CHAPTER FOUR

Procurement and Manufacturing

Chapter Outline

In Chapter 2, performance cycles were presented as the framework for integrated logistics across the supply chain. Three performance cycles were identified that must be linked through effective logistics. The **procurement cycle** links an organization with its suppliers, the **manufacturing support cycle** involves the logistics of supporting production, and the **customer accommodation cycle** links a firm with its markets. As will be seen later in this chapter, manufacturing firms differ in their manufacturing strategies; thus, alternative approaches to procurement may be implemented to support specific manufacturing requirements. Of course, all of this performance must meet customer requirements for quality products. This chapter begins with a discussion of product quality from a customer's perspective and Total Quality Management programs. Procurement and manufacturing are then each discussed with a focus on alternative strategies. The chapter concludes with

a discussion of logistical interfaces necessary to support an organization's chosen procurement and manufacturing strategies.

The Quality Imperative

An overriding concern of all organizations is quality. In a competitive marketplace, no company dares fall behind in providing quality to its customers. Yet quality remains an elusive concept. In the end, quality is in the eyes of customers and how they perceive an organization, its products, and its services. Customer service quality was introduced in Chapter 3 in terms of customer expectations and requirements. Much of the focus in supply chain logistics is on helping ensure products are delivered on time, damage-free, and with all the service attributes necessary to meet customer requirements. In this chapter, dealing with procurement of materials and manufacturing processes, critical issues of **product quality** are addressed.

Dimensions of Product Quality

In the context of physical product form, quality is not as simple as it may first appear. In fact, the term *quality* means different things to different people. While everyone wants a quality product, not all may agree that a particular item or brand has all of the quality attributes desired. Quality is traditionally viewed in terms of eight different competitive dimensions.[1]

Performance

Perhaps the most obvious aspect of quality from a customer's viewpoint is performance, or how well the product actually performs in comparison to how it was designed to perform. For example, personal computers may be judged with respect to their processing speed; audio components, in terms of sound clarity and lack of noise; or dishwashers, relative to how clean and spotless the dishes. Superior performance in a product is generally an objective attribute, which can be compared between items and brands. Of course, an item may actually have several performance dimensions, which complicates comparison. The personal computer is judged not only in terms of processing speed but also by such characteristics as internal memory, hard disk capacity, and numerous other performance features.

Reliability

Reliability refers to the likelihood that a product will perform throughout its expected life. It is also concerned with the number of breakdowns or repairs that a customer experiences after purchase. Consider, for example, Maytag's slogan "The Dependability People" and long-running advertising campaign featuring a company repairman as "the loneliest person in town." Maytag stresses its products are more reliable than those of competitors by showing that the Maytag repairman is never needed to fix a broken appliance. Like performance, reliability is a characteristic of quality that can be objectively measured.

Durability

While related to reliability, durability is a somewhat different attribute. It refers to the actual life expectancy of a product. An automobile with a life expectancy of 10 years may be judged by many consumers to be of higher durability than one with a projected 5-year

[1] David A. Garvin, "Competing on the Eight Dimensions of Quality," *Harvard Business Review* (November/December 1987), pp. 101–10.

life. Of course, life span may be extended through repair or preventive maintenance. Thus, durability and reliability are distinct but interrelated aspects of quality.

Conformance

Conformance refers to whether a firm's products actually meet the precise description or specifications as designed. It is frequently measured by looking at an organization's scrap, rework, or rate of defects. Conformance quality measurement is usually internal in an organization. For example, if 95 percent of a firm's products meet the specifications as designed, it has a 5 percent defect rate. Defective products may be scrapped or reworked to bring them into conformance.

Features

Customers frequently judge quality of specific products on the basis of the number of functions or tasks that they perform independent of reliability or durability. For example, a television receiver with features such as remote control, picture-in-picture, and on-screen programming is typically perceived to be of higher quality than a basic model. But, in general, the more features a product contains, the greater is the likelihood that another quality attribute may be lacking, such as reliability.

Aesthetics

Aesthetics, the styling and specific materials used in a product, is used by many consumers to judge quality. In clothing, cashmere sweaters are considered of higher quality than polyester fabrics. In automobiles, the use of leather rather than cloth for seats, wood or metal rather than plastic, is an aesthetic that implies quality. Included in aesthetics is the notion of fit and finish such as high-gloss paint on an automobile or seams having no overlap. Product designs that are unique or innovative are frequently regarded by customers to be of higher quality.

Serviceability

Serviceability, the ease of fixing or repairing a product that fails, is an important aspect of quality for some customers. Consider, for example, how some new appliances contain diagnostic capability, which alerts users or service technicians that a failure is about to occur. Ideally, serviceability would allow the customer to fix the product with little or no cost or time lost. In the absence of such serviceability, customers generally consider those items or brands that can be repaired quickest at least cost to have superior quality.

Perceived Quality

As noted earlier, customers are the ultimate judges of product quality through their perception of how well the product meets their requirements. Perceived quality is based on customers' experience before, during, and after they purchase a product. Total product quality is a combination of the eight dimensions, how they are blended by an organization, and how that blend is perceived by the customer. It is perfectly plausible that two different customers may perceive two different brands as each having best quality, depending upon which blend of elements each considers most critical.

Total Quality Management

Interestingly, quality is not always clearly defined within some firms. Moreover, different functional managers tend to emphasize different aspects of quality. Marketing managers, for example, care a lot about aesthetics and features, whereas manufacturing executives often focus on conformance. Of specific concern in logistics are the quality dimensions

related to service, satisfaction, and success. From the customer's perspective, not only does the physical product incorporate the desired elements, but also the product must be available in a timely and suitable manner.

Total Quality Management (TQM) is a philosophy supported by a managerial system focused on meeting customer expectations with respect to all needs, from all departments or functions of an organization, whether the customer is internal or external, a supply chain partner, or a consumer. While the specific tools and methodologies employed in TQM are beyond the scope of logistics, the basic conceptual elements are: (1) top management commitment and support; (2) maintaining a customer focus in product, service, and process performance; (3) integrated operations within and between organizations; and (4) commitment to continuous improvement.

Quality Standards

Establishing global quality standards is extremely difficult as a result of different circumstances, practices, and procedures around the world. As a simple example, engineering tolerances in one country might be measured in millimeters, while in another, they are measured in tenths of an inch. Nevertheless, a set of standards has emerged from the **International Organization for Standardization (ISO)** and has gained worldwide acceptance.

A series of quality standards have been issued under the name ISO 9000. Incorporating several subsets (ISO 9001, 9002, etc.), these standards provide basic definitions for quality assurance and quality management. ISO 9001, for example, deals with the quality system in place for product design, development, production, installation, and service. Several organizations around the world are authorized to perform audits of companies and their practices and procedures for TQM. A company that conforms to the ISO guidelines can receive certification. In 1998, another set of guidelines, ISO 14000, was released. ISO 14000 deals with guidelines and procedures for managing a firm's environmental impact. Certification in both ISO 9000 and ISO 14000 indicates a company conforms to both quality and environmental standards. Most major countries today have accepted the ISO standards, and, in many instances, companies will not purchase from a supplier who has not received ISO certification.

