity. Including these activities also shows the assignment of responsibility to parties in the chain. An important part of supply chain design will be deciding where activities like this are performed and what the rules will be. They may also be good candidates for investments in new systems.

25.3.3.2 Cost Drivers

We can take each activity and assign a "driver" that best reflects cost variability in the activity with changes in volume. The cost drivers "use up" the resources supporting the activity and can be measured by either input or output from the activity. Typically, volume in a driver will be tracked continuously in a large ABC system that measures cost continuously.

If we developed fixed and variable costs, we probably gained insights into which drivers best fit any activity. Table 25.10 contains examples of drivers for activities in our supply chain examples.

TABLE 25.10

Examples of Cost Drivers

Activity	Cost Driver
NC machine	Machine hours
Set-ups	Number of set-ups
Inspection	Number of inspections
Purchasing	Number of purchase orders
Subcontracting	Number of material categories
Engineering services	Number of customer requests
Production control	Number of activities to schedule
Machining	Labor hours required

The activity cost for a particular product is the unit cost of that activity multiplied by the number of units required, as measured by our cost driver. For our NC machine, for example, the driver is *machine hours*. The cost could include the categories presented as an example in Table 25.11. We assume the machine is available for 2000 work hours per year. The activity cost is $140 per machine hour. If each unit of our product took two machine hours to produce, the activity cost would be $280.

There are many "tricks of the trade" in setting up activity costs. These are beyond the scope of this book. However, supply chain abc needn't be overly complex. The analysis is sufficient when it has documented costs of each activity to the satisfaction of the participating partners.

TABLE 25.11

Calculating an Activity Cost

Capital recovery	$180,000 per year capital recovery	$90
Operator	1/2 operator including fringes	$35
Maintenance	Experience from similar equipment	$15
	Total:	$140

25.3.3.3 Supply Chain Cost Map

Applying the concepts described above paves the way for mapping costs in the supply chain. This provides a high-level view of where costs are incurred to pursue cost reduction and avoid chasing visible, but unimportant, cost components. If the supply chain supports multiple products, we suggest this be done on a product or product line basis using level IV-D costs. We have already gathered much of the data needed for our three-company supply chain. Figure 25.5 maps costs in this supply chain.

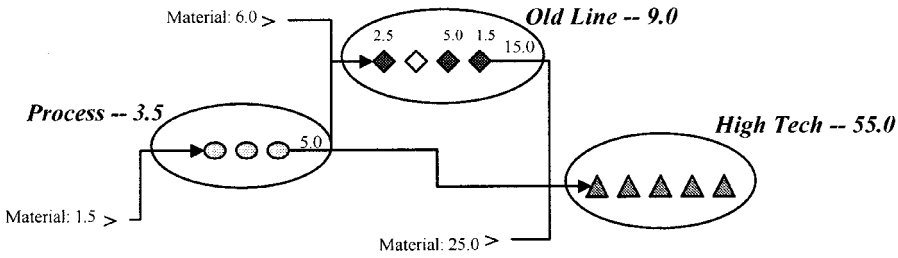


FIGURE 25.5
Supply chain cost map.

The figure shows the costs of activities in each of the three companies. Because it adjusts for internal transfers, it provides a more accurate picture than the composite supply chain cost we calculated previously. Our cost structures enable us to differentiate between internal and external cost at each level. For example, *Process* contributes 5% to total costs; 30% is material, 70% is internal cost. So, for every $1 in sales of the supply chain's product, Process contributes 3.5% in internal cost and buys 1.5% in material. In this case, it is a commodity material.

The mapping approach lends itself to expansion to other supply chain partners. For example, 25% of supply chain cost is contracted to others through *High Tech*. The supply chain team may expand the map to include one or more of these other suppliers.

We can also place activity costs at *Old Line* in perspective. The map shows the activity costs we calculated. A display over all activities in the supply chain will also focus on operations improvements in any of the three companies.

25.3.3.4 Paths to Supply Chain Product Costs

Achieving the vision we have for supply chain product costs will face obstacles. The path is not only strewn with technical obstacles but also with cultural ones. It's also likely that the path will not be a straight diagonal as we showed in Figure 25.6. It is more likely to proceed, at least roughly, in one of the two alternate ways shown in Figure 25.6. In fact, Doug Hicks, a leading activity costing practitioner mentioned earlier, points to an unfortunate "fact of life." This is that the financial management of most firms will likely have little to do with activity costing. So support for the effort must come from elsewhere.

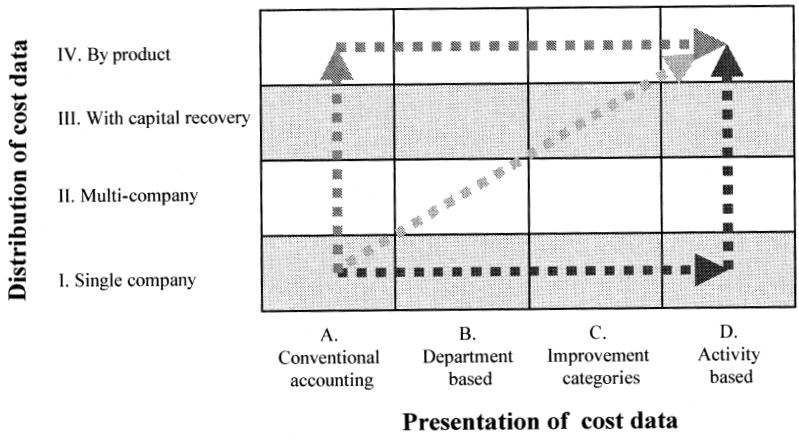


FIGURE 25.6
Paths to supply chain product costs.

The first alternative path moves across the horizontal axis, staying within a single company then expanding to the supply chain. This pattern will fit a situation where a strong supply chain partner sponsors the cost management approach. Our case company, *High Tech*, fits this situation. This sponsor uses its clout to elicit cooperation from its suppliers. Such a situation is common in the industries like automotive and aerospace with dominant companies at

the end of the supply chain. They may also promulgate cost management practices developed internally to their supplier base.

Another path proceeds up the vertical axis. Supply chain partners lay out rules for cost sharing before any move to implement the policies. This situation is most likely to occur in the case of cooperating, coequal companies in the supply chain. A new jointly developed product requiring considerable investment by each partner is an example.

The second path will also characterize the case of a customer seeking to consolidate its supplier base and outsource some of its own operations. In this case, the customer will seek fewer partners offering a broader range of services. A good example is a manufacturer looking to distributors to supply an increased share of its material requirements. The company will evaluate its own costs as a benchmark for make or buy decisions on specific services. It will also use its cost information to design the package of services needed from selected partners.

25.4 Bottleneck Costs

The map of the supply chain we've used will aid the introduction of another concept related to supply chain cost visibility and its effect on clarity in decision making. This concept is the "theory of constraints" or TOC. TOC is the product of thinking by Eliyahu Goldratt, Jeff Cox, and Robert Fox. [3,4] They make the important observation that, in any operation, there is a "capacity constraint resource" (CCR) that determines the pace at which the operation can produce products.

While the authors describe the CCR in the context of a single manufacturing operation, it has important implications for supply chains as well. This is particularly true given the trend to fewer participants in the supply chain. From a cost point of view, it provides a different perspective for understanding an activity's real cost if that activity happens to be a CCR. It also has implications for directing our cost reduction efforts.

TOC argues that the CCR, as the constraint on capacity of the total system, needs special attention. If demand exceeds capacity, gaining one extra unit of capacity at the CCR increases the output of the whole system. In fact, TOC would say that improvements elsewhere in the supply chain are illusory. They really don't matter that much since they don't increase the capacity of the overall supply chain.

For example, activity D at *Old Line* only accounts for 1.5% of the total cost of our supply chain. Suppose it is the CCR for the three-company supply chain. Improving output there could produce far greater benefit than on any other activity. Automotive supply chains are set to the pace of assembly lines. Any disruption along the chain threatens the whole operation. So they take great care to protect themselves from the risks involved. There are other

important aspects of TOC that apply to costs in the supply chain, which we'll discuss later.

25.5 Case Study: Cross-Company Accounting

An example of the problems faced at the Jet Propulsion Laboratory (JPL) provides one organization's response. For the better part of a decade from the mid-1970s through the mid-1980s, JPL managed a research program for the U.S. government. The program sought cheaper ways to produce and deploy photovoltaic solar cells to generate electricity. The solar cell manufacturing process began with wafers manufactured out of silicon and other materials followed by encapsulation into panels, and then assembly into systems.

Potential applications included residential, commercial, and industrial/utility markets. These applications required progressively larger systems. At times, the program had more than $100 million a year in product development funding. Numerous private companies were under contract to develop the technologies needed to make the solar cell systems economically feasible. The JPL role was to manage numerous contracts with private companies to develop the needed technology to economically manufacture the solar cells.

25.5.1 The Cost Accounting Problem

In a sense, this project was a supply chain "partnership," with multiple firms contributing their development skills to different components of solar cell systems. The program had a cost goal of "$1 per peak watt" of solar cell capacity. When the program started, solar cell systems were selling in the area of $10 to $20 a peak watt. This was intended to include a reasonable profit for solar cell producers. The goal centered on what was considered competitive with conventional generation.

Since no production that was suitable for mass markets was in place, it was up to research contractors to estimate the cost of their production technologies. And, since they competed for research funding, they had incentives to put the best "spin" on their estimates. Unfortunately, this situation forced JPL into the position of evaluating not only underlying technology but also the validity of corporate accounting systems. For example, a contractor like Westinghouse might claim that its technology could produce cells for $1.30. Was that more cost effective than the General Electric claim for $1.80? How were the numbers generated? What were the assumptions? Does Westinghouse keep score the same way General Electric does?

The evaluation became even more complex when two companies worked together on different parts of the production process. An example is one com-

pany making the silicon cells while its downstream partner encapsulated them into solar panels. Was the consolidated figure of $2.00 valid? Should funding decisions be made on the basis of these numbers?

JPL program mangers were forced to take lessons on corporate accounting. What they found was perplexing. For example, different companies had vastly different overhead rates. One company might assume a process yield of 80% while another assumed 98%, which led to the different rates. These practices, as one might imagine, produced widely different unit costs for end products. Different companies didn't even include the same things in overhead. Also, they paid different rates for staff. An assembler in one part of the country earned more than one in another. But the research effort wasn't about the best plant location or what was the correct assumption; it was about developing the technology needed to sell in commercial markets. The interests of the program demanded a better way of accounting for costs in a multicompany environment.

25.5.2 The SAMIS Approach

The JPL managers faced a situation similar to what supply chain partners now encounter. That is, how do you measure supply chain cost? Table 25.12 describes some of the structural problems encountered and the consequences. To put everyone on a common basis, JPL developed a common cost model. Its purpose was to eliminate these differences when evaluating the underlying technology needed to produce solar cell systems. The model, called SAMIS for Standard Assembly Line Industry Simulation, used a structure that's adaptable for supply chain cost modeling. Figure 25.7 is a simplified structure of the SAMIS model.

TABLE 25.12

Structural Problems in Understanding Costs

Situation	Consequence
Value adding processes are inconsistently defined from place to place. For example, is "set up" value added or overhead?	It's hard to agree on what's included in an operation, much less on what it costs.
Different operations have different practices for overhead accounting. For example, one may account for sick time as direct, another includes it as overhead.	Overhead is a large factor in many manufacturing companies, often dwarfing direct costs. Understanding what's included and excluded is an obstacle.
Costs for the same thing are different at different locations for a variety of reasons. This could be due to union contracts, seniority, or the cost of local materials.	The differences may be controllable by supply chain design – or they may not. This should be sorted out.
Management organizations and infrastructure are different in different operations. This includes items like depreciation, R&D, and the number of vice presidents.	Non-process structural costs can contribute a large portion of supply chain costs. How does one decide if the supply chain benefits from these expenditures?

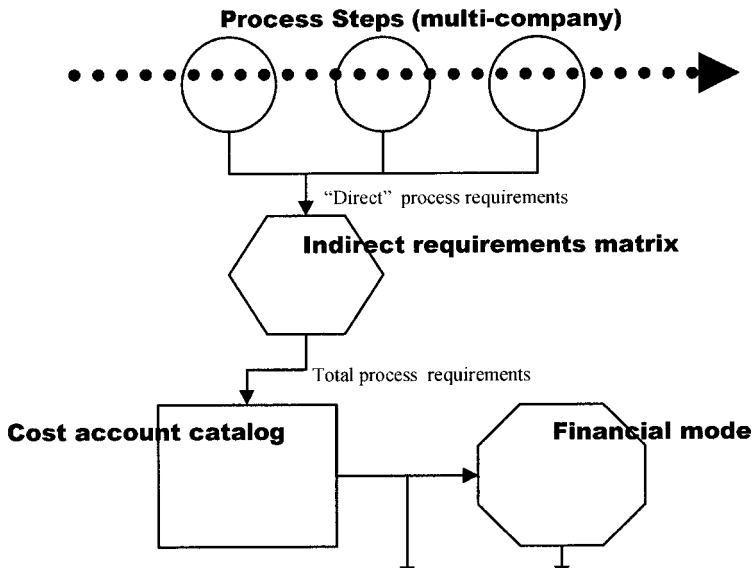


FIGURE 25.7
SAMIS model structure.

In the SAMIS methodology, each process step has to be documented. In a supply chain application, this includes manufacturing, material handling, and transportation operations. Note that the documentation is for "direct" requirements as indicated in Figure 25.7. In SAMIS these are defined more widely than they are in conventional accounting systems. They can include items like the electricity needed to run a machine, the maintenance technician for the machine, and the set-up specialist. Significantly, the model also includes capital costs. This was an early application of the method for treating capital recovery as a direct expense.

Indirect requirements were non-process costs. Examples are the foreman for the machine shop, or the cafeteria attendant. These are "resources" who are not directly involved with the process. The indirect requirements matrix, shown in Figure 25.7, contained relationships between the direct and the indirect resources. For example, the machine shop might require one foreman for every 12 direct workers.

After applying the indirect requirements, SAMIS translated total process resource requirements into a process cost. It relied on the Cost Account Catalog for this function. The catalog contained price/volume relationships for all categories of cost — labor, material, and other factors. One could construct cost catalogs for different regions to evaluate cost factors in different areas. Model outputs included process costs by step and enterprise financial statements. This included profit and loss income statements and balance sheets.

The reason for this explanation is not to promote SAMIS for supply chain accounting. It's to show that the issues faced in supply chain accounting are not new, and creative approaches exist. What is needed are innovations in addressing the issues. Any supply chain partnership should consider SAMIS-type solutions in the design or operation of its own extended enterprises.

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26

Root Cause — Variability

> Within Ford, improved quality is one of our highest priorities. Our experience suggests that (you should) stress the importance of process control and capability including the relationship between process specification tolerances and process variability (or C_{pk})
>
> **Louis R. Ross**, Executive Vice President, Ford Motor Company, 1988

In Chapter 24, we opened this section about cost in the supply chain. We pointed to variability as a root cause of unnecessary supply chain cost. This chapter explores variability in greater detail and shows how it adds cost. Because supply chains are more complex, their productivity is especially vulnerable to variability. Variations will be difficult to recover from; schedules will be uncertain, and effectiveness will deteriorate. The quotation above by an executive at Ford shows the importance placed by that company on eliminating variability at a time, in 1988, when the quality of cars from Detroit was suspect.

Variability takes two basic and interrelated forms, which we summarize in Figure 26.1.

The first form arises from fluctuations in volume. This variability may be externally or internally caused. The principal external cause (top box in Figure 26.1) is likely to be variations in demand as sales increase or decline. They may also occur when customers cancel orders or try to move orders forward. External variability also includes factors that are more predictable, such as seasonality. Many companies make a substantial share of their sales in holiday seasons. They must anticipate demand several months in advance. We have also seen the logic in some ERP systems that interject wide swings in orders to suppliers despite relative, even final, sales demand.

The figure shows two sources of internal variability: internal factors that produce volume variation (middle box) and process variability (lower box). Internal factors are likely to be caused by management policies and procedures. Later in this chapter, we'll provide some examples.

Process variability is associated with basic execution of process steps. An example is variability due to the level of worker training in a particular task. The more skilled worker will perform the task better and faster than the less skilled worker will. Other sources of this type of variability are poor work

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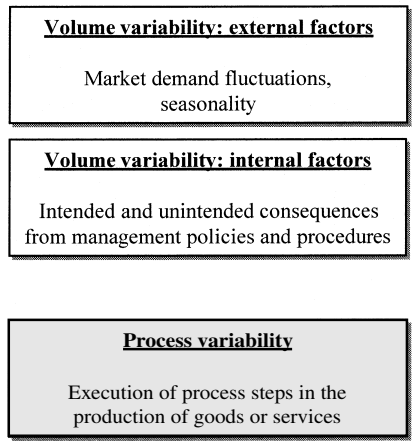


FIGURE 26.1
Sources of supply chain variation.

methods and process design along the supply chain as well as the capability of machines and tooling used in processes. The result is inconsistency in performance. In the supply chain, small variations at one point may be amplified up and down the chain.

Market variability, an external factor, can also lead to process variability, an internal factor. For example, a large increase in business may require the addition of untrained workers, causing glitches in production. We have seen downsizing of the work force move senior people, to comply with union contracts, into jobs requiring skills they did not have. Here we'll describe the kind of efforts needed to make supply chains effective by either eliminating internally generated variability or coping with externally generated variability.

26.1 Volume Variability

Volume variability, as we've just discussed, is of two types. The first is related to market demand (top box of Figure 26.1). For our discussion here, we'll treat variability from this source as an independent variable. In other words, it is not under the power of supply chain partners to control. In reality, many companies try to deal with variability of this type through pricing and marketing programs. These measures fill the gaps in their production capacity with special appeals to different customer groups. As another example, airlines use "yield management" to fill otherwise empty seats. This device employs pricing to draw business from cost-sensitive market segments. The theory is that any paying warm body in the seat, even one who hasn't paid

much, is better than an empty seat. Automotive promotions and rebates are also ways to clear excess inventories, with the effect of leveling volume in the supply chain.

26.1.1 Self-Inflicted Variation

We have also observed that some volume fluctuations are completely within the control of management. This is the second type of variability. Excess cost from these causes is frequently "self-inflicted." Many of these internally caused variations are due to nontechnical, non-market reasons. Their root cause lies in management practice. This indulgence of poor practice at the company level is especially destructive at the supply chain level.

One example of internally driven variation is the proclivity, particularly at the business unit level, to pace operations to the accounting period. Whether the accounting period changes monthly, quarterly, or annually, there is a push to book business and ship product by the end of the accounting period before the company "closes the books." Did anyone ever tell you to shop for a car at the end of the month? This advice reflects the idea that the car salesman will probably cut a better deal to meet a sales quota.

Usually, this lack of discipline arises from efforts to sweeten the income statement. It starts in the corner office, where eyes are focused on the next bonus. It extends downward to the sales force and factory, taking the form of promotions, discounts, or just plain "hustling" of accounts. As a result, half the production goes out the door as the sun sets on the fiscal period. Some refer to this phenomenon as the "hockey stick" effect. Production activity turns up rapidly at the end of the period, resembling the blade of a hockey stick.

Figure 26.2 shows product deliveries as a function of time in a company where the hockey stick is well entrenched. Here the time interval is one accounting cycle. At the beginning, everyone recovers from the last rush to pump out product. Shipments of finished product drop. The company turns its attention to housekeeping and rebuilding its component stock. As the end of the accounting period approaches, the pace picks up — and fast. It peaks just as the last shipments are made — hopefully in time to credit the top line for that month, quarter, or year. It's a difficult syndrome to break. Over time, this cycle becomes ingrained in the organization and the standard way of doing business.

26.1.2 The Cost–Volume Relationship

Another cause of variability lies in the way management views the cost–volume relationship. There are many misconceptions among managers of companies about the behavior of unit costs with changes in volume. One company president, whose background happened to be financial, likened the factory to a radio. "To get more 'volume,' you just turn up the

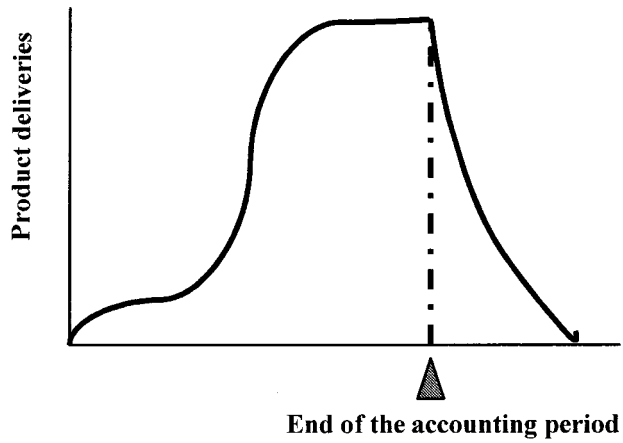


FIGURE 26.2
Production pattern to meet end-of-period goals.

dial." The factory — and by implication its supply chain — would respond smoothly and effortlessly to the new targets. If only it were that easy! Another company put on a "special" near year's end to book orders. The factory, along with suppliers, fell apart when it came to making deliveries.

The president of an electronics manufacturer who went on to run a public company had it more correct when he observed that his operation was "tuned" for a set volume of business. Unit cost, including both direct and overhead components, was lowest at this volume. When production volume moved up *or* down, unit cost only went up! The expected economies of scale were a myth.

Figure 26.3 illustrates these two views of the cost–volume relationship. The straight line depicts the way many executives view costs — increased volume brings economies of scale. The more work there is, the more overhead is absorbed. This sometimes leads to an appeal from manufacturing to sales to raise their forecasts so the factory's "direct labor" will be fully utilized.

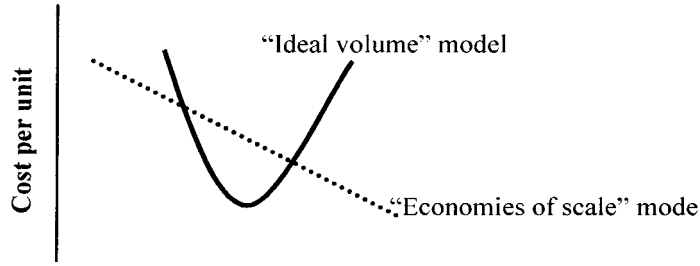


FIGURE 26.3
Two views of the cost–volume relationship.

But, ironically in many cases, an upward move in sales brings higher unit costs. This is frequently due to inflexibility in the supply chain and is particularly common when there is dependence on engineered, long-lead-time components. Each company in the supply chain likely has a V-shaped cost curve with the lowest cost centered on an "optimal" cost. Production above or below that range results in increased cost. An obvious example is production interruptions and shortages. If any one of the supply chain links "breaks" and fails to deliver, then the whole chain is threatened.

Boeing, when orders expanded rapidly in the mid-1990s, was trapped in profitless prosperity. Its supply chain couldn't expand its output and choked trying to rush product to market. Late deliveries produced penalties and added cost.

As a response, organizations should build flexibility into their own operations and into their supply chains. This "resilient" operation will enable them to deal with volume variations — at least within some prescribed range, extending the range in which their supply chain can cost effectively deliver product. The importance of establishing this operating range will increase to the extent that there is mutual dependence up and down the chain.

Figure 26.4 illustrates the broadening of the cost–volume relationship curve to target a production range in which to operate. The shape changes from a "V" to a "U." The bottom of the U is the range of operation with the lowest costs. With the advent of supply chain management practice, this U-shaped function must describe not just a single company's operation but the supply chain's as well. Supply chain design must consider the expected range in which the chain must produce to satisfy its markets. In the following sections, we describe ways to make this happen.

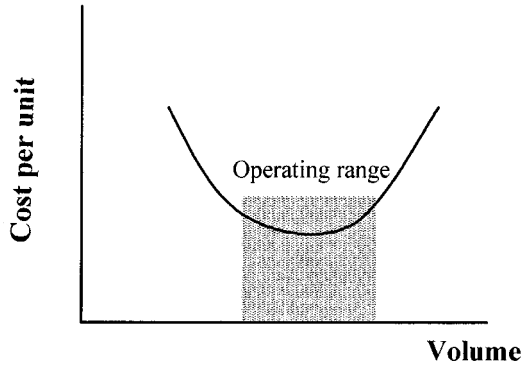


FIGURE 26.4
Efficient operation over a production range.

26.1.3 From Batch to Flow

A response to volume variation of both the external and internal type has been a transition away from a "batch" model to a "flow" model. As with many other trends, this one has been confined mostly to single companies — sometimes with immediate suppliers also included. An industry in the U.S. where it has advanced is the automotive industry. The Big Three have copied Japanese approaches to what has become known as "lean" manufacturing.

The flow vision "ideal" has a river as an analogy and is a foundation for lean manufacturing. This river flows evenly at a constant pace from its source to its customers; there are no dams and lakes or rapids to alter the flow rate. The river delivers only what customers want when they want it — not too much, not too little. There is little waste in terms of unwanted product and inventory. The river' banks adjusts easily to changes in the water level — at least within the bounds established for it.

For many, this view will remain a remote hope. For these companies, their supply chains are too long; most of their sales are at Christmas; there are too many players to make coordination feasible; and, besides, their crystal balls won't produce the accurate forecasts needed to be successful. However, those who are successful in managing their supply chains will make this transition. In the following sections, we'll trace the evolution of this transition from batch to flow and some of the enabling methodologies that work in many supply chains. We believe that companies with "uncontrollable" external barriers like seasonality can also tailor these methods to make life easier.

26.1.3.1 The Batch World

In today's world, most organizations rely on the "batch" model. This comes from reasoning that production in batches is the most efficient way of doing business. This is a consequence of measuring performance as described in Chapter 25. There is a focus on measuring productivity at the level of individual processes. If one does work in batches, one gains economy from the "setup" required to perform the task. The philosophy is "spread as much volume over the setup to gain efficiency." Measures, particularly in factories, reinforce the model. People are deemed "efficient" as long as they are busy. So keep them busy working on large batches of work, the thinking goes, and the company will prosper.

Batches also capitalize on specialization. A person can become really good at a task he or she performs repetitively. The narrow specialist probably often costs less than the generalist does anyway. If you cross-train someone, they will want more money.

Concentrating work into batches also results in high utilization of equipment and manpower. Everyone is busy and little time is lost to idleness. The batch operation is also easier to manage. One can easily track larger batches of parts. Moving one item at a time takes as much time and effort as moving

a thousand. The same thought process is followed in many clerical and administrative processes.

The batch model, illustrated in Figure 26.5, holds that products and services are delivered in "economic" batch sizes. The picture illustrates the pattern of production and movement along the supply chain. There's an "efficient" batch size for every operation. For products, this includes production steps as well as reordering for warehouses down the distribution chain. The batch size quantity is reduced to an equation taught in most courses on production and inventory management.

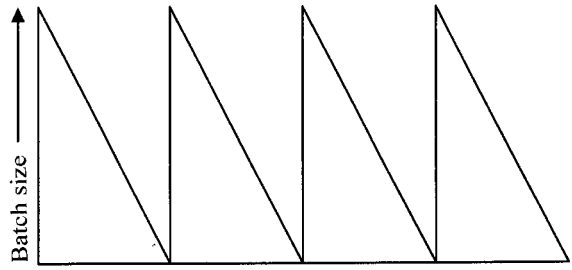


FIGURE 26.5
Batch model approach to production.

The operations research field has given us the means of calculating an "optimal" batch size. It relies on minimizing the total cost of procuring and storing a product. An efficient order (batch) size, or economic order quantity (EOQ), is computed as follows:

$$\sqrt{2RC_p/C_h}$$

The EOQ is that quantity that minimizes the overall cost of inventory.

R = Requirements or demand. This is usually forecast for the coming period. It's expressed in units.

C_p = The costs of each order, or batch.

C_h = The unit cost of inventory per period.

The components include the cost of holding the inventory and the cost of ordering each batch. Holding costs include interest, obsolescence, storage and handling, and other costs. Annual holding costs often can be 25% of the purchase cost of an item, which has become a common "rule of thumb" for calculating the benefits of inventory reduction. The transaction cost associated with each order includes items like administration, moving material, and setup.

Assumptions built into the equation need to be understood. First, the equation assumes demand is continuous and constant. Of course, this is an increasingly difficult assumption. Second, the equation also assumes that lead times are constant, which is also likely to be unrealistic.

The EOQ equation is also based on a model that holds that multiple items in a product line behave independently when it comes to the cost of production. Often, this isn't the case. For example, there may be economies depending on the sequence of production. For example, consider the order sequence for three products that are normally produced in the order: A-B-C. A-C-B would be more cost effective, should A and C require the same tooling and setup.

Another problem with application of this formula lies in the separation of fixed and variable costs. An example is warehouse cost that's part of the cost of holding inventory. The C_h term includes these costs. The cost is usually derived by totaling all the expenses associated with the warehouse — rent or depreciation, supervision, crew, and equipment. The term is computed by adding all these costs and dividing it by the average units of inventory held during the period. Unfortunately, this treatment makes all these costs appear to be variable. Fixed and variable expenses aren't separated. In fact, over the range of production we set for the supply chain, the costs are more likely to be fixed than variable.

The situation is similar for the costs of an order. For example, the cost incurred for people hired to process orders will probably not go down if one less order is made. This includes material management staff, procurement people, and those who move goods into storage. Like the warehouse facility, staff levels in these functions are also likely to be fixed over any relevant range of production.

Other costs like transportation may or may not vary with the number of orders. For example, a transportation manager, measured on costs for transportation, will want to get the cheap rates that go with sending full trucks, referred to as truckload quantities, from factories to distribution centers. The full truck is the equivalent of a "batch" for this manager, and his measure is likely to be "total transportation cost" or even "total supply chain cost" of which transport costs are a major portion. This measure could have a negative effect on customer service because the full truck constraint can reduce the frequency of delivery. So a local optimum overrides a higher goal — and perhaps results in lost business.

Often it is the economics implicit in the EOQ equation, or a similar thought process, that governs decisions like those made by production control and transportation managers up and down the supply chain. The company selling to the final customer orders material in fixed amounts from suppliers according to reorder points and minimum order quantities. Others back along the chain duplicate the behavior leading to a supply chain bloated with extra inventory and operating expense.

26.1.3.2 The Flow World

We mentioned earlier that we want to create a "flow" world with a "river" of production that flows continuously, not a series of streams and lakes with large dams to retain inventory. A modified EOQ equation offers added insight into the economics of the supply chain. This is the case of the "production order quantity," which is a product of the same operations research discipline that produced the EOQ equation. The production order quantity focuses on decisions about how much to *make*. It differs from the EOQ equation because it takes into account the inventory demand during the production lead-time. The production order quantity is:

The terms in the production order quantity equation are the same as those in EOQ, with two exceptions:

$$\sqrt{(2RC_p)/C_h}(1 - r/p)$$

r = Rate of usage.

p = Rate of production stated on the same time basis for r.

For very slow rates of r relative to p, there's not much difference between the economic order quantity and the production order quantity. This is often the implicit assumption by those applying the EOQ equation, that the EOQ is the same for both ordering and production. However, as r approaches p, the production order quantity increases toward infinity. That is, the production is continuous and never stops. So we now have a river rather than a bunch of dams and lakes.

Also, as the cost — and here we use incremental cost — of an individual order declines to zero, so does the economic order size. An example is the development of techniques to reduce costs of activities like set up. *SMED*, or "single minute exchange of dies," emphasizes fast set-ups. In applying SMED, analysts use videotapes and methods analysis to make sure equipment is not off-line too long when set-ups are needed. What SMED does is reduce the economies that go with the batch model.

If usage approaches production or we reduce the cost of changes, we converge on the "flow" model or "river" of goods moving through the supply chain. The rate of production is matched to the rate of demand, and production is continuous. In the flow model, there is also minimum inventory in the supply chain. The root cause that had justified this inventory has been variability. Variability includes the difference between forecasts and actual demand and uncertainties in operational performance. Reliable operations can minimize these uncertainties.

Forecasting in the flow model is simpler as well. One need only forecast and plan to a likely range for production. Supply chain partners then put in place the capability in terms of plant, equipment, and staffing to produce to that range. There is also a reduced need to forecast individual items, as sup-

ply chain production is determined by actual sales. We refer to this supply chain as a "demand-driven" supply chain.

26.2 Demand-Driven Supply Chain

The demand-driven supply chain changes many of the conditions that cause wasteful variation in supply chain production. It is the foundation of the "lean" supply chain. Its implementation also helps establish the operating range for low-cost production for the supply chain. Figure 26.6 shows a roadmap to implement the demand-driven supply chain:

1. Moving from long to short lead times
2. Replacing the economics of the batch model with those of the flow model
3. Basing decisions on actual demand rather than forecasts

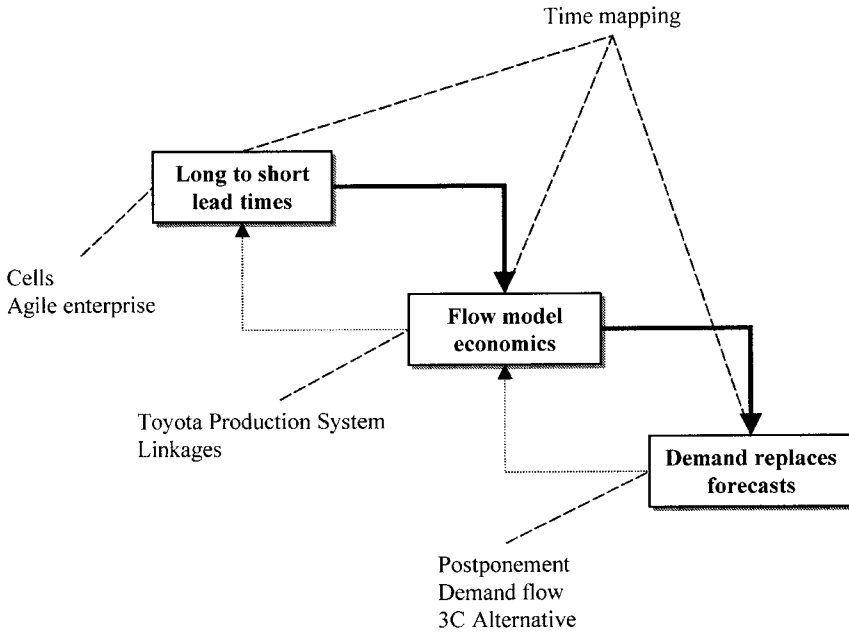


FIGURE 26.6
Demand-driven supply chain — methodologies.

Evolution to a demand-driven supply chain will likely proceed in the order these items are listed. Figure 26.6 illustrates. Shortening lead time is funda-

mental to changing batch model economics. Basing decisions on demand comes after adopting the economics of the flow model. Along the path there is feedback to earlier steps. For example, experience with building to demand rather than forecasts often begins in the operation closest to the end user. This would be final assembly in most manufacturing situations. Beginning here, the organization can propagate build-to-order practices back up the chain to earlier operations.

In this section, we'll review some of the foundation concepts and practices that will help the demand-driven supply chain to become a reality. Organizations, including both product and service producers, will find value here for upgrading SCM practices.

Table 26.1 summarizes the concepts we will discuss. These are also shown in Figure 26.6 at the point in the process where they will likely play a role. We begin by describing a methodology that captures the "as-is" with respect to time in the supply chain. This piece of analysis is a foundation for picking the right approaches to successfully make the transition to the demand-driven supply chain.

TABLE 26.1

Methodologies for Demand-Driven Supply Chains

Approach	Lead Time	Flow Economics	Build to Demand
Time mapping	X	X	X
Cells	X		
Agile enterprises	X		
Toyota Production System		X	
Linkages		X	
Postponement			X
Demand flow			X

26.2.1 Time Is Equal to Cost (Time Mapping)

In our discussion of cost visibility, we mapped activity costs for our example three-company supply chain (refer to Chapter 25). A start to implementing the demand-driven supply chain is to repeat the process, tracking lead time instead of cost. This map will identify supply chain delays and how to select the best approaches for implementing the demand-driven supply chain. Figure 26.7 displays the same supply chain with our companies, *Process, Old Line,* and *High Tech,* using time as a metric.

For each operation in the supply chain, the map depicts expected lead-time. For *Process*, for example, Figure 26.7 and Table 26.2 show that material has a 5-day lead time. Internal operations at *Process* require another 30 days. So total lead time at *Process* is 35 days. Likewise, *Old Line* requires 95 days of lead time, with 35 accounted for by material from *Process* and 60 by internal processes. Notice that one process takes 45 days, which could indicate a sup-

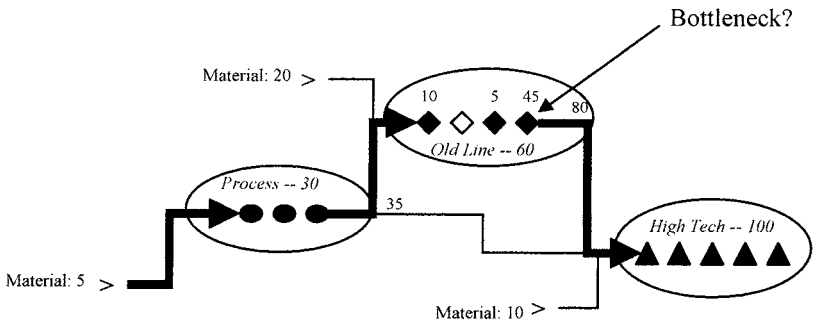


FIGURE 26.7
Map of supply chain lead times.

ply chain bottleneck, as shown by the arrow. The heavy line shows the "critical path." It is the longest lead-time path. In this example, it consists of the components listed in Table 26.2.

TABLE 26.2
Supply Chain Lead Times

Company	Source	Days
Process	External	5
	Internal	30
Old Line	External	—
	Internal	60
High Tech	External	—
	Internal	100
	Total:	**195**

External sources for *Old Line* and *High Tech* are not displayed, as they aren't on the critical path. The resulting map shows a lengthy, but not untypical, supply chain lead time of 195 days. About half is internal to *High Tech*, the end producer. The other half is upstream of *High Tech*. A major delay is encountered at the bottleneck at *Old Line* where one activity requires 45 days.

Lead times like these necessitate forecasting and have spurred the search for methods to attack them. The map helps to focus our efforts to shorten supply chain lead time where they will be the most effective. For example, there appears to be little benefit, at least initially, from effort to shorten lead times among *High Tech's* suppliers. They aren't on the critical path. A better choice is supplier lead time for *Process* or attacking the bottleneck at *Old Line.*

We begin our discussion of techniques with two that increase the speed with which business is done. These are cells and what has been referred to as the "agile enterprise." One focuses on improving speed in an existing business. The other describes the need to quickly assemble enterprise level supply chains in response to new market opportunities.

26.2.2 Cells

Cells have proven to save time and reduce cost in both manufacturing and service companies. The design of any particular process may fall into one of two generic categories: functional or cellular. The functional design is the older, traditional approach. It has its foundation in traditional accounting mentality and the associated batch approach to production. In the functionally organized process, operations and equipment are organized by type. So all milling machines in a manufacturing plant, for example, are located together. In the claims-processing operation of an insurance company, the staff is organized and located around steps in the operation. The work has to progress through each unit to be completed. Since the batch model measure of productivity stresses worker and machine utilization while ignoring lead time and responsiveness measures, the functional design has been a natural response.

The cell design philosophy has been applied most strongly in manufacturing. It is also a component of the Toyota Production System described later in this chapter. We give it special billing here since cells are a basic building block of high-speed supply chains. In the cellular shop floor, machines of different types — all of which are required to produce the product — are located together. The focus shifts to the product being the produced, not the means of production. In a functionally structured paperwork process, each department does only a small part of the process. In a cellular paperwork process, small groups perform all, or almost all, operations.

Cells reduce lead times and enable products to be produced in small-lot or single-lot quantities. In the cell, one can perform all the steps required to make a part instead of moving that part through several departments. The time required is measured in minutes, rather than days or weeks. In a reference work on cellular manufacturing produced by Ingersoll Engineers (now The Bourton Group), the authors cite the experience of the John Deere Harvester Works in Moline, Illinois.[1] Before cells, a year's supply of rear-axle parts traveled over 2800 miles in a sprawling plant. Cells cut this distance to less than 1000 miles. Other benefits included less inventory, material handling, and lead time.

The Bourton Group cites three outcomes from implementing cells in manufacturing. The same outcomes apply to service environments. They are improvements in *flow, density, and velocity.* Goals for *flow* include simplicity of layout and minimal movement distance of components around the factory. *Density* is the measure of workspace to total space, that is, how much of the factory floor is occupied by value-adding activities as a proportion of total space. Density should be as high as possible. In particular, there should be little floor space in which to put aside inventory because, once it's put down, it tends to stay there. The "bone yards" in electronics plants that collect parts that fail inspection are examples. No one takes the time to perform the rework needed to get the parts moving again or, worse, make needed fixes to the process to prevent the faults in the first place.

Velocity refers to the percentage of time spent in value-added operations. Low velocities are characteristic of high waits for processing — usually in a batch. By this measure, many operations have velocities of 1 or 2%. This means there is only a few minutes of value-adding time in a total process time of days or weeks or months.