Procurement[2]

Every organization, whether it is a manufacturer, wholesaler, or retailer, buys materials, services, and supplies to support operations. Historically, purchasing has been perceived as a clerical or low-level managerial activity charged with responsibility to execute and process orders initiated elsewhere in the organization. The role of purchasing was to obtain the desired resource at the lowest possible purchase price from a supplier. This traditional view of purchasing has changed substantially in the past several decades. The modern focus is on total cost and the development of relationships between buyers and sellers. As a result, procurement has been elevated to a strategic activity.

The increasing importance of procurement can be attributed to several factors. The most basic of these factors has been the recognition of the substantial dollar spend for purchases of a typical organization and the potential dollar savings from a viable procurement strategy. The simple fact is that purchased goods and services are among the largest cost elements for most firms. In the average manufacturing firm in North America, purchased

[2] This section draws on Robert Monczka, Robert Trent, and Robert Handfield, *Purchasing and Supply Chain Management* (Mason, OH: Thomson South-Western, 2005).

goods and services account for approximately 55 cents of every sales dollar.[3] By way of contrast, the average expense of direct labor in the manufacturing process accounts for about 10 cents of each sales dollar. While the percentage spent on purchased inputs varies considerably across manufacturing industries, it is clear that the potential savings from strategic management of procurement can be substantial.

Related to the cost of purchased inputs is a growing emphasis on outsourcing. The result is that the amount spent on procurement has increased significantly in many organizations. Firms today purchase not only raw materials and basic supplies but also complex fabricated components with very high value-added content. They spin off functions to suppliers to focus internal resources on core competencies. The result is that more managerial attention must then be focused on how the organization interfaces and effectively manages its supply base. For example, General Motors uses its first-tier supplier network and third-party logistics providers to complete subassemblies and deliver finished components as needed to their automotive assembly lines. Many of these activities were once performed internally by the General Motors organization. Developing and coordinating these relationships represent critical aspects of an effective procurement strategy. The logistical requirements related to effective procurement strategy are identified later in the chapter.

Procurement Perspectives

The evolving focus on procurement as a key organizational capability has stimulated a new perspective regarding its role in supply chain management. The emphasis has shifted from adversarial, transaction-focused negotiation with suppliers to ensuring that the firm is positioned to implement its manufacturing and marketing strategies with support from its supply base. In particular, considerable focus is placed on ensuring continuous supply, inventory minimization, quality improvement, supplier development, and lowest total cost of ownership.

Continuous Supply

Stockouts of raw materials or component parts can shut down or force a change in production plans, resulting in unexpected cost. Downtime due to production stoppage increases operating costs and may result in an inability to provide finished goods as promised to customers. Imagine the chaos that would result if an automobile assembly line had all parts available but tires. Assembly of automobiles would have to be halted until tires become available. Thus, one of the core objectives of procurement is to ensure that a continuous supply of materials, parts, and components is available to certain manufacturing operations.

Minimize Inventory Investment

In the past, downtime due to material shortages was minimized by maintaining large inventories of materials and components to protect against potential disruption in supply. However, maintaining inventory is expensive and requires scarce capital. One goal of procurement is to maintain supply continuity with the minimum inventory investment possible. This requires balancing the costs of carrying material against the possibility of a production stoppage. The ideal, of course, is to have needed materials arrive just at the moment they are scheduled to be used in the production process, in other words, **just-in-time (JIT).**

[3] Shawn Tulley, "Purchasing: New Muscle," *Fortune*, February 20, 1995, p. 75.

Quality Improvement

Procurement is critical to the quality requirements discussed earlier in this chapter. The quality of finished goods and services is dependent upon the quality of the materials and components used. If poor-quality components and materials are used, then the final product likely will not meet customer quality standards. Thus, both a firm and its suppliers need to be jointly committed to a continuous quality improvement initiative.

Supplier Development

In the final analysis, successful procurement depends on locating or developing suppliers, analyzing their capabilities, and selecting and working with those suppliers to achieve continuous improvement. Developing good supply relationships with firms that are committed to the buying organization's success is critical in supplier development. It is important to develop close relationships with those suppliers in order to share information and resources to achieve better results. For example, a manufacturer might share a production schedule with key suppliers, which in turn allows them to better meet the buyer's delivery requirements. A retailer might share point-of-sale information and promotional plans to help suppliers meet quantity requirements at specific times. This perspective on effective procurement stands in stark contrast to the traditional focus on price alone, which inherently created adversarial relationships between a firm and its suppliers.

Lowest Total Cost of Ownership

Ultimately, the difference in perspective between a traditional adversarial and more contemporary collaborative procurement strategy can be summarized as a focus on **Total Cost of Ownership (TCO)** as contrasted to a focus on purchase price. Procurement professionals recognize that, although the purchase price of a material or item remains important, it is only one part of the total cost for their organization.[4] Service costs and life cycle costs must also be considered.

Whether established through competitive bidding, buyer-seller negotiation, or simply from a seller's published price schedule, the purchase price and discounts of an item are obviously a concern in procurement. No one wants to pay a higher price than necessary. Related to the price quote is normally a schedule of one or more possible discounts a buyer may receive. For example, quantity discounts may be offered as an inducement to encourage buyers to purchase larger quantities or cash discounts may be offered for prompt payment of invoices.

Consideration of supplier's discounts immediately takes the buyer beyond simple quoted purchase price. Other costs associated with purchasing must be considered. For the benefits of quantity discounts to be factored into the total cost, the buyer must quantify inventory holding costs. Larger purchase quantities increase average inventory of materials or supplies. Size of purchase also impacts administrative costs associated with purchasing. Lot-size techniques such as Economic Order Quantity (EOQ), discussed fully in Chapter 7, can help quantify these cost trade-offs.

Supplier terms of sale and cash discount structures also impact the total cost of ownership. A supplier offering more favorable credit terms is, in effect, impacting the purchase price from the buyer's perspective. For example, a discount for prompt

[4] Zeger Degraeve and Filip Roodhooft, "Effectively Selecting Suppliers Using Total Cost of Ownership," *Journal of Supply Chain Management* (Winter 1999), pp. 5–10. See also Lisa M. Ellram, "Total Cost of Ownership," *International Journal of Physical Distribution and Logistics Management* (August 1995), pp. 4–23.

payment of an invoice offered by one supplier must be compared with the offers of other suppliers.

What normally is not considered in traditional purchasing practice is the impact of pricing and discount structures on logistics operations and costs. For example, while traditional EOQ does consider inventory carrying costs, it generally does not include such factors as the impact of order quantity on transportation costs or the costs associated with receiving and handling different size shipments. Many of these logistical considerations are ignored or given cursory consideration as buyers attempt to achieve the lowest purchase price. Today there is increasing recognition of the importance of these logistics costs to the TCO.

Sellers typically offer a number of standard services that must be considered in procurement. Additionally, available value-added services must be evaluated as organizations seek to identify the lowest TCO. Many of these services involve logistical operations and the logistical interface between buyers and sellers.

The simplest of these services is delivery. How delivery will be accomplished, when, and at what location all impact cost structures. In many industries it is standard practice to quote a price that includes delivery. Alternatively, the seller may offer the buyer an allowance if the item being purchased is picked up at the seller's location. The buyer may be able to reduce total costs, not only through taking advantage of such allowances, but also by more fully utilizing its own transportation equipment.

In Chapter 3, value-added services were discussed, ranging from special packaging to preparation of promotional displays. Performance of subassembly operations in a supplier's plant or at an integrated service provider warehouse represents an extension of potential value-added service. The point is that each potential service has a cost to the supplier and a price to the buyer. A key aspect of determining the TCO for purchased requirements is to consider the trade-offs involved in terms of value added versus cost and price of each service. To do so, the purchase price of an item must be **debundled** from the price of services under consideration. Each of the related available services should be priced on an independent basis so that appropriate analysis can be performed. In Chapter 9, this practice will be referred to as **menu pricing.** Where traditional purchasing might overlook value-added services in seeking lowest possible price, effective procurement executives consider whether such services should be performed internally, by suppliers, or at all. Debundling allows the buyer to make the most appropriate procurement decision.

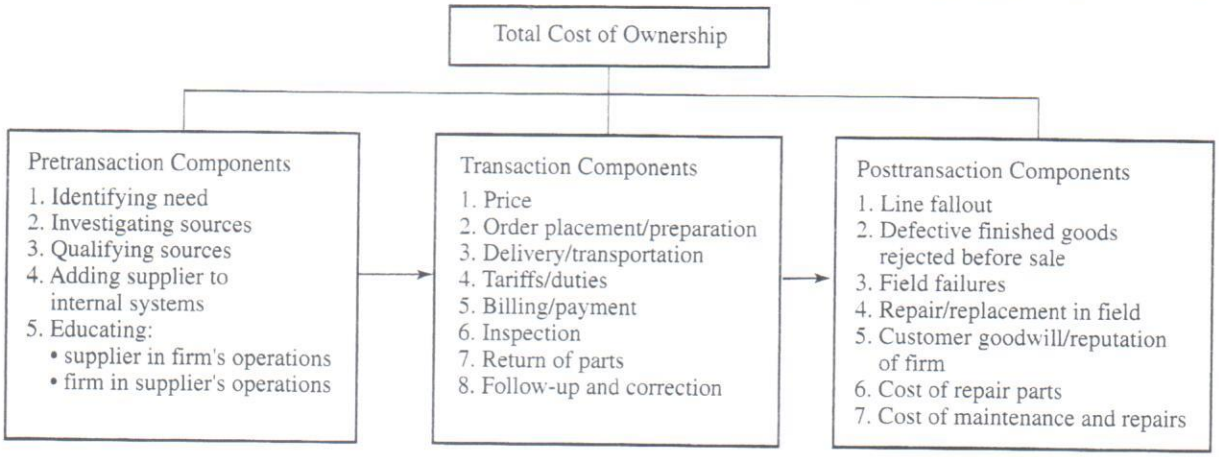
The final aspect of lowest TCO includes numerous elements known as life cycle costs. The total cost of materials, items, or other inputs extends beyond the purchase price and value-added service to include the lifetime costs of such items. Some of these costs are incurred before actual receipt of the items, others are incurred while the item is being used, and some occur long after the buyer has actually used the item.

One aspect of life cycle costs involves the administrative expense associated with procurement. Expenses related to screening potential suppliers, negotiation, order preparation, and transmission are just a few procurement administrative costs. Receiving, inspecting, and payment are also important. The costs related to defective finished goods, scrap, and rework associated with poor supplier quality must also be considered, as well as related warranty administration and repair. Even the costs associated with recycling or recovery of materials after the useful life of a finished product may have an impact on TCO.

Figure 4.1 presents a model of the various elements that TCO comprises. When each of these elements is considered in procurement, it is clear that numerous opportunities for improvement exist in most companies. Many of these opportunities arise from

FIGURE 4.1 Major Categories for the Components of Total Cost of Ownership

Source: Reprinted with permission from Michiel Leenders and Harold Fearon, *Purchasing and Supply Management*, 11th ed. (New York: McGraw-Hill Irwin, 1997), p. 334.



closer working relationships with suppliers than would be possible if adversarial price negotiation dominated the buyer-seller relationship. When buyers work cooperatively with suppliers, several strategies may be employed to reduce both the buyers' and the sellers' costs, making the total supply chain more efficient and allowing it to more effectively meet the requirements of downstream partners. Such strategies are discussed next.

Procurement Strategies

Effective procurement strategy to support supply chain operations requires a much closer working relationship between buyers and sellers than was traditionally practiced. Specifically, three strategies have emerged: volume consolidation, supplier operational integration, and value management. Each of these strategies requires substantial collaboration between supply chain partners and should be considered as stages of continuous improvement.

Volume Consolidation

An important step in developing an effective procurement strategy is volume consolidation through reduction in the number of suppliers. Beginning in the 1980s many firms faced the reality that they dealt with a large number of suppliers for almost every material or input used. In fact, purchasing literature prior to that time emphasized that multiple sources of supply constituted best procurement practice. First, potential suppliers were continually bidding for a buyer's business, ensuring constant pressure to quote low prices. Second, maintaining multiple sources reduced the buyer's dependence on any one supplier. This in turn served to reduce the buyer's risk should a specific supplier encounter supply disruptions such as a strike, a fire, or internal quality problems.

By consolidating volumes with a limited number of suppliers, procurement is also positioned to leverage its share of a supplier's business. At the very least, it increases the buyer's negotiating strength in relationship to the supplier. More important, volume consolidation with a reduced number of suppliers provides a number of advantages for those suppliers. The most obvious advantage of concentrating a larger volume of purchases with a supplier is that it allows the supplier to improve economies of scale by spreading fixed cost over a larger volume of output. Additionally, assured of a volume of purchases, a

supplier is more likely to make investments in capacity or processes to improve customer service. When a buyer is constantly switching suppliers, no one firm has an incentive to make such investment.

Clearly, when a single source of supply is used, risk increases. For this reason, supply base reduction programs are almost always accompanied by rigorous supplier screening, selection, and certification programs. In many instances, procurement executives work closely with others in their organization to develop preferred or certified suppliers. It should be noted that volume consolidation does not necessarily mean that a single source of supply is utilized for every, or any, purchased input. It does mean that a substantially smaller number of suppliers are used than was traditionally the case in most organizations. Even when a single source is chosen, it is essential to have a contingency plan.

The savings potential from volume consolidation is not trivial. One consulting firm has estimated that savings in purchase price and other elements of cost can range from 5 to 15 percent of purchases.[5] If the typical manufacturing firm spends 55 percent of its revenue on purchased items and can save 10 percent through volume consolidation, the potential exists to deliver a $5.5 million improvement on revenue of $100 million to the bottom line.

Supplier Operational Integration

The next stage of development occurs when buyers and sellers begin to integrate their processes and activities in an attempt to achieve substantial performance improvement. Such integration typically involves alliances or partnerships with selected suppliers to reduce total cost and improve operational integration.