Figure 26.8 illustrates a number of differences between the functional and cellular philosophies. First, the functional, or batch, factory on the left is larger — it covers more space to accommodate batches of components that make up work-in-process inventory. The batches flow between departments is shown by different shades. These batches require floor space. So one measure, *density*, is lower.

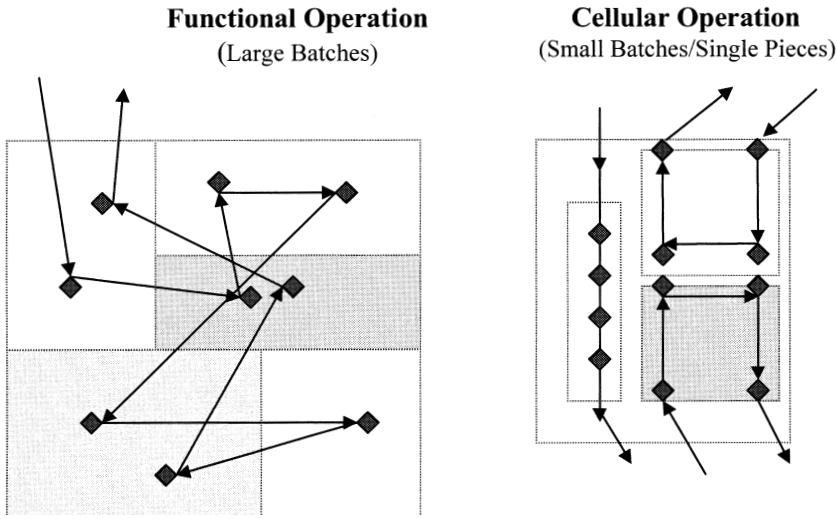


FIGURE 26.8
Functional and cellular layouts.

The flow is also convoluted. Figure 26.8 shows ten moves for a component in the batch operation. Of course, this takes longer, especially when each component moves as part of the batch, which is the only feasible way. The need to control all these moves also raises reliance on computer systems or production control departments to track the parts.

In the functional operation, there is little identity for part families. This makes "flow" hard to identify. Each part has its own distinct routing through the same departments. Another part, if projected onto the diagram, would follow a slightly different, but equally convoluted, path.

The cellular factory has a flow that's easier to understand. This is achieved by dividing the factory into cells based on similar part-family flows. Parts can more easily move in lots of one. Options for designing the cells include the alternatives described in Chapter 13 and shown in Table 26.3.

TABLE 26.3

Alternative Ways to Organize a Cellular Operation

Cellular Approach	Preferred When:	Not Preferred in Cases Where:
Product-centric	Multiple products with differing production technologies. Cost-driven business. Homogeneous customer base. Capital-intensive production technology.	Varied customer base with differing requirements. Relative low-cost production technology. Cost secondary to service in production decision.
Customer-centric	When strategy calls for targeting attractive segments. Style-driven business requiring fast response. Heterogeneous customer base/many segments.	Too many segments to serve. Lack of scale could cause loss of focus. Price-sensitive market.

The selection need not be the same for all partners in the supply chain. For example, our *Process* could find cellular approaches of no value since it is relatively capital-intensive. A functional design around its core process is the best choice. *Old Line* may decide a product-centric arrangement makes the most sense, and *High Tech* might employ a customer-centric cell arrangement to cater to different requirements among its customer segments.

Figure 26.8 shows three cells. These can be product-centric or customer-centric. One line is linear. Others are arranged in the "U" shape characteristic of many cell designs. The U-shape allows for rapid hand-offs in the cell and a common area for flow into and out of the cell. Velocity is up as well as density. Parts move through in minutes or hours rather than days or weeks. There is little work in process on the shop floor to waste space.

Cellular manufacturing has other benefits. A major one is improved quality. In a functional batch manufacturing set up, a whole batch of bad parts may be produced before the error is detected. In the high-velocity cellular environment, the next operation will receive the part much more quickly, and defects will be caught before more bad parts are produced. Methods like this are one of the "pillars" of the Toyota Production System described later.

Cells also facilitate implementation of the "focused factory." The focused factory is a concept introduced by Wickham Skinner.[2] It was further examined and developed by Hayes and Wheelwright.[3] These authors report research supporting the finding that "focused" factories — ones that don't attempt too much — outperform their competitors. The analogy is the athlete. To excel in a sport, one must concentrate on that sport. The two-sport professional athlete is relatively rare. So it goes with factories.

Within the focused factory, each cell can be tailored to customer needs, rather than operating in a "one size fits all" environment. Our description of Acme in Chapter 7 includes a methodology for establishing focused factories. Such an arrangement also supports activity-based costing. Concentrating

operations into a cell produces a budgetary unit closely aligned with a narrower range of products or customers.

26.2.3 Agile Enterprises

A step above cells lies the "agile enterprise." The Bourton Group also coined this term. Later, the Department of Defense sponsored a multicompany effort to develop the concept, referred to as "agile manufacturing,"[4] This effort sought to solidify the vision of "agile." More recently, another article by Eisenhardt and Brown describes patching as practiced by Hewlett-Packard.[5] Their insights enhance the concept. According to these authors, patching "takes the form of adding, splitting, transferring, exiting, or combining chunks of the business."

"Agility" is more a quality than a procedure or body of knowledge. The agile enterprise line of thinking relates to the need to respond quickly in dynamic markets. In these markets, opportunities come and go rapidly. To respond, managers must design production systems capable of rapid deployment to meet these opportunities. We see the agile enterprise as being built on a base of high-velocity "modules" in the form of cells and focused factories (Figure 26.9).

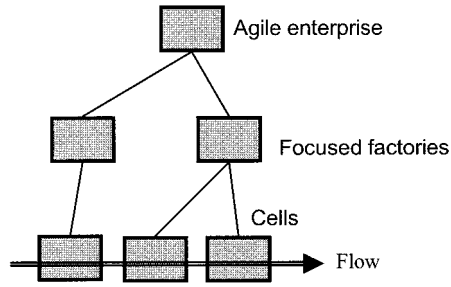


FIGURE 26.9
Agility in the enterprise.

The agile enterprise is one with the capability to respond to these opportunities. It will be able to do two things well:

1. *Rapidly reposition internal operations for new opportunities.* This means structuring internal operations using cells and focused factories. The cells, in particular, must be built to be flexible, even if it means putting wheels under machines.
2. *Be good at partnerships.* Be ready to form or participate in multicompany supply chains. This means the organization must cultivate partnership capabilities, as described in Chapters 15 and 16.

Agility requires rapid responses. Cell capabilities could be deployed more rapidly than entire factories. So the focus in cell design may be more on building in an ability to shift market positions rather than defend any particular market position. Flexibility, rather than cost, is the primary goal.

The agile enterprise extends the philosophy of cellular manufacturing up into the organization. It would encompass infrastructure including control systems, union contracts, rewards and incentives, information systems, and technology competencies. This means, in all probability, that the focused factory or cell can even be dissociated from the enterprise. In implementing information systems, this is something to keep in mind. One company with both manufacturing and distribution capabilities wanted to sell off the distribution side. But interconnected systems made this unlikely, if not impossible. Potential buyers quickly perceived that common systems made these businesses mutually dependent Siamese twins.

Agility also adds another dimension to our definition of speed in the supply chain context. The agile enterprise will be fast, not only in putting out product once it's up and running, but also in setting up supply chains in response to market opportunities. This also supports our theme that variability adds to cost. The agile enterprise should hit the ground running, cutting weeks and months off the start-up of the new business. This is also a goal of automobile companies, as they seek to minimize lost production due to model changeovers.

26.2.4 Toyota Production System

The Toyota Production System is a philosophy of manufacturing that Toyota credits with its success in producing high-quality automobiles. The "system" also relies on manufacturing cells, which we have already discussed. Yasuhiro Monden has documented the system.[6] Many of the features of this system have been copied and modified to fit American companies. The Toyota Production System also serves as a model for "lean" manufacturing. Womack and Jones advocate extending the Toyota approach to the entire enterprise, including paperwork as well as product processes.[7]

Monden's theoretical model points to two "pillars" of the Toyota Production System:

1. **Just-in-time.** This means producing the right products in the needed quantities at the right time.
2. **Autonomation.** This is "autonomous defect control." This term refers to preventing the passing of defective units from one step to another. This avoids the disruptive impact of passed-on defects.

We can see that both support elimination of the unexpected events that introduce variability into the supply chain. Supporting these "pillars" are two complementary concepts. One is the flexible work force. Worker flexibil-

ity enables varying the number of workers with the workload and thereby operating with fewer workers. The other concept is creative thinking that encourages workers' ideas in improving operations.

Monden also explains the technology of the Toyota Production System — some of which we have already described briefly. Examples include

- *Kanban systems* to pull product through the factory and supply chain. These systems create links between operations notifying upstream operations when to move and make production units.
- *Smoothing* of production to minimize fluctuations. This component establishes an operating band to avoid too-rapid fluctuations in production. It also levels the variation due to product mix. So if an operation makes both "easy" and "hard" products, these will be interspersed to even workload. Production leveling includes the idea of "takt" (German word meaning "beat," as the beat of a metronome) time. This time is the interval between production of units of product. It can be long or short depending on the type of product.
- *Standardized operations.* Documentation of individual operations as well as factory-wide expectations for a process. The latter includes cycle time, the operations routine, and quantity of work in process.
- *Set-up reduction.* These efforts, characterized by the SMED (single minute exchange of dies) term, usually involve advanced preparation of equipment needed for production. The external preparation makes for a fast changeover from one operation to another. This is a foundation for attacking the batch mentality that squeezes as much production as possible out of a single set-up.
- *Cells* with improved layouts and flexible workers. A worker can operate several types of machines and is cross-trained in different operations. Multifunctional workers also enable the operation to work with fewer workers.
- *Small-group improvement efforts.* These efforts keep moving the organization toward better operations. It also improves worker satisfaction by offering them a stake in the improvement effort.
- *Visual control systems.* This includes measures to display what is happening in the operations. An example is prominent display of any conditions causing an interruption of flow. A worker can stop a production line if defects are being produced. Such an event would be widely visible to encourage a quick correction to the situation.

Monden describes each of these measures in some detail.[6] In addition to discussion elsewhere in this book, they have also been presented and discussed in depth by others.

26.2.5 Postponement

This term refers to efforts to customize products for customer delivery as late in the production process as possible. An article by Feitzinger and Lee describes the approach used by Hewlett-Packard (HP) with much of its high-technology products.[8] The authors point out that modular design, quick deployment of manufacturing resources, and cost-effective customization are best accomplished as close to the customer as possible.

HP had to make trade-off decisions in its supply chain. These decisions affected product and process design. The company found that the lowest manufacturing cost for a particular product might be achieved by creating an assembly of specialized parts. This meant that each product had unique parts that could only be used in that product. There was no attempt at achieving parts commonality across products.

In this situation, the final configuration was set at the manufacturing plant where the product was assembled. This was "efficient" as far as individual products were concerned. However, when it came to delivering all the products, total cost including inventory and shipping was not competitive. The cause was the proliferation of specialized parts and finished goods inventory. But HP found that a low-cost supply chain could be achieved by using modular parts and customizing the product at the point of delivery. This would be in the distribution center, not the factory.

Figures 26.10 and 26.11 illustrate the postponement concept. In Figure 26.10, each end item, symbolized by the large boxes, is totally separate and independent from other items. Forecasts and production requirements are split. It is necessary, when making production plans, to also forecast requirements for each of the components required, symbolized by the circles.

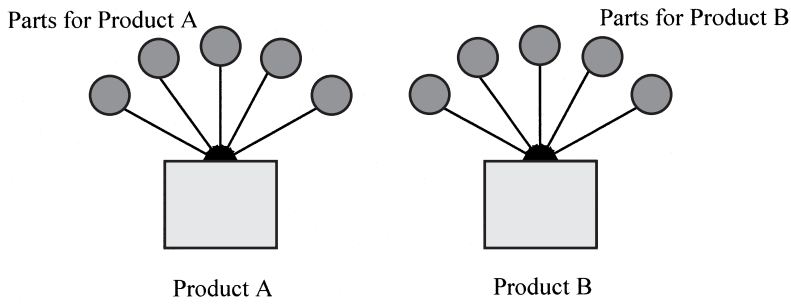


FIGURE 26.10
Before postponement.

The separation increases variability. This arises because fluctuations in the two end products are likely to be greater than fluctuations in the combination. If a way could be found to both shorten lead time and make the total system less susceptible to off-target forecasts, the whole system would be better off.

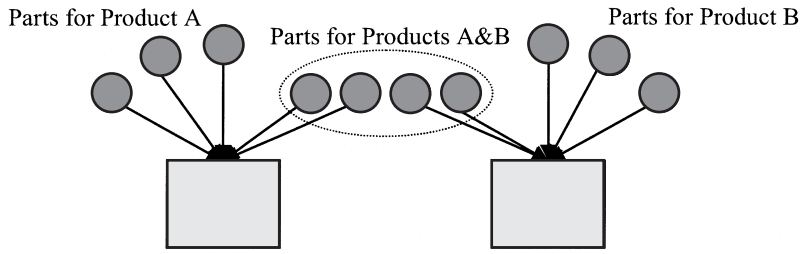


FIGURE 26.11
After postponement.

Figure 26.11 illustrates the impact of postponement. Here the two products are not totally independent. They have common components. These are shown inside the oval in the middle. Both products have been designed with common modules — a foundation requirement for postponement. This is one of the principles behind Dell's success. Using modular components, Dell can build to order. They don't have to forecast end-unit sales at the product level. It can be done at the component level. The benefits of commonality are also demonstrated in the implementation of the 3C approach described in Chapter 29. In fact, "commonality" is the middle "C."

Another parallel is the popular Subway sandwich. Multiple variations are created from relative few basic "modules." In this case the component "modules" are bread, turkey, ham, roast beef, lettuce, onions, and a few others. These are combined into made-to-order products according to customer preference.

A modular product design will affect the operations needed to serve the market. Feitzinger and Lee point to paint stores as good examples of postponement and its effect on operations in the store.[8] Stores equipped with a low-cost chromatograph can analyze paint chips. Then the store can blend "generic" colors to achieve an exact match. This contrasts with the possible need to carry each color as a separate product.

We return to the EOQ equation to illustrate the economics of postponement. The Louis Collection (TLC), a company that imports and distributes French antique "reeditions," had an option for inventory management. The furniture came from Indonesia and had four finishes. One option was to have the Indonesian factory finish the product based on forecasts of customer preferences for individual finishes. The second option was for TLC to finish products to order in the U.S. This entailed the burden of finding reliable, high-quality contract finishers and coordinating the process. Recall that the EOQ equation for each line item is as follows:

$$\sqrt{2RC_p/C_h}$$

where the factors are defined as follows: R is the requirements or demand for each finished line item, usually forecast for the coming period and expressed

in units. C_p is the cost of each order, or batch. C_h is the unit cost of inventory per period.

Since demand was roughly equal for the finishes, TLC was faced with either carrying four line items, one for each finish, or one — with the accompanying headaches of customizing to customer order. The economic order quantity, which set the average inventory, was calculated as follows for the unfinished option:

$$\sqrt{2(4R)C_p/C_h}$$

If we bring the square root term out of the radical, we have the EOQ for carrying the items in the unfinished state:

$$2\sqrt{2(R)C_p/C_h}$$

With the finished state option, commonality is eliminated. The total inventory would be four times that required for each item. (We'll assume that the costs for the additional orders for the finished options are offset by the headaches of finishing the items locally.) The calculation for the finished option is as follows:

$$4\sqrt{2(R)C_p/C_h}$$

So the cycling inventory (without safety stock) is twice what would be expected with postponement. In addition to the savings in inventory, most postponement advocates find there is better customer service. The likelihood of stock-outs goes down with a larger base of inventory from which to draw.

26.2.6 Demand Flow

Demand Flow® is a variation on the theme of postponement.* John R. Costanza has described Demand Flow in his book, *The Quantum Leap*.[9] He uses *DFT* as an acronym for "demand flow technology."

DFT is an organized approach to matching production with demand, as the term implies. It envisions taking a "pile of parts" and assembling them to demand. So DFT works well with products designed around modules. Costanza offers a comprehensive guide to implementing DFT. It incorporates many of the concepts ascribed to the Toyota Production System and other approaches.

DFT could prove useful in extensions to the supply chain. Our conclusion is that DFT techniques must move back into the supply chain to have the greatest impact. Dealing with final assembly, particularly in a complex supply chain, is the "tip of the iceberg." The roots extend backward into the supply base. This also includes design for commonality to maximize the potential for postponement.

* Demand Flow is the registered trademark of the John Costanza Institute of Technology.

26.3 Process Variability

At the outset of this chapter, we mentioned three sources of variability. These include volume variability arising from external factors such as demand fluctuations, internal factors such as end-of-period pushes for output, and process variability. This section deals with the last, process variation. Process variability lies in the execution of the value-adding steps that produce the product or service. These are the "hands-on" operations that directly create value for the customer. Our opening quotation addresses the need to eliminate process variation. We described in Chapter 20 how larger companies, in this case DaimlerChrysler, are dealing with their supply chain partners in terms of assuring both the quantity and quality of incoming goods shipped to their factories.

Reducing process variability is even more critical as partners become more tightly bound by just-in-time, demand-driven supply chain design. As this trend continues, slip-ups by partners are magnified several times. We address this in this section because poor processes lead to bad parts — or no parts as downstream operations dry up. This creates a scramble along the chain to fill in the gap. Indeed, many of the resources it takes to run a supply chain are dedicated to covering foul-ups. Take away the mistakes and, most likely, costs will drop dramatically.

Here we briefly address a few of the "obligations" sellers to these companies must be prepared to undertake. Suppliers to DaimlerChrysler and others that slip below the established levels will find themselves the subject of unwanted "special" attention at best and lost business at worst. We predict these practices, in time, will spread throughout many industries, including distribution and transportation. The best defense is awareness of the trend and preparation to meet the challenge.

26.3.1 Process Capability

The principal measures of process capability are statistical. Even those that don't work with them frequently have probably heard the terms. Common performance measures include P_p, P_{pk}, C_p, C_{pk}, first-time capability (FTC), line speed, and defective parts per million (ppm). In a discussion of supply chains, these should be understood at least at a basic level. They are fast becoming widespread terminology in discussions between supply chain partners. Here, we'll provide a "management overview" of common process capability terms and address their importance in supply chain management.

We'll illustrate the concepts with an example of a part that must be produced to a certain specification. The concepts described also apply to "attributes." Attribute measures are "yes, it passes" or "no, it doesn't pass"

situations. The so-called "perfect order" in the distribution industry would be judged on attributes.

The performance measures calibrate how well a particular process performs in meeting the specified tolerance level. Suppose a part is specified to be 1 inch long with a tolerance range of ± 0.1 inch. Thus, any part between 0.9 and 1.1 inch is acceptable according to this specification. The performance measures gauge whether the process used to cut the part to that length can repeatedly make parts within that range. Using a sample of actual parts, distributions similar to those shown in Figure 26.12 might result.

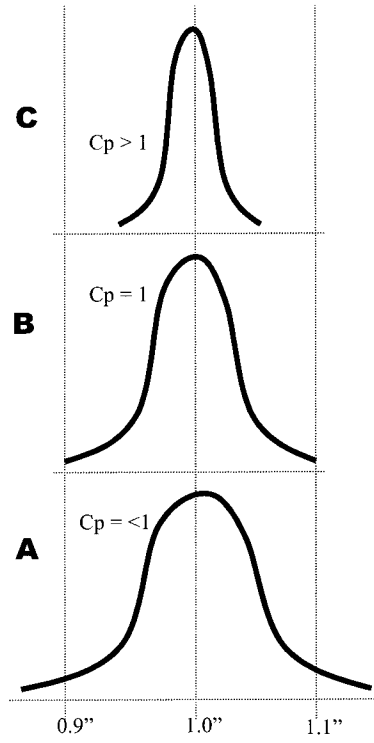


FIGURE 26.12
Process capability.

The shapes take on the familiar normal distribution, or "bell curve." In this example, "A" has the widest distribution as shown by its "fat" curve. The "fatness" is expressed statistically by the *standard deviation*. Higher standard deviations reflect fat distributions, which increases chances a part will be defective. Normal practice is to assure that the variation in the process is low enough so that a six standard deviation spread is well within specified tolerances.

For example, let's assume the six standard deviation spread extends from 0.85 to 1.15 inch, a spread of 0.3 inch. From this information, we can produce a performance measure called C_p. In this example it is 0.2/0.3 or 0.67. C_p is

derived by dividing the specified range (0.2) by the six standard deviation range — 0.3 in this case. This value of C_p will produce about 46,000 defects per million, or about 0.5% defects. On the surface, this sounds quite good. However, if dozens of operations performing at this level are required to complete a product, very few will come off the production line with no defects — at least without expensive rework. So, a C_p at this level is not very good.

Despite the poor performance, such a situation has long been accepted practice in manufacturing and many other industries. For manufacturing, this situation gave rise to "receiving inspection" where buyers tried to prevent suppliers' defective goods from reaching their product lines. Quality procedures now call for 100% inspection of parts if the processes that produced those parts fall below standards, creating a very visible cost of operations. More recently, the healthcare industry has come under fire for sloppy, low-quality operations. The physician's scrawl on a prescription may be illegible. This leaves the process susceptible to quality lapses.

In Figure 26.12, "B" has a C_p of 1. That level of performance corresponds to about 3000 defects per million. "C" has a narrower variation. If the C_p for "C" is over 1.3, a common threshold, the defects per million drop to 60.

Figure 26.12 showed distributions centered on the specified mean — 1 inch. What if they aren't centered? Figure 26.13 shows tight distributions, equivalent to acceptable values of C_p, but off the desired mean. "A" in this case is centered above the mean. "B" is below, while "C" is acceptable because it is centered. The measure C_{pk} corrects for shifts in the mean even though the spread is acceptable. Both "A" and "B" would have C_p ratings in the acceptable range but C_{pk} would be unacceptable for both.

Sometimes only a small sample is available. This happens in the case of a new component or a new process. In these cases the sample may be small and the process untested under high-volume conditions. So managers will calculate P_k and P_{pk} using pilot production samples. In these cases, a higher threshold is required. For example a C_{pk} threshold can be 1.33 while a P_{pk} threshold must exceed 1.67.

The measures we just discussed are likely found for individual operations. Other commonly used performance measures gauge the overall process. First-time capability (FTC) counts the number of acceptable products at each step in the process and at the end of the process. The constraint is that no rework can be done on the item. The picture provided is twofold. It shows how capable the collective process is. It also points to possible bottlenecks that diminish capacity.

The equation for measuring FTC at the operation or process level is as follows:

$$\text{FTC} = (\text{Quantity attempted} - \text{Quantity rejected})/\text{Quantity attempted}$$

An expansion of the measures can take into account the impact of rework. With rework included the yield will of course increase.

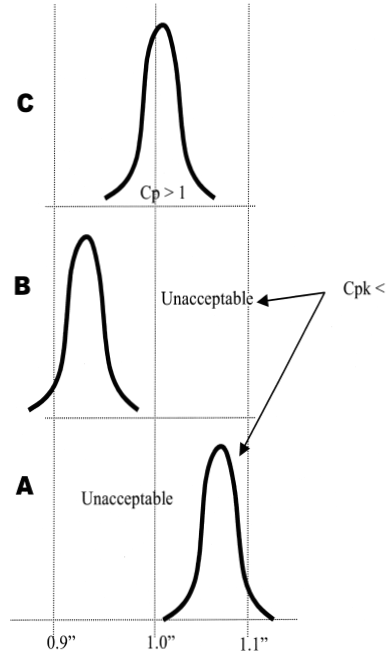


FIGURE 26.13
Calculation of $C_{pk.}$

FTC is often combined with a line speed evaluation. In manufacturing, this evaluation will confirm that the capacity required by the buyer is available. Line capacity is an issue, especially with high-volume, closely linked supply chains. Often the supplier is dedicating capacity, including machines and tooling to fulfill the buyer's requirements. Line speed verification means producing product using the facilities and equipment when full-scale production begins. FTC can be calculated simultaneously. Product can also be produced to measure process capabilities.

26.3.2 Implications for SCM

With low tolerance for error becoming more prevalent, collaboration along the supply chain becomes more crucial. Here are some examples where quality issues are likely to play a part in effective SCM.

- **Designer vs. doer.** The designer, in manufacturing an engineer, must specify what has to be made. He or she sets the tolerances. It does little good to create a specification beyond any known manu-

facturing process. Yet just such incidents draw frequent complaints in many manufacturing organizations. Engineering is accused of "throwing the design over the wall" to manufacturing. Supply chain management will increasingly recognize the need for designers and doers to work together to advance process capabilities.

- **Price vs. quality.** The supplier selection decision may be driven by purchase price. But the lowest purchase price may bring lower quality and an abundance of hidden cost. Buying organizations must guard against this possibility. Supply chain management practice will find new ways, some of which we've described here, to reconcile conflicts between these two perspectives.
- **Old loyalties vs. new blood.** There will be a time when the cord between the organization and a long time supplier will have to be cut to assure the flow of quality components. When this should happen is often a gray area. Changing suppliers imposes a real cost on the buying organization. New sources have to be found; patterns of behavior have to be relearned.

The quality measures mentioned in this section emerged from manufacturing industry experience. They were first applied in the manufacturing operations of major producers like the Big Three automakers. From there they have spread through automotive supply chains to major suppliers. They will continue to move into the operations of non-manufacturing supply chain partners. Examples are transportation, warehousing, and consolidation centers. Similar philosophies will also spread to after-market support, the healthcare industry, and various other services.

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27

Root Cause — Design

> Functionally, however, collaborative engineering calls on a very large cross section of enterprise constituencies and is not limited to engineering or manufacturing professionals.
>
> **C. Anthony Mills**, CASA/SME Blue Book Series

27.1 The SCM Opportunity in Design

There is much awareness regarding the impact of product design on the subsequent costs of the product once released for production. A consistent theme is that the cost of a product or service is "built in" when that product or service is designed. After introduction to the market, control over cost is, to a large extent, lost. Unfortunately, many organizations fail to address supply chain costs in the early stages of product development when the technology challenges are likely to dominate. The focus is on solving those technical problems and getting the product into the market on schedule within defined budgets. As the opening quotation notes, the other "constituencies" that need to contribute to the effort appear on the scene too late.

The consequence is that the product is launched and soon runs into the red. Some of these consequences could have been avoided with better planning. The advent of competition on the supply chain level, added to rapid change in product design and shortened product life cycles, will make planning in the design phase even more important. Examples of such planning include the following:

- *Increased cooperation between designers and producers.* In manufacturing, this takes the form of "concurrent engineering" or joint product development teams. The teams work together to shorten product development lead time and cut costs. The teams are not just from engineering but also include marketing, procurement, manufacturing, and distribution. Our description in Chapter 13 of team for-

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mation at DaimlerChrysler is an example of one company's efforts along this line.

- *Design for manufacturing (DFM).* Design teams use analytical tools to reduce the number of parts in the product and make assembly processes faster and cheaper. This element includes building commonality into the product design. In Chapter 26, we described "postponement." Postponement means the final product configuration can be set further along in the manufacturing process, with final configuration of the delivered product to individual buyer specification. In Chapter 29, we discuss the 3C method of inventory management as an alternative to traditional MRP/ERP approaches. This methodology is most potent when components of various products are interchangeable.
- *Early supplier involvement.* Designers bring their suppliers aboard early to assure the supply of high-quality, often custom-designed components. Suppliers can also identify opportunities to take costs out of products through design changes.
- *Early documentation of financial assumptions.* Companies like Hewlett-Packard measure how long it takes for new products to break even. The focus on a financial return increases the visibility and focuses developers' attention on the importance of meeting cost and revenue targets.[1]
- *Application of best practices.* Early planning, benchmarking, and supply chain modeling can pave the way for new products. The Supply-Chain Council has developed techniques to apply best practices in product planning. Chapter 23 introduces the resource.

These approaches have great value for both individual company and supply chain application. They are also covered well in other books on product development. We have selected two approaches for further discussion. We believe they will find particular value in improving SCM practice.

27.2 Discovery-Driven Planning

This is a methodology for establishing economic assumptions to be encountered in introducing a product concurrently with the technical side of new product development. The tool is described in an article by Rita Gunther McGrath and Ian MacMillan.[2] We believe that discovery-driven planning is especially applicable where a new supply chain is needed for a product.

In essence, planners establish assumptions about the costs, revenues, and profits from the product. In this process they must make educated guesses about the structure and performance of the supply chain, including elements

both internal and external to the company. They then set milestones for the implementation process. At these milestones, they compare actual results with assumptions. The outcome is anticipated in the planning and then "discovered" through this process. If the technique is well executed, contingency plans are at the ready to react when reality departs from the assumptions.

The process requires four documents: a reverse income statement, pro forma "operations specifications," a checklist of key assumptions, and a planning chart showing significant milestones. It is in the preparation of operations specifications that the technique adds value for supply chain management. Here planners must elucidate their assumptions regarding distribution, production, and marketing costs.

The following paragraphs briefly describe the process.

27.2.1 Step 1: Prepare a Reverse Income Statement

The income statement establishes the basic viability of the business. It is "reverse" because one starts with the required profit from the product. This is a foundation principle of discovery-driven planning. It requires that product strategists have such a goal in mind as they authorize products for development. Planners, using the profit objective, work backward to the required costs and revenues. In doing this, they arrive at supply chain cost limits for manufacturing, materials, and distribution.

In our view, an important decision in this process is whether the product is functional or innovative. "Functional" products require different supply chains from "innovative" ones. We discussed the difference in Chapter 6. If the product is innovative, the planning approach needs to estimate the market mediation costs. These are the costs that arise from mismatches between supply and demand. For example, shortages cause loss of contribution from sales — one type of market mediation cost. Overstocking can lead to product markdowns — another such cost.

27.2.2 Step 2: Lay Out Pro Forma Functional Activity Specifications

With the financial statement, one forecasts the operational performance needed to meet financial goals. This requires defining the supply chain activities needed to run the venture. The range of assumptions is broad and will vary depending on the product. Examples are production, distribution, sales force, and revenues. If the product requires a new supply chain, this tool will set financial constraints for its performance.

Because the planner must document performance in the supply chain, discovery-driven planning is valuable for guiding supply chain planning. It is also an excellent time to quantify the innovative or functional supply chain design. The specifications will be different for the two types. Functional products will show narrower margins; so the supply chain design will emphasize

low cost. Innovative products should reflect higher margins; supply chain design will emphasize availability of stock.

If a company specializes in either functional or innovative products and has its supply chains designed accordingly, this is a good time to decide whether it's wise to invest in a completely different type of chain. Alternatives would be dropping the product altogether or licensing the technology to a company with a supply chain that matches the requirements of the product and market.

Some examples illustrate the assumptions needed to write the specifications. In the assumptions regarding sales, this can include salesperson productivity, size of orders, necessary inventory, and sales price. Manufacturing assumptions include capacity, cost of material, and worker salaries. Distribution includes markups and costs of getting the product to customers. In the case where important suppliers provide components or supply logistics services, they should participate in the process of establishing specifications.

27.2.3 Step 3: Track Assumptions

The activity specifications give rise to detailed assumptions that are measurable. For example, an assumption about market share will lead to assumptions about sales per customer and number of customers. The number of customers would, in turn, drive assumptions about distribution channels and inventory levels. In this step, discovery-driven planning provides an important discipline. Assumptions must be reduced to writing, examined for realism, then measured as the venture unfolds.

27.2.4 Step 4: Revise the Income Statement

With the detailed assumptions, the planner can re-create the income statement from the "bottom up." If the assumptions don't produce the financial result demanded by the company, the income statement should reflect that. Changes must produce an acceptable financial outcome. If no such outcome can be produced from reasonable assumptions, then the project should be rethought or scrapped.

27.2.5 Step 5: Test Assumptions at Milestones

The introduction of the product will include several milestones at which the course of the project can be changed. These milestones occur both before and after product release. Examples include completion of market research, prototype production, customer testing, initial sales, plant startup, and periodically after introduction. Variations between actual and forecast performance will point to problem areas — hopefully in sufficient time to take needed action.

Discovery-driven planning will be particularly useful in avoiding mismatches between customer demand and supply chain design. For any one company, a new product or delivery process may fundamentally alter the economics of present supply chains. It may have the effect of rendering them useless for the innovation. It would be an error to assume a new product should ride to market on the back of a legacy supply chain that won't work. Using discovery-driven planning is a way to avoid the trap.

27.3 Stage Gate Process

Stages and gates, an approach developed by Robert Cooper, will improve supply chain planning in companies with numerous projects.[3] In these situations, the projects are usually of different sizes and priorities. They are moving at different paces through a product development "pipeline." While many companies already use some form of the technique, that use is often confined to the technical side of the development process. We believe the stage and gate technique suits both product *and* process improvement.

Like discovery-driven planning, stage-gate design places checkpoints in the development process for review of progress and outcomes. The stage-gate approach focuses on the pre-launch phase of the product life cycle. Discovery-driven planning extends further into the product life cycle, covering the periods both before and after launch.

The "gates" require "deliverables" to be completed before proceeding to the next stage. The design of the stages and gates should fit business needs, with the likely result of more gates when more-complex products or processes are under development. The accompanying figure shows the impact of introducing stage-gate discipline over a product development process.

Figure 27.1 shows two pipelines for development projects. The "Before" pipeline has no stage-gate controls. Projects of both high and low priority are distributed along the timeline. They no doubt move at their own pace. Many may have been in progress for an extended period. Management may have "pushed" products into the pipeline without considering the impact the additional product would have on what's already in progress. In many cases, there is little involvement by supply chain partners.

The "After" pipeline, in this example, has three gates, with stages following each gate. Cooper uses a convention that projects before Gate 1 are in a stage called "ideation." After Gate 1 comes Stage 1, after Gate 2 comes Stage 2, and so on. The gates provide positive control over progress through the pipeline. For example, managers may hold low-priority projects at gates to focus on more urgent projects. This is the right thing to do when the pipeline is too full to complete "hot" projects on time. The gates also enable progress monitoring. Schedules for reaching the next gate provide management by exception.

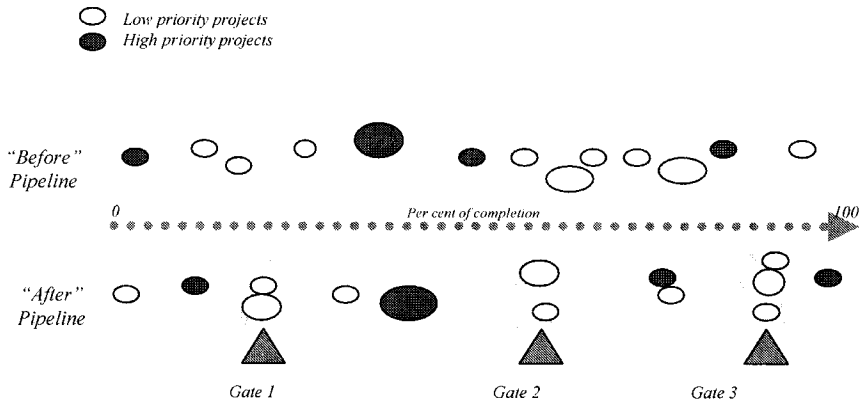


FIGURE 27.1
Before and after view of stage gate implementation.

A gate, according to Cooper, has inputs or deliverables, decision criteria, and outputs.[3] One such deliverable could be updated assumptions using the discovery-driven planning technique. Cooper advocates that the gate decision process should have two parts. The first part decides whether the project is sound. This is done as if the project is the only one under consideration. Assuming the project is sound, the second decision addresses the project's priority. This requires evaluation of resources and priorities to determine if the project should proceed past the gate. The decision may allow the project to proceed, call for its cancellation, or place it on hold until resources are available.

The stage gate process fails, of course, if management doesn't demand the preset deliverables before allowing a project to pass on to the next stage. It also fails if lower-priority projects aren't set aside for higher-priority projects or canceled outright.

Cooper offers a generic stage-gate model with five stages and gates.[3] We show this model in Table 27.1. We've added our suggestions for supply chain decisions that an organization could address at each gate. The shaded rows are stages. The unshaded rows are gates. For each gate, there's a brief description of the supply chain deliverables that could fit that gate.

The recommendations for a "supply chain stage-gate process" call for early consideration of needed supply chain changes. The initial assessment at Gate 1 is whether a supply chain change is needed at all. At Gate 2 developers should know the type of product it is in the case of a new-product situation. At this point, we believe candidate partners should be identified. The business case at Gate 3 should produce a discovery-driven plan that requires documentation of supply chain assumptions.

TABLE 27.1

Applying the Stage Gate Technique to Supply Chain Management

Stage or Gate	Supply Chain Deliverables
Ideation: Developing Product Concepts	
Gate 1. Initial screen	List needed supply chain changes. Assess whether the existing chain is appropriate for the product or process.
Stage 1: Preliminary Investigation	
Gate 2. Second screen	Forecast product margins. Decide whether innovative or functional product. List requirements for a new supply chain if it's needed. Identify supply chain partners to be involved in development process.
Stage 2: Detailed Investigation (Business Case)	
Gate 3. Decision on business case	Perform conceptual design of new supply chain (if applicable). Prepare first-cut discovery-driven planning model. Apply SCOR model if applicable.
Stage 3: Development	
Gate 4. Post-development review	Prepare detail work plan for implementing supply chain requirements.
Stage 4: Testing and Validation	
Gate 5. Precommercialization business analysis	Test early discovery-driven planning assumptions.
Stage 5: Full Production and Launch	
Post implementation review	Measure performance against discovery-driven planning assumptions.

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28

Root Cause — Information

> Most companies have the requisite information technology in place to extend the enterprise; the problem is they are not using it properly.
>
> **James Morehouse**, A. T. Kearney

Chapters 22 and 23 described supply chain applications and the work of the Supply-Chain Council in promoting supply chain information integration. Here, we point to ways to use the capabilities of these systems to reduce supply chain cost and cycle times. James Morehouse points out that, for many, the tools are already available.[1] How to use them "to extend the enterprise" is the challenge.

We have pointed out that information sharing along the supply chain is difficult for many reasons. Inside the walls of a single company, department boundaries are barriers. The barriers are no less difficult across companies. Also, the traditional arm's-length relationship between buyer and seller makes many reluctant to share information. Technologically, the means to share can be difficult as well. The system in the supplier may not talk to the system at the buyer. However, we believe the technological barriers are falling rapidly. The major challenge ahead will be to decide *what* information to share, not *how* to share it.

Once systems are modernized and compatible across the supply chain, there are some exciting possibilities for using the capability. Now that the Y2K surge has passed, many senior managers are asking, "What next? How can I make some money out of this capability?" The consulting firm A. T. Kearney refers to this next level of capitalizing on systems as "XRP." This connotes drawing information for decision making from the newly developed systems.

Keith Kennedy of CGR Management Consultants describes the next level as "proactive systems." It is these systems that offer ways to produce competitive advantage.[2] Proactive systems use technology to "push" needed information to decision makers. Here we'll describe how proactive systems can improve the supply chain.

In earlier sections, we stated that better competitive position comes from being "different" (Chapter 7). We described how to develop supply chains developed around the needs of a target market that would set you apart from

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the competition. In our discussion of information systems, we described some of the new categories of supply chain applications software (Chapter 22). We also described how the Supply-Chain Council (SCC) has developed generic models for supply chains (Chapter 23). The SCC models are "high-level" and generic to broad categories of supply chains. The details that can produce competitive advantage are left to the individual company and its supply chain partners to implement.

28.1 The Cost of Being "Unintegrated"

Manufacturers have long emphasized cost reduction in their improvement efforts — particularly on shop floor and direct labor activity. But today's supply chains are increasingly knowledge based. They are composed of information factories as much as producers of physical goods. The typical cost of a manufactured product is about 10% touch labor, 50% direct material, and 40% overhead. The overhead figure, in particular, includes a lot of information handling — the domain of the so-called white-collar worker. In a company with this cost profile, these functions will consume several times the resources directly related to production. Of course, the service business is even more information-intensive.

How is this 40% spent? What is the deliverable? Too often it is expediting, endless meetings, chasing information, and other "coordination." Little of it is value-added work that matters to the customer. In other words, it is waste. For day-to-day processing of orders and making goods, for new-product design, for better communication along the "supply chain" with customers, distributors, and suppliers, better ways of managing information will reduce waste.

28.2 Defining Integration

In Chapter 3, we referred to Hau Lee, a Stanford professor noted for his contributions to supply chain thinking. Lee defines supply chain integration as having three components.[3] These are *Information*, *Organizational Linkage*, and *Coordination*. *Information* refers to the sharing of information and knowledge. Examples include production and sales forecasts to assure coordinated action among partners. *Organizational Linkage* encompasses the means to communicate, whether by EDI, Internet, or face-to-face meetings. According to Lee, *Coordination* refers to "decision rights, work, and resources in a supply chain."