Such integration takes many different forms. For example, the buyer may allow the supplier to have access to sales and ordering information, thereby giving the supplier continuous knowledge of which products are selling. Detailed sales information allows the supplier to be better positioned to effectively meet buyer requirements at a reduced cost. Cost reduction occurs because the supplier has more information to plan and can reduce reliance on cost-inefficient practices, such as forecasting and expediting.

Further operational integration can result for buyers and suppliers working together to identify processes involved in maintaining supply and searching for ways to redesign those processes. Establishing direct communication linkages to reduce order time and eliminate communication errors is a common benefit of such integration. More sophisticated integrative efforts may involve eliminating redundant activities that both parties perform. For example, in some sophisticated relationships, activities such as buyer counting and inspection of incoming deliveries have been eliminated as greater reliance and responsibility are assumed by suppliers. Many firms have achieved operational integration focused on logistical arrangements, such as continuous replenishment programs and vendor-managed inventory.[6] Such integration has considerable potential for reducing TCO.

Some of the efforts in operational integration strive to reduce total cost through two-way learning. For example, Honda of America works closely with its suppliers to improve their quality management. Honda visits supplier facilities and helps identify ways to increase quality. Such improvements ultimately benefit Honda by reducing the supplier's costs of rework and by providing Honda with higher levels of quality materials.

The primary objective of operational integration is to cut waste, reduce cost, and develop a relationship that allows both buyer and seller to achieve mutual improvements. Combined creativity across organizations can create synergy that one firm, operating in

[5] Matthew Anderson, Les Artman, and Paul B. Katz, "Procurement Pathways," *Logistics* (Spring/Summer 1997), p. 10.
[6] These concepts are discussed in Chapter 7.

isolation, would be unable to achieve. It has been estimated that operational integration with a supplier can provide incremental savings of 5 to 25 percent over and above the benefits of volume consolidation.[7]

Value Management

Achieving operational integration with suppliers creates the opportunity for value management. Value management is an even more intense aspect of supplier integration, going beyond a focus on buyer-seller operations to a more comprehensive and sustainable relationship. Value engineering, reduced complexity, and early supplier involvement in new product design represent some of the ways a company can work with suppliers to reduce TCO.

Value engineering is a concept that involves closely examining material and component requirements at the early stage of product design to ensure that a balance of lowest total cost and quality is incorporated into new product design. Figure 4.2 shows how early supplier involvement can be critical in achieving cost reductions. As a firm's new product development process proceeds from idea generation through the various stages to commercialization, the company's flexibility in making design changes decreases. Design changes are easily accommodated in the early stages, but by the time prototypes have been developed, a design change becomes difficult and expensive. The earlier a supplier is involved in the design process, the more likely an organization is to capitalize on that supplier's knowledge and capabilities.

An example from an automobile manufacturer demonstrates the benefit of early supplier involvement. In designing the front bumper for a new model, the design engineer was completing design of the bracket assembly for the bumper. During the process, an engineer from the assembly supplier, which had already been identified even though actual production was in the future, asked if the bracket location could be moved by about ½ inch. The design engineer, after some consideration, replied that it could be done with no impact on the final product. The design engineer was interested to know why

[7] Anderson, Artman, and Katz, "Procurement Pathways," p. 10.

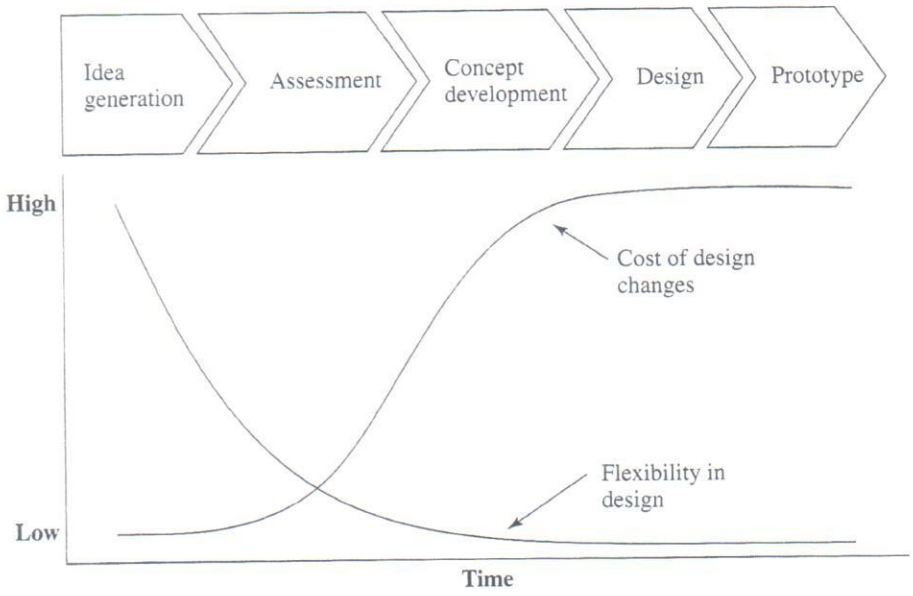


FIGURE 4.2
Flexibility and Cost of Design Changes

Source: Reprinted with permission from Robert M. Monczka et al., *New Product Development: Strategies for Supplier Integration* (Milwaukee: ASQ Quality Press, 2000), p. 6.

the supplier requested the change. The answer was that by moving the bracket, the supplier would be able to use existing tools and dies to manufacture the bracket. Under the original design, major capital investment would have been required for new tooling. The result was approximately a 25 to 30 percent reduction in cost of the bracket.

Clearly, value management extends beyond procurement in an organization and requires cooperation between numerous participants, both internal and external. Teams representing procurement, engineering, manufacturing, marketing, and logistics as well as key supplier personnel jointly seek solutions to lower total cost, improve performance, or improved accomodation of customer requirements.

Purchase Requirement Segmentation

The Pareto effect applies in procurement just as it applies in almost every facet of business activity. In procurement, it can be stated simply: A small percentage of the materials, items, and services acquired account for a large percentage of the dollars spent. The point is that all procured inputs are not equal. However, many organizations use the same approach and procedures for procuring small-volume items that they do for acquiring their most strategic purchases. As a result, they spend as much in acquiring a $10,000 order of raw materials as they do for a $100 order of copy paper. Since all purchased inputs are not equal, many firms have begun to pay attention to segmented purchase requirements and prioritizing resources and expertise to handle those requirements.

It would be a mistake, though, to simply use dollar expenditure as the basis for segmenting requirements. Some inputs are strategic materials. Others are not. Some inputs have potential for high impact on the business success. Others do not. Some purchases are very complex and high risk. Others are not. For example, failure to have seat assemblies delivered to an auto assembly line on time could be catastrophic, while failure to have cleaning supplies might constitute a nuisance. The key is for an organization to apply a segmented approach to procurement similar to that discussed for customers in Chapter 3. Volume consolidation and supply base reduction most likely can be justified for almost every material and service. The benefits described earlier can be enjoyed for office supplies as well as raw materials. Operational integration and value management may be reserved for more strategic purchase requirements.