Once the first two elements are in place, we believe it is the *Coordination* element that offers the best leverage for better supply chains from information systems. This will come through the implementation of proactive systems, which will by no means be trivial.

Application of proactive systems has three dimensions: *deployment*, *completeness*, and *timeliness*. *Deployment* means that those entrusted with decision making understand their roles in the process and how to act on that information. *Completeness* means that the information needed to make the decision is accessible. *Timeliness* means the information is available promptly enough to meet customer requirements. "Zero latency" is a term we used earlier that describes the ideal with respect to timeliness. This means the delay between the occurrence of the event and its communication to the decision maker is instantaneous.

There are many paths to integration for any process. They may or may not involve technology for passing information back and forth. For example, new-product development teams arrange to improve integration. Management empowers the teams to make decisions. Being together makes sharing of information easier and faster. Thus, product-development teams increase integration along the deployment and timeliness dimensions.

Cellular manufacturing, described in Chapter 26, is an example often implemented on the shop floor. Clustering unlike operations gives rapid feedback to workers on quality, cuts production cycle time, and enables companies to match production to actual demand, eliminating dependence on forecasts. Integration increases along all three dimensions.

Quality Function Deployment (QFD), described in Chapter 6, is another integration tool. QFD arrays information to help designers and manufacturing engineers make decisions related to new-product design and production. In particular, QFD addresses the completeness dimension of integration. The discipline of QFD forces the team to "fill in the blanks."

A common mistake is to assume integration has to mean new technology. The consequence of leaping to this conclusion could be a lengthy, expensive, and ultimately unsuccessful endeavor. Business judgment should dictate the role of technology in achieving integration and what matching efforts should accompany the technology. When it comes to coordinating widespread supply chains, simple, low-technology solutions may be better.

But technology is too important to ignore in the journey toward integration. Turning it to competitive advantage will be important in surviving in the coming decade. This will be particularly true as technology users turn to proactive systems to improve integration of decision making.

28.3 New Architectures

Advancing technology enables new ways to think about process improvement. Here we describe current practice, proactive systems, and how this new thinking will affect the way supply chain managers plan and implement improvement. Figure 28.1 is an example of what a manufacturing and distribution company's system architecture might look like. The figure shows the subsystems that might define an order fulfillment process. They require the movement of information across several functional departments — in the example they are sales, inventory planning, and purchasing.

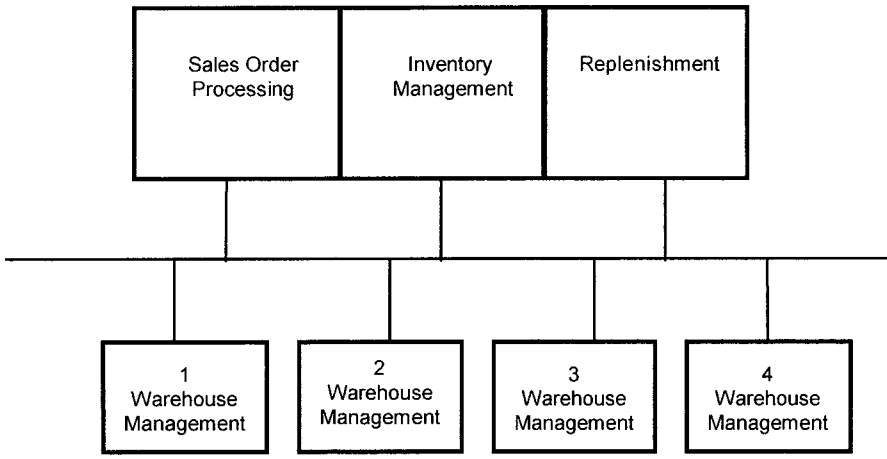


FIGURE 28.1
Traditional manufacturing model.

The architecture probably incorporates a database structure, so transactions are recorded in the system, and the system can share information across departments. Unlike older batch systems, the information is relatively current, as users enter information continuously, and it is readily available to other users. The organization structure may have dictated the system design. Each function (order processing, inventory management, and so forth) has custody of its own piece of the system. For this reason, the processes the systems support tend to be "sequential" in nature. Information moves from department to department for action. Accountability is fuzzy.

An example illustrates the point. A salesman writes a large order for widgets in the field. This order happens to exceed the forecast sales of widgets for the period. In a sequential process, the sales department notifies the inventory planners. They check on-hand and on-order balances and in turn notify purchasing to accelerate orders of widget materials.

The time it takes for this response may be several days or even weeks. The cost of delay is reflected in excess safety stocks, dissatisfied customers from delivery delays, and lost sales. Certainly this activity could contribute to the 40% waste mentioned earlier in many companies.

28.3.1 The Promise (and Threat) of New Technology

As we have indicated, there are several paths to integrating this process. For example, management could place all three widget functions in the same room or in the same department. By word of mouth, people communicate the impact of the big order. Another integration method is the production meeting. A sales-department representative brings up the sales orders in the meeting. Together, attendees check their respective printouts and "discover" the shortfall in widgets. The attendees carry the information back to their departments, passing the warning to the person responsible for widgets.

Many companies improve integration by enabling departments to look into the data generated elsewhere. This access to data across departments is the current standard definition for integration. Information is entered once — perhaps into the sales system. This is important progress, but it is still "passive." People have to identify conditions demanding decision-making action. To do this they use their experience and own personal rules of thumb.

28.3.2 Proactive Systems

Like conventional systems, proactive systems center on major processes. What proactive systems add is a focus on decision-maker needs in those processes. Decision-makers fulfill *roles* in the process based on customer needs. Thus, where decisions are required, such as the case of our large widget order, the proactive system uses preset *rules* to process information. This processing then *routes* information to decision makers, following those rules.

In Figure 28.2 the decision maker is at the center. Extending the example of our widgets, we call this decision maker a "planner buyer." Inputs from the external environment of suppliers, customers, and other departments either pass through existing applications like the order entry system or go directly — by e-mail for example — to our decision maker. The arrows represent data transactions within the system.

So far, this is not too different from what exists today in many companies that use workflow systems. What converts the environment to "proactive" is the *rules server* that processes the inputs to our decision maker. The rules server contains preset rules that shape the direction of information flow. The rules match the needs of the individual decision maker and reflect the authority vested in that individual. They are a product of management practice on empowerment, continuous improvement, and organization philosophy. Values, philosophy of delegation, and decision analysis, not technology, dictate

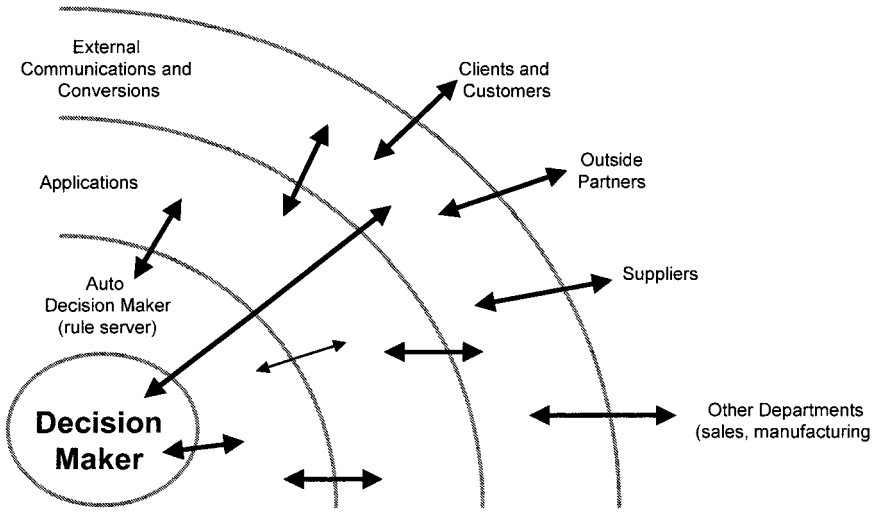


FIGURE 28.2
The proactive system model. (Reprinted with permission of CRC Press, LLC.)

rules. Of course these will be unique to any particular organization and, therefore, a source of competitive advantage.

For example, the rules could notify the planner buyer by sending a message about the large widget order. They would assume our decision maker would know what to do. The workstation would signal the planner buyer about the order. This automated contact makes it "proactive."

The rule designers could be more aggressive. The rules could interpret the sales order, identifying the need for more material. The rules could then print purchase orders and direct them electronically to suppliers. Then the rules could notify the sales forecasting group to review their planning assumptions. Finally, for finance, they might order the system to recast income statements and balance sheets to reflect the order, notify the bank of a need for more credit, and print supplier checks.

The net effect is automation of information processing, replacing the production meeting or messengers carrying paper. Just as automation in the factory streamlined metal cutting through numerical control, or material handling through robotics, the proactive system speeds information flow. When measured against our indices of integration — deployment, completeness, and timeliness — a proactive system moves the organization closer to 100% integration.

Starting on the path to the proactive system offers many opportunities for short-term improvement. There may be ways to integrate, permanently or temporarily, the widget fulfillment process without automation. For exam-

ple, in the case above we combined the functions of inventory management and purchasing into the role of the planner buyer.

In many cases, the critical examination of required decisions finds all sorts of alternative solutions that produce faster and better decisions. Individual practice, a result of training and habit, gives way to a uniform "best practice" by design.

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29

Root Cause — Weak Links

In emerging markets, we don't have lots of bricks and mortar, so they are perfect markets for us to learn from.
Mark Hogan, General Motors, *Wall Street Journal*, October 25, 1999

29.1 The Role of Links

Linkages are how partners in the supply chain coordinate their joint enterprise. They include any of the supply chain components — physical, information, financial, or knowledge flow. Strong links lead to a well-coordinated effort; weak ones to an uncoordinated effort. The above quotation comes from a General Motors executive. He was pointing out the "green field" opportunity presented by emerging automobile markets. These markets are unencumbered with the dealer networks and inflexible assembly lines we have in the U.S. As such, they are an excellent test bed for introducing e-commerce solutions — an innovative linkage — into the supply chain. For a world moving to e-commerce, the dealers and assembly lines could become weak links.

Supply chain partners are like warships at sea, where their combined strength is presumably greater than that of any one member. When under way, the movements of the fleet must be coordinated. For example, to maintain their formation, all ships must turn at the same time when the course they are steering is changed. Moving independently creates chaos, and leaves the fleet vulnerable to attack. Ships at sea have many ways to communicate their course changes. These include radio transmissions of voice messages, semaphore (signaling flags), encrypted radio signals, blinking lights, and, particularly if submarines are part of the formation, underwater telephones. The supply chain has similar needs for linkages. As one might expect, there are many variations as well.

Some have also likened the supply chain to a symphony. At the symphony, the conductor leads musicians. The sheet music defines the production and timing of contributions from each orchestra member. In SCM, linkages play

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the roles of conductor and sheet music. The SCOR model (Chapter 23) is an example of one method for developing a coordinated effort in supply chain planning. Another example, in the Toyota Production System, is the *kanban* system described in Chapter 26. Proactive systems (Chapter 28) are another example. The decision to use any particular technique at a point in time is an important supply chain design feature. As in the case of ships at sea, there are others, of course.

We have contended through this book that supply chain linkages are a special category. Supply chain linkages can range from "tight" to downright "unwieldy." So supply chain partners must be careful in their design. In general, we believe that "less is more" and "elegant simplicity" will win out over complex, expensive linkages. Here we describe approaches that follow this philosophy.

29.2 Theory of Constraints

TOC will find, we believe, widespread application in supply chain orchestration. The theory of constraints was described earlier in Chapter 25.[1] In formulating this theory, Eli Goldratt and Robert Fox observe that a production system can produce no more than its "capacity constraint resource," or CCR. They use this principle as a foundation for what they call the "drum-buffer-rope way." While the authors focus on individual factories, the lessons apply equally to the supply chain.

To illustrate its application, we return to our supply chain case study. From Figure 29.1, we see that the longest lead-time operation in the supply chain is 45 days at *Old Line*. This is likely to indicate the presence of a CCR at that operation. Managing the CCR is the core of the drum-buffer-rope, or DBR approach. The *drum* sets the beat determined by the capacity of the CCR. This is equivalent to takt time, or the interval at which products are produced. For example, a supply chain that operates 5000 minutes a week and is designed to produce 1000 units per week will have a takt time of 5 minutes (5000 minutes/1000 units) with level loading of work centers in the supply chain. This drumbeat paces the entire supply chain's production. Because it is the constraining resource, there is no point in letting other operations march faster than the "drum" will allow.

The *buffer* is a device to protect capacity at the CCR. This protection is in the form of inventory that assures a supply of work for the CCR in case of upstream disruption in supply. The size of the inventory is equivalent to the number of days needed to recover from any anticipated disruption upstream interruptions. If a disruption at *Process* stops the flow of material to *Old Line*, a buffer will keep the CCR at *Old Line* going until the disruption is fixed.

The DBR system's final component is the *rope*. The rope is symbolic of the link between the CCR and the front end of the production process, or gating

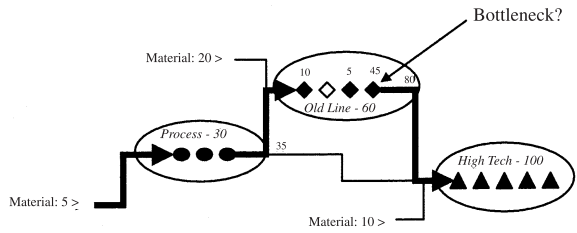


FIGURE 29.1
Identifying the CCR in a supply chain.

operation. Its purpose is to prevent production in excess of capacity at the CCR. This avoids the common problem of launching more production into the supply chain than it is capable of handling.

Like the ships at sea, the linkage that communicates along the supply chain should fit the situation. Alternatives range from digital signals from linked information systems to physical forms like the *kanbans*. For an automated linkage, a proactive system approach, as described in Chapter 28, could establish the routing of the signal and the appropriate responses.

The DBR system assures maximum output from the CCR, hence the entire supply chain system. For example, assume the supply chain partners determine that *Old Line's* operation is the system's CCR. As such, it will set the pace for the entire supply chain. Linkages will pace operations at both *Process* and *High Tech.* The form is less important than the realization that it's needed. Options include periodic (hourly, weekly, or even monthly) status or automated linkages for continuous monitoring.

29.3 Replenishment Rules

Another component of supply chain linkage is the quantity-timing decision for production. This decision includes the rules by which partners will order and replenish stock along the supply chain. Monden also describes the alternatives used to set up *kanbans* in the Toyota Production System.[2] The first option is *constant quantity*. With the constant quantity decision, the same quantity is produced when a production need is triggered. This is particularly appropriate for operations with high set up costs. The selected quantity should be sufficient to assure an economic transfer. The second decision option is *constant cycle*. With this rule, stock is replenished on a fixed cycle. The quantity is determined by the actual amount used.

Both methods pull material through the supply chain. According to Monden, the constant cycle method is favored for subcontractors in the Toyota Production System. These may take the form of "milk runs" to the supplier several times a day, a constant cycle method, to pick up material for

assembly lines. The constant quantity method is favored for internal suppliers. The difference is the distance factor. Constant cycle delivery leaves less to chance from transportation disruptions over longer distances.

The supply chain requires linkages to trigger movements of material. In general, they will follow either the constant quantity or constant cycle rule. The rules can be mixed as we saw in application of the SCOR model. But one or the other should govern the movement of each item in the supply chain. Table 29.1 displays the advantages and disadvantages of each.

TABLE 29.1

Constant Quantity or Constant Cycle?

Option	Advantages	Disadvantages
Constant quantity	Better for close operations with minimal transportation requirements. Can take advantage of EOQ economies for operations involving high set-up costs. Fast, doesn't require counting or tracking of inventory. Simplicity. Compatible with visible signaling. Examples are the two-bin system and *kanban* approaches. Easier to predict time requirements once orders are placed.	Can cause excess inventory in the system. Better for low-cost, "C" items. Some companies expense items in this category.
Constant cycle	Establishes a regular rhythm in the supply chain. Decreases variability from uncertainty about production volume. Can take advantage of set-up economies when set-up times depend on sequence. An example is paint lines where different color sequences require different set-up efforts.	Variation in quantities can cause production to run behind. Have to track production through the chain. Need to know usage at various points to signal correct quantity. Fits higher-value "A" items.

Working out which method to use is subject to objectives for the supply chain, contractual discussions, experimentation, and logistics between partners in the supply chain. But agreement to linkages and replenishment rules will be vital to orderly and low-cost movement of work through the supply chain.

29.4 The 3C Alternative

Three managers from Lucent Technologies operations in Spain have devised and road tested a simplified tool for optimizing supply chain performance.[3] They call their methodology "3C," which stands for *Capacity*, *Commonality*, and *Consumption*. The method is an alternative to what they view as flawed MRP approaches. In particular, they object to the reliance on forecasts inherent in the MRP methodology. We also discussed MRP/ERP shortcomings in Chapter 22.

In the 3C method, supply chain *capacity*, the first C, is the governing parameter over the amount of inventory in the system. Under 3C control, the chain should have a sufficient number of any one part on hand to produce to the capacity of the chain for usage of that part. To the extent parts are *common*, then the overall inventory is less, since a single part will support several products.

Table 29.2 provides an example to explain the concept. The simple system we describe only has four parts and three products. The capacity of the supply chain is the number of units of each product that can be produced in a given period. This assumes that the system is producing nothing but that single product. The "target" inventory is determined by the maximum potential demand for the part during the period. For example, Part A's target inventory should be 20, since Product 2 capacity is 20. Part C's target is 30 due to potential demand from Product 3. A level of 20 for Part A and 30 for Part C will cover the needs of any potential demand scenario.

TABLE 29.2

The 3C Alternative Method

	Product 1	Product 2	Product 3	Target
Part A	1	1	1	20
Part B	2		1	20
Part C	1		3	30
Part D		1		20
Capacity	10	20	10	

As parts are *consumed*, then they are replaced in sufficient amounts to maintain the target inventory. This concept is applied to all "points of consumption" through the supply chain. Thus, actual demand provides the signal for replenishment in the chain. No stock is reserved for any single forecast need. So a company using the 3C method would do away with forecasts for each of their products — eliminating a source of confusion and inventory overbuilding. With 3C, only capacity, not lack of parts, restricts what can be delivered to the customer. Frequent updating is abolished.

Changes in the targets occur only at times when product or market changes make it necessary.

The authors have performed simulations demonstrating that 3C bests the MRP method in many cases. We believe 3C is a valuable addition to thinking about both supply chain systems and "rules of the road" among partners. In our discussion of system needs in Chapter 28, we stated we believe that supply chain management will call for simpler rule making with respect to inventory maintenance and restocking rules. 3C fulfills the criterion for simpler methods.

29.5 Collaboration

Throughout this book, we have described the barriers to more effective supply chains. We have also described many of the tools and techniques that address this barrier. One initiative addresses both the cultural and technical barriers to collaboration among supply chain partners. The initiative is collaborative planning, forecasting, and replenishment (CPFR). CPFR requires a business relationship between partners and has taken root in the retail industry. Collaboration strives to better match demand and supply, improve inventory management practices, and capitalize on new systems through sharing. CPFR is primarily a link between retailers and their manufacturer suppliers. It is expected that the concepts will expand to other industries.

CPFR is moving forward with standards for communications, innovations in placing and filling orders, and roadmaps for business arrangements. The obstacles are not technical, however, but cultural. As we discussed in Chapter 14, top management commitment is necessary to forge partnerships. A key to successful implementation of CPFR will be removing these barriers. A primary barrier is the evolution of the "flow model" described in Chapter 26. Often the planning cycles of manufacturers and their retail customers are unsynchronized. CPFR attempts to implement a common forecast that represents a compromise between the needs of both parties.

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Section III

Supply Chain Methodologies

The following chapters (30 through 33) are directed at the "how to" aspects of implementing supply chain improvements. In any supply chain improvement effort, one can use a guide with instructions for proceeding. The methodologies provide such direction. They contain advice of two types:

1. Help in executing a supply chain improvement program
2. Help in executing a task one is likely to face in implementing a program

We suggest reviewing the methodologies that might apply to your situation. You have the best knowledge of where you have been and where you need to go. Then select the elements of the methodology you think best fit your needs. The four chapters that follow cover the following:

Chapter	Title	Description of the methodology
30	Supply Chain Prestudy	This is a Type 1 methodology that lays out ways to organize a supply chain improvement effort
31	Implementation Roadmap	This is a Type 1 methodology that describes how a supply chain improvement effort is likely to unfold over a three-phase implementation process.
32	From Purchasing to Strategic Sourcing — A Roadmap	This Type 2 methodology describes the stages a purchasing organization is likely to pass through as it changes its supply chain management practices.
33	Selecting Supply Chain Software	Supply chain improvement teams are likely to evaluate software applications over the course of the improvement program. This Type 2 methodology provides advice on accomplishing this task.

30

Supply Chain Prestudy

Once an organization has decided to compete on the basis of supply chain design and performance, management must begin the process of changing their supply chains. The "prestudy" assesses opportunities for improvement in order to decide where to begin. The prestudy recognizes that identifying supply chains in a complex operation is something of an art. Many operations overlap. Many departments support multiple products. Products are sold to a variety of customers in different market segments, each of which has different objectives.

Because of this complexity, many companies evolve to functional organizations with "one-size-fits-all" supply chains. These are seldom efficient in terms of cost, service, or speed in meeting the competitive demands of customers. Newcomers, with little investment in outmoded structures, take over markets with superior supply chains. Extracting and evaluating the underlying supply chains embedded in the organization is the beginning of the improvement effort. The prestudy starts to "disassemble" functional processes and catalog the differences among customers that can lead to tailored, competitive supply chains.

The prestudy should last no longer than 3 or 4 weeks. One or two analysts are sufficient for the effort. The conclusions of the prestudy should focus on the best opportunities for improving competitive position through supply chain redesign. The effort may reform an existing chain, create new ones, or combine multiple chains into one. In many cases the information gathered in a prestudy will be preliminary — that is, management's best guess as to the situation. Judgment should determine if further verification of an assumption is warranted. If so, the plan should include this work.

30.1 Organize End Users

The prestudy should begin with end users. These may not be direct customers for an organization, but they ultimately determine the success or failure of the product. To understand what will make the supply chain more effective, one has to understand the motivations of these users.

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30.1.1 Define Market Segments

The prestudy team should list user groups. Groupings may be by application of the product, location, volume, the supply chain to reach the user, or other characteristics. You will define several groups. We assume four for illustration.

- Customer group 1
- Customer group 2
- Customer group 3
- Customer group 4

Next, form segments from the customer groups. One or more groups may make up a segment. Combinations of groups into segments are particularly valid when they share supply chains. So one might have a revised grouping like the following:

- Segment 1 (Customer groups 1 and 2)
- Segment 2 (Customer group 3)
- Segment 3 (Customer group 4)

Four customer groups have been combined into three segments for the purpose of supply chain design. This could be due to commonality in the supply chains that reach them plus the belief that they have common requirements in terms of supply chain design.

30.1.2 Map Products to Segments

Next, list products or product lines. A line may be a group of products produced in the same facilities. Or it may include different products that serve common markets. A common supply chain could also define a product line. An example would be "all products sold in Asia" or "all products sold through distributors."

Map the product lines to segments. The resulting table could appear as follows:

	Segment 1 (Customer Group)	Segment 2 (Customer Group)	Segment 3 (Customer Group)
Product line A	$$$	$	
Product line B			$
Product line C		$$$$$	
Product line D	$$		

In the table, the dollar signs indicate product profit by segment. It shows that Product C is the most profitable by virtue of sales to Segment 2. Product line B is the least profitable, with sales to Segment 3.

30.1.3 Identify Supply Chains

Identify the supply chains supporting the customer segments. In our example above, we might find there are three supply chain types. These include the following:

1. One supply chain for all three segments. This is most common in smaller companies.
2. A separate supply chain for each product line. This is often the case when each product is made by a different profit center. This is the most common in larger companies.
3. Supply chains organized by customer segment.

Seldom do we see supply chains organized around customer segments.

If we identify two supply chains, they might appear as follows:

Supply Chains		Segment 1 (Customer Groups)	Segment 2 (Customer Group)	Segment 3 (Customer Group)
SC1	Product line A	$$$	$	
SC1	Product line B			$
SC2	Product line C		$$$$$	
SC2	Product line D	$$		

In this case, we show two supply chains (shown with the prefix *SC*). As commonly found, they are product-oriented. SC1 serves product lines A and B. SC2 serves C and D.

30.2 Describe the Supply Chain(s)

With the supply chains identified, their configuration should be documented with flow charts and supporting data. These need not be elaborate due to the time limitations of a prestudy. But they should convey an understanding of the basic structure of the chains. Accompanying the flow charts should be metrics and other information that characterize current performance.

30.2.1 Document Physical Flow

Fundamental to most supply chain representations is physical flow. The prestudy flow chart should show the following:

- Echelons of the supply chain including major suppliers, manufacturing centers, distribution centers, warehouses, and customer segments.
- Methods of transport between echelons.
- Volumes of product flow in dollars, units, or volume.
- Cycle time for moving material in the chain, preferably broken out by echelon.
- Inventory levels along the chain, including those at suppliers and customers.

30.2.2 Document Information Flow

Information flow is an increasingly important component of the supply chain. A great deal of competitive advantage is possible by improving information flow. Among the elements needed to describe information flow are the following:

- An information flow chart that shows where sales information is generated
- Decision points along the chain, including the people responsible for the decisions
- An inventory of information systems tools used to plan and control the process
- A listing of formal and informal contracts between supply chain participants

30.2.3 Document Financial Flow

A similar process should include financial flows. This is particularly true if there are any innovations in the way this flow is handled. Among the topics to include are the following:

- Cash-to-cash cycle. This shows how long it takes from the first expenditures to the time money is collected from the end user.
- Balance sheet figures including inventories, accounts payable, and accounts receivable.
- Estimated activity costs across the chain. Use end-user purchase price to "allocate" funds to supply chain activities.

30.2.4 Document New Product Flow

New products can often upset existing supply chains. To the extent new products are contemplated, the processes should be examined. This should include

- Expectations for new-product introductions. Supply chain implications.
- An understanding of how the new-product process incorporates supply chain participation, if it does.
- Special supply chain requirements for supporting new-product development. An example is finding reliable sources for components requiring special features.

30.3 Document Management Processes

Time should be spent on understanding basic planning processes and recent initiatives. This will help frame management's approach to process improvement, strategic planning, and capital investment. The processes described here are usually available in document form.

- Understand strategic plans that affect the supply chain. Review strategic initiatives and competitive evaluations.
- List recently completed and ongoing improvement projects. This includes facilities, equipment, and systems. Trace back at least 3 years and forward over the company's planning horizon.
- Explain justification process for capital investments. If a procedure exists, review how it's applied. If possible, review candidate projects in the most recently completed capital budgeting cycle.

30.4 Interview Executives

The prestudy should include interviews in one-on-one meetings, group settings, or workshops. These should draw out the following information.

30.4.1 Describe Customer Requirements by Segment

Understand what customers demand by segment. Use interviews, market surveys, or direct input from key customers.

30.4.2 Assess Relative Strengths and Weaknesses by Segment

Gain an understanding of current position. This can be based on opinions of management, market share data, and financial reports.

30.4.3 Understand Barriers

Any organization will have constraints on its ability to act. Here is a list of possible constraints or barriers that should be considered in planning supply chain changes.

- Human resources. Considerations for employee relations. Constraints on talent.
- Financial. Constraints on capital availability and objectives for profitability.
- Capacity. Limitations on the ability to increase or decrease capacity.
- Product lines and customers. Products and customers, whether they are profitable or not, that must be supplied. The source of the constraint.
- Past capital investments. Infrastructure that must be included in future plans.

30.5 Prepare Conclusions

The conclusions condense the data into recommendations for proceeding. They should set the direction for guiding supply chain changes. Among areas for comment in the conclusions are the following:

- Effectiveness of current supply chains. Their appropriateness in light of customer expectations.
- New supply chain proposals that would more effectively serve a customer segment.
- Recommendations for dealing with constraints.
- Comments on the role of systems. Needs for systems upgrades.
- Opportunities for improving profits and cash flow in the supply chain.
- Questionable product lines and market segments in terms of profit and the supply chain capability to serve them.
- Requirements, schedule(s), and program plan(s) for a multi-phase supply chain improvement project.

31

Implementation Roadmap

This chapter describes in some detail the products generated and the issues faced during the three phases of a supply chain improvement effort. Its purpose is to integrate and expand on material presented in earlier chapters, pulling together various aspects of supply chain redesign. Where appropriate, the chapters are noted when a reference to material in that chapter is made. In Chapter 30, we described a prestudy, a short analytical effort to set the stage for changing the supply chain. This chapter lays out the path ahead once the prestudy is completed.

31.1 More about Spheres

We introduced "spheres" in Chapter 18. In larger organizations or companies with diverse product lines, it may be necessary to divide supply chains for the purpose of implementing improvements. If a company makes radios for consumers in one division and computers for corporations in another, it's not likely that a single supply chain will suit the needs of both businesses. In another example, an electronics company is dependent on a common group of suppliers to support a wide ranging product line produced by several divisions. This company may want to focus on sourcing in a single effort as it applies to all these product lines.

Chapter 18 described several examples of the use of spheres to organize a supply chain improvement effort. A sphere is combination of products, markets, and operations. The prestudy (Chapter 30) should identify the spheres before applying the three phase approach.

Two considerations to weigh in defining spheres and proceeding with implementation are the need for quick improvements balanced against long-term strategic priorities. The need for quick returns in areas deemed to have high-profit improvement potential might lead to one sphere as a starting point. Results would come faster, leading perhaps to self-funding of longer-term improvement initiatives pursued more for their strategic contribution than for immediate cost reductions. In smaller operations, there may be only

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one sphere. But the growth of global markets and the need to recognize differences in these markets is good reason to consider segmenting the supply chain into spheres.

31.2 The Three Phases

Once the supply chain is divided into spheres for improvement activity, the three-phase process can begin. The flow chart, first introduced in Chapter 12, for the three phases is repeated as Figure 31.1.

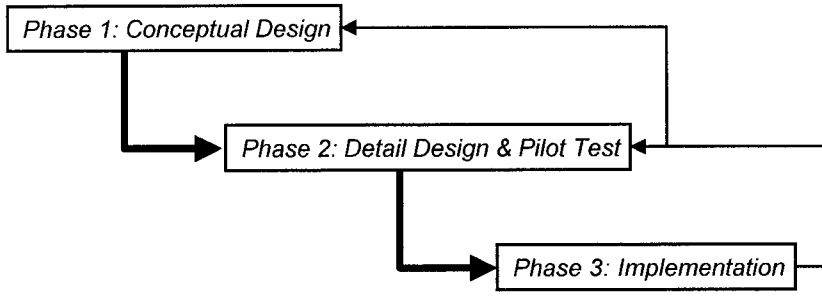


FIGURE 31.1
Three-phase implementation.

Phase I, which is strategy building, sets the direction, providing a vision for the future and a structure for implementation. The process for Phase 1 will have similar deliverables, tailored to the situation, for each sphere under examination. Chapter 12 describes these tasks in some detail. The end product of Phase 1 is a "conceptual" design. The conceptual design is essentially a justification document. It is in sufficient detail to understand what will be implemented and the costs and benefits of implementation. This will vary from organization to organization.

In Phase 2, detail design and parallel pilot implementation proceed concurrently. It is at this point that detail documentation, which can be substantial, is prepared. Concurrently, solutions are tested in actual application. At this time, we recommend implementing changes in the organization structure to support the new supply chain design.

Phase 2 should usually be implemented within the current systems and facility infrastructure. If either or both of these are to change, then the specifications for each must be prepared to support the process design that is developed and tested in Phase 2. Phase 3, full-scale implementation, continues the work begun in Phase 2. Added to it will be scheduled implementation

of long-term action items like systems and facilities changes. It is possible to move into Phase 3 in a graduated fashion. For example, designs for systems changes may be ready before the facility plan. So systems work can go forward with both Phase 2 and 3 work pursued simultaneously.

31.3 The Five Tasks

Our task structure provides a framework for structuring deliverables and organizing initiatives. The five tasks described in our Section II chapters frame the deliverables. We can reorder these tasks according to how they fit into the three phases. Figure 31.2 aligns the tasks with the appropriate phases.

Figure 31.2 shows that Task 1, Designing Supply Chain Strategies, is the core Phase 1 task. Initial strategy setting will be complete at the end of Phase 1. As implementation goes forward, the Steering Committee and Design Teams (DT) should update that strategy based on implementation results. Phases 2 and 3 implement the initiatives arising from the strategy.

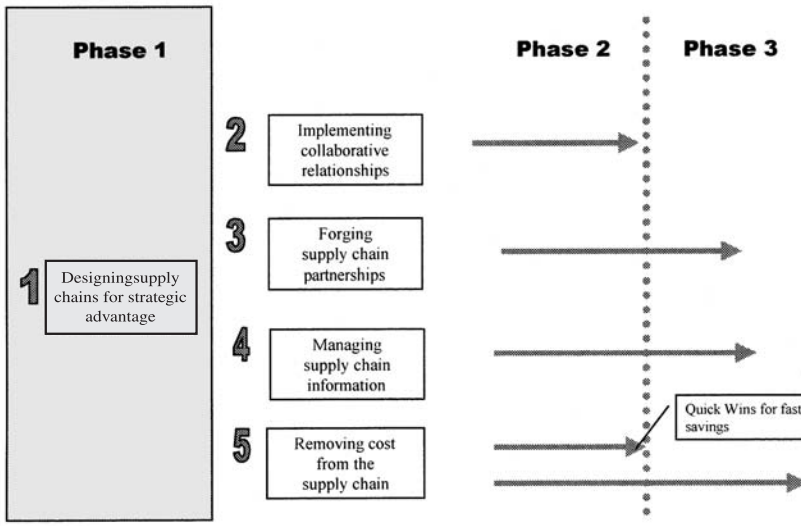


FIGURE 31.2
Initiatives centered on five SCM tasks.

Initiatives are broad programs. Each initiative will have one or more action plans that define individual implementation projects. These take the form of arrows showing activity in Phases 2 and 3. The length of the arrows

represents that task's relative duration. Several action plans compose each initiative.

Task 2, Implementing Collaborative Relationships, deals with internal structural issues. Example of initiatives in this area are organization structure and performance measures. While these can be difficult in terms of gaining acceptance from employees, they are less likely to involve new systems or facilities. So Figure 31.2 shows a shorter time frame for implementation of initiatives in this category.

Task 3, Forging Supply Chain Partnerships, is the next longest in terms of duration. Phase 2 will probably develop partnership requirements, and Phase 3 will probably implement them. Of course, the nature of the partnership will determine the length of time it takes to implement. Also, there are likely to be multiple partnerships for each sphere. One set might be supplier-related, focusing on incoming material. The other set may look downstream to use partnerships to expand company "space" in the supply chain to better meet the needs of customers.

Changes to information systems, implemented as part of Task 4, will probably require more time. Some organizations will require major additions to their capability. Others will modify their existing structure in response to process changes. These include the addition of partnerships and cost reduction projects.

Task 5, Removing Cost from the Supply Chain, has the longest time line. Normally, it can't be totally complete until systems changes are implemented. Certainly there is opportunity to reduce cost in most cases within the current systems environment. This is reflected by the shorter arrow, which shows a completed initiative in Phase 2. Also a cost reduction initiative may be based on a reconfiguration of physical locations — which usually requires a longer-term transition.

31.4 Crosscurrents

All the tasks are interrelated. For this reason, we suggest that a single Design Team (DT) guide implementation in the sphere under study, improving control over the project. After Task 1 starts the process, the remaining tasks should go forward in a coordinated fashion. What happens in one task will affect the others. This interaction may be positive and reinforcing or it may be negative and conflicting. Table 31.1 provides some examples of how efforts in one task category could possibly spill over and hurt or help the completion of another task.

A complex program, with initiatives in all four downstream tasks, presents management challenges. There is danger that the left hand will miss what the right hand is doing. So integration of initiatives will be an important task. With that said, we will discuss the nature of deliverables for Task

TABLE 31.1

Interaction of Tasks

		Action			
	Task	**2**	**3**	**4**	**5**
Reaction	2		Partnership choices may eliminate the work of internal staff.	Technology investments will change the work content of internal groups.	Pressures for cost reduction may overshadow internal cooperation.
	3	Failure to organize effectively internally will jeopardize other tasks.		Systems may need additional flexibility to work with outside partners.	Cost reduction may become the focus of partnering effort.
	4	Reorganization will alter the information requirements of internal work groups.	Partnerships may require new systems development		Cost reduction will generate new process designs, which lead to new systems requirements.
	5	Internal staff realignment could include cost reduction incentives.	Some partnerships may focus on cost reduction.	System changes will enable some cost reduction efforts.	

1 and potential initiatives for Tasks 2 through 5. The reader should keep in mind the potential for crosscurrents like those in Table 31.1 when designing their programs.

31.5 Task 1 Strategy Deliverables

Deliverables for this task are the most likely to look alike, at least structurally, from sphere to sphere. The subsequent initiatives, such as systems design or cost reduction, will vary greatly based on the activities in the sphere. But the process proposed here should produce similar sets of Phase 1 deliverables.

In the following subsections, there are two categories of deliverables: workshops and documents. A workshop is either a decision-making or training session. It may or may not produce a document. Documents report decisions, support an analysis, or provide a method of communicating change.

31.5.1 Describe the As-Is Situation

Deliverables in this task are intended to document the existing situation without evaluating it. So the Task 1 effort focuses on gathering both quantitative and qualitative data to describe how the current supply chain operates. The effort will also gather comments from knowledgeable staff about the current operation, but no final evaluations are made.

	Name	Description
Documents		
	Catalog of activities	List of supply chain activities and organizations performing them within the boundaries of the sphere (both own company and partners).
	Segmentation	Operational categories based on markets, products, or operations.
	Process flow charts	Supply chain processes across the sphere. Includes the role of existing systems and partnerships. Captures decision-making points in the process. There should be charts for each segment.
	Existing activity system	Activity map of the current operation. Includes themes and supporting activities.
	Performance factors	Description of the supply chain using key quantitative parameters.
	Financial baseline	Activity costs assigned using the flow charts.
	Improvement suggestions	Interview/focus group results.
	Customer surveys	Results in QFD format.
Workshops		
	Process flow	DT meeting to define supply chain activities.
	Principles of process redesign	Education session on supply chain redesign techniques.

31.5.2 Assess As-Is Strengths and Weaknesses

This task produces an assessment of the as-is supply chain. The intent moves from describing "how" the supply chain operates to describing "how well." The task ends with defined specifications for a new process.

	Name	Description
Documents		
	Listing of current improvement projects	Current efforts directed at improving the sphere's supply chain.
	Market requirements for the supply chain — by segment.	Criteria market imposes for performance. Should include whether a functional or innovative model and comparative performance.
	Assessment of each activity	Summary of appraisals of each activity in the supply chain operation.
	Cost of quality analysis	Financial analysis of cost of maintaining quality standards. Includes detection, prevention, and internal/external correction.
	Benchmarking	Results of comparative analysis of operating practices (as needed).
	Potential for performance improvement	First-cut estimate of cost reduction or sales/margin improvement.
Workshops		
	SWOT analysis (strengths, weaknesses, opportunities, threats)	DT evaluation based on information provided through other deliverables.
	Specifications for future supply chain performance	List of desired performance level by a new supply chain, usually organized by activity.

31.5.3 Develop Greenfield, or Ideal, Vision

The greenfield is unconstrained by the current operation. It is meant to introduce dramatic change to meet the specifications for the new supply chain. It plays a vital role in the process because it sets goals for implementing ultimate improvements.

	Name	Description
Documents		
	Greenfield vision for supply chain	Conceptual design of "ideal" supply chain, including activity system, processes, organization, partnerships, systems, cost reduction.
	Fast track projects	Report of actions that should be taken immediately.
Workshops		
	Presentation of supply chain evaluation	Joint Steering Committee and DT session discussing results of Task 2.
	Greenfield presentation	Presentation of conceptual design result by DT based on specifications.

31.5.4 Develop the To-Be Process

This task tempers the ideal greenfield vision with the realities of current operations. This requires an understanding of the constraints obstructing implementation as conceived by the greenfield. A danger is backing away from needed changes because support is not there. The task also structures the program structure for implementing the to-be. This includes needed initiatives and action plans.

	Name	Description
Documents		
	To-be strategy	Modified design based on environmental constraints.
	Initiatives/action plans/assignments	Action plan list sorted by initiative.
	Organization changes	Plan for needed immediate organization changes needed to implement the to-be design.
Workshops		
	Meetings to discuss to-be	The to-be relies on the greenfield format for a structured review of barriers and trade-offs that need to be considered.

31.5.5 Prepare Conceptual Design and Action Plans

These deliverables are the control documents for the implementation process. At this point the action plans will define what will be done in Phase 2.

	Name	Description
Documents		
	Action plans	Action plans include tasks, schedule, and assignments for implementation. They can be Phase 2 or Phase 3 plans or both. Normally, at this time, only Phase 2 action plans are needed.
	Pilot programs	Requirements for pilot testing of new processes. Identification of processes and objectives of pilot test.
	Consolidated plan	Combined resource requirements for multiple action plans. Includes time-phased costs and benefits.
Workshops		
	Action plan development	Meetings of DT and Front Line Teams (FLT) to develop action plans.
	Phase 2 approval	Steering Committee authorization to proceed.

31.6 Tasks 2 Through 5 Initiatives

Phases 2 and 3 consist of initiatives. Initiatives, described in some detail in Chapter 12, are convenient groupings of action plans for implementation. The strategy is developed in Phase 1. Phase 1 defines the initiatives needed and develops the action plans needed to start Phase 2.

Our tasks for effective supply chain management are a convenient framework for grouping implementation initiatives. Not all the initiatives listed here will be required for any particular sphere under examination. However, the following lists should serve as a starting point for defining potential initiatives. Design Teams should also add their own initiatives to the list based on the need.

When developed, each initiative will have one or more action plans. Depending on the nature of the projects, we believe five is an appropriate limit for each initiative. More than that would prove difficult to implement in most organizations. Action plans will "come and go" as they are executed. Initiative lives are longer — continuing through both Phases 2 and 3 — as they serve as "umbrellas" for implementing the strategy.

31.6.1 Task 2 Collaborative Relationships Initiatives

A number of possible initiatives support development of collaborative relationships. These should be viewed as essential building blocks for other initiatives. Most aggressive programs that fail do so because organization and performance measurements don't match the desired direction for the business.

Possible Initiatives	Description
Organization structure	Covers changes to the structure in advance of process improvements. Includes the plan for Front Line Teams for action plan implementation.
Performance measures	Action plans to change measures throughout the organization.
Implementation resources	Plans for managing implementation of all the initiatives.
Cost management	Implements new methods for measuring cost for internal measurement, pricing, or strategic decision-making.
New product processes	Focuses on the processes that improve new product introductions.

31.6.2 Task 3 Partnership Initiatives

The three suggested initiatives are separated by their emphasis. In Chapter 16, we used the term "space" to characterize new services along the supply

chain. This coincides with the trend toward fewer participants performing larger shares of supply chain activity. Cost reducing partnerships are characterized by outsourcing initiatives. Sourcing is a special case of an initiative focused on purchased material.

Initiative	Description
Space-creating partnerships	Marketing-oriented partnerships designed to improve overall competitive position.
Cost-reducing partnerships	Operationally oriented partnerships designed to improve margins.
Sourcing strategies	Focuses on partnerships as primary method to decrease supplier base and/or shift activities to outsiders.

31.6.3 Task 4 Information Systems Initiatives

These initiatives either provide or improve a fundamental capability. Examples are ERP implementation (Chapter 22), implementation of proactive systems (Chapter 28), or improvements in information systems management practice. The rest provide supporting technology for other efforts, which is the appropriate emphasis for supply chain improvement. The decision support category focuses on the enabling technology to improve decision making tools.

Initiative	Description
Infrastructure	Implementation or upgrading of basic capabilities that support multiple departments and processes.
Internal process support	Action plans to change systems in response to process redesign conducted in other initiatives, mostly likely in the cost reduction category.
Partnership support	Measures to improve the ability to make connections with outside partners. The partnerships are likely also covered in the partnership initiatives.
Decision support	Development of tools to improve decision making in the supply chain.

31.6.4 Task 5 Cost Reduction Initiatives

The suggestions in this category focus on the type of cost to be reduced. So the initiatives here are overlapping. For example, the cost of quality initiative will reduce personnel cost if less rework is performed. It will also reduce material cost to the extent supplier quality improvement increases yields in the supply chain.

Chapter 24 pointed to the root causes of unnecessary cost. Chapters 25 through 29 describe five root causes and ways to deal with them. Approaches to addressing the root causes are often pursued as "flavor of the month" efforts. Table 31.2 shows some the techniques and the associated root causes.

Initiative	Description
Personnel productivity	Staff productivity plans tailored to the type of work done.
Material cost reduction	Action plans focused on material categories designed to reduce costs in this category. Can also include partnerships for the same purpose.
Balance sheet improvement	Action plans for improving working capital (inventory, receivables) and fixed asset categories (facilities and equipment).
Cycle time improvement	Focus on cycle and time and/or customer service that encompasses both expense and balance sheet categories.
Cost of quality reduction	Quality improvement, like six sigma programs, that use quality cost as the goal. Cost reductions occur in expense and balance sheet categories.

These, in turn, are related to the cost categories where they are most likely to have an impact. This should help in making sure that the right tools are called upon for the right reasons.

TABLE 31.2

Techniques for Cost Reduction

Chapters	Tool/Technique	Capital Items	Working Capital	Touch Labor	Support Costs	Technical Support	Administrative Support	Transport and Warehousing	Engineered Material	Commodity Material
24, 29	Bottleneck analysis	x	x							
24	White-collar productivity					x	x			
24	Manufacturing technology		x	x	x				x	
24	Activity-based costing	x	x	x	x	x	x			
9, 12, 22, 27	Concurrent engineering								x	
15	Early supplier involvement								x	
27, 44	Postponement		x						x	
7,26	Cellular manufacturing	x								
35, 43	Distribution network analysis	x						x		
15	Outsourcing functions				x	x				
15	Supplier reduction						x	x		
10, 11, 12	Education and training			x	x	x				
26, 48	Demand-driven supply chain		x							
20, 26	Quality improvement			x	x					
2, 3, 12	Six sigma			x	x					

32

From Purchasing to Strategic Sourcing — A Road Map

David Malmberg

This chapter describes a "how-to" methodology for improving sourcing through the use of commodity teams. Such efforts will lead to both cost reductions and closer relationships with suppliers. Both results provide "strategic" advantages — ones that improve the basis for competition. The methodology comes from the author's long career in strategic roles in purchasing and material management with several large companies that depended heavily on suppliers. This methodology first appeared in article form in the January 1999 issue of *Inside Sourcing* published by the Sourcing Interest Group.

32.1 Why Pursue Strategic Sourcing?

In many traditional non-manufacturing firms, the purchasing function has long been relegated to the corporate back-40 with little visibility and little consideration of its impact on the bottom line. By contrast, in a number of more innovative firms, "Purchasing" has been renamed "Procurement" or "Sourcing" to imply both an expanded scope and role. These companies have also adopted significantly improved processes, and now view the procurement function as an important source for profit growth. This methodology presents a summarized road map for the journey from *purchasing* to *strategic sourcing*.

First, why embark on this journey? Simply answered, the impact of improved sourcing is often greater than any other profit lever in management's arsenal. For example, the purchase of goods and services can range from 30% of total revenues (for services companies) to a high of 80% (for personal computer or auto manufacturers who largely integrate sourced compo-

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nents). By following the road map described here, savings in purchasing these goods and services of 10 to 20% should be achievable. These savings fall directly to the bottom line and can have the same impact to a corporation as a 50 to 100% increase in revenues.

32.2 Methodology

32.2.1 Step 1: Determine Your Spending

Quantify the following for every major expense category from office supplies to legal services: (1) How much was spent? (2) Who spent it? (3) Where and how was it spent? and (4) What specifically was it spent for? When you complete this analysis you may be shocked to discover that

- Your total expenditures in the category are significantly greater than you thought (30 to 50% greater is not uncommon).
- The number of suppliers you are purchasing from is much greater than you thought (at times more than 1,000).
- The range of prices you are paying for the same or similar items is incredibly broad (200 to 300% ranges are not uncommon).
- The number of "untrained" and unmanaged buyers is quite large (especially in decentralized organizations).
- The size of the average purchase (typically less than $500) seldom justifies the cost of processing the purchase order and other paper work (typically $100 or more).

At first, these discoveries might seem discouraging. However, they represent tremendous opportunities for both operational and economic improvement.

32.2.2 Step 2: Prioritize the Spend Categories

Prioritizing is straightforward and involves looking at the size of the savings opportunity compared to the degree of difficulty in actually achieving the savings. The degree of difficulty is determined by such issues as organizational turf, complexity of the product or service itself, and the complexity of the actual sourcing process (e.g., vendor selection, vendor certification, RFP, negotiations, and so forth). It is always best to go after the "low-hanging fruit" first by selecting the high savings opportunities that can be achieved with little difficulty. Then attack the other categories based on the availability of knowledgeable people to serve on the various category teams.

32.2.3 Step 3: Form Category Teams

These teams are small groups with the charter to examine the sourcing options for the category and to make recommendations to senior management. Ideally, especially in a decentralized organization, you would have representatives from each of the key business units on the teams to obtain diversified inputs and to build consensus.

32.2.4 Step 4: Develop a Sourcing Strategy for Your Categories

Each category team needs to develop a basic strategy to source its category. These can range from joint ventures with suppliers when the product or service being sourced is highly technical, critical to your business, and only a few suppliers are capable of meeting the specifications (e.g., jet aircraft engines), to very competitive bidding situations when the product is simple and widely available, like office supplies.

Other issues to consider in putting together the strategy are your product and service specifications — what they should be and how both you and the supplier will measure them. Also, understand the pros and cons of your current procurement practices for this category. Then, what opportunities for improvement will be pursued? For example, do you plan to leverage purchase volume across the organization to achieve better pricing, work with the supplier to better manage or limit demand through pricing and other methods, and/or promote joint efforts to mutually save costs, like changes in delivery method or frequency? Finally, what can you do with the supplier to simplify your internal processes or reduce your costs of operations, e.g., does the supplier have systems to simplify order entry, better track usage, interface with your payables system, etc?

32.2.5 Step 5: Perform the RFP Process and Make the Final Selection

Identify a list of potential suppliers, starting with your current suppliers. The members of the category team should reach consensus on the basic ground rules for awarding the business (e.g., a national contract for *all* of the corporation's office supply purchases) and the criteria (e.g., prices, rebates, breadth of offering, delivery frequency and options, order entry system, etc.) to use to select the winning proposal. It is extremely important to reach consensus on these issues *before* sending out the RFP.

In crafting the RFP, clearly state your assumptions about volumes of business to be awarded, service levels, etc., explain the selection process and criteria, and outline how you intend to measure both your and the supplier's compliance to the terms of the contract. Point out the potential increase in business that winning the contract would mean. Send out the RFP and then make your preliminary decision based on your *preestablished* criteria and use your best negotiating skills to come up with a final choice.

If the decision is a substantial change from prior practices (e.g., all business units must buy from a single national supplier rather than buy from multiple sources), you will need to present your basic business case to senior management. This business case should stress the trade-offs between the current purchasing practices and those envisioned under the contract. For example, the business case would deal with the expected cost savings for each of the business units, the mechanics of placing orders, changes expected in average order size and frequency, changes in basic terms and conditions, and so forth. If the category team has done its homework and is united in its recommendations, senior management's acceptance should be a foregone conclusion.

32.2.6 Step 6: Manage the Supplier Relationship Aggressively

Supplier management is the area of strategic sourcing with the greatest opportunity for both success and failure. Too many companies just sign the contract and forget about the relationship until contract renewal time. To make the relationship a real success and to ensure that the benefits you and the category team fought so hard to achieve are sustained. Both parties should be actively involved in monitoring results, reviewing preestablished performance metrics, partnering on creative ways to mutually lower costs, and ironing out any contract or performance disputes.

32.2.7 Step 7: Provide Feedback to Both Suppliers and Senior Management

Give your suppliers feedback on both successes and failures. Make them feel a part of your overall strategic sourcing process. Similarly, keep senior management informed about what you and the category teams have accomplished. Present an annual plan to them that recaps savings achieved during the year and planned activities for the following year. Finally, be a missionary for strategic sourcing by trumpeting the successes of the program and carrying the message throughout the corporation.

32.3 Strategic Sourcing Success Stories

Using the seven-step process outlined above (or something similar), some remarkable successes have been achieved. Below are just a few of the successes that have been made *public*:

- At CNA Financial Services, consultant-led client teams developed and adopted sourcing "best practices," built economic business cases for various sourcing alternatives, leveraged the entire enter-

prise's buying power, and dealt with various organizational and implementation issues. Teams examined categories ranging from office supplies to legal services and identified savings ranging from 12 to 18%, equivalent to $200 to $300 million annually.

- A large building products company ($4 billion in annual revenues) achieved its target of a 20% reduction in costs when it applied a strategic sourcing process to its IT and maintenance procurement functions.
- At Sears, an internal effort to reduce the cost of purchased goods and services used for internal use sponsored by the CEO and led by the Senior Vice President of Purchasing reduced annual procurement costs by $1 billion in the first 18 months. These savings were achieved primarily by better processes and by centralizing supplier management and negotiations.
- An electric and gas utility ($1.5 billion in annual revenues) reduced the number of services providers it used for utility line clearance and storm drain damage repair from many to one. As a result, it reduced its costs by 15%.
- Another utility ($2 billion in annual revenues) reduced its inspection and repair costs by 30% annually by implementing a strategic sourcing process.
- AMR Corp., the parent company of American Airlines, hired its first Chief Procurement Officer in 1995. He was given the charter to use procurement to enhance AMR's bottom-line. Just a few of his accomplishments since that time:
  1. Slashed the number of suppliers from over 17,000 to 2,000
  2. Increased the percentage of purchasing staff with college degrees from 55% to over 90%
  3. Eliminated more than 230,000 purchase orders and 600,000 invoices annually
  4. Forged sourcing partnerships with a number of key suppliers including Boeing, AT&T, and a number of the major fuel suppliers
  5. Negotiated with 70% of the spare parts suppliers to carry the inventory and operate emergency depots in AMR facilities
  6. Added $250 to $500 million annually to AMR's bottom-line
- An electronic switch manufacturing firm with annual revenues of $3 billion used cross-functional teams, including customer and supplier personnel to reengineer its overall procurement process. It reduced costs by 15%.
- Owens Corning, a $4.5 billion global fiberglass materials and building products company, had seven separate business units

with P & L responsibility and with separate sourcing activities. Raw material purchases accounted for 50 to 70% of revenues. Several years ago it undertook a corporate-wide strategic sourcing study that resulted in a "matrixed" sourcing organization and in annual cost reductions in the range of 3 to 7%.

- Milliken Textiles reduced its "time-to-market" from 36 months to 6 months by aggressive supplier partnerships and management.
- First Chicago National Bank instituted a centralized procurement function headed by a senior vice president that achieved some notable success in the first few years, including
  1. Sourcing approximately $500 million annually
  2. Saving about $100 million annually or 20%
  3. Instituting standards, metrics, and a number of improved processes across the organization.
- United Technologies (UT), now a part of Honeywell, recently outsourced its non-production procurement to IBM Global Services. Among the company's objectives in outsourcing was to force standards and best practices by centralizing with IBM. The CEO has committed to his shareholders that this move will result in annual savings of $750 million in 2000.
- BankBoston established a centralized procurement function in 1993 with the mission "to save money; reduce business risk; and make management's lives easier." By 1997, the centralized group had (1) reduced invoices by 11% while the business itself actually doubled, (2) reduced overall cost of purchasing by 13% (3) increased its spending influence and management to $400 million annually, and (4) achieved savings of $80 million annually.

33

Selecting Supply Chain Software

Bernhard J. Hadeler

This chapter provides a practical guide to selecting software for supply chain applications. We described several of the major applications in Chapter 22. Chapter 28 describes innovations we expect to see in the use of information in SCM.

Selecting software packages for supply chain management support requires an in-depth knowledge of business and IT applications. To obtain the best fit at the lowest price in the minimum time requires knowledge of the latest software packages, plus the application of smart buying practices. A sound selection process will

- Reduce the risk of buying an unsuitable package.
- Minimize the time and cost of selection.
- Deliver the best value for the money.
- Set up the implementation project correctly.
- Provide a sound basis for resolving any problems, which almost always occur.

The selection process typically consists of seven stages:

1. Specify functional requirements.
2. Decide evaluation criteria.
3. Short-list suitable suppliers.
4. Evaluate suppliers' packages.
5. Obtain proposals from suppliers.
6. Negotiate the contract and price.

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7. Select the preferred supplier.

Here are a few realities in the software marketplace you need to consider as you initiate selection:

- Software packages, like automobiles, can be divided into classes. Expect to find simple features in simple packages, luxury features in luxury packages.
- Package prices vary widely and are not indicative of functionality or quality.
- Most suppliers will negotiate a discount from their list price, but will try to recover it from services.
- Some suppliers make their real money from modifications and support services. Expect to make modifications to modules that can give your business a competitive advantage. (Hint: the customer service area.)
- The better packages are highly parameterized or modular, which reduces the extent and cost of modifications.

Following are 15 tips for getting the best package at the lowest price and getting it installed as quickly as possible.

Tip 1: Plan your business and IT strategies first.
The software packages selected will be expected to last 5 years or more. Best results are achieved if a written strategic business plan has been prepared, and the company has defined its supporting objectives. The clearer these objectives, the easier it will be to determine the best software package.

Tip 2: Prioritize your financial and technical constraints at the start.
The selection of a package should follow a feasibility study, which estimates the costs and benefits of new software. Use the results to set financial constraints for the total cost of the project, not the package price.
Determine, in advance, your priorities on technical issues, such as

- Obtaining all modules from the same supplier, or the best package regardless of the number of suppliers
- A package written in a new language or CASE tool

Tip 3: Buy the steak, not the sizzle.
Be sure you buy the product, not the salesmanship. Control the interactions with suppliers, especially

- The time you spend with each
- The information they provide to you and vice versa

- The functions they demonstrate

Make sure that you have all the information you need to compare packages by the end of the evaluation.

Tip 4: Control all contact with suppliers through your team of negotiators.
Negotiating the contract and the price starts at the first contact with a supplier. The information that is given to suppliers has to be carefully controlled so that they all have equal opportunities to present their products in the best manner. Suppliers that have connections to your people but are not the negotiators may gain information that will give them an advantage in negotiations (and you a disadvantage).

Tip 5: Prepare a *short* specification of functional requirements.
List only the future functions that are

- critical to the business
- unique to your systems
- helpful in differentiating packages

Because a package is a complete system it is not necessary to specify your requirements for all functions. You can establish much of what it will do with a few key questions. A common mistake is to produce a long, detailed specification of requirements. This isn't necessary and can slow up the process because of the following factors:

- Users have difficulty understanding the long list of requirements. It diverts attention from the key issues.
- Suppliers are not inclined to spend the time necessary to answer it fully.
- The time for the selection process is increased considerably.

Tip 6: In the specification, list what functions are required . . . not how to do them.
Unless you have definite views on how functions should be performed, allow suppliers to suggest best practices.

Tip 7: Make your key success factors your criteria for selection.
Does it matter if the package documentation is poor? Or if the package is unproven or obsolete? Or if the users have to cope with two different systems? Of course! Each of these factors, as well as the functionality, is critical to the success of your new system. So write them down as the criteria against which you will evaluate each package.
Typically the criteria will include

- Functionality of the software for the requirements specified
- Ease of use
- Flexibility to change with business and technical requirements
- Hardware and system software
- Language and development tools
- Compatibility with current systems
- Ease of conversion
- Vendor support and training
- Package documentation
- Audit trail
- Security and recovery
- Obsolescence
- Contractual terms
- Total cost over a 3- or 5-year period

Through desk research, telephone calls and meetings, short-list the suppliers who are worth evaluating in detail.

Tip 8: Make it clear that the packages must meet your needs; cost is a later consideration.

The best negotiating tactic is to explain to all prospects that the first priority is to find the best package for the job, and then to consider cost. Pressing for price reductions too early in the meetings may cause suppliers to cut corners in ways that are not to your advantage.

Tip 9: Stick to the specification when evaluating package functions.

Give prospects a copy of the functional requirements and your criteria for selection before they demonstrate their packages. Ask them to demonstrate specific functions that you consider to be critical. You will need at least two demonstrations from each vendor.

Have prospects show how each requirement will be met, so that you understand whether the method would be the most suitable for you. Make notes on plain paper during the demonstration. Write them up against the points in your specification later. Be prepared to improve your specification if suppliers suggest better ideas.

Beware if too many functions that you need are "in the next release." Ask for written confirmation and a penalty if they are not, or add in the cost of the modification when rating the prospect.

When a prospect compares its product to that of another supplier, never believe the information about the other package. It is invariably wrong.

Tip 10: Identify all potential modifications; weigh the costs against the benefits.

Identify modifications, and ask the prospect to quote them. The higher the total for modifications the more likely it is that the supplier will be willing to make concessions on prices. Identification of the modifications is essential for implementation planning.

Tip 11: Have the best prospects put their proposals in writing.

It is essential to have clearly written proposals to resolve problems that could arise during implementation. Prepare a Request for Proposals (RFP) that states what information is required. Otherwise, each supplier will submit totally different proposals, and it will be extremely difficult to compare them on an apples-to-apples basis. Invite proposals only from suppliers who have a real chance of winning your order. Ideally, this will be at least two, and no more than four.

A common mistake is to ask the suppliers to include in their proposal a yes or no answer to each detailed functional requirement. The methods for carrying out a function can vary so widely that these answers are meaningless unless you understand how the function is fulfilled.

Tip 12: Compare total costs.

Compare suppliers' *total* costs over 3 or 5 years. Include the license fee, required hardware and systems software, modifications, training, support, maintenance, conversion, and vendor expense charges in the total.

Tip 13: Find two suppliers who rate equally, except for cost.

Evaluate the two finalists against all selection criteria. If a supplier is lacking in some respects, add in the additional costs for correcting the shortcoming. At the end of the evaluation you should have at least two suppliers who, in total, rate equally against the criteria, except for cost.

Tip 14: Negotiate a large reduction in the initial license fee, but less for the ongoing work.

Negotiate only with an executive from the supplier who has the authority to make decisions during the negotiations. Use your budget, the competitors, or any other negotiating tactic that you prefer to convince the finalists that they should reduce the price to less than you think they will accept. Aim to gain concessions on the initial costs, particularly on items where the supplier's cost is low. Examples are the license fee, multi-client training classes, and some modifications.

Tip 15: If the finalists are rated equal, award the order to the one with the lowest price.

Eliminate the other finalist only on the grounds of cost. This prevents each of them from saying that you have not given adequate weight to their tech-

nical superiority. It will also help the salesperson to avoid blame for losing to the competition

Good luck. But always remember that you will have to live with the new software and the supplier you've selected for a while. Always work hard to make the supplier an important member of your extended enterprise.

Section IV

Supply Chain Case Studies

This section contains case studies from supply chain practitioners. Most are consultants describing a client situation. We have asked the case writers to describe both the motivation and business logic behind their supply chain improvement projects as well as the technical approach to a solution.

The purpose of the case studies is to illustrate the implementation of one or more principles described in the book. Each case study contains a short introduction. In most cases there is a reference to one or more chapters that discuss issues raised by the case.

34

Partnership Barriers in the Nuclear Industry

Leonard R. Wass

Partnership barriers are common across many industries. Due to increasing costs and competition, the nuclear electric generating industry has had strong motivation for forming partnerships. However, prospective partners have had to face significant obstacles to "getting the deal done." Wass Consulting Group, in a white paper from their *Management Insight* series, describes those obstacles.

The partnership type described is the "Jointly Owned Nuclear Operating Company" or JNOC. In JNOCs, "coequal" partners form a partnership entity to manage operations and maintenance activities for several nuclear power plants. Using our vocabulary from Chapter 16, this is an example of a one-to-one, horizontal partnership combination. This chapter raises issues regarding top management and functional support addressed in Chapters 11 and 12. It also addresses the problems of cost documentation and savings sharing covered in Chapter 25.

34.1 Introduction

Significant recent efforts have gone into attempting to form Jointly-Owned Nuclear Operating Companies (JNOCs), but none have yet been successfully established. Some of the key reasons for failure are presented in this chapter. The reasons also pose considerations that must be addressed in order to establish a JNOC successfully. This chapter deals only with JNOCs that pool a number of different owners' plants for O&M purposes, but where ownership is retained by each utility.

The concept of cost sharing and transferring "lessons learned"/expertise is intuitively sound and should be very appealing to nuclear plant owner utilities. Why then have virtually none of these jointly owned nuclear operating companies been formed? Three areas stand out as the main barriers:

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1. Insufficient initial consideration of and compensation for differences in the generating units placed into the pool
2. Inadequate executive oversight and involvement by all owner utilities
3. Inadequate up-front analysis, planning, and forethought

34.2 Historical Look

Before getting into these areas, a brief historical perspective is instructive. Joint ownership of generating plants is not new. For many years, utilities have pooled their capital, built fossil and nuclear generating plants, and appointed one utility the owner–operator. This worked well when all owners shared in the benefits, costs, and risks in proportion to their plant ownership.

Other successes occurred in taking multiple nuclear plants and placing them under a single, self-contained management organization (e.g., Southern Nuclear Operating Company and Entergy Operations). These arrangements were really internal organizational restructuring rather than true joint multi-owner pooling arrangements, however. For all intents and purposes, a single utility holding company was involved with its own plants without participation by outside owner utilities.

Similar past successes included forming a nuclear operating company to operate a single plant with multiple owners (e.g., Wolf Creek Nuclear Generating Company and South Texas Project Nuclear Generating Company). These too are simply examples of internal organizational change, however. In both instances, the co-owners merely moved from an owner–operator model to a self-contained nuclear operating company (NOC) model for that single plant. Hence, NOC (single company) formations have been successful but JNOC (multi-company) formations have not. The best we've been able to do is create shared services organizations that a few utilities subscribe to in order to gain scale economies from purchasing, warehousing, and the like.

This lack of JNOC formation success is not the result of lack of effort, as there have been a number of attempts. For example, one group of four utilities considered pooling their several units into a JNOC, but the deal came apart over differences in market philosophy in an unregulated environment, a legitimate barrier. Similarly, four New York State utilities started work on forming a JNOC well over 2 years ago. Since the utilities are in a single state, the regulatory issues would presumably be nonexistent.

To date, it has not yet been formed, and whether it will be is questionable. In a third case, four upper Midwest utilities have been discussing JNOC arrangements for over a year, but implementation success has been slow. In each of these instances, significant resources were expended in terms of personnel costs; living, travel, and meeting expenses; and so forth. Combined

expenditures have been in the tens of millions of dollars, and probably much more if the true cost of employee time were included.

In view of the above, we will define the term "JNOC" before presenting the reasons for these difficulties.

34.3 Challenges in Partnership Formation

A Jointly-Owned Nuclear Operating Company (JNOC) is a single, self-contained management organization responsible for operating multiple nuclear units, which are owned by multiple owners in a safe, efficient, and reliable manner. A key goal of the JNOC is to manage, with regard to cost and operational performance, the nuclear units (i.e., there must be more than one plant site) for the mutual benefit of all co-owners; hence, no single unit would receive preferential treatment. The JNOC's objective, then, would be to optimize the performance of all the nuclear assets taken as a group. This has important implications, as will be shown later. In principle, the formation of the JNOC *need not* include

- Transfer of asset ownership
- Risk sharing of production costs and/or electricity output

Let's turn to the first barrier to successfully forming a JNOC.

34.3.1 Generating Unit Differences

Nuclear plant owners often fail to account for differences in the plants they want to pool, even though these differences may carry substantial risks for their utility. Such differences include, but are not limited to, items such as staffing levels, operating philosophy, reliability, efficiency, refueling cycle, maintenance practices, age, size, and regulatory standing. It appears that utility owners tend to ignore these differences early in their deliberations in favor of initial efforts aimed at securing regulatory approvals or documenting the expected "cost savings" from forming a JNOC.

A comparison with the airline industry makes a useful analogy. Imagine that one intends to form an airline with two other parties. Each party owns and plans to pool one commercial passenger jet. Imagine further that the three airplanes are (1) an inefficient, four-engine, three-crew B-707, (2) a slightly more efficient three-engine, three-crew B-727, and (3) an efficient two-engine, two-crew B-757. No one would pool such resources into an airline without looking very carefully into the assets to be pooled, how they would be operated and maintained, and agreeing beforehand on a set of operational ground rules (e.g., does each co-owner share costs/profits

equally?). Yet the temptation is great to jump to expected "cost savings" when forming a JNOC without first developing a workable game plan.

34.3.2 Cost Savings

Let's examine the topic of "cost savings." Within the JNOC context, a single critical question must be asked of each and every cost reduction opportunity, namely, "Is this cost reduction opportunity available only through formation of a JNOC?" If the answer is "No," it does not represent cost justification for forming a JNOC. Similarly, left unaddressed, cost disparities among plants can result in unanticipated financial subsidies from one co-owner to another. It is well known that personnel costs have tremendous leverage on changing the production cost of a nuclear generating unit. Plant staffing levels provide a good example of this point. To compare plants, certain measures might include INPO (an industry association) Top Quartile staffing (lean), or other measures such as: number of employees per unit of electricity generated or number of employees per reactor.

So, how does one deal with sizeable staffing level differences among pooled plants? A common response is that a good accounting system will ensure that all costs are allocated properly. While theoretically correct, we believe this to be a pragmatically faulty conclusion, especially for indirect costs. Centralized services, support, and administration costs are sizeable in a nuclear plant and their allocation, at best, is imprecise. To be fair to all co-owners, each item of difference must be looked at and dealt with individually to ensure that such costs are properly applied, and not incorrectly allocated across all owners.

34.3.3 Inadequate Executive Oversight

Even though nuclear plant operations carry sizeable financial risks as well as grave career risks, sufficient co-owner–CEO involvement does not always exist. As a JNOC formation decision could well be a "bet your company" decision, the CEO (together with his or her Board of Directors) is the principal executive to be entrusted with this heady responsibility.

Nonetheless, it is all too common for a group of CEOs to initially meet and reach conceptual agreement on forming a JNOC, and then to turn the project over to a committee of their direct reports. What typically results is a plethora of even lower level committees being formed, each carrying out their work without an adequate framework for a disciplined review or formation process.

Utility CEOs would be well advised to concentrate on those "deal breakers" that might prevent the successful formation of the JNOC — and to stay personally involved in the details until analysis shows the JNOC to be a good (or bad) idea for that utility. They should also insist on seeing those compen-

sating adjustments required to treat all co-owners fairly. Like other important issues in life, "the devil is in the details, but so is salvation."

Guidance that executive management can provide during the JNOC formation process is invaluable. Such guidance should include a written statement of intent, which provides the rationale for forming the JNOC, and what benefits the JNOC is expected to provide. The several goals for such a document include

- To establish an optimal JNOC organization structure to achieve desired objectives
- To provide a historical frame of reference for evaluating future decisions and actions
- To achieve and maintain a uniform level of operational performance at all plants through implementation of best practices and placement of the best people in key positions
- To obtain economies of scale and other potential JNOC savings and benefits in order to generate electricity cost-competitively and safely

Executive management should also keep in mind that JNOC formation without retention of the best personnel and practices is likely to result in severe performance degradation. Their active participation in the process helps maintain the correct strategic focus during data collection, analysis, evaluation, and implementation, and also helps cut through the inevitable internal/bureaucratic obstacles to progress.

Finally, there are other tasks that are best accomplished with direct CEO input, including developing and approving a JNOC mission and operating philosophy; citing the core values on which the JNOC is to operate; listing prerogatives to be retained by the co-owner utilities and the limitations of the JNOC Board; developing the JNOC Board authorities and governance arrangements; the rights and obligations of each co-owner (e.g., for financial capital contribution, decommissioning, spent fuel, etc.); and adjustments that need to be made in financial and/or power output arrangements.

34.3.4 Inadequate Analysis and Planning

As with many other management issues, the three keys to success are "plan, plan, plan." Such planning is difficult to achieve in forming a JNOC, however, because there is little historical experience and successes to draw upon. Hence, JNOC formation calls for a comprehensive process that actively seeks out issues, and then resolves each of them thoughtfully and in a disciplined manner.

JNOC formation is complicated, and includes many considerations. There are several interrelated analyses that are required up-front. Examples include

cost analysis, operating philosophies, governance framework, and risk-sharing arrangements.

As noted earlier, a proper cost analysis is quite involved by itself. One output of the cost analysis should be quantified savings and implementation costs (one-time and annual). Another output that should be included is difficult-to-quantify cost savings opportunities (such as lower production costs, lower outage costs, lower maintenance costs from mobile or pooled maintenance resources, etc.) and benefits (such as improved capacity factors, improved outage scheduling and outage coordination, improved regulatory relations, increased access to nuclear management talent, improved employee career path flexibility and selectivity, less reliance on contractors, etc.). This is because such subjective items may result in far greater benefits (or costs) than those that are quantifiable. They can also serve as a reminder of those goals and objectives that need to be incorporated into the JNOC's business plan.

This short chapter can hardly do justice to such an important but complicated topic as JNOC formation. While we believe that there are few barriers to forming a JNOC that cannot be surmounted, the biggest barrier appears to be the JNOC formation *process* itself utilized by many utilities. Considering the significant cost and risk-sharing benefits potentially available from a JNOC, it has so far only represented a missed opportunity for many nuclear plant owners.

35

Wholesale Grocer: Supply Chain "Streamlining"

Peter A. Crosby

This chapter describes the efforts of a major distribution and retail company to lower its cost and modernize its systems, and details the use of distribution network modeling in locating a consolidated distribution center. This model sought to develop the lowest-cost alternative distribution center for Smart & Final. The chapter also outlines the barriers arising from opposition to change within the organization.

35.1 Distribution Center Consolidation and Relocation

Smart & Final is a leading cash-and-carry wholesale grocer and is also a foodservice distributor. Its three primary types of customers are:

- Small-restaurant operators who shop and pick up their own food at the cash-and-carry retail outlets
- Institutional foodservice customers, such as restaurants, schools, clubs, and in-house feeders, who wish to have their orders delivered to them
- Consumers who traditionally shop at warehouse clubs and supermarkets for their own consumption or for group events

Smart & Final operates over 200 stores in seven states and Mexico. It has broad foodservice distribution capabilities in California and Florida. Recent acquisitions have expanded its base of stores. Typical stores are from 20,000 to 25,000 square feet. Some have been converted from Thriftimart grocery stores the company operated prior to the 1980s. New services and food item categories are being added as the company expands its capabilities.

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The company therefore competes with supermarkets, institutional foodservice distributors, and with warehouse clubs. With its mix of a specialized line of approximately 7000+ items, many in the restaurant-packaging size, it provides a unique offering in the marketplace.

Since 1886, Smart & Final and predecessor companies had utilized and added onto its central distribution center located in Los Angeles County. In the 1990s, due to high growth in the number of stores, the facility had been overutilized, and outside warehouse space had to be obtained to accommodate the expanding number of items and throughput volume. This case study focuses on the planning process that was used to justify, plan, locate, and design the new distribution center building.

35.2 Planning Considerations

Some issues and company strategies had to be integrated with the facility location, site selection, and distribution center (DC) design planning process:

- Consideration of industry initiatives in the e-commerce areas, such as efficient consumer response (ECR), efficient foodservice response (EFR), warehouse management systems (WMS), strategic sourcing and cross-docking, vendor-managed inventories (VMI), and continuous replenishment planning (CRP)
- How to handle foodservice items and orders in the same facility with store items and orders
- The projection of warehouse items 5 to 10 years into the future, considering direct-store-delivery (DSD), and store direct items from other wholesalers (such as Certified Grocers and frozen food third-party logistics providers)

Information from the company's strategic plan and its information systems plan was used as guidelines for the study. Interviews with key executives provided insight where necessary.

35.3 Distribution Center Location Scenarios

The basic facility location and site selection planning scenarios within the project scope were:

1. Continue to meet growth needs with use of outside space and shuttles between the central distribution center and the outside leased and public facilities.
2. Move to a single consolidated DC location.
3. Keep the existing facility and establish a second DC location.

The Southern California and Mexico stores were within the project's scope.

35.3.1 The Facility Location Problem

The nature of the basic problem the company faced was that no one in the company knew what the true cost of the current facilities was, or what the financial benefits of moving were. The following is a summary of some of the problems encountered.

Organizational: The facility was leased from a parent company, at a lease rate that might not have reflected the market or "true" costs.

Accounting: Cost elements were scattered through the company and its parent's accounting statements, so there was the aspect of transfer pricing and sorting out of where the costs and benefits show up on the balance sheet and income statement.

Political: There were factions within the company who were perfectly happy staying where they were; others wished to move, but not all to the same city location. The city where the DC was located favored manufacturing clients, which typically hired more personnel per square foot, and generated more taxes to the city's coffers.

Human: Individuals that worked at the facility lived in different cities, and commute time changes could be onerous with a new facility.

Physical: The office and the DC were located in the same facility; the facility was aged, in some places had a very low ceiling, and included a patchwork of many additions and "add-ons."

Regulatory: The city where the DC was located had new rules which, if enforced, could shut the building down in the future.

Business considerations: Industrial real estate brokers had an "ax to grind" in providing building alternatives that might not be in the best interests of the company in terms of location, cost, and design.

The independence and objectivity of an outside third party was needed to adequately address these issues and to recommend a solution.

35.3.2 The "Total Logistics Cost" Approach

The Smart & Final (SFI) managers faced a situation that is similar to that which many supply chain operators now encounter. That is, how do you measure supply chain cost for different scenarios? Table 35.1 shows structural problems encountered and the consequences.

TABLE 35.1

Structural Problems Encountered at Smart & Final

Situation	Consequence
Value adding processes are inconsistently defined from place to place. For example, is all warehousing labor direct or some overhead?	It's hard to agree on what's included in an operation, much less on what it costs.
Different types of warehouses have different practices for overhead and cost accounting. For example, one may account for overtime as direct cost, whereas another includes it as a separate cost.	Overhead is a large factor in many distribution companies, often dwarfing direct costs. Understanding what's included and excluded is an obstacle.
DC costs and transportation to the stores for the same volume of product are different at different locations for a variety of reasons. This is due to a variety of geographic and demographic factors.	The differences may be controllable by supply chain design — or they may not. This should be sorted out in the cost modeling effort.
Management organizations and infrastructure are different with one vs. two distribution centers.	Non-process-related costs, such as product price and IT expenses, could contribute a large portion of supply chain costs. How does one decide if the supply chain benefits from different sourcing strategies, related to the number of distribution centers.

To put every scenario on a common basis, CGR Management Consultants and SFI developed a common cost model. Its purpose was to eliminate these differences when evaluating the underlying changes in location. The model, called *SITELINK*, used a structure that's adaptable for supply chain network optimization modeling. Figure 35.1 is a simplified structure of the *SITELINK* model.

In *SITELINK*, each process step has to be considered. In a retail chain supply chain application, this should include sourcing, warehousing, and transportation operations. Note that the documentation is for "direct" requirements. Indirect requirements were non-process costs. Examples are the logistics management, and other building related costs. These are "resources" that are not directly involved with the process. The indirect requirements matrix contained relationships between the direct and the indirect resources.

Costs for buildings by size, type, city location, and level of mechanization were developed. Transportation costs for varying lengths of route and merchandise lading were developed. Sourcing issues for one vs. two facilities were modeled. For example, smaller purchase order sizes for some vendors

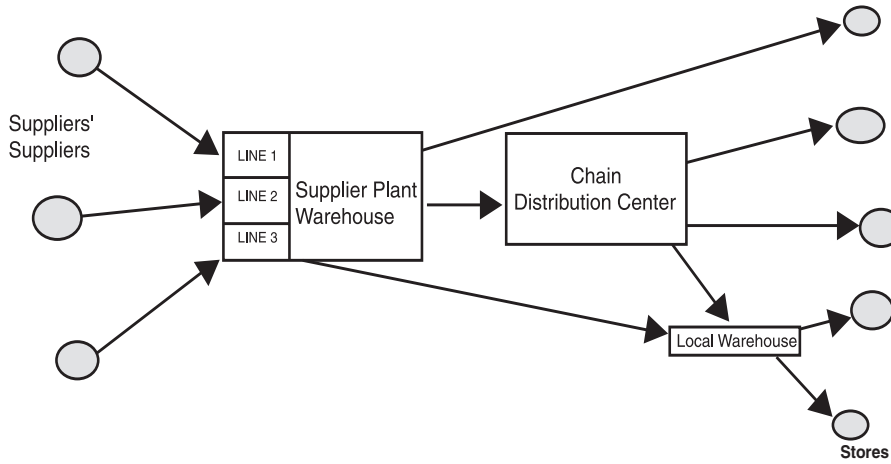


FIGURE 35.1
Overview of SITELINK model.

and for some items would be encountered for LTL (less than truckload) bracket orders with two facilities. If cross docking was employed at the larger facility, some of the bracket price discounts could be preserved vs. a single facility. Inventories with two facilities would be greater than with a single facility. Different sets of stores would be served from each facility, and two facilities managers would be required. The differences between two facilities were considered in the analysis to consider the total costs of

- Sourcing
- Warehousing
- Transportation
- Store delivery
- DC administration
- Order and inventory information requirements

35.3.3 Results of the Analysis

Study output showed that the ideal location from a cost standpoint was not a single city, but a series of cities, all at the cost "center-of-gravity" between the stores served. As real estate and lease prices increased, transportation costs to the stores decreased. One DC showed benefits over two. It was simpler to operate and to purchase goods for, and the transportation cost savings for two did not offset the increase in warehousing, inventory, and administration costs.