E-Commerce and Procurement

The explosion in technology and information systems is having a major impact on the procurement activity of most organizations. Much of the actual day-to-day work in procurement has traditionally been accomplished manually with significant amounts of paperwork, resulting in slow processes subject to considerable human error. Applying technology to procurement has considerable potential to speed the process, reduce errors, and lower acquisition cost.

Probably the most common technology used in procurement is **Electronic Data Interchange (EDI).** EDI involves the electronic transmission of data between a firm and its suppliers. This allows two or more companies to obtain and provide timely and accurate information. Using EDI there are many types of data being directly transmitted, including purchase requisitions, purchase orders, purchase order acknowledgment, order status, advanced shipment notification, and tracking and tracing information. The explosion in EDI usage is a direct recognition of associated benefits, including standardization of data, more accurate information, more timely information, shortening of lead times with associated reductions in inventories, and reduced TCOs. More specifics related to EDI and related information technologies are provided in Chapter 5.

Another procurement application of electronic commerce is the development of electronic catalogs. In fact, making information available about products and who can supply them is a natural application for **Internet-based** communications. Electronic catalogs allow buyers to gain rapid access to product information, specifications, and pricing, allowing buyers to quickly identify products and place orders. Many companies have developed their own online electronic catalogs and efforts have also been devoted to developing catalogs containing products from multiple suppliers, which permits buyers to rapidly compare features, specifications, and prices.

Buying exchanges are another technology-based purchasing development. Typically, buying exchanges allow users to look for sellers or buyers of specific goods or services. Depending on the approach, a buyer may post a request for proposal, post a request for quotation, or invite bids for specified products and services. Transactions can be initiated and completed electronically.

The potential volume of procurement activity through buying exchanges is enormous. Exchanges have been developed in the aircraft parts industry, chemicals, steel building products, food distribution, and even retailing. However, there is a potential downside. Many suppliers fear that the exchanges will become a mechanism that ultimately will reinforce past practice of buyers to focus strictly on purchase price. If buyers post their requirements and needs on the Internet primarily for the purpose of soliciting bids from alternative suppliers, or use the technology to have suppliers enter into an auctioning process, some fear many of the advances in supplier integration and value management will suffer.

In a supply chain management context, the link between a company and its external suppliers is critical. It provides for the integration of materials and resources from outside the organization into internal operations. Procurement is charged with the responsibility of ensuring that this transition is accomplished as efficiently and as effectively as possible. Much of the concern in procurement is focused on the logistical interface between the organization and its supply base. Ultimately, the purpose of procurement is to integrate material flow in accordance with requirements. It's the job of logistics to efficiently move purchases to the desired location. In the next section, alternative manufacturing strategies are discussed with a focus on identifying their logistical requirements.

Manufacturing[8]

A substantial number of firms in the supply chain are involved in manufacturing products. Manufacturers add value by converting raw materials into consumer or industrial products. They create value by producing product/service bundles for either customers or intermediate members in the supply chain. For example, retailers purchase a wide range of products from varied manufacturers to create an appealing assortment for consumers. This section reviews supply chain structure and strategy from a manufacturing perspective. As in the previous section that discussed procurement, the objective is to highlight logistics requirements and challenges necessary to integrate and support manufacturing supply chain operations.

Manufacturing Perspectives

The range of products a firm manufactures is based on its technological capability and marketing strategy. Firms perfect manufacturing competencies on the basis of market opportunity and willingness to take innovative risk. At the outset, a manufacturing firm creates or

[8] This section draws on Steven A. Melnyk and Morgan Swink, *Value-Driven Operations Management: An Integrated Modular Approach* (New York: McGraw-Hill, 2003).

invents a new product assortment as its entry point as a value-added supply chain participant. Initial market success serves to define and clarify a firm's competency as perceived by customers and suppliers. A firm initiating manufacturing operations to produce automotive parts will be viewed by trading partners as being distinctly different from one that produces garments. While the products produced are clearly different, the real differentiator between firms is found in competencies related to knowledge, technology, process, and strategy. Once established, a manufacturing firm's image and focus are continuously modified in the eyes of supply chain partners as it conducts business, researches and develops new products, and performs agreed-to value-added services. Thus, the combinations of capabilities and competencies that are exhibited by a manufacturing firm are dynamic. In terms of supply chain participation, the combination of products, services, capabilities, and competencies represents a firm's value proposition and provides dimension to its supply chain opportunities. A firm's manufacturing competency is based on brand power, volume, variety, constraints, and leadtime requirements.

Brand Power

Many manufacturers spend a great deal of promotional money to create brand awareness and acceptance among prospective buyers. As a result, they are typically identified by their product brands. The measure of a customer's purchase preference based on a manufacturer's reputation, product quality, and supply chain capabilities is known as **brand power.**

Buyers across a supply chain range from consumers to industrial purchasing agents. Under market conditions wherein a brand has high customer awareness, acceptance, and preference, manufacturers can be expected to have a great deal of influence. As a general rule, the stronger a firm's product brand image among buyers, the more leverage the manufacturing organization will have in determining supply chain structure and strategy. For instance, Deere & Company dominates how farm machinery is sold, distributed, and maintained.

Independent of customer acceptance is the reality that a firm that brands and markets a particular line of products may not, in fact, be engaged in either the actual manufacturing/assembly or in the performance of associated logistics services. It is common practice for an organization to outsource some or even all manufacturing and logistics operations required to market a specific product. The nature of the manufacturing process, cost, and final destination in the supply chain go a long way to determine the attractiveness of such outsourcing. Logistical requirements are created by the geographical network linking locations of manufacturing operations and those of suppliers and customers. However, the power to determine the range of value-added services, physical product movement requirements, timing, and characteristics of flow along the supply chain is directly related to brand power.

Volume

Manufacturing processes can be classified in terms of the relationship of cost per unit to volume of output. The traditional perspective is to treat volume in terms of the well-established principle of **economy of scale.** The scale principle defines a relationship wherein the average cost of producing a product declines as its manufacturing volume increases. In terms of economy of scale, product quantity should be increased as long as increases in volume decrease the average cost per unit manufactured. Economy of scale results from efficiencies generated by specialization of process, workforce, fixed asset utilization, procurement economies, and reduced need for process changeover.

Economy of scale is extremely important when high-fixed-cost machinery is used to convert raw material into finished products. Typical examples are the paper, steel, and refining industries. In fact, some petroleum processing firms have decoupled their

refineries from their supply chain marketing structure and positioned them as independent external suppliers. The refineries are then able to sell in the open market to all potential buyers and fully exploit economy-of-scale advantage.

In volume-sensitive industries, high capital investment coupled with high cost of changeover tends to encourage extremely long production runs. In terms of logistical support, two considerations related to volume influence supply chain design. First, supply chain logistics must accommodate the number of times a product is manufactured during a planning period. Such manufacturing frequency has a direct impact on both inbound and outbound logistical requirements. Second, the quantity or lot size typically produced during a manufacturing run determines the subsequent volume that must be handled and warehoused in a supply chain logistics structure.