A central facility is located in the heart of the Los Angeles County area, with over 500,000 square feet of space and over 300 full-time hourly associates on multiple shifts. The complex is designed to accommodate perishables and foodservice. First store deliveries were made in early 1999.

The project

- More than doubles storage capacity.
- Reduces "real" rent expense to the entire company and its parents.
- Accommodates foodservice and store business in the same facility.
- Has much better freeway access than the replaced facility.
- Shortens commute and delivery times for many associates and trucks.
- Is close to the new corporate offices.

This project was truly a "win–win–win" undertaking, for the management, for the hourly employees, and for the stores.

36

Plumbing Supplies: Manufacturer/Distributor

Douglas T. Hicks*

This chapter describes the problem of cost visibility we addressed in Chapters 24 and 25. Plumbco faces a situation we find increasingly common. Its operations include heavy elements of both manufacturing and distribution, but its methods for determining product and customer profitability were outdated. The case study shows how company management can expeditiously get a handle on profitability for decision making.

36.1 The Faulty "Intellectual Model"

A company's cost accounting system often results in an organization-wide "intellectual model" that is used by the company's management despite the fact that every one of the organization's managers knows the model is not true.

For example, one manufacturer with many large machine centers had a cost accounting system that charged machining costs to jobs as a percentage of direct labor costs. For decision support purposes, this direct labor-based rate was further separated into its "direct" and "variable" components. On one occasion, this manufacturer's engineering staff found new controls for several of the machine centers that would make it possible for them to operate with only one machine operator instead of the existing two-person crew.

In determining the savings that would be generated by purchasing and installing these new controls, the company followed the model inherent in its cost accounting system. It measured the reduction in direct labor cost that would result from adding the new controls and then multiplied that savings by the "variable" component of the machining overhead rate. As a result, the "savings" on which the decision to invest in these controls was based

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included a reduction in "variable" machining costs, including items such as energy and tooling.

If you suggested to any manager at this manufacturer that the elimination of one operator at a machine center would reduce the energy or perishable tooling consumed in manufacturing the product, they would think you were crazy. Nevertheless, the structure of the cost accounting system caused them to make that very assumption when supporting a fundamental management decision. Their "intellectual model" for managing the company was at variance with the facts that they could observe and experience. Yet they never questioned the economic measurements of the costing system.

36.2 PlumbCo's Faulty Model

A similar problem plagued the management of PlumbCo, Inc., a $20 million manufacturer and distributor of molded PVC plumbing products for the building, waterworks construction, and home repair industries. PlumbCo scheduled the manufacture of its products based on a sophisticated demand forecast. Once manufactured, the company stored the products in its warehouse until ordered by wholesale plumbing or waterworks suppliers or retail mass merchandisers. Although products were sold from a catalog that provided each product's "list price," most customers were allowed a discount based on their overall volume of purchases from PlumbCo. When a customer order was received (usually for a variety of products), the purchased items were "picked" from the warehouse, the order assembled, and shipment made.

PlumbCo used a typical manufacturing cost accounting system to cost their products. There were several manufacturing cost centers to differentiate the various type of molding presses and post-press operations (e.g., assembly, labeling, and packaging). All nonadministrative overhead costs, including set-up costs, were allocated to these manufacturing cost centers and included in each center's direct labor-based overhead rates. Selling and administration costs were included in a single cost pool and assigned to products as a percentage of total cost.

In the early 1990s, PlumbCo began to notice a shift in the types of orders they received and a decline in their profitability. Although their total sales remained steady, the number of orders they filled and the variety of products included in each order increased. As the Chairman of the Board put it, "We have gone from making obscene profits to making only reasonable profits. We'd like to return to obscene profits."

To help them understand the reasons for their decline in profitability, PlumbCo sought the assistance of a small-business-advisory group affiliated with a local university. This group suggested that an activity-based costing (ABC) study of the company might be informative. One of the first things the

activity-based analysis did was to segregate PlumbCo's costs into major categories as follows:

Direct materials/components	$13,200,000
Manufacturing costs:	
Direct labor	$ 1,200,000
Manufacturing overhead	$ 1,000,000
Distribution costs	$ 2,200,000
Sales and Administration costs	$ 1,400,000
Total Costs	$19,000,000

When the consultant pointed out that the company's distribution costs were equal to its manufacturing costs, management's reaction was, "Yeah, so what?" Further questioning by the consultant revealed that, although the company realized that it was just as much a distribution company as it was a manufacturer, it did not see any problem inherent in treating the $2,200,000 of distribution costs as if they were manufacturing overhead.

As work continued on the activity-based analysis of the company, management began to understand that its distribution costs were wholly independent of its manufacturing costs. PlumbCo was, in effect, two companies: a manufacturer that sold its products to one customer and a distributor who purchased its products from one supplier and distributed them to many customers. Management also began to realize that the cost information it used to support management decisions had to be based on this correct "intellectual model" of the company. If based on the assumption that PlumbCo was just a manufacturer, managers would be basing their decisions on inaccurate and misleading information.

36.3 Revising PlumbCo's Model

The focus of activity-based costing at PlumbCo was the $5,800,000 of "activity costs," those costs relating to the activities performed by the company. The $13,200,000 of direct material and purchased component costs were already assigned to products appropriately. As shown in the summary above, $2,200,000 was related to manufacturing, $2,200,000 to distribution, and $1,400,000 to selling and administrative activities.

Manufacturing activities began with the purchase and receipt of direct materials and components and ended with the delivery of the manufactured product to its assigned location in the warehouse. Costs related to the purchase and handling of materials and components were assigned to products as a cost per pound of material or a cost per dollar of components. Costs

related to manufacturing operations were segregated by major manufacturing activity. Within each manufacturing activity, costs were further segregated into set-up costs, machine operating costs, and production labor costs. Costs related to in-process material handling were assigned as a cost per move.

Distribution activities began with the receipt of an order and ended with the shipment of an order. The cost of processing orders was treated as a cost per order. The cost of picking orders was treated as a cost per each "line item" on an order. The cost of preparing shipments was treated as a cost per box shipped. Finally, the cost of shipping was assigned as a cost per shipment.

Selling and administrative activities were also subdivided into selling activities and administrative activities. Selling activities were further segregated into the company's three major markets: building, waterworks construction, and retail. A rate was established to assigning the selling costs within each of these markets and an overall rate was established to assign administrative costs.

The net result of these changes was that the actual manufactured cost of each product as it sat in PlumbCo's warehouse was accurately stated, the distribution cost related to each customer order could be accurately determined, and the cost of selling in each of the company's markets accurately measured.

36.4 The Impact of PlumbCo's New Model

Armed with the accurate cost information provided by a spreadsheet model based on its new "intellectual model," PlumbCo was able to make numerous changes that not only improved its own profitability, but also reduced costs to its customers.

The first change enabled the company to more quickly and reasonably establish price discounts for its customers. Prior to the activity-based analysis, discounts were negotiated with customers by sales personnel who required approval from the corporate office before the discount percentage could be finalized. Approval could take several days. These discounts were generally based on anticipated annual sales volume.

The activity-based analysis showed how a combination of the customer's mix of products purchased and ordering habits determined customer profitability. The company concluded that these same factors should be considered when establishing a customer discount. To effect this change, PlumbCo provided each sales representative with a laptop computer and a simple spreadsheet to support the discount decision. This spreadsheet is shown in Figures 36.1, 36.2, and 36.3. On the spreadsheet, the boxed and shaded areas are for input of customer data; the balance of the spreadsheet calculates automatically.

By entering the customer's market category, its projected purchases by margin category (PlumbCo sorted its products into three "list price" margin categories: 20, 30, and 40%), and four customer ordering characteristics (orders per year, average line items per order, average pieces per order, and average pieces per box), the customer margin at "list price" could be determined. Sales representatives could then determine the impact on customer margin at various discount levels by simply entering a proposed discount percentage. Management preapproved any discount that would keep the calculated customer margin over 10%. As a result, sales representatives could grant customers discounts "on the spot" with no wasted time or effort in obtaining corporate approval.

Figures 36.1, 36.2, and 36.3 show the different calculated customer margins that result from the characteristics of three different customers. All three customers purchase the same volume and mix of products. They each purchase 31,200 items annually that total $50,000 in sales and $15,000 in gross margin at list price. However, their markets and ordering behavior significantly impact their contribution to PlumbCo's profits.

In Figure 36.1, Acme Builders (part of the "building" market) places only 26 orders per year with an average of 30 line items and 1,200 pieces on each order. Approximately 30 pieces fit in each box. These characteristics generate a 16% margin for PlumbCo at list price. This means that they could be granted a discount of up to 6.5% and still have a calculated customer margin of over 10%.

In Figure 36.2, Ace Contracting (also part of the "building" market) places 104 orders per year with an average of 10 line items and 300 pieces on each order. These characteristics reduce PlumbCo's margin to 14.4%. Maximum discount for Ace Contracting would be 4.5%.

In Figure 36.3, Plumbing Centers is a four-store retail chain (part of the "retail" market). PlumbCo is required to ship to each store individually resulting in 208 orders per year with an average 20 line items and 150 pieces per order. At list price, Plumbing Centers only generates a 9.1% margin for PlumbCo. No discount can be granted without corporate approval.

Customers can receive greater discounts by changing their ordering characteristics. PlumbCo enters the projected ordering characteristics on which discounts are based into their computer system and then compare them with each customer's actual ordering characteristics. If more costly ordering behavior is detected for a 3-month period, the discount is canceled and must be renegotiated.

Pricing and discount decisions were not the only areas in which the new model had an impact on PlumbCo's management. The identification of costs with the individual activities involved in manufacturing and distribution helped direct the company's cost reduction and process improvement efforts.

Two major areas in manufacturing were addressed: set-ups and in-process material movement. Set-ups, which had long been buried in overhead, were attacked from two perspectives: the cost of the set-up itself and the equipment capacity lost while the set-up is taking place. In-process material move-

ment, which had also been buried in overhead, was addressed by automating some material movement and rearranging some of PlumbCo's equipment. Neither of these areas had even been seriously considered for process improvement before the activity-based analysis.

In distribution, the costs of processing, picking, and packaging orders gave management measurable performance factors for focused improvement. The impact of automating order processing, rearranging stock in the warehouse, and changing product picking techniques was measurable and led to cost reductions that both improved PlumbCo profitability and lowered costs to the customer.

36.5 Lessons Learned

A cost accounting system that did not reflect the actual operations of the business had a significant impact on the way PlumbCo's management viewed the company. This distorted view caused it to make many decisions that led to deterioration in the company's profits.

To effectively support management, a company's costing practices must provide an accurate cost model of its operations. It must also provide tools for supporting the variety of decisions for which cost information is an important input. Most importantly, it must promote an "intellectual model" in the minds of all members of management that helps them understand the true economic implications of every decision they make.

PlumbCo, Inc.

Customer Evaluation Template

Customer No: 54321 Customer Name: Acme Builders

Market (BLD/WTR/RTL): BLD Proposed Discount: 6.5%

CALCULATED MARGIN			
$ without discount	$8,018	$ with discount	$4,768
% without discount	16.0%	% with discount	10.2%

		40% margin	30% margin	20% margin	Total
Forecast Annual Sales at List Price		$15,000	$20,000	$15,000	$50,000
Gross Margin		$6,000	$6000	$3000	$15,000
Customer Ordering Characteristics:					
Orders per year	26	26	$5.800 per order		$151
Average line items per order	30	780	$0.600 per line item		$468
Average pieces per order	1,200	31,200	$0.100 per piece		$3,120
Average pieces per box	30				
Average boxes per shipment	40	1,040	$1,400 per shipment		$1,456
Marketing Costs:		$5,195	12.0% internal coats		$623
Administrative Costs		$5,818	20.0% internal costs		$1,164
Total Distribution, Marketing, and Administrative Costs					$6,982
Calculated Customer Margin					$8,018

FIGURE 36.1
Customer evaluation template (Acme Builders)

PlumbCo, Inc.

Customer Evaluation Template

Customer No: 54322 Customer Name: Ace Contracting

Market (BLD/WTR/RTL): BLD Proposed Discount: 4.5%

CALCULATED MARGIN

$ without discount	$7,201	$ with discount	$4,951
% without discount	14.4%	% with discount	10.4%

		40% margin	30% margin	20% margin	Total
Forecast Annual Sales at List Price		$15,000	$20,000	$15,000	$50,000
Gross Margin		$6,000	$6000	$3000	$15,000
Customer Ordering Characteristics:					
Orders per year	104	104	$5.800 per order		$603
Average line items per order	10	1,040	$0.600 per line item		$624
Average pieces per order	300	31,200	$0.100 per piece		$3,120
Average pieces per box	30				
Average boxes per shipment	10	1,040	$1,400 per shipment		$1,456
Marketing Costs:		$5,803	12.0% internal coats		$696
Administrative Costs		$6,499	20.0% internal costs		$1,300
Total Distribution, Marketing, and Administrative Costs					$7,799
Calculated Customer Margin					$7,201

FIGURE 36.2
Customer evaluation template (Ace Contracting)

PlumbCo, Inc.

Customer Evaluation Template

Customer No: 64322 Customer Name: Plumbing Centers

Market (BLD/WTR/RTL): RTL Proposed Discount: 0.0%

CALCULATED MARGIN			
$ without discount	$4,570	$ with discount	$4,570
% without discount	9.1%	% with discount	9.1%

		40% margin	30% margin	20% margin	Total
Forecast Annual Sales at List Price		$15,000	$20,000	$15,000	$50,000
Gross Margin		$6,000	$6000	$3000	$15,000
Customer Ordering Characteristics:					
Orders per year	208	208	$5.800 per order		$1,206
Average line items per order	20	4,160	$0.600 per line item		$2,496
Average pieces per order	150	31,200	$0.100 per piece		$3,120
Average pieces per box	30				
Average boxes per shipment	5	1,040	$1,400 per shipment		$1,456
Marketing Costs:		$8,278	12.0% internal coats		$414
Administrative Costs		$8,692	20.0% internal costs		$1,738
Total Distribution, Marketing, and Administrative Costs					$10,430
Calculated Customer Margin					$4,570

FIGURE 36.3
Customer evaluation template (Plumbing Centers)

37

Supply Chain Management in Maintenance, Repair, and Overhaul Operations

Crispin Vincenti-Brown

This chapter describes the complexities of the repair and overhaul process for major capital equipment. The case touches on several issues described in the book:

- The extended product (Chapter 1)
- Segmentation and designing supply chains for different market segments (Chapter 7)
- Shortcomings of over reliance on sophisticated information systems (Chapter 21)
- Innovative linkages between suppliers and customers (Chapter 29)

Supply chain management in production operations for new products tends to be rather binary; information flows backward from the customer and products flow forward from the "digging it out of the ground" suppliers, through various tiers of transformation until it arrives to satisfy the customer need.

Maintenance, repair and overhaul (MRO) operations are rather different. This case study covers the supply chain issues of a multinational organization that is a leader in the field of repair and overhaul of large gas turbines.

37.1 Demand Chain Issues

Once a user has purchased a turbine, and it has passed the warranty period, the customer–supplier relationship within the supply chain fundamentally changes. The user demand is that the engine continues to reliably fulfill the

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function for which it was purchased. Examples would be continued supply of electrical power of a generation set operation or continued pumping flow in the case of a compressor set.

The first impact of this relationship was for the MRO provider to evaluate alternative ways to satisfy this demand:

- Traditional fast turn-around repair on a time and material basis
- Exchange units with fixed price billing or billing for repair of the returned unit
- "Power by the hour" arrangements with guaranteed costs for repair based on the hours operated
- On-site availability of stand-by units and guaranteed return to service times
- Unit "leasing" based on the function output such as kilowatt hours produced

Two fairly obvious things happened. The first was that no single solution would satisfy all the customers. Some customers were very competent in managing their own assets and wanted the "supplier" to be exactly that — a supplier of quick and cost-effective repair at the instruction of the customer. Some customers, especially those who were newer in the business and whose financial structure was more taxed, were very interested in pure pay for output arrangements. The result of this was that the MRO operation had to be able to satisfy numerous different demand relationships.

The second consequence was that this thought process caused the company to start rethinking their new-product selling process. The traditional approach of selling products, optimizing margins on after-market part sales and managing obsolescence to support life cycle replacement, started to be challenged to give way to a more "interventionist" strategy of "never" selling the product. Discussion of the results of this strategic reconsideration are beyond the scope of this case study, but it provides a real life example of how intelligent planning of the demand chain, within supply chain management, will bring up issues that can have major strategic impact on a company.

37.2 Service Imperatives

In spite of the variation in the demand chain, the customer-driven key success factors for the MRO operation remained almost the same:

1. Maximize the serviceable asset availability.

2. Minimize the capital assets tied up in stand-by units or component part spares.

As always, these imperatives seem to present conflicting pressures; this is the lot of the supply chain manager.

In this case, significant effort had gone into, and still is going into, the more esoteric technological enhancements of things like remote monitoring and sophisticated early diagnostics of failures and wear. These aspects had then, and will continue to have, an increasing impact on the supply chain management challenge. However, they are beyond the direct scope of this description and we leave the readers to reflect on how such evolution might impact the management challenges described.

37.3 Supply Chain Management

As mentioned above, the supply chain in MRO activities is not the same as first build. The physical sources of supply are shown in Figure 37.1. As will be obvious, the issue in this case is that it is difficult to know what components will be required from each part of the supply chain. The biggest single source of parts comes from a returned unit. In many cases, customers require that the recovered or repaired parts used in any unit come from the same original unit. In some cases, this has technical advantages due to questions of balance and assembly of the units after maintenance is complete. In some cases, the customer can be persuaded to allow either recovered parts from other of his units (fleet parts) or any recovered part certified by the MRO organization as being to specification.

In all of the above cases, it is still a fact that the largest "supplier" of parts is the returned turbines. The problem is that in most cases you don't know the condition of the parts in the turbine until the unit has been disassembled. At that point, various dimensional and other NDT (non-destructive test) inspections are completed and identified as follows:

- Parts that can be used as-is
- Parts that can be repaired and returned to the unit
- Parts that are unrecoverable and a replacement part must be obtained

This picture was slightly more complex in that some of the parts that were technically recoverable could not be repaired in an appropriate time span to fit the customer redelivery date. These parts were typically repaired on a longer cycle and held in stock for those customers who would accept a "certified" repaired part that had been used on another turbine.

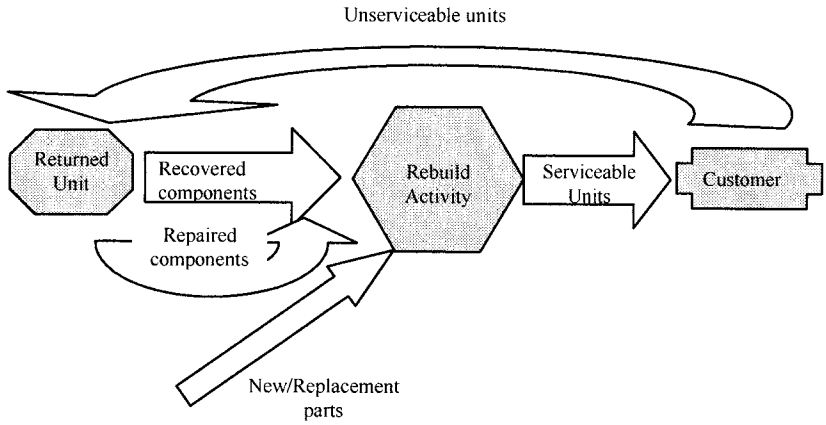


FIGURE 37.1
Repair and overhaul supply chain.

37.4 Stockholding

There were a number of more or less sophisticated computer programs being used to provide "planning bills of materials" to give an idea of the forward requirements for new parts. These were the equivalent of a sales forecast in a first-build situation but at the component level. The replacement statistics for every component on a turbine can be analyzed and the "likelihood" of a component needing replacement calculated. This then provides the information upon which decisions can be made as to which parts to hold in stock.

This situation is somewhat complicated by the fact that at the component level both new and repaired "certified" parts were stocked. The supply of new parts was relatively straightforward and could be based on a reorder level basis. The supply of repaired parts depended on what parts arrived from customers in turbines that could be repaired. The decision could then be made whether to repair these parts now or hold onto them in an unserviceable condition until the planning bills showed that they should be worked on to provide certified parts for stock.

37.5 Practical Solutions

In this case, trying to use very sophisticated planning and execution management systems to manage the supply chain proved very un-robust. Increasing

sophistication of forecasting algorithms, shorter time buckets for regeneration of plans, closer control of inventory accuracy and so forth all resulted in improvements that could not be sustained. Things would improve for a while, maybe more due to some sort of Hawthorne effect than anything else, and within months, most of the parts were being expedited through most of the supply chain most of the time. Inevitably, this led to strained communications between supply partners and frequent endless coordination meetings via video and conference calling.

Many improvements were implemented, and not all of them are appropriate to describe here. The underlying approach was to simplify the physical process and make the information flow more visible and directly connected to those that did the work.

37.6 Primary Supply Line

The biggest impact on the supply of parts on time was clearly the way the incoming unserviceable turbines were treated. Previously, these units were "fed" into the process to balance the workload of the whole operation. This meant that turbines could wait several days in the fully assembled state before being disassembled. Although this workload buffer was effective in managing capacity, it caused a major delay in the supply chain dynamics.

The approach adopted may seem obvious: to establish a "disassemble cell" that "seized" the unit immediately when it arrived on site (or even in some cases earlier) and got all the components affected by the customer requirement to the point of "disposition." In this way, the usability of the primary source of parts was established at the earliest moment and the work for repair or replacement could be planned and managed inside a larger portion of the turnaround time.

37.7 Replenishment

The reassembly of the turbines was organized in a series of "pull" cells. This was most effective from a physical work organization process. However, initially these cells called for the required parts from a central stores. While maintaining good stores accuracy, this placed an immense load on the stores operation and little direct visibility by those who actually rebuilt the units.

The approach adopted was to move most of the parts to point-of-use storage, managed directly by those doing the rebuilds. These technicians are responsible for building up their own kits and reordering replenishment parts to the supply chain. This approach was not implemented without some

problems. Significant training was required and a number of administrative system modifications were needed. Inevitably, there was also significant resistance in many parts of the organization to this change. How those were addressed is beyond the scope of this case study.

37.8 Ordering from the Supply Chain

Replenishment parts were called from the supply partners on pre-established "service agreements." These service agreements established both the replenishment fulfillment time and also the responsibilities of each part of the supply chain.

Physically the call of parts was achieved using "faxbans." These work in the same manner as a *kanban* card and are transmitted directly from the user technician to those who supply the components. In this case the faxban was transmitted by fax, from a machine in the rebuild shop area to another at the different supplying shops. Some of these shops are 1000 miles away.

A major difference from classic *kanbans* stems from the varying requirement for parts for each unit rebuilt. In normal production, one unit built leads to one kit's worth being resupplied. In this case, because there are multiple supply lines, one from the turbine (as-is parts), one from repaired parts, and one from new parts, the requirement changes for each unit.

To take account of this, the faxbans use an "exclusion" process. This is in fact very simple. Each faxban calls for a kit of replenishment parts from each supply chain partner. The list on the faxban includes the full list of all the parts that can be in the kit. The original faxban resides at the rebuild area and is laminated. As the rebuild technician gets ready to call for replenishment parts using the faxban, he crosses out with a wax marker those items on the faxban that do not need to be replenished since parts are available that have been recovered from the returned turbine. He then faxes this "amended" faxban (the list with a number of kit parts crossed out) to the supply partner. A miniature copy of the fax is printed by the fax machine and is kept in a rack until the parts are received.

On receiving the fax, the supply partner produces only those parts required on the amended list and sends them with the copy of the faxban that he received to the rebuild shop. On receipt, the rebuild shop can match the faxbans and remove the corresponding copy in the rack.

37.9 Results

This approach was implemented between a series of pilot supply chain partners. The results have been impressive. With a number of other improvements implemented at the same time, the use of a rapid disassembly and disposition cell to manage the incoming "parts" supply and the use of faxban variable kit resupply led to

1. A significant reduction in the turnaround time for turbines
2. A reduction in the number of stock-out of parts at reassembly
3. A reduction in the amount of expediting of parts throughout the system
4. Improved trust and communication between the real actors in the supply chain
5. Increased capacity in the MRO activity

While the physical cost of implementation was small (a few fax machines, some recovered shelving, cards, and so forth) and the non-physical cost reasonable (training, outside guidance, etc.), the returns are impressive. In addition, this approach opened the way for other such approaches in other parts of the business, which has been formally recognized as a leading quality supplier in this very competitive industry.

38

Retail Distribution: From Low Tech To Leading Edge Distribution Center

Don Derewecki

This case study describes the process for designing, obtaining funding for, and implementing a major distribution center. The case stresses the importance of planning in successfully completing the project in a short time. The distribution center was motivated by retail customer demands for more "value added" by their suppliers. In this case, as it is in many others, the value added put more demands on supplier distribution centers. Such demands include direct-to-store shipping, labeling, and accommodating a variety of shipping requirements.

38.1 Background

This case study outlines how a consumer goods company with a worldwide reputation for manufacturing quality products upgraded its distribution center operations to world-class level. The inbound supply chain involves raw materials, semi-finished goods, and some finished product sourced worldwide. The outbound supply chain primarily services North America, but a substantial and growing percentage involves South America. In peak season, about 50,000 daily outbound cartons are shipped.

Mass merchant retailers comprising about 75% of the business dominate the customer base. Given the scope of the initial project and the ongoing effort, this case will be limited to hitting the highlights to provide the reader an overview of the new distribution center project.

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38.1.1 Motivating Factors

All efforts requiring massive investments of capital and staff are motivated by some factor that focuses top management's attention. How much capital and staff would these changes require? For this company, the motivating factor was compliance with the supply chain requirements of its major customers in the mass merchant sector of retail.

As anyone familiar with the mass merchandising supply chain situation knows, the question is not whether you will comply, but how soon you will be in full compliance. The compliance issues involve a complex and continuously evolving combination of requirements including the following:

- Carton and pallet labeling
- Pallet or unit load preparation
- Crossing docking
- Retail "floor ready" stipulations
- Use of "irregular" carriers
- Order response time and other customer service issues

As these supply chain requirements were evolving in the early 1990s, the management of the case study company was proactive in planning not just to meet but to exceed the expectations of its customers. This high level of management commitment, including financing major material handling and information systems support, was a critical factor in making this company into a logistics leader that companies in a wide variety of business segments use as a benchmark.

As another motivation for the project, domestic manufacturing requirements and the associated material storage requirements were increasing. This created pressures for storage on the inbound supply side from the company's factory and other suppliers.

38.2 Distribution Center Existing Conditions

The original distribution center was located in the manufacturing complex. Operating methods and processes were very conventional. The systems were all paper based with no computer direction or bar code scanning. Picking was done using pallet jacks to pick from floor stacks of product. Checking was a manual process. Although well managed, the existing distribution center operations were limited by the conventional technologies in place. These conventional processes could not be upgraded to satisfy supply chain demands and requirements relating to response time, accuracy, and a host of other issues.

38.2.1 Planning Criteria

The subject company did not fall into the trap too many companies do — *failure to plan*, ensuring *planning for failure*. This company has long dedicated the necessary resources to planning. The company also has a tradition of committing the appropriate level of management attention to its projects. To assist, the company chose a material handling logistics consulting firm to assist with the planning process.

The planning process started with developing the design criteria for the new distribution center. Input from the marketing department was solicited to determine the future customer expectations from the distribution center relating to orders and service levels.

Planning coordination with production planning was also established very early in the project to determine the inventory projections to be maintained at the facility. The company's sales are seasonal with a very high Christmas season peak. Within the limits of a high capital cost structure for manufacturing equipment, the company attempts to adjust production output to demand. However, manufacturing cannot be ramped up sufficiently to permit the company to produce to order, particularly during the peak season. This led to a design requirement to hold tens of thousands of finished goods pallets of inventory during most of the year and ship at very high volume levels during a 2-month window.

Although the overwhelming majority of the company's sales are to the mass merchants, the company could not neglect its smaller customers, who are mostly specialty, niche retailers. The order profiles, shipment characteristics, and other customer service requirements for these smaller customers also had to be developed. The large customer shipments are truckloads and frequently multiple truckloads. Small customer shipments are typically LTL or parcel quantity shipments. The needs of both had to be accommodated by the facility design.

38.2.2 Operations Planning and Layout

There were several strategic operations issues that needed to be resolved;

- What should the unit load be? (The unit load is the standard material handling unit used in the facility design. The unit load was a pallet in this case.)
- How to transport product from the on-site manufacturing plant to the new distribution center — approximately 2000 feet.
- How to induct pallet loads into the storage system.
- How product should be stored.
- How product should be picked, sorted, and unitized.
- What the loading process should be.

- What level of information systems support will be required and how will it be integrated into the host systems?

After a thorough review of alternatives, the following operations decisions were made:

- The unit load would be a double stacked pallet (same SKU) to fully cube out the trailer — two unit loads are automatically double stacked at the factory and stretch-wrapped on a pallet-handling system.
- The product would be transported to the new distribution center using a pallet-conveyor system to load trailers with conveyor beds inside.
- Product would be inducted into the storage system using an automated pallet-conveyor sortation system.
- The storage technology would be very narrow aisles (6 feet) with ten-pallet-high stacking (five levels of double stacked pallets).
- Product would be batch picked using a pick-to belt system on four levels leading to an automated sortation system ending in mechanized palletizing workstations.
- The majority of the dock doors would be loaded using counterbalanced lift trucks with three doors equipped to convey cartons directly into the trailers for floor stacking.
- The information systems would be state-of-the-art with computer-directed paperless operations and bar code scan confirmation of all material handling transactions.

38.3 Validation of the Plan

After the new distribution center processes and layout were developed, the company and the consultant wanted to prove the distribution center operating plan. Given the capital investment requirement of $25 million, the complexity and sophistication of the planned operation and the mission-critical nature of the new DC, the decision was made to validate the plan using computer simulation.

A model was developed to mathematically simulate the material handling requirements starting at the manufacturing plant loading dock for transfer to the DC and ending with product being loaded onto trailers in the DC for delivery to customers. Each of the following system components had to be programmed.

- Automated pallet double stacking and stretch wrapping in the manufacturing plant
- Automated pallet label application, trailer loading, DC storage location assignment, and pallet transfer to the DC
- Automated pallet unloading from the trailer onto the powered pallet-conveyor system and diverting into the drop-off station opposite the system-assigned putaway aisle
- System-directed putaway into the VNA* location and confirmation of the transaction
- System-directed replenishment pull from the VNA location and confirmation of the transaction
- System-directed placement into the system-assigned pick-to-belt location
- Batch picking
- Automated sortation into individual orders
- Palletized order processing
- Accumulation capacity of the divert** lanes
- Mechanically assisted palletizing
- Transfer to stretch wrap stations
- Transfer to staging location
- Loading of the trailers
- Nonpalletized order processing
- Accumulation capacity of the divert lanes
- Loading/handstacking

In addition to the physical processes, the warehouse management system (WMS) logic and response times had to be programmed into the model. The model identified capacity constraints given workload levels and dispatching methods. After several runs, the optimum operating scenario was identified. This optimum scenario provided validated productivity and throughput capacities for each subfunction and for the system as a whole.

After operations management accepted the results of the simulation model, they used this validation as part of the capital request to justify the project. The company's top management funded the project as designed.

* VNA means "very narrow aisle." Narrow aisles in a warehouse enable more storage. VNA aisles are typically between 50 and 72 inches.

** Divert lanes are two-pallet-deep accumulation zones for staging pallets diverted from the inbound pallet conveyor. The divert aisles are opposite the assigned storage aisles.

38.4 Implementation

As with any plan, no matter how complete, implementation is key to achieving the planned results. In this case, company management decided to invest in the proper resources to turn the plan into reality. The implementation team included operations, engineering, and consulting staff involved with the study phase of the project. Additional team members included representatives from the company's information systems staff, a warehouse management system (WMS) company, an architect firm, various engineering specialty firms, the various construction and related companies, a conveyor manufacturing company, a rack manufacturing company, and a local representative of a lift truck manufacturer.

Coordination, cooperation and collaboration among all the implementation team members was key to the speed and eventual success of the operation. The master plan developed at the start of the process was modified and updated but remained the basic blueprint for the project.

Given the technological complexity, state-of-the-art material handling hardware and software, and the size of the project, 42,000 pallet positions, the project was fully implemented and performing according to expectations in less than 15 months of funding the project. This quick turnaround time was achieved in spite of starting construction during the wettest spring on record for the region.

38.5 Results Achieved

The validation of any project is in the results achieved. This project allowed the company to meet or exceed all of the supply chain objectives initially set for the new distribution center:

- Creating additional space for additional raw materials and component parts storage to support manufacturing
- Buffering enough finished goods inventory to satisfy the inventory plan
- Improving productivity to minimize the staffing required to operate the DC
- Developing the DC throughput capacity to meet seasonal demands
- Designing a quality distribution center operations so that the quality of the service was on a par with the quality of the product itself

38.6 Recent Steps

The case company's growth and evolving supply chain requirements have mandated that the company take the following actions:

1. Double the size of the building and pallet containment capacity to over 80,000 pallets.
2. Plan for automated handling of pallets from reserve storage to customer mandated case labeling for full pallet quantities.
3. Plan for automated de-palletizing, case labeling, and re-palletizing.

The company in this case study has invested to not only meet but to exceed the requirements of their supply chain customers. This advantage has allowed them to outpace their competition.

39

British Telecom — Capacity Planning in a Deregulating Industry

Mark Marcussen

This chapter describes some of the changes brought on by telecommunications deregulation in the United Kingdom. Deregulation brought new opportunities in the form of growth and challenges in terms of changing long-term habits. The case illustrates the principles of organizing supply chain change described in Chapters 11 and 12. These changes were necessary to assure that British Telecom preserved its role in its customers' supply chains.

39.1 Background

British Telecom (BT) is the largest telecommunications provider in the United Kingdom. It was privatized in 1984 under the Telecommunications Act when it was brought out of the Postal Service. Simultaneously, the telecommunications industry was stimulated to create a competitive environment, initially in the form of Mercury; a part of Cable and Wireless, a Hong Kong-based British company. Then and presently, BT as well as Mercury, cable companies, mobile network operators and an increasing number of new entries are under regulatory control by OFTEL. This "watchdog" agency monitors and enforces operating licenses. Over the last 15 years, BT has expanded to become a strong international player and remains the dominant source for local and long distance traffic in Great Britain.

Early in privatization, BT's residential and business connections were devolved into 30 districts. These varied in geographic size and in population. This case study describes a consulting assignment conducted by Saga Consulting Group, Inc., a U.S. management consulting firm with operations in the U.K. The project was one of a number the firm carried out for a variety of functional areas within several of the 30 districts. In this instance, the fast-

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growing client providing service to 2.5 million people over some 370 square miles, with about one million exchange connections on 150 exchange units. The staff totaled about 5,000.

Five years of operating in the private sector had only begun to make inroads in the strict hierarchical mindset of many high- and middle-level managers within British Telecom. Nor had these years succeeded in notably changing the paternalistic culture of the organization. Uncomfortable personnel decisions were commonly avoided, both for cultural and labor-relations reasons. Strategic and organizational improvement opportunities were easily waited out or in some other manner defeated. Or throughout the excessive levels of management, an idea could simply be viewed as too unthinkable in the context of traditional convention and logic. It is to the great credit of the senior management of this district that changes were made in strategic thinking, in structure and practices and, most impressively, in the case of disposition and assignment of high- and middle-level management staff.

39.2 The Challenge

The BT organization faced a challenge in maintaining its capacity. As laid down by its management, the district faced a critical situation, succinctly stated by the following:

> After successive years of neglect, the local line network is suffering from exhaustion of spare capacity and poor reliability. Adequate spare line plant is essential if provision of service and repair service targets are to be met. Reliable line plant is necessary if repair service cost targets are to be met.

The goal became "to produce a process which will enable the local line planning and execution work to be prioritized, scheduled, and reviewed such that a program of exchange areas going from red to green can be produced. Also to address the line plant backlog; and further to establish the practices and processes to keep green areas green."

A "green" exchange area has a spare pair margin of 10% for Exchange side (E-side) and 20% Distribution side (D-side) in 100% of its distribution points (DPs). While the planning activities had undergone reorganization into a functional mode with the key objective being to balance "expedient," or urgent repair, work and longer-term requirements for capacity addition, this had not been accomplished. Expedient work was driving the entire activity in planning and in the field. As a result, both lost their focus on forward work and control of their priorities in regard to the present demand. The aim of functional specialization was appropriate, but the structure was poor, staff assignments were inappropriate, and the execution had failed. The overall

state of planning and execution was one of chaos as priorities were jumbled, fire fighting reigned, customers rebeled, and finger pointing created a negative and depressing environment.

39.3 The Reconnaissance Study

A preliminary analysis identified the following specific areas for consideration:

- Bringing the district to an acceptable level of performance would require a long-term and sustained top management involvement and would necessitate major changes in strategy, structure, and management personnel.
- The macro plan that had been employed was inadequate in detail and in documentation to ensure the required precision in assignment and control of internal and external resources.
- The information available to the planning function was weak and inaccurate.
- The fragmentation of the planning function did not allow for the required level of coordination and control.
- Planning and execution was divided between the two North and East areas that had been established for the district. This complicated establishment of overall priorities, utilization of resources and the logistics of equipment and materials purchasing, warehousing, and delivery.
- The absence of strategy as expressed in fundamental plans and associated schedules inhibited the flexibility of the district in deciding on priorities for turning red areas into green.
- The utilization of district resources was insufficient, since the structure precluded economies of scale, and this was abetted by the practice of assigning much routine clerical activity to technical staff that was critically required elsewhere.
- There was a lack of effective monitoring and control of planning and execution progress. The execution staff suffered from uncoordinated flow of work and at times from no available planned work at all.
- Administrative practices such as procedures associated with approval circulation and other necessary practices were overly bureaucratic and time consuming to the point of preventing effective flow of work.

39.4 The Improvement Program

The program to rectify the shortcomings in the planning process was undertaken over a 6-month period by a task force consisting of Saga consultants and first- and second-level client managers. This task force worked actively with a Steering Committee, which was headed by the Chief Operations Manager. The program progressed through the four steps of Conceptual Design, Detailed Program Development, Implementation Preparation, and Implementation.

The Conceptual Design Phase produced a new structure staffed by personnel that differed in significant positions from the original management cadre. This new arrangement is illustrated in Figure 39.1. It created **The Overview Unit** that reported to a newly selected Network Services Manager. The objective of this unit was to develop the strategies and priorities and for monitoring progress and providing ongoing assessment of new and existing requirements relative to available resource capacities in house and outside. A new central planning group was then established consisting of three functional units:

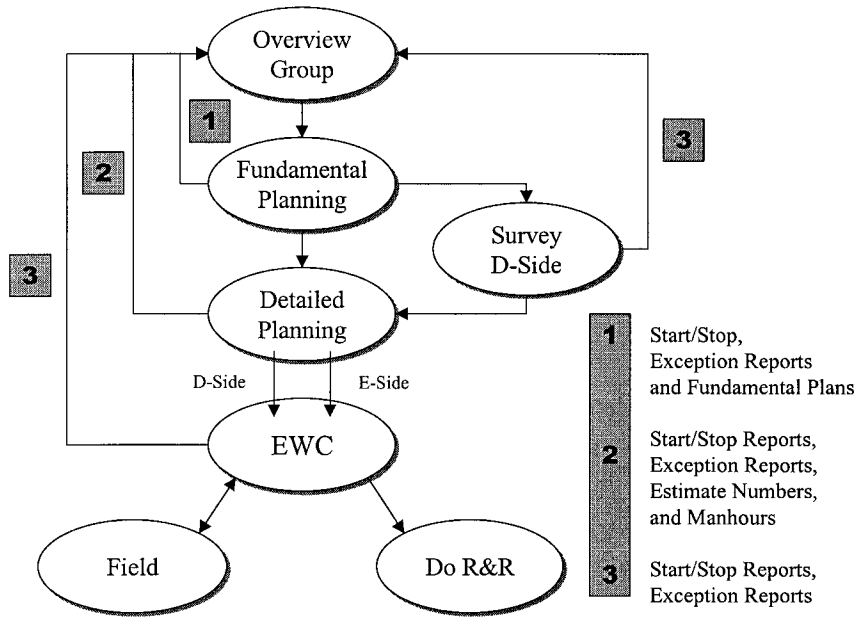


FIGURE 39.1
Network planning responsibilities at British Telecom.

- **The Fundamental Planning Unit** was chartered with delivering the required master plans for production of E-side for 1 year and D-side for 5. This unit would also be the depository for all information that would require updating of fundamental plans and would perform such updating immediately prior to release to subsequent units in the process as appropriate or on schedules established by the overview group.
- **The Survey Unit** was established to enhance timeliness and productivity for D-side surveying. This unit was field based and appropriately equipped for fieldwork. The crews worked on predetermined schedules, annotating plans in preparation for detailed planning.
- **The Detailed Planning Unit** was a production group charged with E-side surveying and the preparation of E-side and D-side estimates. This enhanced efficiency in both planning and execution. It would also provide planning support for duct and cable work. This unit, as the other two, were reinforced with appropriate clerical support.

Finally, **The External Works Control Unit** (EWC) was established along industrial production control lines. It was separate from planning units and focused on scheduling manpower and material to the released work activity and on monitoring and reporting progress in the field, the drawing office (DO) and in routing and records (R&R). It was also centralized to serve the total district as opposed to separately serving North and East areas.

The purpose of these new in-line organizational arrangements was threefold:

1. To provide a strategic view of the requirements to turn red into green and to keep it that way
2. To build a reserve capacity commensurate with predictable growth patterns
3. To ensure discipline and urgency and to maximize utilization of all staff, in particular the technical personnel

Another significant decision organized contractor-related activities into a separate unit. This divorced outside involvement from in-house planning and execution, provided improved visibility, and set the stage for eventually managing down the external component.

The Detailed Program Development established structures, procedures, and qualifications to support the new arrangements. These were developed and presented in the form of project summaries for each of the functional areas. The packages contained defining characteristics of the units. This included statements of purpose, objectives, internal organization, and their relationships to other parts of the district, resources required in terms of full-time equivalents (FTEs) as well as ranks and skills, duties and accountabili-

ties, and necessary practices and formats designed for management planning, direction, and effective feedback and control.

A thorough review of the managerial skill requirements and the match-up to the present staff capabilities became a key feature of the detailed development part of the program. Primary focus addressed two areas of concern. First, that a considerable number of managers were unsuited for assignment to these new tasks as a result of their inability to respond to the need for urgency and prudent risk taking. Another, the certain managers were simply unable or unwilling to accept any form of change. It therefore became necessary for top management in the district to make uncomfortable personnel choices and to embrace a factor of risk in the eventual staff assignments. Top management faced this challenge to BT tradition with exceptional courage and success.

At the stage where the detailed development was still fluid, the project team led a series of discussion sessions with all affected field and support supervision and with a cross section of technical and administrative staffs. This led to important constructive input that was incorporated into the eventual practices and procedures.

The Implementation Preparation and the Implementation completed the improvement program. Continuous dialogue with supervisors and staff combined with sustained senior management support and visible demonstrations that senior management had taken this project on as its top and continuing priority allowed a complex implementation to become remarkably rapid and seamless.

Following through on the match-up of present staff to the skill requirements of the new ways of doing things, the implementation process considered a feature that was novel within BT at the time. As an organization that represented technology, because of job security and generous benefits, BT had not experienced problems recruiting suitable talent. But when that talent was brought into entry-level management, there was little effort made at augmenting technical with managerial skills. As people grew in the organization, there was also little effort made to develop middle managers. Consequently, new supervisors attempted to hang on to their technical skills as their security blanket while not learning new managerial ones, and many middle managers who had become obsolete technically were equally short of management knowledge.

The district embarked on a program to intensify the use of available BT as well as outside resources to supplement the technical skills of new managers. These programs focused on greater appreciation of the tasks of management, on the roles of individuals within the management ranks, and on prescriptive techniques and man-management methods.

39.5 Conclusions

The district packaged the reforms under the banner "Network '90" with the aim to provide "service on demand" rather than trying to catch up with the demand for telephone service and finding that there is insufficient line plant capacity. The district management estimated that providing a planned connection could cost one-tenth of an unplanned operation where new line plant and capacity are required. The program results were widely publicized through the district's internal newsletter and they received favorable treatment throughout BT.

Most important, the changes stood the test of rapidly meeting the challenges that were identified by the district management at the outset of this transformation project. New and different market demands and new technologies in line plant and in management information have inspired revisions over time. But this project was a demonstration of the results that can be achieved when a determined management group decides to think what might have been unthinkable thoughts and then to act.

40

Semiconductor Equipment: Supply Chain Links

Terry S. Mercer

This case describes a familiar situation in many manufacturing companies. It includes the breakdown of processes for managing production in periods of peak demand. The author was a manager brought in to solve the problem. His approach included a number of elements described in this book:

- A focus on final demand rather than forecasts to sort out the chaos (Chapter 29)
- Use of a "drumbeat" to get supply chain partners on the same page (Chapter 29)
- The role of MRP/ERP in planning production requirements (Chapter 22)
- Coordinating the efforts of supply chain partners (Chapter 19)

40.1 Background

The semiconductor equipment industry periodically goes through wide swings in demand. These swings, ranging from 50% drops to 100% increases on the upturn can severely test any supply chain. This case describes the problems encountered by a component supplier in this industry trying to keep up with the expansion phase of one of these cycles.

At the start of the case, the company was 6 months into the upturn and struggling to keep up. Lead times had drifted out to 6 months and there was a past-due backlog of 2 months. The customers of this company included original equipment manufacturers (OEMs), wafer fabricators, subsidiaries in Europe and Japan that were consuming components, and an internal division that was using finished instruments. This presented a very complex load profile, with each market making distinct demands on the supply chain.

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This was an assemble-to-order environment using common components to build instruments that are calibrated and tested after assembly. The parent company supplied subassemblies and other components to three subsidiaries that also assembled and calibrated instruments. The subsidiaries, in total, assembled a volume equal to the parent company and placed a significant load on the parent.

This company was primarily an assembler, although it did manufacture the sensor used in the instrument. The product had a large material content; and suppliers consisted of machine shops, electronic component suppliers, and a variety of other sources. The company was in the process of implementing a classic MRP system to manage this material flow, and at the start of the case it was using a manual system based on "buy cards" for the various components.

40.2 Goals

The goal of the company was to eliminate the past-due backlog, provide better service (more timely deliveries) to customers, and to put systems in place that would support future plans and growth.

This case illustrates a number of key issues:

1. The entire system or supply chain must be understood/defined to get a clear picture of the problem and the potential solutions.
2. Individuals/departments/companies in the system are usually aware of only their particular needs and issues.
3. Once the nature and scope of the system are defined, the next step is to determine the demand on the system and the capacity available to meet that capacity. Many companies fail to understand their capacity and how it impacts their performance. If capacity is the problem, other solutions short of increasing capacity will fail. (An example of a failed solution would be adding expediters.)
4. Effective communication of requirements to all levels of the supply chain is a key to good performance.
5. Aligning all resources in the supply chain to a common drumbeat or target is critical to effective execution, and is an excellent method of communicating requirements.
6. Measuring performance is critical to effective ongoing execution.
7. Running to a rate stabilizes the flow between steps in the chain and minimizes disruptions.

8. A clear definition of the supply chain and the strategy for operating it are a necessary prerequisite for effective implementation of a management tool like MRP or ERP.
9. The first step to continuous performance improvement is to get out of the crisis-management mode.

40.3 Company Operations

The company was structured functionally with separate materials, sales and manufacturing organizations. The subsidiaries reported to the President and Executive Vice President. The company had two other product lines that had their own manufacturing and engineering organization. The communication mechanism among customers, subsidiaries, and suppliers was traditional purchase orders. The sales order entry group took orders independent of the manufacturing organization and basically took the order as requested by the customer promising the standard lead-time.

This resulted in orders coming in hunks and gobs throughout the supply chain. If a subsidiary decided to build inventory, it would simply enter an order for the amount desired. No lead times had been established for components or subassemblies. On the supply side, purchasing would release purchase orders for a particular part when the minimum order quantity was reached.

The MRP software and hardware were in place, but training and data input like bills of material would take another 6 months before the system could be utilized. Further, with everyone struggling to keep up with daily crises, it would be difficult for the organization to accomplish the required tasks in this time frame. The MRP implementation was significantly behind schedule and virtually at a standstill after 3 years in process.

Naturally, everyone was screaming for parts — customers, subsidiaries, and internally the manufacturing department, which never seemed to have the right part at the right time. Buffer inventories of subassemblies within the facility and at the subsidiaries had been reduced to zero. The subsidiaries had an urgent desire to rebuild their stocks, adding to the demand. There was also evidence of double ordering by the customers because of the long lead times.

With each department and each supplier and customer working independently, no one had a clear picture of the overall problem and related issues. It was not clear if the installed capacity was adequate.

40.4 Designing a Solution

The key to understanding the problem and developing a solution was to step out of the trees and look at the entire system from supplier through to the many customers and demands on the system. This was a two-step process.

1. To look at the overall demand on the system and determine whether the capacity was adequate to meet these demands
2. To streamline the interfaces and communications among the various elements in the supply chain and develop an effective execution system

The end customer load on the parent was easy to determine since there was a 6-month backlog. The subsidiaries were a little more difficult to deal with. Rather than sort through all of their orders and desires to build inventory, we decided to determine their end customer demand. With the total end customer demand on the system, we could then determine the total component demand throughout the system.

The subsidiary managers were a bit reluctant to supply this information, since they viewed it as an infringement on their prerogatives. We were merely a supplier to them. This reluctance was quickly overcome when they understood what we were trying to do. After the numbers were assembled, we found that we had adequate assembly capacity in place, but did find that our capacity to manufacture the sensor subassembly, which everyone used, was inadequate. This situation was quickly rectified with overtime in the short run and the addition of operators and equipment in the longer term.

The final step was to determine if the suppliers could meet the demand. Meetings with key suppliers were quickly pulled together and they all agreed that they could meet the requirements, since the company had for several months been operating at close to this level on the average. We now knew that it was possible to meet the demand and could focus on the execution phase of the solution.

In this first step of the solution, we established the collaborative relationships required to manage the supply chain together. Internally, the managers went beyond screaming at each other for parts, and we moved beyond doing the same thing to our suppliers. Together, we looked at the total demands on the system, and determined that the capacity was in place or added required capacity to satisfy the needs. This gave everyone a common understanding of what was happening and what to expect. The process of going through the analysis itself helped to build the confidence that we had the ability to solve the problem.

The second step was to put the processes, ground rules and metrics in place to ensure that the overall system was operating as expected. A relatively

small number of changes were required to take the kinks out of the system and streamline the flow.

The forecasting process for end demand was continued on a routine basis with a monthly update and review. Any change in the level of demand was communicated to all parties in the system. As it turned out, the demand was stable for the next year, but when it did drop off, at the end of the cycle, a new rate was set and all parties in the system adjusted to the new level.

Based on the demands on the system, a final assembly target or "drumbeat" was established at 400 units per week. This provided enough output to supply current needs, catch up on past-due orders and reduce lead times to 6 weeks over the subsequent 6 months. The assembly manager had his targets and key metrics to measure the department's performance. If they fell behind, immediate action could be taken to correct the problem.

More importantly, everyone else in the system could key off this drumbeat. The appropriate rate was established for all of the subassemblies and the sensors. Each of these departments also knew what was expected of it and its performance metric was reviewed weekly. The targets at this level were set to allow for gradual replenishment of safety stocks in the system.

The use of minimum order quantities and the processing of masses of purchase orders were eliminated. Vendors were given blanket orders and shipped to the drumbeat or forecast. If they had a problem, we were immediately informed and the problem was addressed. The process with our subsidiaries was similar. They provided us with blanket orders and we shipped at defined rates to them.

At the end-customer interface, the drumbeat also provided coordination, although the customer never knew anything had changed. The lead-time concept was eliminated. Order entry simply filled in the available capacity with orders. When a week's schedule was filled they simply began promising delivery for the following week. When customers called, they were asked when they wanted delivery. If the week still had capacity the order was taken, without any discussion of lead times. If the week was full, they were given the next available date. The result was a very simple order entry system that featured immediate response to the customer and was tied to available capacity.

40.5 Benefits

First, we should look at the short-term benefits. Over a period of 6 months, past-due orders were eliminated and lead times were reduced to 6 weeks. All of our customers were satisfied; they were receiving the parts they needed when they needed them. There was a significant reduction in crisis management and expediting at all levels of the organization. Everyone could spend more time on building the business for the future.

Time was now available to implement the MRP system. This new system gave us the tools to manage our forecast and plans more effectively. With this tool we were able to further reduce lead times to 2 weeks and stores inventory by 30%. The new system provided the basis for future expansion as new products were added, which increased the complexity of the forecast and the number of parts that had to be planned.

Our ability to deliver with short lead times resulted in additional business, including the return of a large customer we had lost earlier in the year. Once in control, we were able to reserve some capacity for emergency 24-hour and 48-hour orders. This brought even more satisfied customers and enhanced profits, since our customers were willing to pay a premium for this service.

If you look at the entire supply chain, you can see that everyone was able to reduce costs. Customers were typically carrying 6 months of inventory because of the long lead times and uncertainty of supply. Likewise, our suppliers at the beginning of the chain had to carry more inventory and equipment to handle the wild swings in demand. Everyone in the system was spending less time expediting and chasing parts once the supply was predictable. Reducing the number of purchase orders from customers and to suppliers further reduced costs. The organization was now able to focus on the development and introduction of new products and lower cost processing equipment. It is clear that once there is stability and fewer crises, time is available for other efforts aimed at improving performance.

41

Footwear Distribution

Frederick Neu

This chapter describes the types of issues faced by many companies exporting fashion products over long supply chains. In many cases, the nuts and bolts of operations become a secondary priority to product design. However, lapses in the nuts and bolts can retard profits and lower the company's stock price. The case describes the issues faced and the actions taken by management to reduce cost and improve customer service.

This case addresses the situation of a manufacturer and distributor of quality footwear and apparel. The company had $112 million in annual sales and experienced rapid sales growth. The company manufactured 25% of its products in Southern California, and the other 75% was manufactured in Mexico, Costa Rica, Australia, New Zealand, and China. The company relied heavily on contract manufacturers. With its growth, it had concerns regarding managing freight costs and distribution related performance.

The latter was a particular concern. The company had experienced "charge backs" from their major retail customers due to noncompliance to their various packaging, labeling, routing, and delivery window requirements.

The company had recently acquired another footwear company, which meant there were four warehouse and distribution centers located in California, plus one in Canada, and one in Holland.

41.1 Major Decision Required

The situation posed problems related to the supply chain for managers of the company.

- Management had to decide if they should retain outside consulting assistance to address their concerns. Their decision was to retain a

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consultant on an interim management basis to run the distribution operation and make the necessary improvements.

- Management had to decide if they believed that their manufacturers could plan raw materials properly to ensure on-time deliveries. They decided that a transition period of 1 to 2 years was appropriate for them to assist in the planning of three critical raw materials used in the shoes.
- Management also had to decide if quality had improved sufficiently to send product from the manufacturers directly to Canada instead of to the U.S. for inspection, then to Canada. They decided it was improved from most manufacturers, which could send product directly to Canada.
- Management had to decide if they should select and implement a bar code based warehouse management system immediately or wait for 1 year. They decided to wait for 1 year and use the savings accrued from the other improvements help pay for it.
- After inventory accuracy measures had been taken, internal and outside auditors had to decide if inventory accuracy was improved adequately to discontinue quarterly physical inventories. They decided that an annual physical inventory was sufficient.

41.2 Management Incentives

The company's stock price was cyclical, but it was always lower than management thought it should be. All management personnel had set price stock options and would benefit from increase in the stock price.

The company had no assets, except inventory (all facilities were leased), so the investment community needed to see sustained profit performance for all four quarters of a year. Management saw a successful cost cutting and productivity improvement campaign as a way to achieve this.

Cost cutting and productivity improvement goals were included in key management personnel's bonus plan, which represented a minimum of 25% additional annual income if achieved.

41.3 Benefits of the Program

Improvements were made in all aspects of domestic and international inbound and outbound distribution, warehousing, and finished goods order processing, including the following:

- Reduced overall operating expense by 23%.
- Discontinued manufacturing in Southern California, thereby eliminating all the expense related to planning, shipping, and storing raw materials.
- Consolidated the four Southern California warehouse and distribution facilities into one efficient centralized distribution center.
- Negotiated lower rates for inbound international containers, and emphasized the importance of using 40-foot containers at all times, thereby eliminating the non-cost-effective use of 20-foot containers.
- Negotiated lower rates for domestic and international small-package delivery service.
- Sent the majority of products from the manufacturers directly to Canada, instead of first to the U.S. for quality inspection.
- Reduced insurance related costs for domestic and international small-package delivery service.
- Educated internal staff regarding making the most cost-effective choices for small-package deliveries and importance of avoiding higher service than was needed.
- Increased the discounts for common carrier shipments.
- Reduced annual charge backs from retail customers 83%.
- Increased inventory accuracy to 99.8%, without an automated system.
- Eliminated three of four annual physical inventories.
- Increased order accuracy to 99.2%.
- Improved on-time shipments to 99.9%.

42

Bicycle Manufacturer: Internet Strategy

Charles A. Cox*

This chapter describes the case of Andiamo, a start-up company that has made use of the Internet to build customer relations and speed its back office work. Andiamo is a fictitious company. However, it does represent a composite of supply chains, so the ideas and strategy are within the reach of any single company.

The scope of the Internet capability at Andiamo Bicycle Company is broad. It covers suppliers, manufacturing operations in the U.S. and Mexico, and customer service. The case illustrates creativity in establishing links throughout the supply chain. It also shows how partnerships within the supply chain can promote fast growth. Throughout the case study, *italics* denote links in the supply chain and the nature of those links, e.g., one-way or two-way.

Andiamo ("let's go" in Italian) is a high-tech bicycle company that was founded by John Renquist, a retired aerospace engineer who was an expert in aerodynamics and carbon filament composite construction. Today, Andiamo (ABC) caters to the needs of serious cyclists in three market segments: racing, touring, and mountain biking. It's been in business for 11 years, now has 105 employees, and anticipates doubling that number in the next 2 to 3 years.

ABC has developed a following for its products and services by being very responsive to its customers and solving their problems, often in very innovative ways. To this end, Andiamo has developed a cadre of product testers who will take a new product and test it or take an existing product and suggest modifications.

To be part of the test cadre, Alpha Group, the members have to agree to participate in three test projects per year and give timely feedback. Both the post-

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ing of upcoming projects (so members can bid for them) and Alpha Group feedback is done via a special projects area on ABC's Internet site. ABC provides a chat area for Alpha Group members to discuss various aspects of the projects and leverage each other's findings and knowledge. In return for their feedback, members are given discounts on ABC products and services and free flashy racing jerseys with the ABC logo and URL on them: "Let's go BIKING www.andiamo.com."

Initially, ABC set up its Web site to provide information to the biking communities (racing, touring, and mountain biking). The site offered the latest news on competitions and technologies of all types that might be embodied in bikes. There was also a catalog of ABC frames available off the shelf that could be ordered using an 800 number *(one way information).*

Within weeks of setting up the Web site, John modified an aerodynamic program he had written to allow visitors to the site to input details about themselves and their bikes and calculate their coefficient of drag, C_d. It also allowed them to play "what-if" simulations using various ABC products. This site proved to be enormously popular, and within months John had augmented the program to allow for calculations of calories consumed when using various combinations of derailleurs, tires and tire pressures, rims and frames. The program not only allowed bikers to play "what if," but also it allowed them to click immediately into technical areas where the nuances of the different components were explained as well as the benefits of customizing them, where appropriate *(two-way information).*

From its founding, ABC had made ultra-light bike frames using hand-wound carbon filament composite construction. It was an expensive, but very light and durable frame that was preferred by many racers. Initially, these were made in three sizes and put into inventory. As the superior characteristics of composite frames became better known and the hand-winding operation was semi-automated, John began making frames that were customized to the body dimensions and preferences of a few racers.

When he first started making the customized bikes he faxed or mailed a question sheet to the customer, who recorded his or her dimensions and preferences. The customer then faxed it back along with a down payment. After the Web site had been up for almost a year, John worked with his Web site designer and arranged for a third party to handle the credit card transactions for custom frames. John set the amount of the down payment so that all of his manufacturing costs were covered, and he was able to charge a premium price because the frame was custom-built. He also kept a small inventory of standard sized frames for those customers who were especially price sensitive. In this way, he financed and operated the entire frame operation on his customers' down payments.

Now, instead of faxing in their sheets with dimensions, the customers access the custom frame section of the Web site, fill in the on-line form, and give their credit card number for the down payment over a secure line *(pre-sales information, transaction information, and transaction).*

At the time customers give their credit card numbers, they are provided a way of accessing the status of their orders. This includes the dates their frames will be released to the manufacturing floor, serial numbers, and access to a reserved area at the ABC Web site. From this area they can follow the frames as they go through the "factory." By keying in the serial number, they would be able to visit the virtual factory and "see" where their frames are in the manufacturing process.

After this was first implemented, John actually placed two video cameras in key positions on the factory floor. Then the customer really could see the manufacturing process at the Web site. This was done to help customer relations, but also because there were two places in the process where proprietary operations were done and John did not want to give tours of the actual factory floor. Nor did he want to reveal his technology by obtaining patents for the specialized operations *(pre-sales information, sales transaction, mid-sale/order tracking information).*

When the frames were ready for shipment, their final measurements were taken and forwarded to the customers along with a digital picture showing the color. When the customers received the picture, they would trigger their frames' shipment by specifying the mode of shipment and paying the balance due. This includes the shipping and packing charges, which are automatically calculated by a Web site algorithm. Again, the customer can play "what if" with several different shipping choices, and a customer service agent (or John!) need not be involved *(two-way information).*

After doing the custom frames for 6 months, and receiving numerous inquiries for specialty components such as titanium axles, RockShock shocks, and specialty handlebars, John began looking for suppliers. He knew from his experience with the frames that he did not want to stock an inventory of parts, but he felt that he could still sell components. Initially, he partnered with a small machine shop making titanium turned parts like axles and hubs. He set up his Web site so that, when ABC received the order and the credit card amount, an order was placed with the machine shop to drop-ship the component to the customer and credit the machine shop's bank account *(transaction with customer, transaction with supplier with accompanying information for both).*

After several months, John had created similar relationships with a group of different specialty item makers, but there were still gaps in his component offering. So he sought a different approach and found a multi-line distributor willing to provide a full line of products, including handling (on the same basis John had) the specialty manufacturers. Now, when a customer called in and placed an order, it went directly to the distributor, who supplied some of the components from his warehouse, and others were drop-shipped directly from the other suppliers *(transaction with customer, with distributor and with supplier to distributor).*

Because of John's proprietary semi-automatic winding technique, he was able to profitably supply frames to other custom bike makers. From the contacts made by the Alpha Group members who occasionally toured Japan and

Australia, John was able to start a small export business to these markets. It was through these exports and contacts with export brokers that John became aware of opportunities in Latin America.

To exploit this opportunity, Andiamo had some sections of its Web page translated into Spanish, and John was surprised at the demand for specialty bicycle components. But what really surprised him was the export demand for fully assembled custom bicycles — but with considerable price sensitivity, at least in the Latin American markets.

Just as he had done with his initial efforts in so many aspects of e-commerce, he looked for a way to provide his customers a good product at a good price. As a result, John entered into a partnership with a firm in Mexico. Persons accessing the ABC Web site from Latin America could go into their own section presented in Spanish. There they could create their bikes using a standard sized frame or a custom frame with a wide range of choices for tires. These could be custom "siped," which modified the tire tread to meet their requirements. A hot button took them to an explanation — in Spanish — of which types of siping to use under which conditions.

Once they had "designed" their dream bikes, customers would pay with a credit card, and the distributor would immediately be informed what components to place in a kit. The kit was shipped to ABC, where it was joined by the frame and the entire knocked-down kit was shipped to the partner in Mexico, who had already scheduled the assembly of the bike and been partially paid for it *(sales transaction with the end user, transaction with ABC's customer—the custom bike maker, or the Mexican bike assembler, transaction with the distributor and the supplier to the distributor — all initiated by one customer purchase, but carried out and coordinated by e-commerce).*

Eventually, the Mexican partner approached John and proposed they make high-end bikes but without customized components or frames. So Andiamo and its partner began using e-commerce to purchase and coordinate the shipment of dozens of different components to Mexico, including the product that started it all: carbon filament composite frames. After many visits to the Mexican factory, John became comfortable with the idea that he could get workers with skills not just to assemble bikes, but also to make the somewhat labor-intensive carbon filament frames. So they began making the frames in both Mexico and the U.S., and coordinating their production using e-commerce. The types of manufacturing and supplier coordination that had only been possible in the past by using EDI were done today using the e-commerce model. A pilot was set up and proved out the approach very inexpensively *(information, coordination between different segments of the business, as well as between business and customer, including transactions).*

From the time that John set up his initial Web site just to provide information, to today when there are hundreds of transactions daily between ABC and its customers and ABC suppliers and their Mexican partner, he has depended on his local ISP (Internet Service Provider), which has also evolved. The ISP has provided ABC with server space for its (now) quite large Web site with thousands of visitors a day. The site has secure transaction

capability for financial transactions as well as sending manufacturing release information to Mexico, getting updates on supplier shipments (from the suppliers and the motor carriers the suppliers use), and information from the export/import brokers on the status of shipments.

The ISP has also set up an Intranet for John and his Mexican partner and several of their critical suppliers in the U.S., Canada, and Mexico. This site allows them to communicate quickly and coordinate both their manufacturing production and business activities. For example, accounts are balanced between all parties at the close of every day. They are currently expanding their Intranet to include all of the critical steps in shipments between the U.S. and Mexico so they will be able to know where each shipment of components is at any time. And, they are currently negotiating with a Japanese bicycle company to supply semi-assembled bikes to that market (everything except derailleurs, chains, and brakes). They will also use e-commerce to coordinate the U.S., Mexican, and Japanese operations. This is a success story that would not have been possible except for the inexpensive, ubiquitous Internet coupled with inexpensive, reliable, transaction software with encryption algorithms and techniques that allow both security for financial transactions as well as Intranets over the Internet and dedicated or public telephone lines.

43

Consolidation Centers in the Lean Supply Chain

Michel Baudin

This case describes the role of consolidation centers in the "lean" supply chain. The description here articulates the rules for designing a consolidation center, a supply chain "middle man," that makes the total chain more effective. Consolidation centers are playing an increased role in many supply chains, particularly as feeders to manufacturing operations that produce complex products with many components. Every supplier can't or won't link its operations with its customers. The consolidation center enables this linkage — at least until better suppliers can be found. In some cases, consolidation centers are under the control of third-party logistics providers responsible for ordering material, its transportation, and its preparation for the manufacturing center.

43.1 Introduction

A consolidation center is a facility, located near a manufacturing plant, that receives components and parts from many suppliers and delivers them to the plant. Practitioners of lean production use these centers to insulate the factory from overseas suppliers with long lead times and from domestic suppliers who cannot or will not work with *kanbans*, returnable containers, and truck "milk runs." In addition, in the automobile industry, consolidation centers allow materials handling work to be paid at its market rate rather than the high rate of car assembly.

The consolidation center is not used for every item. Indeed, suppliers deliver directly all the items from other than those explicitly identifed above. Returnable containers with item-specific dunnage are used for local deliveries on milk runs because (1) they save assembler time and disposal costs, (2) their number caps the amount of parts in circulation, (3) the trucks that ride back to the supplier plant would otherwise be empty. The economics of

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returnable containers become less favorable for distant suppliers, whose remote or overseas locations may provide opportunities for return freight.

First, we define what a consolidation center is and examine the reasons for practitioners of lean production to resort to this structure rather than deal directly with their suppliers. Then we describe the work that can be profitably off-loaded to the consolidation center, the physical organization of how this work is or should be done, and where the consolidation center should be located. We also describe the type of work that is best *not* entrusted to the consolidation center but kept in the manufacturing operation.

Moving up from brick, mortar, and equipment, we then discuss possible business structures for the consolidation center and its relationship with the manufacturing plant. Finally, we briefly present the consolidation center's information needs and how they can be met through the combination of visual control and computer systems.

43.2 Definition of a Consolidation Center?

Figure 43.1 depicts the relationship between the consolidation center, suppliers, and its "client" manufacturing plant. The concept has found particular use in the automotive industry. Its use is on the rise in other industries. The consolidation center receives components and parts from many suppliers and delivers them to the manufacturing plant. It is often operated by a separate company, in which the manufacturer may or may not own equity.

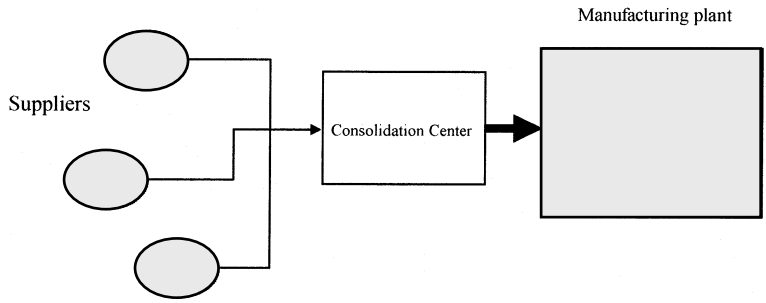


FIGURE 43.1
Definition of a consolidation center.

43.3 Motivations for Using Consolidation Centers

In general, adding a middleman between suppliers and users does not enhance a supply chain, and it is therefore surprising to find leading, lean carmakers doing it. They have many different motivations. A consolidation center can shield the factory from dealing with overseas suppliers with lead times in months. The consolidation center is then a domestic supplier, working with the plant as if it made its own parts on a day-to-day basis.

The complexities and risks of working with remote suppliers and 4-month lead times do not disappear but, rather than dealing with them, the customer plant prefers to pay the consolidation center to do so. The plant staff has its hands full keeping assembly lines and machines running, and can do without the additional work load.

A second, similar motivation is to insulate the plant from domestic suppliers who won't work with *kanbans* or returnable containers. These suppliers should convert or be weeded out, but this process takes time, and meanwhile their products still need to be delivered to the plant. Again, the consolidation center relieves the plant from having to accept large, sporadic deliveries of inappropriately packaged parts.

While the first two reasons for using a consolidation center apply to other industries as well, labor cost reduction is a strong third one that is special to the automobile industry. In every country where it exists, the automobile industry is and has been paying high wages to its operators, whether they work on the assembly line or in the warehouse. Outside of it, a consolidation center can recruit warehouse personnel for half or even one third of a car assembler's wages. It cannot do all the materials handling for the manufacturing plant, but what it does, it can make a profit on while saving money for the plant.

43.4 The Work of the Consolidation Center

The flows of materials into a plant that uses a consolidation center can follow many paths. The following subsections describe a few of these.

43.4.1 Which Items?

Not every item needs to go through the consolidation center. Let us assume that its purpose is to insulate the plant from overseas suppliers and from domestic suppliers who do not deliver at the frequencies, in the quantities, and in the containers that the plant wants. Then, logically, the suppliers of all

other items should deliver them directly to the plant. In particular, the following types of items should not go through the consolidation center:

- Body-on-sequence items. The supplier is notified electronically when each unit starts final assembly and starts making it in order to deliver it to the appropriate assembly station just when the unit reaches it. This is used in the car business for such model- and option-dependent items as seats and body upholstery.
- Pay-per-build items. For this category, the supplier is responsible for maintaining stocks at or near the line side (where the item is used), and is paid based on the bill of materials for finished products leaving the assembly line. In car assembly, this is used for nuts, bolts, washers, and similar standard items. The suppliers, often distributors, of these items may in fact consolidate inputs from second-tier suppliers, but that is not the same thing as going through the consolidation center of the plant.

Over time, the plant will most certainly attempt to localize sourcing for all items and the populations of both overseas suppliers and uncooperative domestic suppliers will wither. The consolidation center should therefore be needed most when the plant is new, and less and less as the plant matures. No matter how far we look, however, not every supplier will have a factory within 10 miles of the plant, and those who don't will be under pressure to open at least a warehouse there. The consolidation center can find a long-term mission in serving as a common warehouse for a group of these suppliers.

43.4.2 Why Returnable Containers?

Lean producers' insistence on reusable containers with item-specific dunnage is puzzling to those who are not used to it, because it appears to be an unnecessary expense. Why not just use pallets and disposable cardboard boxes? Single-use containers appear to be cheaper, even after including their disposal cost. Let us explore why it isn't so.

Returnable containers are made of sturdy plastics and contain item-specific dunnage that separates and presents parts to assemblers one by one. The top shelf is slanted in the opposite direction and used to return empties. The main reason is that the containers used on the line side present parts to the assemblers, and the lean philosophy is that they must be designed for the assemblers' convenience. In practice, most plant managers view transporters and assemblers as equivalent, when in fact they are not. First, there are ten times more assemblers than transporters. Second, the assemblers are linked together in a chain of balanced operations leading to shipment of a product. Each assembler is a bottleneck, so that each second added to an assembler job means one second added to the jobs of all the assemblers on the same line.

This multiplier is not present with transporters, because they work in parallel. (This principle was described in Chapters 25 and 29.)

Returnable containers also play a role in regulating the flow of parts. We know how many returnable containers are in circulation, and this number places a cap on how much material is in the supply chain. The two-bin systems and variations on it are examples of the use of returnable containers as pull signals. For most items, however, *kanbans* are preferred because they offer more sequencing flexibility.

Whenever an assembler has to open a cardboard box, extract a part from a bag, or dispose of packing materials, the product waits. The need to make the assembly line productive justifies the investment in containers that present parts one at a time, unpacked, and properly oriented. The cost and work added in materials management can result in savings that are ten times larger in assembly.

This explains why the containers must be customized, but not why they need to be returnable. Single-use, item-specific containers could be quite expensive, but using returnable containers means sending empties back to suppliers. Clearly the economics of doing it depend on how far that is and, more specifically, on whether there are opportunities for return freight.

If the supplier is overseas, the ship can be loaded with export goods for the return trip, and the opportunity cost of not doing it would be prohibitive. Car companies have been known to set up trading subsidiaries for the sole purpose of finding freight for returning ships. If, on the other hand, the supplier is located within a few miles of the plant, there is no opportunity for return freight. With the exception of scrap metal for recycling in a foundry, there isn't anything the suppliers buy from the customer plant. For the trucks, the alternative to bringing back empty containers for reuse is returning empty.

In other words, from the strict point of view of transportation, the economics of returnable containers are favorable with local suppliers but not with remote or overseas suppliers. The customer plant, however, always needs item-specific containers that present the parts appropriately, and can't be cheap enough unless they are returnable. The consolidation center emerges as the solution to reconcile these conflicting needs.

43.4.3 Physical Organization of the Work

The consolidation center receives large shipments, breaks them down into the smaller quantities that the plant needs, disposes of the supplier's transportation crates, boxes, and bags, places the parts in the plant's reusable containers, and delivers them either to plant receiving or directly to the point of use. Because it breaks large quantities into small ones, the consolidation center holds substantial inventory and needs a warehouse.

The operator stacks empty pallets for reuse, along with any skids or item-specific, blow-molded separators used in transportation. Disposable pack-

ing materials are conveyed to recycling by an underground or an overhead conveyor.

43.4.4 Location of the Consolidation Center

From a strict logistics point of view, the best location for the consolidation center would be inside the plant building. Transportation from the consolidation center to the line side could then rely on the same marshaling trains or carts used for other items, and the weather would not matter.

If, however, the purpose of the consolidation center is to insulate the plant from certain supply problems, collocating the two in the same building may not be the best way to achieve it. At the management level, proximity and the sharing of food service facilities may make it difficult for plant-materials managers to refrain from intervening in the management of the consolidation center. In addition, close daily contact among operators who make different wages for similar jobs is bound to create tension.

Consolidation centers are often located in a separate building within the same industrial park as the plant. If the climate permits, it is still possible to load vehicles that go directly to the line side at the consolidation center. Otherwise, an additional transfer is needed when the parts reach the plant. The consolidation center staff still comes from the same labor pool as the plant staff, but corporate identities are more clearly separated, and daily contacts are few.

Manufacturing companies usually do not set up from scratch a consolidation center that is several miles from their plant, because transportation would then require road trucks. This sort of situation arises mostly when an existing trading company is drafted into the role of consolidation center. If it has a facility that is less than a 15- to 20-minute drive from the plant, then it isn't worth building a new one nearer. This facility then taps into a different labor pool from the plant, and can recruit employees for whom the wages it offers are an improvement.

43.4.5 What the Consolidation Center Shouldn't Do

There are limits to what can be reasonably asked of a consolidation center. We describe here three examples of work that, for different reasons, must be kept in-house.

43.4.5.1 Kitting

The consolidation center should not be asked to pick kits for production, for several reasons. To pick kits, you need pick lists based on the product's bill of materials, and sharing a bill of materials with the consolidation center means not only letting out key proprietary information but also keeping it up to date. Whenever engineering changes are implemented in the plant, they

must also be at the consolidation center. The corresponding exchanges of data are much more complex than if the consolidation center only deals with individual items.

The best time and place to pick a kit is next to the assembly line and just before it is assembled. The pickers can be experienced assemblers who will do a more careful and thorough job as a result of knowing what each part is for. Missing or defective components can be easily replaced, and there is no need to manage and transport a stock of kits.

43.4.5.2 Incoming Quality Assurance

Again, the issue here is the information that consolidation center employees need to have. They would have to be trained not only on the plant's quality-assurance methods but also on the characteristics of the parts. This is better done inside the plant — without sharing technical information with outsiders — and where engineers are present who can analyze problems as they are detected.

43.4.5.3 Sorting Empty Boxes and Dunnage

The temptation is great on the production shop floor to throw all empty boxes and dunnage together at random and count on the consolidation center to sort it out. After all, consolidation center labor is cheaper than assembly plant labor, so why not do it? The reason it is a bad idea is that it is not a transfer of work to the consolidation center but the creation of work that otherwise wouldn't need to be done. The empties on the shop floor are found where the parts have been consumed. They come out automatically organized by item, operation, and product line. By scrambling the boxes, production is actually destroying a structure it already had and that the consolidation center must later reconstruct. In this case, it is more economical to organize the pickup of empties by item.

43.5 Business Structure

For a consolidation center to achieve the goal of insulating the plant from remote or uncooperative suppliers, it should buy the parts and resell them to the plant. There are, however, impediments that make it necessary to at least start on a different footing, where the plant still purchases the parts, and the consolidation center provides handling services for materials it doesn't own. In addition, except for handling damage at the consolidation center, quality problem reports and technical information about parts must be communicated directly between the plant and the supplier.

The consolidation center takes a considerable risk if it buys parts on a 4-month lead time to deliver them several times a day to the plant. Playing this right, particularly with thousands of items, requires good inventory control, sophisticated management, and the clout to influence suppliers to improve deliveries and reduce costs. A consolidation center typically starts out weaker than its manufacturing client in all three areas, but can catch up and become a real trading company.

For overseas products, we should add up 2 days of process time within the supplier plant, 5 days for ground transportation on both sides of the ocean, and 10 or more days for the transoceanic passage. This produces a minimum of about 3 weeks to get one part from raw materials to overseas delivery. If the purchasing lead time is 4 months, or 17 weeks, then it means that the parts spend 14 weeks waiting.

Technically, some of the methods used to reduce lead times domestically are equally applicable in this context. For example, milk runs could be set up in the country of origin to fill shipping containers with mixed loads from multiple suppliers. Practically, however, this is much more difficult to set up overseas than in the plant's own neighborhood.

Because of the long lead times, short-term variations in demand will cause shortages and overages. As discussed below, a good information system — composed of both visual controls and computer technology — is necessary to anticipate both. Shortages can be alleviated by emergency air shipments, and a warehouse is needed to cope with overages.

43.6 Information Flows Around the Consolidation Center

When we talk about the consolidation center's information system, we mean the combination of visual controls, paperwork, and computer systems that is used to communicate with the plant on one side, the suppliers on the other, and consolidation center staff in the middle. We distinguish several categories for information flows.

43.6.1 Routine Operations

This is the information required to drive operations on a daily basis. The flow of *kanbans* from the plant tells the consolidation center what needs to be picked and delivered. On the other side of the flowracks, the pallet-unloading fixtures need to be sequenced by item, and the corresponding trailers need to be brought to the docks. Outside in the yard, incoming truck drivers need to drop off their full trailers at an assigned location, get appropriate credit for them, and know which empty trailer to take away. If the empty trailers contain skids or blow-molded separators, they are also item specific.

The drivers also need to be directed to the return freight, unrelated to the plant, that they may carry on the way back.

43.6.2 Planning

The consolidation center needs forecasts from the plant, for capacity planning if it is acting as a service contractor, and to order from suppliers if it is acting as a trading company.

43.6.3 Alarm and Emergency Response

The information systems must detect when the *kanban*-driven consumption of an item is such that the consolidation center will run out of it before the next planned shipment arrives. This is an alarm situation, calling on consolidation center management to intervene in the supply chain to expedite delivery. Actual shortages are emergencies requiring more drastic action, such as air shipments of parts.

43.6.4 Performance Monitoring

If the consolidation center works as a trading company, it needs to monitor the suppliers' delivery performance in terms of shortage history, on-time delivery, lead time, flexibility with respect to volume changes, and so forth.

44

Demand-Driven Supply Chain in a Start Up

James B. Ayers

This case describes the situation of The Louis Collection (TLC). TLC, a young company based in Los Angeles, is an importer and wholesaler of "reeditions," or reproductions, of antique French furniture. The furniture is new, but the designs go back to 18th century France. The case demonstrates the issues faced in synchronizing supply chains with distant suppliers, the need for customizing information for decision makers, and establishing policies for managing inventory in the case of a complex supply chain.