Variety

In contrast to manufacturing situations dominated by scale, other production technologies feature flexibility. These manufacturing processes are characterized by relatively frequent product runs and high repetition of small lot sizes. As contrasted to economy of scale, manufacturing processes that feature variety rapidly switching production from one product to another while retaining efficiency are referred to as having **economy of scope.** Scope means that a manufacturing process can use varied combinations of overhead support, materials, equipment, and labor to produce a variety of different products.

Variety also refers to the **range** of product variations that are capable of being manufactured by using a given process. Range may result from the sequence of routing products through a manufacturing plant as well as the use of general as contrasted to specialized equipment. The achievement of economy of scope is also directly related to the speed and cost of changeover from one product to another. In terms of logistical support, high variety translates to relatively small manufacturing lot sizes, flexible material requirements, and a broad range of product outputs. High manufacturing variety directly impacts the type of logistical transportation and warehousing services required to support flexible manufacturing.

Constraints

All manufacturing processes reflect a balance between economy of scale and economy of scope. Volume and variety drive logistical support requirements. Constraints interact with volume and variety to create realistic manufacturing plans. The three primary constraints that influence manufacturing operations are **capacity, equipment, and setup/changeover.** Each of these constraints drives compromise regarding ideal manufacturing operations. Such compromise planned in the context of forecasted sales and planned promotions creates the production plan.

Capacity, as the name implies, is a measure of how much product can be produced per unit of time. Of particular interest is a firm's demonstrated capacity of quality production. Whereas a factory, process, or machine may have a rated capacity, the relevant measure is a firm's demonstrated ability to reach and maintain a specific level of quality output in a predictable time period. A measure of manufacturing competency is the speed to which a particular process reaches demonstrated capacity, given an unplanned change in requirements.[9] Such **scalability** is achieved by a combination of manufacturing, procurement, and logistical agility.

Equipment constraints are related to flexibility concerning the use and sequencing of specific machines to perform multiple manufacturing tasks. The variety a factory can

[9] Thomas G. Gunn, *21st Century Manufacturing* (Essex Junction, VT: OM NEO, 1992), Chapter 8.

produce is constrained by the range of available equipment and the required sequence of work. However, some manufacturing requirements are more easily accommodated across a family of machines and by using variable work sequences than are others. In many situations, a specific machine or work task tends to constrain or act as a bottleneck to the overall manufacturing process. Likewise, logistical capability to accommodate different patterns of equipment utilization may serve to enhance or constrain flexibility of the manufacturing process. Manufacturing executives devote substantial time and resources to eliminating bottlenecks that serve to constrain operations. The structure for focusing managerial attention is captured in **theory of constraint** methodology.[10]

Setup/changeover constraints are directly related to the need for variety. Substantial progress has been made in manufacturing management to speed up both process changeover time and the time required to reach demonstrated capacity. Whereas several hours and even days were once required for changeover, today the tasks are being performed in hours. For example, modular-manufacturing units, such as paint sprayers, are being set up and calibrated offline and then being inserted ready to spray paint into assembly lines. Of course all efforts to increase setup/changeover speed are directly dependent upon supply chain logistical support.

Leadtime

Manufacturing leadtime is a measure of the elapsed time between release of a work order to the shop floor and the completion of all work necessary to achieve ready-to-ship product status. Any given manufacturing process consumes operational and interoperational time.[11]

Operational time is the combination of setup/changeover and running or actual production time. In any manufacturing situation, the greater the amount of total leadtime accounted for by actual production, the inherently more efficient is the conversion process. Efficient operational time must be traded off against the issues discussed earlier concerning volume and variety.

Manufacturing processes also encounter unexpected delays or **inoperational time.** During periods that a process, line, or machine is idle because of queuing, waiting, breakdown, or failure in logistical support, manufacturing efficiency is negatively impacted. All forms of unexpected delay represent serious bottleneck issues. For example, it is estimated that between 75 and 95 percent of all nonproductive delays result from unplanned queuing in manufacturing processes.[12] Needless to say, most senior managers have little or no tolerance for unexpected production delays that result from late or damaged arrival of critical materials or components. Logistical delay on the part of a supplier who provides parts or materials can result in manufacturing failure to meet planned output. A firm's strategic impact is directly affected by leadtime performance. As a general rule, firms that compress manufacturing leadtimes and control or eliminate unexpected performance variance exhibit greater flexibility to accommodate customer requirements while simultaneously enjoying low-cost manufacturing.

Logistical operations commitments to supporting manufacturing can impact operating efficiency in a variety of ways. The potential benefits of brand power are based on a firm's track record regarding timely accommodation of customer order-to-delivery requirements. Lot-size efficiencies related to manufacturing frequency and repetition depend on reliable

[10] For origins of this logic, see Eliyahu M. Goldratt and J. Cox, *The Goal* (Croton on Hudson, NY: North River Press, 1984); and Eliyahu M. Goldratt and Robert E. Fox, *The Race* (Croton on Hudson, NY: North River Press, 1986).

[11] Steven A. Melnyk and R. T. Christensen, *Back to Basics: Your Guide to Manufacturing* Excellence (Boca Raton: St. Lucie Press, 2000), pp. 15–17.

[12] Ibid., p. 17.

assembly line through various stages of production, where pieces or components are added at each stage.

A **continuous** process is typically used to manufacture such items as gasoline, chemicals, laundry detergent, and aluminum soda cans. Many food products such as pasta and cereal are made using continuous processes. These products offer customers very little variety and are often referred to as commodities.

These four general process structures can be modified to create more options. For example, changes in management practices and technology have led to the cost advantages of high-volume continuous and line flow processes while increasing variety through **mass customization,** where a product is produced quickly and at a low cost using a high-volume production process. Dell Computers is an example of mass customization. Selecting from a range of components and warranty options, customers can design a computer system that best meets their needs at the price they want to pay and have delivery within about a week. Standardizing parts, using modular designs, and postponing product differentiation are practices used with mass customization.[13]

Matching Manufacturing Strategy to Market Requirements

In Chapter 3, typical marketing strategies were classified as being mass, segmental and focused, or one-on-one. These strategies are differentiated, in part, in terms of the desired degree of product and service accommodation. Mass marketing requires limited product/service differentiation. In contrast, one-on-one marketing strategy builds on unique or customized product/service offerings for each and every customer. A firm's strategic marketing posture concerning flexibility and agility to accommodate specific customer requirements is directly related to manufacturing capability. To a significant degree, a firm's manufacturing capability drives the feasible range of effective marketing strategy. For a manufacturing firm to effectively compete, it must be able to integrate manufacturing capability into a meaningful marketing value proposition.

Alternative Manufacturing Strategies

The most common manufacturing strategies are **make-to-plan (MTP), make-to-order (MTO),** and **assemble-to-order (ATO).** It is also common to refer to MTP as **make-to-stock (MTS).**

As a general rule, MTP strategies are characteristic of industries exploiting economy of scale gained from long production runs. Significant finished goods inventory is typically manufactured in anticipation of future customer requirements. The logistical requirement to support MTP is warehousing capacity to store finished product and to facilitate product assortment to meet specific customer requirements. When flexible manufacturing is introduced to speed up switchover, the inventory lots produced are typically smaller in quantity. However, warehouses are still required for temporary storage and to facilitate product assortment.