Although TLC is a small company, it had many of the problems faced by larger organizations. The case also reflects a trend in that many companies with which we deal are continually experimenting with alternative approaches to setting inventory levels that are both economical and provide competitive service levels. The case describes the company situation and the proposed solutions.

44.1 The Business

TLC began operation in 1999, based on faith in the marketability of its product line. Dr. Patricia Gail Mahoney, who goes by "P-Gail," had found the furniture lines attractive when outfitting her apartment in Paris. She believed — and her belief has been confirmed by market acceptance — that the furniture would have similar appeal for customers in the western U.S.

She contracted with two furniture manufacturers for product in two distinct value ranges. Style et Confort, which manufactures its products in France, represents the TLC premium line. Style et Confort products are marketed as "antiques of the future," are built to last, and are expensive by most standards. An "economy" line is produced by AG*R, also of France. AG*R, however, manufactures in Indonesia, close to mahogany sources and a ready labor supply. Both lines include chairs, *radassiers* (two- or three-seat benches),

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armoires, beds, stools, and bookcases of various styles. In terms of unit sales, the largest category for both lines has been chairs.

The product line is broad, with more that 100 specific items carrying manufacturer stock numbers. Each item can also be finished with multiple options. Many products are also upholstered with custom fabrics. TLC can choose to have the wood finish done at the factory or by a local (Los Angeles) finisher — a form of "postponement" described in Chapters 26 and 27. TLC preferred the factory finish for consistency and lack of hassles in arranging the logistics of moving the item to the finisher and back — and tracking each item in the process.

In the U.S., TLC established a showroom at the local furniture "mart." Furniture sellers maintained showrooms at the mart where they displayed their goods for wholesale purchase. Here, designers and decorators bring their clients for furniture selection. TLC invested in an elaborate "showcase" exhibition of both its product lines. Part-time salespeople staffed the showroom.

To fill its pipeline, TLC also purchased several containers of furniture, committing to a large inventory without firm customer orders. The manufacturers considered 20- or 40-foot containers an "economic lot size" for efficient transportation. However, TLC sales in the early stages were less than a container a month, leading to low inventory turnover.

For storage, TLC leased warehouse space about 10 miles from its showroom. A part-time warehouse staff stored the merchandise for sale, showed customers around, and answered questions on available items. It soon became apparent that customers liked to browse the warehouse to make selections from available stock. So two models for customer fulfillment emerged early. One alternative was to special-order items on the factories and wait weeks and months for delivery. The other was to visit the warehouse and make a selection from the ample inventory. To reduce inventory, TLC also held occasional warehouse sales to purge it of slow-moving items.

44.2 Markets

After a few months' operating experience, TLC came to believe there were several additional attractive markets — beyond designers and their customers with good sales potential:

- Other retail: Selling wholesale to retail outlets. Retail stores would buy from TLC or take items on consignment. This segment broke down into local and longer distance customers — some as far away as Alaska. Most were within easy delivery range of the TLC warehouse.

- Direct retail: There was an appeal to capturing the retail margins and perhaps economizing on warehouse and showroom facilities by opening a retail outlet operated by TLC.
- Representatives: Striking agreements with furniture representatives was another way to increase geographic coverage. These representatives would cover areas outside the Los Angeles area.
- Catalog sales: Presenting selected products in mail order catalogs. The catalog sponsor would perform the customer interface function.

Customers in these segments had varying expectations for delivery lead time. TLC salespeople found that 12- to14-week promise dates were acceptable within the designer segment. Retail customers expected 8-week delivery. This presented a problem for TLC — particularly with respect to its AG*R line. Because it had a long lead time with its supplier, TLC needed to forecast its requirements, presenting a large obstacle to establishing a demand-driven supply chain. Early sales history also showed that the AG*R line represented 80% of sales, and that sales were concentrated in a few items.

44.3 Needs for Improvement

TLC found that, as growth occurred, it had to face the obstacles encountered by companies of greater size. These centered on three core processes.

1. *Order entry and tracking*. Inventory was tracked in QuickBooks, a small-business accounting program. Individual items came in several finishes and could be located at several points in the supply chain pipeline — in the warehouse, the showroom, in transit, or on order. It was difficult to know the status of inventory and orders, necessitating numerous calls to the warehouse and office. Quotations and sales order paperwork were also time-consuming. There could be as many as four quotations generated for each actual order. This work was manual, performed by salespeople in the showroom. It was anticipated that this problem would be aggravated by expansion into other channels.
2. *Inventory management.* Forecast sales were "guesses." TLC had felt compelled to order in container-sized quantities. There were no arrangements with manufacturers to "design" the pipeline. The result was low inventory turns and a high probability that requested items could not be delivered within customers' expectations for lead time.

3. *Sales management*. TLC had few systems for administrative support for the designer market. This involved promotional material, inventory reports, quoting and order fulfillment, and price lists. Price lists were particularly aggravating in that they were in French and needed currency conversion.

The remaining section describes proposed solutions. These make use of principles found in earlier chapters. TLC is in the process of implementing the changes as their needs evolve. In some cases, which we note, they found obstacles to gaining supplier support for "partnerships."

44.4 Process Recommendations

This section provides a high-level view of the recommendations to improve the three supply chain processes at TLC. The comments are related to those recommendations that hold lessons for SCM. Other recommendations, not discussed here, addressed other areas of the company. Each recommendation required TLC managers to evaluate alternatives and set priorities to increase sales and improve cash flow.

44.4.1 Order Entry and Tracking/Sales Management

Figure 44.1 depicts paper flow in the TLC fulfillment process. As mentioned previously, this cycle was typical of the designer segment. The numbers give an indication of the potential volume of documents at each step when TLC had reached the business plan volume. Inquiries, as shown in Figure 44.1, didn't necessarily involve handing the customer a document. However they did require access to up-to-date information. Of particular criticality was inventory availability. The company needed to know if items were in the warehouse, on a ship, or on order. It also needed to know finishes and upholstery status. This made the assignment of stock numbers, an early approach, cumbersome since the manufacturers had no unique stock numbers for each stock-keeping unit.

Many potential customers who were "just shopping" required quotations. These had to take into account the latest exchange rates plus different categories of discounts offered to various classes of customers. In some cases, a quotation would be converted to an order; in others, a new order would be generated. Of course, many quotations lapsed without action by the potential customer. Once an order was completed, the QuickBooks system would generate invoices and shipping documents — but the information was keyed into the application. After the order, there is a need to keep customers

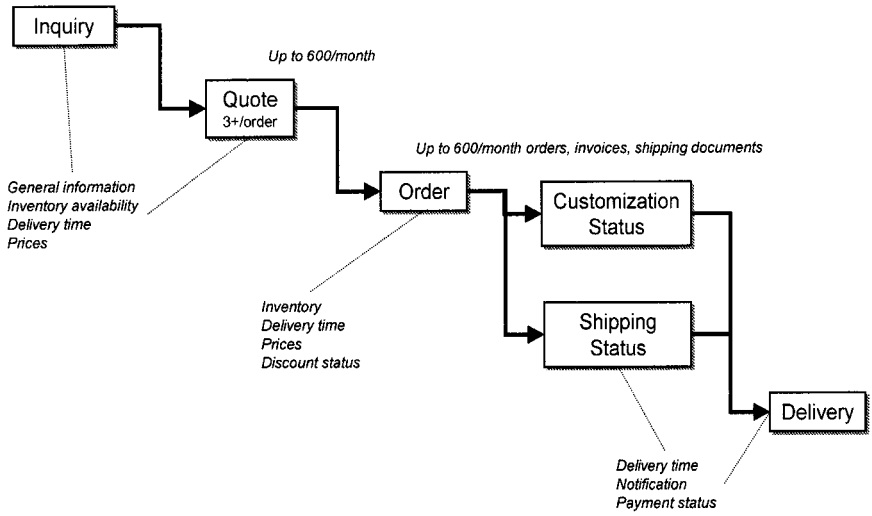


FIGURE 44.1
Placing and filling an order at TLC.

informed of status — particularly since orders could take weeks or months to fill.

Each document in TLC was generated by hand. Even data entered into the QuickBooks application on the computer was keyed from hand-written documents. While acceptable at lower volumes, the system was seen as inadequate for further growth. Manual entry was also prone to errors and inadvertent violations of pricing policies. It was also difficult to know what inventory items were committed to customers and which were available-to-promise.

TLC felt its supply chain was already unique. But it was also considering alternative channels for its products, which promised further complication rather than simplicity. For this reason, TLC chose to customize a database for entering and tracking orders through the fulfillment cycle. The result was the conceptual design for the database to cover all the desired functionality. One advantage of this approach was the ability to add functionality incrementally. The top priority was gaining visibility over available-to-promise (ATP) product in the pipeline. This was selected as the first component of the database.

Rather than assign unique stock numbers to each item, TLC chose to identify items by several categories:

- Manufacturer's number and name
- Finish and upholstery
- Distinguishing characteristics (e.g., damage)

- Location (on order, enroute, in stock, and so forth)
- Available to promise (yes/no)
- Customer order (if committed)

It was felt this approach provided the flexibility TLC needed and was reflective of its method of operating.

44.4.2 Inventory Management

TLC also faced many issues with regard to inventory management processes. This was especially true with regard to the AG*R line. Style et Confort products were usually upholstered, and customers more readily accepted longer lead times. Indeed, long lead times added to the product line's exclusivity. As with many distributors, however, inventory management means the difference between success and failure. So the inventory management recommendations turned toward coordination of production with AG*R. The intent was to move TLC toward a "demand-driven supply chain." If successful, TLC could reduce its dependence on forecasts and carry as much inventory as possible within logistics constraints for known customer orders.

To this end, TLC divided its customer base into segments for the purpose of establishing inventory strategies. The segments and associated policies were as follows:

- Designer — the current sales base. TLC would carry limited stock and provide reliable, if not short, lead times.
- High end — the customized order segment. This segment is not time sensitive and generally orders from the Style et Confort product line.
- Fast response — higher-volume resellers, including representatives, catalog, and retail sales. The segment requires shorter lead times and carrying stock for popular items.

This segmentation led to the assignment of inventory categories to each product. There were three: high movers, moderate movers, and build-to-order (BTO). Inventory policies for the categories were as follows:

- High movers — finished and unfinished items on hand. Replenishment on a fixed schedule; 80 to 90% service level goal. Use LTC (less than container quantities if necessary). This category would serve all segments with popular items.
- Moderate mover — modest finished/unfinished inventory. Replenishment on a fixed schedule; 50% service level goal. LTC quantities if necessary. This category would principally serve the designer segment plus others as TLC expanded.

- BTO items — finish at factories. Transport in order quantities or in the next container. This category would serve the high-end-customer segment.

Figure 44.2 shows the framework in which TLC would synchronize its inventory with AG*R for high and moderate movers. Its purpose was to establish a "replenishment period." In the example shown in Figure 44.2, this period is 12 weeks. Four weeks are designated the "order taking period" or OTP. The remainder of the replenishment period is represented by the lead time needed to get the order to the warehouse for delivery to the customer. The length of the replenishment period depended on the manufacturer's lead-time and transit time. For TLC to build only to inventory, this replenishment period had to be competitive in terms of lead times for customer delivery. To the extent customers demand shorter lead times, more safety stock inventory would be required.

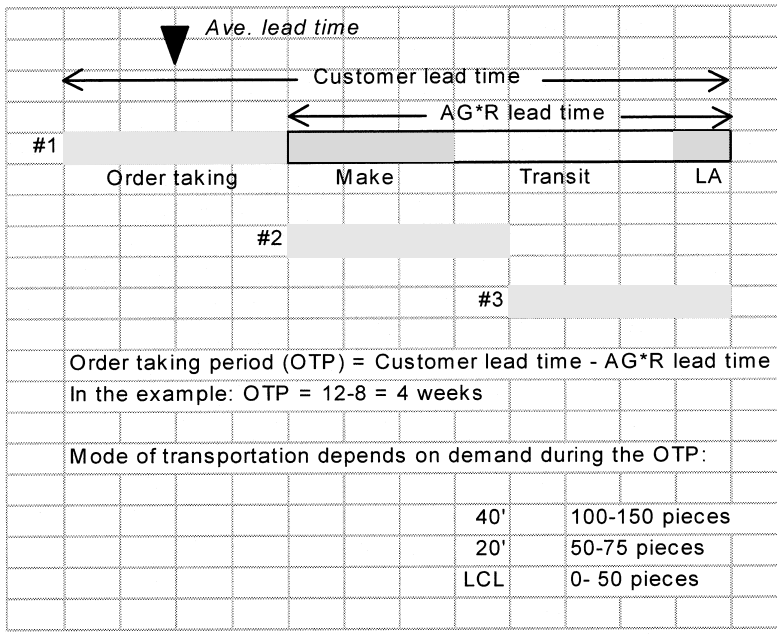


FIGURE 44.2
Synchronizing schedules with AG*R.

Setting the period relied on the following algorithm.

1. Estimate the pace of sales in pieces sold per week. This will principally determine the method of transportation. Until TLC achieved higher volumes, this was likely to be less-than-container loads (LCL).

2. Establish the AG*R lead-time including manufacture, transit, and inbound processing. In real life, this turned out to be difficult for a number of reasons. Fundamentally, AG*R had little appreciation for the value of short lead-times, making it an expensive partner with which to do business.
3. Set the customer lead-time objective based on market conditions. This will set the "order taking period" which is the size of the window for each order. In Figure 44.2, the average lead-time is 10 weeks; the peak is 12 weeks. If all customers would accept this lead time, then theoretically TLC orders to AG*R could be 100% BTO. Since that was not the case, it had to stock medium and high movers.
4. Set the container type and frequency. This was determined by expected volumes, the AG*R lead time, and the acceptable customer lead time.
5. Arrange logistics with AG*R and its freight forwarder. The regularity of shipping in LCL quantities placed new demands on TLC and AG*R since AG*R preferred container quantity orders.

The last component of the inventory management program was the reorder rules for each category of the product line. TLC used a "target" inventory approach, which provides sufficient safety stock to accommodate demand fluctuations as long as the reorder frequency is maintained. With this arrangement, TLC will reorder to maintain the target inventory level. So, at the end of each OTP, TLC would order the amount sold during the OTP plus whatever it will take to reach the target inventory. If the plan is followed strictly, this will always be the actual unit sales during the OTP. Thus, the supply chain becomes "demand-driven."

The target inventory depends on the OTP and the inventory category. For high movers, the target inventory was expected demand over two OTPs. For moderate movers, a lower service level was the goal, so target inventory was set at a one OTP level of demand. Table 44.1 illustrates the decision to be made for a product designated as a high mover.

The advantage of this method was its simplicity and flexibility. TLC could reset inventory up or down by just changing the expected sales per week as it accumulated sales history. This didn't remove the need for a forecast, of course, but did assure that inventory levels would track actual demand.

TABLE 44.1

Calculation of Reorder Quantity for High Mover Product

1	Expected weekly demand	20 units
2	Order taking period	4 weeks
3	Expected demand during the OTP = (#1 * #2)	80 units
4	Target inventory (2 * #3)	160 units
5	Actual demand in OTP	100
6	Number on order	70
7	Current inventory	50
8	Order quantity = #4 + [#5 — (#6 + #7)]	140

45

Automobile Industry: Incoming Material

Michael Tracy

In this case, Mike Tracy describes the support provided in the model-year launch of the LH model produced by DaimlerChrysler (then Chrysler Corp.). The launch was a major opportunity to upgrade the system used by Chrysler in bringing components to its assembly plant. The case describes the role of a third-party engineering group to manage the process. The purpose was to decrease the lead time to meet the launch schedule. The case also describes the features Chrysler sought in changing its system for handling incoming material.

The successful launch of Chrysler's 1998 LH vehicles at the Bramalea Assembly Plant (Bramalea, Ontario, Canada) capped the efforts of many relatively unsung players, both within and outside Chrysler. Among these were the people responsible for packaging and containerization of incoming parts, delivery logistics, and the wide variety of line-side equipment for handling those parts.

45.1 The Big Picture

Chrysler had always performed the major task of logistics integration in-house through the Corporate Material Handling Group in conjunction with Corporate Non-Production Purchasing. The responsibilities of the group included program management of the total solution, material flow system analysis and simulations, packaging engineering, rack design engineering, facilities and equipment management, production control services, and procurement services.

This process typically had problems with meeting schedules and working within the program budget. These problems were not due to any issue with the competence of the staff, but rather, were a function of internal corporate business processes that supported launch priorities over fiscal priorities.

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There was also serious debate within Chrysler if that aspect of the automotive business should be considered a core competence of an automaker.

To make the process more effective, Chrysler decided to outsource the program, making it a turnkey, major contract/purchase-order-based process. Chrysler's partner in this effort was the Packaging Systems Division of DCT, Inc. (now I*Logic), assisted by The Agile Group, Inc.

45.2 Outsourcing

The supplier planned and delivered the total system of racks, containers, dunnage, and material handling systems from suppliers to assembly operations. Put simply, the supplier served as Chrysler's Systems Integrator, working closely with Chrysler's entire Large Car Platform team. This involved an unusually close liaison with Chrysler and more than 200 of Chrysler's key suppliers. The end result is an optimized solution achieved through the coordination of engineering resources, centralized change management, and supply chain management.

The supplier's responsibility to Chrysler boiled down to one tough bottom line — make sure that everything was ready to go by launch and do it with major savings in costs. All incoming parts suppliers needed the proper containers and dunnage,* in the correct quantity, in time to deliver parts for launch. The supplier was also responsible for all line-side equipment throughout the plant — things like turntables, lift tables, line-storage and handling equipment as well as any associated moving equipment and battery-charging facilities.

What's new and different here is that Chrysler turned over all of this work to an outside source, eliminating the departmental overlap that often occurs when that work is done in-house. The supplier served as the systems integrator for all packaging and indirect labor material flow for the plant. They didn't need five or six internal groups with supporting suppliers to handle container and rack design, packaging engineering, material handling, equipment, and expediting. When you add it all up, the outside management of those activities for Chrysler derived about $32.8 million in savings on the "98LH program."

* Dunnage is loose material placed in the package to prevent damage to the contents.

45.3 The Golden Rule — Support the Vehicle Build Process

The first project task was for the material flow analysts to work with Chrysler to develop a database of program needs. Packaging engineers then knew what the baseline container was. If the size or type of a container had to change, the supplier was alert to what impact that might have on material flow and the method of moving these containers from receiving dock to the assembly line. That's just one benefit of being on board early and working intimately with Chrysler from the point where the new methods had to be implemented.

Being involved up front with the program also led to a smooth integration of racks with production equipment. The supplier worked closely with Chrysler's Advanced Manufacturing Engineering and all weld systems suppliers to develop integrated material display in the concept design of weld systems. They continued with detailed follow-up to ensure that the equipment that was specified and procured could be installed cleanly. Using the 1993 model year LH vehicles as a baseline, there was a 50% improvement in ergonomic performance based on NIOSH standards.

45.4 Eliminating Cardboard

The emphasis in vehicle manufacturing is on using returnable containers to achieve the substantial savings they represent in labor, storage, and warehouse costs. Quality improvement through elimination of dust and similar contamination as well as the improved protection from a returnable system make this a real winner. The system design eliminated the use of cardboard at Bramalea for almost 100% of parts.

45.5 Reducing Rack Costs

The supplier managed the design, fabrication, acquisition, and deployment of 26,533 custom racks for 94 unique, critical parts (sheet metal, major modules, etc.). The supplier helped design, engineer, and source more than 93,000 containers made of state-of-the-art materials for over 1100 different parts. In-plant inventory was reduced by 35% through small lot containerization. And, a major saving was achieved through the rehabilitation and reuse of existing standard containers.

Rack quantities are an interesting chapter in the Bramalea story. Notes the supplier's general manager, "Working with Chrysler's logistics team, we analyzed the total rack usage cycle from supplier to plant and back to determine how many days each rack was in the total procurement system. Using that data, we were able to reduce the number of racks in the supplier base by 38%. This required that assembly plant suppliers then had to conform more closely to a just-in-time operations scenario."

45.6 Facilities and Equipment

Facilities and equipment planned, specified, installed, and/or managed by the system integrator include:

- Material display for approximately 600 work stations
- Approximately 700 tilt stands
- 86 over/under conveyors
- 11 tugger tractors and 100 trailers
- 28 shipping/receiving docks (built or rebuilt)
- Rebuild of two lift truck battery rooms

In addition to the benefits and successes mentioned, the program managed by the supplier also led to a 20% reduction in overall line length requirements in final assembly.

46

Water Utility: Logistics Services Partnerships

Mark Marcussen

This chapter describes an approach to overcoming the barriers inherent when several organizations are joined together. The solution was a partnership between the new company and a third-party provider to whom Thames Water turned to solve supply chain integration problems.

Thames Water Utilities Limited is the largest of the ten regional organizations, referred to as "authorities," for provision of water and for disposal of wastewater in England and Wales. The regional authorities were formed in 1973 by combining numerous local agencies of almost any size imaginable and with a wide range of practices and omissions in practically every management process.

The integration of management staffs, styles and practices was a long and laborious affair that significantly picked up momentum when the ten were individually privatized in 1989. As for logistics, the process was complicated by the wide differences in plant, equipment, and materials aggravated by a heritage of the previously local organizations. In the case of Thames, there were substantial dissimilarities in parts and components and wide variety of methods in procurement, warehousing, and distribution.

46.1 Development and Operation

In 1993, a major commitment was made to rethink strategy, structure, and operating practices. Over several years, new organizational arrangements came into place. One subset of this dealt specifically with logistics. Organizationally, this began with combining all of the elements of the supply chain, including contract administration. Andersen Consulting, a large international consulting firm, was brought on board to provide support for the information systems requirements. In 1995, "Connect 2020 Limited" became operational as a strategic alliance between Thames and Andersen Consulting.

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Connect 2020 Limited is a wholly owned subsidiary of Thames Water Utilities Limited. Its mission is to provide a full range of supply chain services to the parent company and also to make such services available to other organizations in the U.K. and elsewhere. Thames already provides management service of various types for water and wastewater operations internationally, and Andersen supports some of these activities with its own worldwide information systems expertise. Andersen also provides many of the staff resources. The services offered include sourcing, tendering, negotiating, purchasing, warehousing, logistics and payment processing. For illustrative purposes, specific tasks are described here for two functions. The list is useful for companies in similar situations.

46.1.1 Purchasing

- Establishing and managing long-term supply arrangements
- Identifying most suitable suppliers worldwide
- Framework agreements through competitive bidding using whole life costs and service criteria for selection of suppliers
- Managing relationships with key suppliers to ensure continued performance and value for money, using principles of partnership
- Reducing numbers of suppliers
- Improving control of expenditures, including restricting the number of people authorized to purchase by the introduction of teams of specialized buyers
- Managing day-to-day purchasing, goods received, and payment processes
- Managing registers of approved and prequalified contractors and suppliers
- Managing the supplier master file
- Coordinating the preparation of practical, legally compliant specifications

46.1.2 Supply Chain Management

- Development of service-level agreements
- Systems for vendor rating
- Customer service systems and processes, including service/help desk systems and customer surveys
- Price and service benchmarking

- Contract management, assisting Thames in the management of capital works contracts and term contracts
- Information technology software and support

46.2 Benefits

The general benefits of the efforts in supply chain management have included a professional upgrading of the supplier relationships, improved field work productivity, and the assurance that services are measured and benchmarked. Specific benefits include the following:

- 15% reduction in cost of procurement services
- 13% reduction in costs of goods and services
- 90% reduction in number of suppliers
- 51% reduction in inventory value
- 90% reduction in back-orders
- 87% improvement in inventory turnover
- One-third reduction in number of warehouses and stock centers

Connect 2020 is part of a comprehensive initiative to develop strategies for the future requirement of Thames Water domestically and internationally, implementing the structures to succeed in such strategies and developing ongoing efforts in operational enhancement.

What started as the "logistics project" in 1993 has had a profound impact on TWUL and has also become a standalone service offered to other organizations.

47

Auto Parts Retailer — Logistics Partnership

James B. Ayers

This case is based on the experience of AutoZone and its logistics services provider, J.B. Hunt Logistics (JBHL). It describes the motivations for a partnership that began in 1995 and has been in place long enough to assess results. Joel Sutherland of J. B. Hunt Logistics, Inc. and Richard McDuffie, Director Transportation and Logistics Customer Satisfaction at AutoZone, Inc. presented this case at the 1999 Council of Logistics Management (CLM) meeting.[1]

The case describes efforts with a primary goal of removing cost from the supply chain. Lowering supply chain cost supported an ambitious corporate expansion effort. The solution involved partnering with a logistics services firm to help redesign and than manage a rapidly expanding transportation network.

47.1 AutoZone Before the Partnership

AutoZone at the turn of the century had annual sales of about $4 billion. It sold its products through 2750 AutoZone stores and 43 TruckPro stores in 14 states. Its growth in recent years has been at a 27% rate, putting AutoZone in the Fortune 500. At the time of its commitment to its partnership with J.B. Hunt in 1995, AutoZone had 1143 stores, with a plan to add a store a day to its network.

As a retailer, AutoZone's success relied heavily on the effectiveness of its supply chain. In 1995, AutoZone was finding that its growth was being held back by operational issues that led to management distraction and added cost. Among the issues cited were the problems of processing inbound product from a variety of suppliers around the country.

Each of AutoZone's seven distribution centers at the time received shipments from each supplier. The result was that many incoming shipments,

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73% of the total, arrived in "less than truckload" or LTL quantities. Since the suppliers arranged for shipping, these were expensive and difficult to coordinate. There was also little that could be done to gain economies from filling returning trucks. The distribution centers also had little visibility over what was coming in and when. Company store growth only aggravated the situation.

Companies that receive goods at multiple distribution centers must also forecast demand at that level. This goes against the idea of the demand-driven supply chain, since each distribution center must make its own forecast. The practice adds to the inventory required to maintain a particular service level. Our description of "postponement" in Chapters 26 and 27 provided examples. Just as lack of commonality in design causes multiple line items that must be forecast, so does proliferation of stocking points.

AutoZone also had limited resources for information technology. Other areas of the company were considered a priority over the requirements of inbound transportation. The components of its supply chain were seen to be "unintegrated." These included merchandising, where decisions are made regarding product lines; distribution centers; transportation; and accounting and finance.

47.2 Goals for the Partnership

AutoZone sought to head off problems that were bound to increase along with company growth. The principal goals of the partnership included the following:

- "Optimization" of the supply chain
- Control and visibility over incoming product
- Shorter lead times and order cycles
- Scheduled, time-definite shipments
- Support of AutoZone core business and growth

Optimization variables for AutoZone included site locations for distribution centers, flows between distribution centers, suppliers, and AutoZone stores, inventory and cycle times, transportation modes, and trade-offs between service and cost. The central feature of the improved AutoZone transportation network was the shift away from a system where suppliers shipped product to each distribution center. This was replaced by supplier shipments only to the nearest center. That center, in turn, would replenish the other centers with products from that supplier. This enabled AutoZone to enjoy the benefits of truckload rather than LTL quantities. AutoZone trucks and selected carriers could now make the distribution center to distribution

center transfers. Where practical, the AutoZone fleet also performs inbound pickup at suppliers after making store deliveries.

Transportation responsibility was turned over to J. B. Hunt Logistics. JBHL created savings for SQA by converting the supplier transportation arrangement from "prepaid" to "collect." Under this arrangement, JBHL, not the supplier, would have control of the shipment at the point of origin. JBHL selects and pays the carriers rather than the suppliers. This resulted in lower transportation costs since JBHL has the freight volume to gain lower rates and manage shipments from multiple suppliers to lower transport costs through coordination. An example of this coordination is called "continuous move." In this arrangement, the shipping requirements of several JBHL customers can be sequenced efficiently using a single truck, raising the utilization of the vehicle's capacity and developing schedules that are more appealing to drivers.

AutoZone was motivated to partner for this transition by the expertise in transportation as well as the information technology already developed and maintained by J.B. Hunt Logistics. Roles for J.B. Hunt Logistics included the following:

- A single point of contact for transportation inquiries. Inquiries could arise from AutoZone distribution centers, administrative functions, stores, and suppliers.
- Provide information technology capability, expertise, and personnel.
- Select, negotiate, contract with and manage carriers.
- Arrange pick-up and delivery with suppliers and carriers.
- Monitor carrier compliance and maintain records.
- Measure and report performance.
- Audit freight bills, pay carriers, and bill AutoZone.
- Provide shipment status visibility.

To set up an optimized supply chain, J.B. Hunt Logistics pursued an analytical approach that required documentation of movements between "nodes" of the supply chain, including suppliers, distribution centers, and stores. An important foundation was the "vendor profile." This included physical characteristics of shipments, frequency, mode of shipment, guidelines for cross-docks, designated cross-dock, and pick-up schedules.

Figure 47.1 shows the optimization in practice during operations. Customers, stores, or distribution centers in this case, generate demand for transportation services. The optimization step determines the preferred mode of transportation (LTL or TL). If it is a truckload shipment, it is scheduled and routed to minimize cost. A TL situation may require routing to cover several shipment requirements. The remaining steps track the shipment through deliver and billing steps.

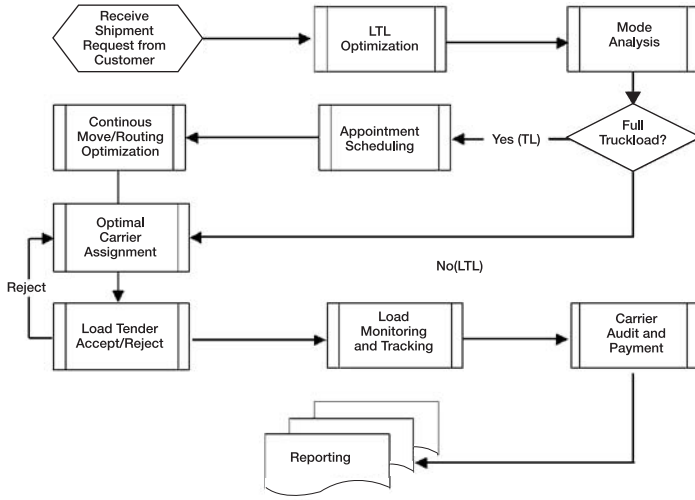


FIGURE 47.1
Operations process.

47.3 Benefits

After operating the newly designed transportation network for 4 years, AutoZone and J. B. Hunt Logistics have evaluated the results. The following paragraphs compare the "before" and "after" conditions with respect to the initial objectives.

Before	After
Supplier-controlled freight prepaid	77% of suppliers converted to collect
85% LTL inbound shipments to distribution centers	Less than 2% LTL inbound shipments to distribution centers
1 week average transit time — supplier to distribution center	1.5 days average transit time — supplier to distribution center
No visibility, poor performance on advanced shipping notices	Complete pipeline visibility
Substantial freight damage	Freight damage eliminated
High transportation cost	20% transportation cost reduction
Growth constrained	Significant inventory reduction freeing capital for growth and providing additional space in distribution centers
Poor on-time performance	98% plus on-time performance
Poor utilization of private fleet	25% increase in private fleet utilization

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48

Improving Furniture Manufacturer EVA

This case describes the situation of Miller SQA and its results in improving its ability to deliver office furniture to its customers. The case description draws on several sources: a presentation at the Council of Logistics Management (CLM) annual meeting in 1998, a case description at the SynQuest, Inc. Web site, and descriptions on two additional Web sites.[1,2,3,4] Representatives of the companies involved in the changes presented the case. They were Bill Bundy, Vice President Operations, Miller SQA; Art Brown, Vice President Strategic Consulting, SynQuest; and Steve Dean, Director, Menlo Logistics.

This case combines many concepts described in Section II and other case studies. These include the value of partnerships, cellular manufacturing, increasing velocity in the supply chain, inserting a "consolidation center" into the supply chain, and improving return on capital investments. As we describe the case, we point out strategic "themes" used by Miller SQA as foundations for its supply chain design. Chapter 7 described Michael Porter's model using strategic themes and activity systems and its application to supply chains. We apply the activity system model in this case description to illustrate its application. The supply chain design also incorporated the design philosophy of Marshall Fisher by creating an "innovative" product from a functional one by virtue of the speedy delivery capability built into the supply chain. Chapter 6 describes this model. The case also describes deployment of advanced systems for customer interface and control of the operation including those described in Chapter 22.

48.1 The Need for Speed

Miller SQA is a subsidiary of Herman Miller, Inc., a manufacturer of office furniture. The "SQA" term is short for "simple, quick, and affordable." Miller SQA specializes in made-to-order furniture systems. SQA furniture includes the workstations, chairs, partitions, and other accoutrements found in offices. It does about $300 million in business and has grown rapidly at a rate of 37% annually. The supply chain for office furniture usually involves an SQA

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dealer taking an order from a customer who needs to refurnish an existing office, is opening a new office, or is moving. Most orders involved office "systems" with many components, each of which is assembled in a separate work cell. At the beginning of the supply chain redesign effort, such orders took more than 5 weeks to fill. The lead time for an order had three components:

1. From "I need" to "order entry"
2. From "order entry" to "shipment"
3. From "shipment" to "I'm moved in"

This cycle had several problems that affected financial performance. First, a long lead time gave customers more time to change their minds and cancel their orders. After all, when given time to mull it over, the old furniture may begin to seem more and more functional. "Why not save the money on the new furniture?" someone on the customer side was likely to ask. So long lead times gave rise to lost revenue arising from buyers' remorse.

A second problem was that analysis showed that there were only 2 days of actual manufacturing time within the 5-week lead time. The nonproductive time represented waste. It also created the third problem — that of excess cash tied up in inventory and factory facilities to store that inventory. Production was authorized by an MRP system that generated work orders for stock, rather than actual customer orders. The orders were not prioritized by the system, and manufacturing management had to sort out the priority of work from "hundreds or thousands of job cards from the MRP scheduler."

48.2 The New Supply Chain

Figure 48.1 shows the redesigned supply chain. Underlying the design were several themes connecting the operational design with the corporate strategy. Among the themes were the following:

1. *Improved EVA*. This financial concept accounts for capital required to run the business and was described in Chapter 24. For SQA this included raw material, in-process and finished-goods inventory and the space required to store that inventory.
2. B*uild-to-order*. This theme displaced the old method of building to inventory, so any authorized job order would be backed by a customer order.
3. *Increased responsiveness*. This was also measured in lead times and the ability to communicate order requirements quickly through the supply chain, including passing requirements on to suppliers. It

also required that SQA maintain its excellent reputation for delivery reliability through the implementation process.

SQA figured it could turn a "functional" product into an "innovative" one just by promising *simple*, *quick*, and *affordable* delivery. Design of the base product was not the point of distinction, but the supply chain to deliver the product was.

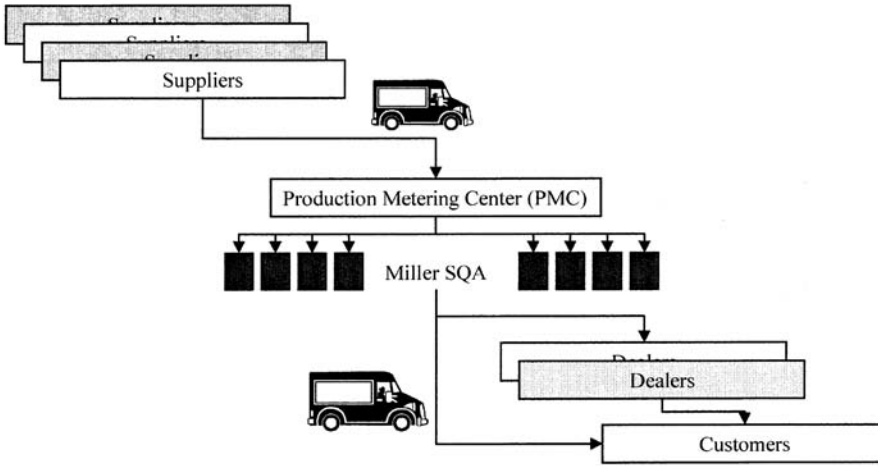


FIGURE 48.1
Miller SQA supply chain.

Figure 48.1 shows relationships among players in the supply chain. An actual customer order triggers the requirement for material. The order originates by a transaction between a dealer and a customer, and is transmitted to SQA by EDI or paper documents. Components for the office systems originate with suppliers. They can view requirements through the Supply Net. Components travel from suppliers to a Production Metering Center (PMC) operated by a third-party logistics provider, Menlo Logistics. Suppliers are responsible for assuring that SQA never runs short of an item they supply. They maintain ownership of inventory until it's transferred into SQA.

The PMC stages the material for one of SQA's production cells, shown as small squares. The PMC is 3 miles from SQA, and the material comes to SQA in specially designed point-of-use vehicles. A single order will likely require components from several cells. These are consolidated into shipments. The manufacturing execution system (MES) schedules the SQA work cells. It receives order downloads from SQA's MRP system. In this case, the MES was Factory Manager from SynQuest. As the order is completed, it is transported to the customer or dealer site.

We illustrate the building of an activity system with strategic themes and supporting activities in Figure 48.2. The figure shows the three themes we have selected to illustrate the case. Around them are the activities pursued by SQA to implement the themes. Some activities support other activities. Some support multiple activities and themes. In the table below we describe the contribution of each activity to implementing SQA's strategy.

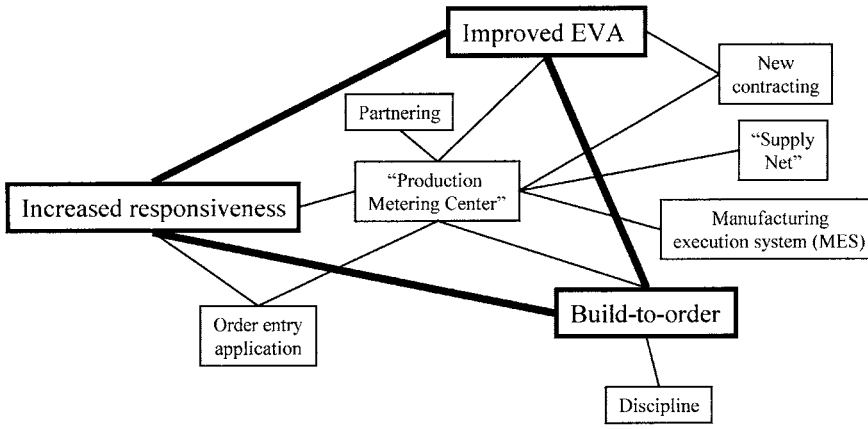


FIGURE 48.2
Miller SQA activity system.

This depiction places the PMC at the center of the activity system. It is supported by several systems that process transaction and provide information. The "new contracting" activity was necessary because successful implementation required new processes among suppliers. "Partnering" encompassed contracting with a third-party logistics provider — in effect outsourcing material handling functions. A key implementation step was "cleaning up" and documenting inventory, status, bills of material and manufacturing methods.

48.3 Results Achieved

The redesigned supply chain has been in operation long enough to assess results, which include the following:

- Average time from order start to order finish is 8 to 10 hours with a goal of 2 hours.
- Order lead time is 2 days rather than the 5 weeks common in the industry.

Activity	Themes/Activities Supported (themes are in bold)	Role in Strategy
Production Metering Center (PMC)	**Improved EVA** **Increased responsiveness** **Build-to-order**	The PMC is central to strategy implementation, supporting all three themes.
Partnering	PMC	SQA turned the operation of the PMC over to a third-party logistics provider.
Supply Net	PMC	This information system provides suppliers visibility into requirements.
New contracting	**Improved EVA** PMC	Implementation required suppliers to maintain inventory. It also fundamentally changed the way orders for material were placed.
Manufacturing execution system (MES)	PMC	The MES is an important tool in scheduling SQA work cells, of which there were 19 operating in parallel.
Discipline	**Build-to-order**	Implementation requires accurate inventory and bills of material.
Order entry application	**Increased responsiveness** PMC	Automation of order entry greatly speeds the flow of information from the point of sale to production operations.

- Has enabled 32% sales growth vs. 7% for the industry.
- Inventory is down from 12 to 15 days to 3 to 4 days. SQA is striving for 200 inventory turns annually.
- Throughput (capacity) per square foot has doubled.
- On-time deliveries exceed 99%.
- Profit has increased by 40%.

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49

Performance Improvement Through Metrics for Buyers

David Malmberg

This case describes the author's experience running a purchasing department for one of the country's leading distributors. The challenge was to motivate a relatively inexperienced group in order to improve customer service and achieve cost-effective inventory management.

49.1 Background

When I joined Merisel, a $5 billion distributor of computer hardware and software, as vice president of Purchasing and Inventory Management, I was in for a real shock. The position I was taking had been open for over a year because my predecessor had had a heart attack and was planning to return as soon as he was well enough. He never returned. During his absence, the buying staff of approximately 50 reported "temporarily" to someone with no purchasing experience. Little departmental or functional direction was provided. Customer service in terms of fill-rates was poor and the sales staff was frequently outraged that important SKUs (stock keeping units) were not available for customers. Purchasing-department employee turnover at 45% per year was the highest in the company, and department morale was very poor.