In contrast, MTO manufacturing strategies seek to manufacture to customer specification. While MTO may not be as limited as the traditional job shop, exact quantities and configurations are produced in relatively small quantities. Logistical capacity may be required for temporary storage and to achieve outbound transportation consolidation, but most product produced in an MTO environment is shipped direct to customers.

In ATO situations, base products and components are partially manufactured in anticipation of future customer orders; however, the products are not fully assembled or customized until a customer's order is received. Such final assembly reflects implementation of the

[13] Various aspects of postponement and mass customization were discussed in Chapter 1.

principle of manufacturing or form postponement. The need for logistical capacity is critical in ATO operations. In fact, an increasing amount of ATO product finalization is being performed in supply chain logistics warehouses. The attractiveness of an ATO manufacturing strategy is that it has the potential to combine some facets of economy of scale typical of MTP with a degree of flexibility characteristic of MTO. Full implementation of an ATO strategy requires that warehouse operations be integrated in the value creation process to perform customizing and assembly operations.

Manufacturing strategy clearly has a significant impact on the leadtime experienced by customers. The choice of MTO, ATO, or MTP determines whether a customer will bear the cost of waiting for completion of one or more of the three performance cycles discussed in Chapter 2. For MTP items such as most fast-moving consumer goods, customers essentially only experience the customer accommodation cycle, the time from placing an order until the product is received from the supplier. An ATO strategy choice by a manufacturer requires that customers also wait during the time that the product is actually configured to their requirements. Generally, an MTO strategy requires that customers incur the additional time of the manufacturer purchasing the needed components and materials to make the product.

Table 4.1 summarizes the essential characteristics of manufacturing processes and strategies. Each process is associated with the product variety and volume generally produced as well as the strategy generally employed and the resulting impact on customers in terms of their expected total leadtimes. Keep in mind, however, that creative organizations implementing mass customization are exploiting ways to blend different process and strategy combinations.

Total Cost of Manufacturing

The marketing and manufacturing strategies of a firm drive logistical service requirements. For example, MTO manufacturing strategies typically require less finished goods inventory than MTP and ATO strategies. However, MTO strategies typically require significant component inventory and may result in high-cost customer accommodation. In

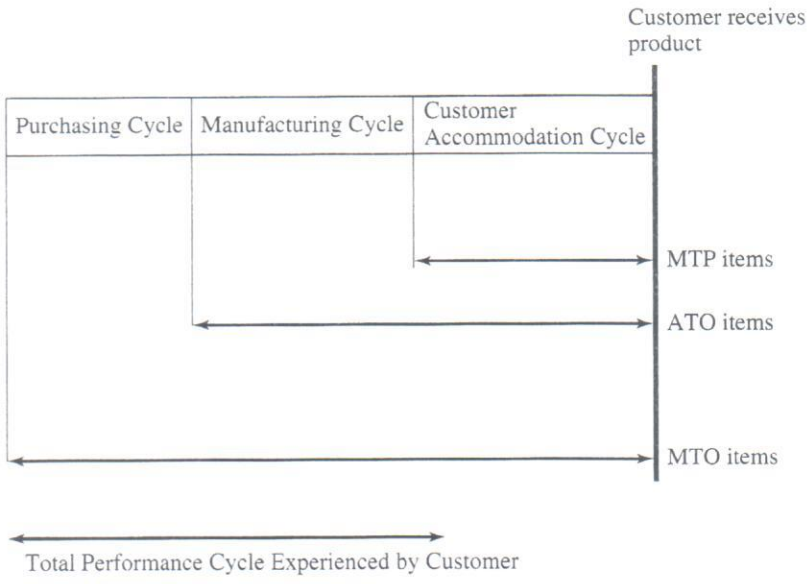


FIGURE 4.3
Manufacturing Strategy and Performance Cycles

TABLE 4.1
Manufacturing Process Characteristics

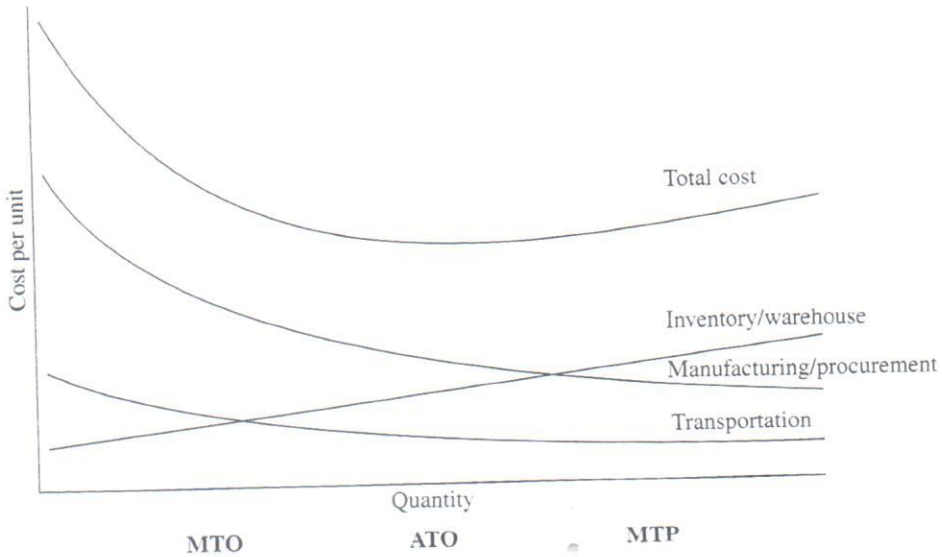
	Product Variety	Volume	Strategy	Customer Leadtime
Job Shop	Very high	Very low	MTO	Very long
Batch	High	Low	MTO/ATO	Long
Line Flow	Limited	High	ATO/MTP	Short
Continuous Flow	Very limited	Very high	MTP	Very short

light of such cost trade-offs, the design of a logistics support system should be based on the **Total Cost of Manufacturing (TCM).**

Total cost of manufacturing consists of production/procurement, inventory/warehousing, and transportation. All of the above costs are impacted by manufacturing strategy. As such, TCM represents the foundation for formulating a customer accommodation strategy. Figure 4.4 represents a generalized model of the TCM **per unit** ranging across strategic alternatives from MTO to ATO to MTP. Naturally, exact cost relationships will depend upon specifics related to individual business situations. The design objective is to identify the manufacturing strategy that best fits the marketing opportunity confronted.

In Figure 4.4, the per unit cost of manufacturing and procurement declines as quantity increases, reflecting economy of scale associated with MTP. Inventory and warehousing costs increase, reflecting the impact of larger manufacturing lot sizes. Transportation cost per unit decreases as a result of shipment consolidation. In contrast, MTO strategies reflect high per unit manufacturing and procurement costs which are, in part, offset by lower inventory and warehousing costs. In the MTO strategy, transportation cost per unit is higher, reflecting small shipment and/or premium transportation. The value of Figure 4.4 is to generalize relationships and visualize important cross-functional trade-offs. The TCM results from functional integration of manufacturing, procurement, and logistics. From a perspective of integrated management it is important for manufacturing firms to design a supply chain strategy that achieves lowest total cost of manufacturing across the entire process.