Because of the high personnel turnover and the absence of department leadership, the quality and experience levels of the buying staff were low. In addition, for most of the buyers, this was their first job out of college. The average buyer had less than 2 years experience as a buyer — and almost all of that was at Merisel — which had few buying role models.

I felt that a "get-well-quick plan" was in order. This plan needed to focus on two main things. The first was buyer education about the basic activities

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of purchasing and inventory management and an understanding about what composed a "JWD" (job-well-done). The second was the need for education for each buyer on measuring his or her own job effectiveness and the appropriate steps necessary to make improvements.

The first of these, basic buyer education, was achieved by conducting in-house training classes. We brought in a certified APICS (The Educational Society for Resource Management) instructor and worked with him to tailor a training program to meet our needs. This was supplemented by sessions given by other members of the management team and me. We spent a great deal of time on teaching fundamentals — instilling the kind of knowledge to be expected from people with more than 2 years' experience at Merisel or experience gained by working at several firms.

The results from this education process were very positive. The buyers felt more confident. They had a much better understanding of what was expected of them, that is, what constituted a job-well-done. Their confidence increased — and with it, their morale.

For the second major part of the get-well-quick-plan — measuring their individual job effectiveness and identifying the appropriate steps necessary to make improvements — I wanted to develop some specific performance metrics.

49.2 Philosophy and Use of Metrics

Before instituting a metrics system, I considered the qualities needed in an effective performance measurement system for a distributor. The remainder of this case shares these principles and how we applied them at Merisel.

The use of metrics has been a hot management topic for several years. This popularity has been fueled by two primary factors. The first is the phenomenal success of a series of articles in the *Harvard Business Review* and a subsequent book, *The Balanced Scorecard*, by Kaplan and Norton, which make a case for metrics as a key ingredient for excellence in both operations and strategy. Chapter 13 describes the approach. The second is the fact that metrics are easy to implement and produce very clear and measurable results, causing metric success to be largely self-propitiating.

Just what is a metric? Simply stated, a metric is a number for measuring and reporting a key performance indicator of the business, the department, the workgroup, the product line, or the individual. For example, measuring and reporting EPS (earnings per share), employee turnover, percentage of units rejected by quality assurance, customer order fill-rates, and purchase orders processed per day — would all qualify as metrics.

However, to be truly useful, a metric needs to be used to drive improvement. For example, just measuring and reporting a high employee turnover rate accomplishes little. In fact, it may have a negative impact, because it is a

signal that management is aware of the problem and has taken no steps to correct it. Metrics must be used to guide and drive the enterprise's actions. They are not just a handful of pretty graphs posted on the bulletin board each week.

Why do we need metrics? And, how do we use them? The primary answers are their usefulness in

- Providing needed direction and help in setting priorities
- Gauging progress
- Keeping focused on key issues
- Identifying areas needing attention for groups and individuals
- Helping to communication key issues and results
- Measuring and rewarding people and teams

Here are some guidelines to get a metric program off to the right start:

- **Limit the number of metrics for any one audience to no more than ten.** Picking three to five is even preferable. It is much better to measure and do three things well than two dozen poorly.
- **The calculations/measurements must be believable and consistent.** Nothing will harm a metric program more than the possibility that the numbers are inaccurate — either intentionally or unintentionally.
- **The metric being measured must be "controllable" (or at least "influenceable") by the department, group, or individual being measured.** For example, measuring picking errors for a picker in a warehouse is quite reasonable, while giving him a metric for percentage sales increase is not reasonable.
- **The measurement process should focus on improvement — not just "raw scores."** Raw scores often result from things beyond the control of the people being measured. For example, two buyers may have very different scores because their suppliers behave in very different ways. The raw scores will take care of themselves if people consistently improve.
- **The overall metric process should be fun and, if possible, facilitate a spirit of competition among groups and/or individuals.** Especially when dealing with your direct reports, make metrics a game that rewards great performance. By doing so, you will be rewarded by the overall improvement you see.

49.3 Back to Merisel

In developing and implementing a metric process at Merisel, I had two main issues to deal with (1) performance goals, and (2) data availability.

For performance goals, I wanted to keep it very simple. I wanted to improve the service levels we provided to Merisel customers, and I wanted to increase the effectiveness of investment we had in inventory. The table below provides just some of the measurements that are appropriate for a distributor like Merisel in each of these areas.

Customer Service	Inventory Investment
• Line fill-rate • Percentage of orders shipped complete • Availability or coverage (percentage of SKUs with inventory-on-hand) • Customer back-order in percentage or dollars • ETA (estimated-time-of-arrival) maintenance • "Splits" (percentage of SKUs filled from other than nearest warehouse) • SKUs with no on-hand and no on-order	• Dollars • Turns • "Excess" — inventory above targeted maximums • Obsolete — inventory in SKUs that had been discontinued • Returns from customers (that we had not returned to suppliers) • "Opportunity" — inventory purchased at special prices • "Inactive" — inventory that has not moved in a stated period of time

Unfortunately, Merisel was data poor when it came to inventory measures — especially at the buyer level. We had to make do with what our inventory analyst could generate through "ad hoc" reports. We finally settled on tracking the specific buyer metrics shown in the following table on a weekly basis:

Customer Service	Inventory Investment
• Percentage of SKUs not on customer back-order • Availability (percentage of SKUs with inventory-on-hand) for all normal SKUs (i.e., A, B, and C SKUs) • Availability of A SKUs • Availability of B SKUs • Percentage of Help Desk questions answered in 24 hours • Percentage of orders with non-past-due ETA (estimated-time-of-arrivals)	• Inventory turnover (as percentage of department target of 12 times per year) • Percentage of inventory dollars that was not "excess," i.e., above targeted maximums • Percentage of inventory dollars that was not "inactive," i.e., inventory that has not moved in a stated period of time

A few words of explanation are in order. Merisel had a standard "ABC" inventory classification scheme with the top 10% of its SKUs when ranked top-to-bottom by sales constituting the "A" SKUs. The next group, also about

10% of SKUs made up the "B" SKUs and the remaining active SKUs being classified as "Cs." In dollars, the A items accounted for approximately 80% of all sales, the Bs 15% of all sales, and the Cs only 5%.

Several of the above metrics were designed to address the support role the Purchasing Department played to both the Sales Department and to the ultimate customer. When a customer called in with a specific detailed product question that Sales could not answer or a question about when the next shipment of an item was due from the manufacturer, we were supposed to provide timely and accurate answers. If we did not, we disappointed both Sales and the customer. Our performance here was a key driver of overall customer satisfaction.

The fact that there were three separate metrics for availability was due to my personal decision to emphasize this area and to compensate (perhaps overcompensate) for the prior unofficial decision—rule of "only order product when there is a crisis, but then order a ton of it!"

All of the metrics were designed so that larger numbers were better than smaller numbers and they all had a maximum of 100%. Further, an average was calculated for all of the Customer Service metrics and Inventory Investment metrics to give composite performance scores for these two areas.

I wanted some way to graphically present these performance scores that would illustrative both current standing as well as areas needing improvement. I came up with a variation on the Boston Consulting Groups' old "Growth-Share" matrix. Only instead of plotting market growth-rate vs. market share, it plotted the Service Level metrics vs. the Inventory Investment metrics. Figure 49.1 shows the result.

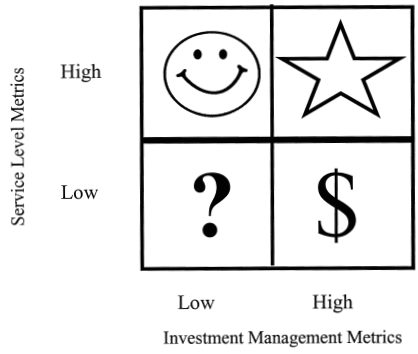


FIGURE 49.1
Buyer performance matrix.

The quadrants show current standing plus general areas needing improvement.

- **"Star Quadrant"** — indicates a star performer with both high Service Level and high Investment performance. Priorities are to continue excellent performance and to help other buyers improve.
- **"$ Quadrant"** — indicates you are keeping the bankers happy with excellent Investment Management, but you need to work on Customer Service metrics.
- **"Happy-Face Quadrant" —** indicates you are keeping your customers happy with excellent customer service, but you need to work on improving your Inventory Investment metrics.
- **"? Quadrant"** indicates both poor Customer Service and poor Inventory Investment metrics. The buyer needs to work with his/her manager to develop a specific improvement plan.

Figure 49.2 is an example of a typical matrix.

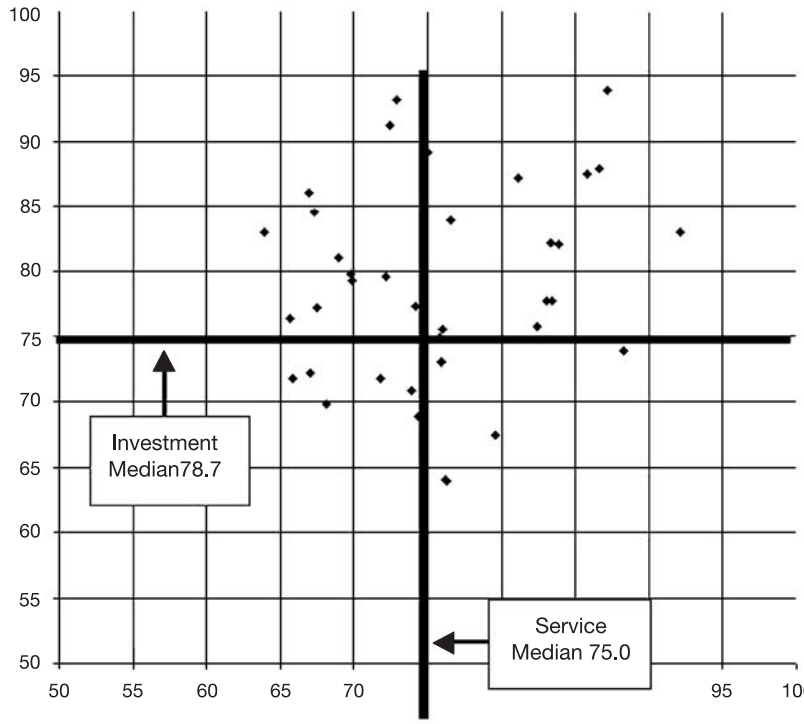


FIGURE 49.2
Buyer performance matrix — example.

49.4 "Sludge" Metrics

In addition to the metrics listed above, I wanted to focus on eliminating "sludge." By this I mean getting rid of all of the SKUs on the shelves that should not be there. So I established three separate metrics for sludge:

1. Percentage decline in the number of "Excess SKUs" — SKUs with inventory levels (unintentionally) greater than a 12-week supply.
2. Percentage decline in the number of "Discounted SKUs" with positive inventory levels (i.e., that had not been returned to the manufacturer for credit or other SKUs).
3. Percentage decline in the number of "Inactive SKUs" — SKUs with positive inventory levels that had had no sales in the last 8 weeks or longer.

An overall "sludge" performance measure was created for each buyer by adding the three individual metrics for the buyer together. There is some overlap with several of the Investment metrics, but I felt that they were important enough that the duplication was more than justified.

49.5 How the Metrics Were Used

Each week the metrics were posted on the bulletin board. Each buyer's current standing and improvement from the beginning of the month were visible to all the other buyers. It soon became a contest, with the buyers striving to outperform one another. Buyers joked about how well they did or how well they were going to do next week. We made it a game, and we all had fun with it! (*Note:* Most of the buyers were in their 20s and blessed with a playful competitive nature.)

In addition, buyers whose performance was not strong worked with their managers and used the metrics as diagnostics to develop specific plans for improvement.

At our monthly department meeting, we announced the winners for the month in terms of (1) best overall metric performance, and (2) "Sludge-Buster-of-the-Month" (the buyer with the best sludge-reduction performance). The winners each received a gift certificate for a dinner for two at a good restaurant.

At these meetings, we really celebrated the winners' success. We also pointed out and celebrated the performance of other buyers whose metrics

were exceptionally good — either in absolute terms or in terms of percentage improvement.

Other forms of recognition included having buyers who were doing something particularly well (e.g., forecasting, getting returns back to suppliers, answering sales help desk calls, and so forth) give a short talk about how they did it.

In addition to the dinner for two, we gave out a special tee shirt with the symbol in Figure 49.3 on the front for the "Sludge-Buster-Of-The-Month." The winner could wear this tee shirt at any time. Normally, Merisel did not allow tee shirts — so wearing this tee shirt became a special badge of honor.



FIGURE 49.3
"Sludge-Buster-of-the-Month" logo.

49.6 The Results

During my 2-year tenure at Merisel, the Purchasing Department made some great strides:

- Order line fill-rates measured as percentages increased from the mid-70s to the low 90s.
- Inventory turnover increased from about seven to about ten.
- Department employee turnover declined from 45% (the highest in the company) to 5% (the lowest in the company).

While it would be inappropriate to attribute all of these improvements solely to using metrics, I am convinced that our metrics program was very

instrumental in enabling these results. The primary reasons were that our metric process

- Focused the buyers on key priorities.
- Acted as a performance feedback mechanism.
- Improved communications — both within Purchasing and with other Departments, e.g., Sales, Finance, and so forth.
- Recognized and rewarded people for a job well done.
- Helped to make Merisel a fun place to work.

Glossary

The following terms are used throughout the book or are relevant to the topic of supply chain management. They are included here for the reader's reference.

3C alternative to MRP	A method that uses capacity, commonality, and consumption as a basis for control of material in the supply chain. The technique decreases the dependence of the supply chain on forecast accuracy by shifting inventory decision to considerations of actual demand and capacity. Chapter 29
5S	A foundation for visual controls in a production operation. Characteristic of "lean" manufacturing. Large customers for manufactured components often require features of 5S. The 5S approach includes the following: 1. Sort (organization): what is needed and not needed 2. Stabilize (orderliness) a place for everything and everything in its place 3. Shine (cleanliness): keeping the workplace clean 4. Standardize (adherence): maintains and monitors the above 5. Sustain (self-discipline): sticking to the rules, scrupulously *Source: Best Manufacturing Practices Center of Excellence*. Chapter 20
ABCD analysis	Technique for analyzing technical and administrative functions. "A" activities add value to the customer and require decision-making discretion. "B" activities require decision making but don't add value. "C" activities don't require decision making but do add value. "D" items don't require decision making and don't add value. The classification is useful for process analysis and deciding how to remove or automate activities.

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Activity-based costing, management (ABC, ABM)	A method to plan, measure and control expenses associated with managing and monitoring the supply chain; specific techniques for assigning cost in business processes to activities. ABC is seen to overcome many of the shortcomings of conventional accounting methodologies. Chapter 25
Activity system	A term used by Michael Porter in defining networks of activities that provide a sustainable competitive advantage. This book recommends activity systems as the basis of a supply chain strategy. Chapter 7
Agile enterprise	Companies that employ rapid customer/supplier partnering to achieve a short product-development life cycle. Chapter 26
APICS	International not-for-profit offering programs and materials for individual and organizational education, standards of excellence, and integrated resource management topics. Formerly called American Production & Inventory Control Society. Now The Educational Society for Resource Management.
APS	Advanced Planning System. Systems that plan actual production based on volume forecasts and actual orders. Normally a "bolt-on" application to MRP/ERP systems. Chapter 22
As-is	The current state, such as how processes in the supply chain process are currently performed. Chapter 12
ASQC	The American Society for Quality Control
Bar coding	An automatic identification technology that uses parallel dark bars and spaces to represent characters. Bar coding is often an important element in automating the tracking of material in the supply chain.
Batch-and-queue system	Refers to a production-management system that relies on large batches of material. This leads to large queues while waiting to complete a production step. Such systems are characterized by high work-in-process inventory and low velocity production. Chapter 26
Benchmarking	A search for those best practices that will lead to superior performance. Benchmarking is usually executed with those who perform a targeted activity the best, regardless of the industry. Internal benchmarking makes comparisons within an organization, such as developing best practices from several stores that perform similar functions.

Branding	Vision, position, "space" in the market. Establishing a brand name is a primary way to compete in many industries. SCM can support the strategy for establishing a brand "image."
Breadman	A term applied to "automatic" replacement of inventory by third-party logistics providers, normally distributors. The analogy is the breadman who replenishes stock at the grocery store.
Business process reengineering (BPR)	Taking a holistic customer-focused systems view to changing processes in the organization. Encompasses "the vision thing," understanding business processes and workflow along the supply chain; business, CIM and IT-based analysis; organization theory; IT support through the Internet, computer-supported cooperative working, and the possibility of telecommuting.
Cash-to-cash cycle time	The time between payments for product components to suppliers to the time payments are made by customers. This parameter has become an important measure of supply chain performance, reflecting both financial and inventory management process performance. Most have negative measures ranging from -30 to -180 days. Some, notably Dell, have a positive cycle time, meaning the company collects payments from customers before it has to pay suppliers.
Cause and effect diagram (Fishbone Diagram)	A tool that uses a graphical description of contributing elements to identify root causes of process variation.
Cellular manufacturing	A manufacturing process that produces families of parts within a single line or cell of machines with operators who work only within the line or cell. The cellular concept is also applicable to administrative and technical process. In this context, it means clustering unlike operations to increase processing velocity. Chapter 26
Channel	A group of businesses that take ownership title to products or facilitate exchange during the marketing process from the original buyer to the final buyer. Effective SCM requires an understanding of the needs of each customer and segment and the correct channel to reach them.
CLM	Council of Logistics Management. A worldwide professional organization of logistics personnel. CLM has contributed heavily to the discussion of supply chain issues.

Collaborative execution systems	Category of application software that enables the effective coordination and flow of information across the entire value chain. Automates tasks required to manage each transaction and, providing real-time visibility to information. Collaborative execution systems are designed to improve productivity and reliability. Chapter 22
Collaborative planning, forecasting and replenishment (CPFR)	An industry initiative aligned with the Voluntary Interindustry Commerce Standards Committee (VICS) focused on improving the partnership between manufacturers and distributors/retailers through shared information. Chapters 22 and 29
Continuous replenishment planning (CRP)	The practice of partnering between distribution channel members that changes the traditional replenishment process from traditional purchase orders based on economic order quantities, to the replenishment of products based on actual and forecast product demand. The result is "flow" supply chain. Chapter 26
Core competence	An organization capability that can be applied to a variety of core- and end-products. The capability is usually technology based, but can also be competence in facets of supply chain management. Chapter 17
Cost of quality	COQ may be viewed as a subset of activity-based costing and can provide the information necessary to drive service improvements and reduce costs. Components of COQ usually include prevention, detection, and correction. Some will divide correction into internal (before the sale) and external (after the sale) components. High cost of quality may have its root cause in the factors discussed in Section III. Chapters 25–29
C_p, C_{pk}	Capability and the index of capability respectively. Typically, a process is considered capable when capability and/or the capability index is 1.33 or greater. Chapter 26
CRM	Customer Relationship Management Systems. Computer applications that deal with the "front office" interface between the company and its customers. Chapter 22
Customer-centric supply chain	Supply chains or organizations whose construct centers on the requirements of targeted customer segments. Alternatives are functional and product-centric supply chains. Chapter 13 and 26

Cycle time	The time required to complete a work process or activity from beginning to end.
Data warehouse	A repository for data organized in a format that is suitable for ad hoc query processing. Data warehouses are built from operational databases used for day-to-day business processes. The operational data is "cleaned" and transformed in such a way that it is amenable to fast retrieval and efficient analysis. A single-purpose data warehouse is sometimes referred to as a "data mart."
Deficiency, discrepancy	Failure of a quality system to comply with requirements.
Demand chain	A term sometimes applied to the "outgoing" side of the business. Supply chain, in this context, only applies to the "incoming" side.
Demand flow	A technique to speed product final assembly. Demand flow uses the concept of a "pile of parts" that can be assembled in response to actual customer orders. The term is trademarked by the John Costanza Institute of Technology. Chapter 26
Demand ordering	A term used by CGR Management Consultants for any technique that uses actual demand, rather than forecasts, as the basis for replenishment.
Demand-driven supply chain	A term developed by CGR Management Consultants that applies to supply chains that use tools that enable decisions to be made on the basis of actual customer demand rather than forecasts. The extent to which a supply chain is "demand driven" is measurable. Most supply chains will require some level of forecasting for advanced planning. Chapter 26
Driving force	A strategic planning concept developed by Michel Robert. The concept holds that there is one and only one driving force around which a company competes. This may be acknowledged by company management; however, often it is not. Chapter 5
Drumbeat	The pace at which an organization produces product. Used to pace all the operations in a factory or in a supply chain. Similar to takt time. Chapters 29 and 40
Echelon	A term that refers to layers of distribution. Each echelon represents the transportation and handling of the product between the source (presumably a factory) and its point of use.

E-commerce	Electronic commerce has come to mean many different things to many different people. Originally, the term meant selling things online. The term has evolved to mean conducting business online, which can include customer service functions, sales, marketing, public relations, advertising, and more.
Economic order quantity (EOQ)	A fixed-order-quantity model that determines the amount of an item to be purchased or manufactured at one time. The intent is to minimize the combined costs of acquiring and carrying inventory. Chapters 26 and 29
Economic value added (EVA)	The dollar amount of value added by an enterprise over a specified period of time. EVA takes into account the capital employed in the business. Chapter 25
Electronic data interchange (EDI)	The computer-to-computer transmission of business information between trading partners. The information should be organized in standard file formats or transaction sets following guidelines administered by the Uniform Code Council (UCC). Standards have been developed for all regular business-to-business communication including purchase orders, invoices, shipping notices, and funds transfer. By eliminating the clerical, mailing, and other costs associated with paper-based information, EDI reduces costs, time delays, and errors. *Source: ECR Best Practices Report*
Enterprise resource planning (ERP)	ERP systems are composed of software programs that tie together all of an enterprise's various functions — such as finance, manufacturing, sales, and human resources. This software also provides for the analysis of the data from these areas to plan production, forecast sales, and analyze quality. Chapter 22
Focused factory	A concept developed by Wickham Skinner arguing that factories or parts of factories perform best if they are designed to fulfill customer requirements as efficiently as possible. The focused factory uses manufacturing capability to support strategies for competing. Chapter 26
Forecast error	The difference between actual and forecast demand, stated as an absolute value or a percentage. Forecast errors are used to adjust forecasts in supply chain with high dependence on forecasts for decision making. *Source: APICS Dictionary*

Forecastable demand	Applies to certain patterns of demand that contain enough history to provide a forecast of future demand. The opposite is "lumpy" demand, for which no forecast is possible.
Freight forwarder	This is a company or person that handles the shipment of goods. The responsibilities of a freight forwarder include arranging shipment details and completing documentation. Because of their brokering role, freight forwarders have a good understanding of market trends, insurance, and transport alternatives and are a good source of information with respect to these matters.
Functional product	A category of product with lower margins and low uncertainty regarding demand. The supply chains for these products should be designed for the lowest possible cost. (See *innovative product*.) Chapter 6
Fuzzy front end	Refers to the beginning of the development cycle, when new-product and service concepts are not clear. Many organizations are defining processes and systems to manage the "fuzziness" of the front end of the new-product development cycle. Chapter 9
Glass pipeline	A term describing a supply chain in which the visibility over the status of the product is high. One is able to track physical movement through the pipeline easily.
Greenfield vision	An ideal state based on specifications for future operations. The greenfield should ignore constraints inherent in the current situation. It should serve as a "stretch" target for implementing improvements in the supply chain. The use of the greenfield approach is based on the premise that, without ambitious targets, only incremental change will occur. Chapter 12
IDEF	Integrated computer-aided manufacturing (ICAM) DEFinition methods are used to perform modeling activities in support of enterprise integration. The original IDEF methods were developed for the purpose of enhancing communication among people who needed to decide how their existing systems were to be integrated. The technique of decomposing a process into activities is a foundation for supply chain process analysis. IDEF0 modeling is supported by Visio software. Chapter 25

Initiative	A broad program to improve supply chain operations. Initiatives can last several years and evolve with changing requirements. An initiative can have multiple projects. Chapter 12
Innovative product	An innovative product has high margins and uncertain demand. The supply chain for such products should be designed for responsiveness to demand, rather than efficiency. (See *functional product*.)
Integrated supply	It is an alliance or long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values.
Integration	The extent to which components of the production process are inextricably linked. A software design concept that allows users to move easily between applications.
Just in time (JIT)	A philosophy of manufacturing based on planning elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product, from design engineering to delivery and including all stages of conversion from raw material onward. The primary elements of just in time are to have only the required inventory when needed; to improve quality to zero defects; to reduce lead times by reducing setup times, queue lengths, and lot sizes; to incrementally revise the operations themselves; and to accomplish these things at minimum cost. In the broad sense, it applies to all forms of manufacturing, job shop, and process, as well as repetitive. Chapter 26
Kaizen	A Japanese word that means, loosely translated, constant improvement.
Kanban	A method of just-in-time production that uses standard containers or lot sizes with a single card attached to each. It is a pull system in which work centers signal with a card that they wish to withdraw parts from feeding operations or suppliers. The Japanese word *Kanban*, loosely translated, means *card*, *billboard*, or *sign*. The term is often used synonymously for the specific scheduling system developed and used by Toyota Corp. in Japan. Chapters 26 and 29

Kano model	The model describes three different types of quality. The first is *basic*, items that one assumes are part of a product. The second is *performance* quality. The customer will be able to articulate this type of quality and can be captured by surveys. The third is *excitement* quality that is unexpected and cannot be articulated by the customer. Supply chain design has the potential for achieving all three types of quality. *Source: The QFD Handbook*
Key characteristic	A feature whose variation has the greatest impact on the fit, performance, or service life of the finished product from the perspective of the customer. Key characteristics are a tool to help decide where to focus limited resources. They are intended to be used for process improvement purposes. Key characteristics should not be confused with flight safety or design features that are sometimes called critical characteristics in the aircraft industry. Key characteristics may or may not also be categorized as critical characteristics. Chapter 20
Key process parameter	A process input that is controllable and that has a high statistical correlation with the variation in a part key characteristic. Key process parameters are most effectively determined by the use of designed experiments. Chapter 20
Knowledge management	Refers to efforts to capture the "knowledge" resident in an organization. Such efforts are often centered on information technology. Some have dismissed knowledge management as a fad, but the concept has value in supply chain management across multiple enterprises.
Lean enterprise	A term coined by James Womack and Daniel Jones to extend the idea of "lean manufacturing" along the supply chain including production partners. (Womack and Jones were the originators of the "lean" terminology.)
Lean manufacturing	Production approach based on using multi-skilled workers, highly flexible machines, and very adaptable organizations and procedures to manufacture an increasing variety of products while continually decreasing costs. Chapters 25 and 26
Legacy systems	A network or hierarchical database system usually running on a mainframe. Replacement of legacy systems is often a motivator for installing new supply chain information systems.

Level plant loading	Efforts to reduce variability in production at the business unit and supply chain levels. Level plant loading is considered a best practice for achieving effective supply chains. *Drumbeat* and *takt times* are related terms. Chapter 26
Lumpy demand	An infrequently occurring demand that can't be forecast. The result is a need to carry an insurance level of stock.
Maintenance, repair and overhaul (MRO)	A class of activity occurring after the sale of the product. MRO often demands special supply chain design and can be an important factor in the success of a product that has a long life cycle. Chapter 37
Manufacturing execution system (MES)	An MES is a manufacturing software application, not an "MIS" system. MES focuses on execution and management of production processes. MES provides synchronization of the following as they are used to make the product: labor, machinery and equipment, tooling, other resources, e.g. power, raw material, and work-in-process inventory. MES usually operates in time increments from sub-shift to real-time. Chapter 22
Manufacturing strategy	The concept that manufacturing can support other strategies for competing. Examples are product, marketing, and financial strategies. Chapter 4
Merge-in-transit	A technique for combining order components from various sources while those components are in transit from sources to customers.
MRP, MRP II	Materials Requirement Planning — a concept developed in the 1970s to make use of high-speed computers to model the requirements of material for a manufacturing operation. Chapter 22
Operational excellence (OE)	A term used by Michael Porter in discussions of strategy. His contention is that the OE is a necessary but not sufficient condition for sustained competitiveness. He advocates the development of activity systems to distinguish the company from its competitors. Chapter 7
Partnering	A management approach used by two or more organizations to achieve mutual business objectives by maximizing the effectiveness of each partner's resources Chapter 14
PDCA	Plan-Do-Check-Act. The Shewhart Cycle for implementing process improvement. Chapter 10

Performance-based pricing	Basing prices on value to the customer, not necessarily what the product costs. The supply chain can influence value to the customer. Applies specifically to "innovative" products as opposed to functional ones where prices tend to be cost driven in competitive markets. Chapter 5
Point of sale (POS)	1. Place where the purchase is made at the check-stand or scanning terminals in a retail store. The acronym POS frequently is used to describe the sales data generated at the check-out scanners. *Source: ECR Best Practices Report* 2. The relief of inventory and computation of sales data at a time and place of sale, generally through the use of bar coding or magnetic media equipment. *Source: APICS Dictionary*
Price-taker	A buying organization that typically takes the low price every time. Generally requires a functional supply chain in the face of competitive alternatives.
Proactive systems	An approach to designing information systems to focus on the needs of decision makers. The approach may rely on computer-based tools to disseminate the needed information. Non-computer-based approaches may also be used. Chapter 28
Process owner	The process-centered organization is no longer merely a concept. It has become a widespread reality, as ever more companies make process a principal axis for management and structure. The process owner is the central figure in this new kind of organization, charged with end-to-end responsibility and authority for a cross-functional process. Chapter 12
Product life cycle	A well-known marketing concept that holds that products pass through phases in their market lives. These are generally the inception, growth, maturity, and decline phases. The presence of the product life cycle has implications for supply chain design. Chapter 5
Product pipeline, product funnel	A visual model of the way new products are developed. The concept infers a repetitive pattern for producing products. SCM should be a part of the product-development process. Chapters 9 and 27
Product-centric supply chain	Supply chains or organizations whose construct centers on the production of products. Alternatives are functional and customer-centric supply chains. Chapters 13 and 26

Project	A change program, usually associated with an initiative, with a manager, budget, objectives, and schedule. Several projects may support an initiative. Action plans define the goals for the project. Chapter 12
Provider service models (PSMs)	A tool for defining the staffing requirements to meet defined service objectives. Often used as a tool in managing customer service operations.
Push and pull systems	Production control systems are often described as "push" where decisions are made chiefly on the basis of forecasts or "pull" where decisions are made chiefly on the basis of actual demand. A *demand-driven* supply chain is an example of a pull system. Most organizations try to move from "push" to "pull" decision making. Chapter 26
Quality function deployment (QFD)	A system engineering process that transforms the desires of the customer/user into the language required, at all project levels, to implement a product. It also provides the glue necessary, at all project levels, to tie it all together and to manage it. Finally, it is an excellent method for assuring that the customer obtains high value from your product, the intended purpose of QFD. Chapter 8
Quality standard	A set of rules for those seeking to qualify under the standard. Standards are either general or industry-specific. Standards bring consistent practice to large numbers of participants in the supply chain.
Quality threshold	The expected features of a product and its supply chain. Any participant must at least operate above the threshold to maintain market share. Those falling below the threshold will lose market share and may have to exit the business. Chapter 1
Radio frequency/ automatic data collection	Technology frequently deployed in distribution centers for rapid processing of operating information.
Reengineering	Analysis, redesign, and implementation of process changes. Can involve new technology, new methods of performing process steps, and organization change to support the process. The idea of reengineering should not be confused with downsizing or staffing cutbacks, although they may occur in conjunction with process change.

Representative product	A typical product flowing through a process that is used as the basis for process design. First applied in developing manufacturing cells. *Source: Bourton Group*
Reverse logistics	The processing of returned merchandise from the customer's customer. This process includes matching returned goods authorizations, sorting salvageable, repairable and non-salvageable inventories. Reverse logistics may be a neglected function in supply chain design. The flows involved include physical goods, information, and funds in the supply chain.
Safety stock	A quantity of stock planned to be in inventory to protect against demand fluctuations. The level of safety stock is a function of the certainty of the demand forecast and the length of time required for replenishment. High uncertainty (such as for an innovative product) and longer lead times increase the need for safety stock. Chapters 26 and 40
SCOR	Supply-Chain Operations Reference model. An activity model developed by the Supply-Chain Council to standardize descriptions of supply chain processes. Chapter 23
Segmentation	Breaking the market down into definable subcategories. For instance, Coca-Cola may segment its audience based on frequency (one can a month or five cans a day), location (Bangkok or Bangladesh), and many other criteria. Supply chains should be designed with the differing needs of various segments in mind. Chapters 4 and 8
Sell-Source-Ship (3S)	A supply chain characterization in which the seller doesn't hold inventory. Once an order is placed, the seller channels orders to single or multiple sources. This is the opposite of the Buy-Hold-Sell model in which the seller does hold inventory.
Single minute exchange of dies (SMED)	The techniques for performing setup operations in under 10 minutes, the number of minutes expressed in a single digit. The SMED philosophy is important in moving from "batch-" to "flow-oriented" supply chains. Chapter 26

Six Sigma	Sigma is a letter in the Greek alphabet. The term "sigma" is used to designate the distribution or spread about the mean (average) of any process or procedure. For a business or manufacturing process, the sigma value is a metric that indicates how well that process is performing. The higher the sigma value, the better. Sigma measures the capability of the process to perform defect-free work. A defect is anything that results in customer dissatisfaction. The sigma scale of measure is perfectly correlated to such characteristics as defects-per-unit, parts-per-million defective, and the probability of a failure/error. A six sigma capability means no more than 3.4 parts per million defects. Recently, six sigma programs have become more general in their approach, reflecting overall efforts to make improvement as well as error-free production. Chapter 3
Specification	A description of performance required from the supply chain for a process based on an evaluation of the as-is. The specification only states what is required, not how that goal will be reached. Chapter 12
Sphere	A term used in this book to divide complex operations for the purposes of supply chain improvement. A sphere consists of market-product-operations combinations. Each sphere under examination would usually be an independent improvement effort. The Supply-Chain Council uses the term "threads" in a similar sense. Chapter 18
Sponsor	An executive champion for a supply chain improvement effort. The level of the individual will depend on the level of the project — functional (department level), business unit level, or supply chain level. Chapters 12 and 19
Stage gate approach to product development	A formal process that can be used for the development of new products and services in companies of all sizes. It includes (1) clearly defined stages in which specific tasks are undertaken, (2) the development of compelling, comprehensive business cases, rigorous, and demanding, (3) go/no-go decision points at the end of each stage using clearly defined measurable criteria, and (4) the objective review of actual vs. planned performance for every new product, after its introduction to the marketplace. Chapter 9

Statistical process control (SPC)	SPC embodies a set of techniques and tools that help characterize patterns of variation. By understanding these patterns, a business can determine sources of variation and minimize them, resulting in a more consistent product or service. Many customers are demanding consistency as a measure of high quality. The proper use of SPC provides a powerful way to assure that the customer gets the desired consistency time after time. Chapter 26
Strategic sourcing	The use of the overall acquisition function as a tool for strategic improvement rather than one focused on transactions only. Involves both cost reduction from better purchasing and effective partnerships across the supply chain. Chapters 15 and 32
Supply chain	Life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with products and services from multiple, linked suppliers. Chapter 1
Supply-Chain Council (SCC)	A trade association of companies interested in supply chain management (SCM). The Council was incorporated in June 1997 as a not-for-profit trade association. The Council offers members an opportunity to improve the effectiveness of supply-chain relationships from the customer's customer to the supplier's supplier. Chapter 23
Supply chain management (SCM)	Design, maintenance, and operation of supply chain processes for satisfaction of end user needs. Chapter 1
Target costing	A strategic profit planning and cost management system that incorporates a strict focus on customer wants, needs and values, and translates them into delivered products and services. A variation is using cost as a design criterion in product development.
Theory of constraints (TOC)	A portfolio of management philosophies, management disciplines, and industry-specific "best practices" developed over the past 20 years by physicist Dr. Eliyahu M. Goldratt and his associates. Chapters 25 and 29
Third-party logistics provider (3PL)	A company specializing in performing logistics-related services for its customers. Examples include warehouse, transportation, and product assembly.

To-be	The future state, or how a supply chain process will be performed in the future. Determined after examining trade-offs between an ideal goal (greenfield) and constraints standing in the way of implementing that ideal. Chapter 12
Total productive maintenance (TPM)	A systematic approach for minimizing machine "downtime" resulting from unexpected breakdowns. TPM emphasizes the role of the machine operator — who becomes more involved with routine checks and fine-tuning. TPM enables machinery to operate more efficiently and reliably, decreasing the risk of a "broken link" in the supply chain.
Total quality management (TQM)	An approach that involves all employees in continually improving products and work processes to achieve customer satisfaction and world class performance. TQM is generally associated with "bottom up" incremental improvement. Chapter 10
Toyota Production System	A manufacturing process model developed by Toyota that led to its dominance in the auto industry. This production approach enabled Toyota as well as many other companies to achieve major improvements in productivity and quality. The Toyota Production System was built on three key factors that differentiated it from practices being employed by the company's competitors in the auto industry: (1) Reduced lot sizes, leading to production flexibility. (2) Controlling parts required in production to enable them to be provided when and where they are needed for specific tasks. (3) Arranging production equipment in the order that people work and value is added instead of grouping by equipment function. All these elements involved suppliers and customers to some extent. Chapters 26 and 29
TRIZ	Russian acronym for theory of inventive problem solving. TRIZ is a methodology for eliminating conflicts that arise in product design. *Source: QFD Handbook*
Truckload/less than truckload carriers (LTL)	Carriers that cater to the needs of different classes of shippers. Truckload-only carriers generally serve larger shippers. LTL carriers generally serve smaller shippers.

Two-bin system	An inventory rule that calls for a new order when one bin (either real or conceptual) runs out. The second bin then becomes the source of new requirements. The reorder quantity is equal to the bin size and depends on lead times and usage quantities. The method is one of the simplest to implement and lends itself to visual approaches. Chapter 29
Value-added network (VAN)	A company that acts as a clearinghouse for electronic transactions between partners. *Source: ECR Best Practices Report*
Value chain	A term introduced by Michael Porter in his books *Competitive Strategy* and *Competitive Advantage*. These works gave rise to the model of a "chain" for delivering products to the marketplace.
Velocity	A term that describes how much time a unit of production spends in actual process steps as a percentage of total time in the process. Low velocities mean much of the time required for processing is spent in waiting on value-adding steps in the process. A goal of supply chain redesign is often to increase velocity. The term is increasingly applied to administrative as well as physical processing. Chapter 26
Vendor-managed inventory (VMI)	The practice of partnering between distribution channel members that changes the traditional replenishment process from distributor-generated purchase orders, based on economic order quantities, to the replenishment of products based on actual and forecast product demand. *Source: CRP Best*
Virtual enterprise	A team of individual companies organized to meet a market opportunity as if they were all part of the same company with a common goal. Chapter 19
Virtual value chain	The virtual, information-based equivalent of the value chain model where value is created by gathering, selecting, synthesizing, and distributing information. From Rayport, J. F. and Sviokla, J. J., Exploiting the Virtual Value Chain, *Harvard Business Review*, November–December 1995.
Voice of the customer	A component of Quality Function Deployment (QFD) that enables a company to take account of the customers' requirements in the design of a product or process. Chapter 8

Warehouse management system (WMS)	A system that tracks and controls the movement of inventory through the warehouse, from receiving to shipping. Many WMS systems also plan transportation requirements into and out of the warehouse. The WMS allows visibility to the quantity and location of inventory, as well as the age of the inventory, to give a current and accurate picture of the available to promise (ATP). The WMS also analyzes warehouse information. For example, the WMS recommends pick and putaway locations, based on FIFO, warehouse layout, and other business rules. A WMS can also identify the best suitable warehouse employee to perform the pick or putaway, and automatically assign the employee to the task. Technologies used in conjunction with the WMS include bar coding and radio frequency (RF) transmission. Using handheld bar code scanners speeds processing and reduces errors. RF transmission allows these handheld scanners to interact continuously with the system from anywhere in warehouse. Chapter 22
WERC	An international professional association dedicated to the advancement and education of people involved in the management of warehouses and distribution facilities.
Work flow	A class of software application that includes automation of the flow of information according to process rules. Similar to, but not as encompassing as, a proactive systems approach in which the requirements of decision makers are part of the redesign of the supply chain. Chapter 28
Work in progress (WIP)	Units of production that have started, but not finished the production process. Material entering the factory usually starts as raw material, then becomes WIP, and then proceeds to finished goods. High WIP levels are characteristic of long cycle times.
World class	Being best in your industry on enough competitive factors to achieve profit goals and be considered one of the best in satisfying customers. Chapter 3
Yield management	Using price and other promotions to maximize the return on investment. Usually implies a fixed capacity, such as airline seats, filled with customers from segments paying different prices.

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