FIGURE 4.4
Total Cost of Manufacturing



Lean and Six Sigma

Two significant developments in recent years have had a significant impact on supply chain operations. The first is the development of lean principles in manufacturing. The second is development of six-sigma quality initiatives, which have been applied in manufacturing as well as logistics operations. Each is discussed below.

Lean Systems

Lean has been defined in several different ways, but, in general, it is a philosophy of manufacturing that emphasizes the minimization of the amount of all the resources (including time) used in the operations of a company. Operational processes are considered to be lean when they are very efficient and have few wasted resources. The elimination of "waste" is actually the defining principle of lean.

By eliminating wastes of all sorts in the system, the lean approach lowers labor, materials, and energy costs of production. Lean also emphasizes building exactly the products customers want, exactly when they need them. When lean capabilities are introduced in a firm it can produce smaller quantities, and it can change outputs more quickly in response to changes in customer demand.

The primary objectives of lean systems are to

1. Produce only the products (goods or services) that customers want.
2. Produce products only as quickly as customers want to use them.
3. Produce products with perfect quality.
4. Produce in the minimum possible leadtimes.
5. Produce products with features that customers want, and no others.
6. Produce with no waste of labor, materials, or equipment; designate a purpose for every movement to leave zero idle inventory.
7. Produce with methods that reinforce the occupational development of workers.

Note that the first two objectives emphasize producing "just-in-time," that is, building products only when customers want them and at the same rate that customers demand them. If operations managers can synchronize their production systems with the rate of demand in this way, they can eliminate many sorts of waste. The other five objectives are frequently associated with the operation of lean systems—emphasis on perfect quality, reduce amount of leadtime, eliminate unwanted product offerings, and place a greater emphasis on employees as the primary agents for improving operations.

Six Sigma

In the recent years, the **six-sigma** program for quality and process improvements has been adopted by many of the larger firms in the United States and around the world. From statistics, the term "sigma" refers to standard deviation of values for the output a process and is an indicator of variability. While traditional quality management programs defined three sigma as the objective, in a six-sigma approach, the goal is to achieve a process standard deviation that is six times smaller than the range of outputs allowed by the product's design specification. A primary objective of six-sigma programs is to design and improve products and processes so that variability is reduced. For example, imagine a grinding process that automatically grinds metal parts to a specified width. As the grinding wheel wears, the average width of the processed parts increases. It is this type of movement that creates quality problems. When a process is stable and centered within specification limits, a three-sigma quality level means that the firm

produces defect-free product 99.74 percent of the time. A six-sigma process that is centered produces defect-free product 99.99966 percent of the time. Thus, a six-sigma process produces only 3.4 defects per million parts, while a three-sigma process produces 66,807 defects per million parts.

The six-sigma approach is actually a structured process for first identifying sources of variability and then reducing them. Early developers of the six-sigma approach at Motorola originally chose six standard deviations as an appropriate goal given the nature of their manufacturing processes. In truth, very few business operations ever attain a six-sigma level of quality. More important than the absolute goal are the quality improvement processes that comprise a six-sigma program.

Logistical Interfaces

The efficient and effective coordination of manufacturing strategy with the procurement of materials and components ultimately depends on logistics. Resources must be procured and positioned as needed to support manufacturing operations. Whether the manufacturing strategy is MTO, ATO, or MTP, logistics links suppliers and customers with manufacturing processes. Clearly, the more seamless the interface, the better the opportunity is for achieving lowest total cost of ownership and, ultimately, lowest total cost of manufacturing. Such operations only emerge when there is high-level supplier integration in both operations and design. Just-in-time, materials requirements planning, design for logistics, and performance-based logistics represent four approaches to achieving desired coordination.

Just-in-Time

Just-in-Time (JIT) techniques have received considerable attention and discussion in recent years in all areas related to supply chain management. Sometimes referred to as just-in-time purchasing, and frequently referred to as just-in-time delivery, the goal of JIT is to time-phase activities so that purchased materials and components arrive at the manufacturing or assembly point just at the time they are required for the transformation process. Ideally, raw material and work-in-process inventories are minimized as a result of reducing or eliminating reserve stocks. The key to JIT operations is that demand for components and materials depends on the finalized production schedule. Requirements can be determined by focusing on the finished product being manufactured. Once the production schedule is established, just-in-time arrival of components and materials can be planned to coincide with those requirements, resulting in reduced handling and minimal inventories.

The implications of JIT are numerous. Obviously, it is necessary to deal with suppliers who have high and consistent levels of quality, as their components will go directly into the finished product. Absolutely reliable logistical performance is required and eliminates, or at least reduces, the need for buffer stocks of materials. JIT generally requires more frequent deliveries of smaller quantities of purchased inputs, which may require modification of inbound transportation. Clearly, to make JIT work, there must be very close cooperation and communication between a manufacturer's purchasing organization and suppliers. In JIT operations, companies attempt to gain the benefits of backward vertical integration but avoid the formal tie of ownership. They achieve many of the same ends through coordination and process integration with suppliers.

Originally, JIT was applied to manufacturing processes characterized as MTP, since the effective functioning of the system is dependent upon a finalized production schedule. However, as manufacturing strategies have evolved with more emphasis on flexibility, reduced lot-size production quantities, and quick changeovers, JIT concepts have evolved

to accommodate ATO and MTO manufacturing as well and in manufacturing is now refered to as *lean*, as discussed above. In many situations, lead suppliers are used by manufacturers to sort, segregate, and sequence materials as they flow into assembly operations. The goal is to reduce handling and facilitate continuous JIT.

Some organizations, seeing the benefits of JIT systems and recognizing the benefits of supplier integration, have gone so far as to bring their suppliers' personnel into their production plants. The supplier personnel are empowered to use the customer's purchase orders, have full access to production schedules, and have responsibility for scheduling arrival of materials. Originally introduced by the Bose Corporation, the term **JIT II** has been applied to these efforts to reduce leadtimes and cost.

Requirements Planning

In complex manufacturing organizations a process known as **materials requirements planning (MRP)** is frequently used to aid in the interface between purchaser and supplier. MRP systems attempt to gain benefits similar to those of JIT, minimize inventory, maintain high utilization of manufacturing capacity, and coordinate delivery with procurement and manufacturing activities. Implementation of MRP systems, discussed in Chapter 5, requires a high level of technological sophistication. Software applications such as advanced planning and scheduling systems deal with the complexity of information required, such as leadtimes, quantities on-hand and on-order, and machine capacities for literally thousands of materials across multiple manufacturing locations.

Design for Logistics

The logistics interface with procurement and manufacturing, as well as with engineering and marketing, can be greatly enhanced by incorporating a concept known as **design for logistics** into the early phases of product development. Recall that the objectives of JIT and MRP are to minimize inventories and handling, with materials and components being ready for assembly or transformation as they are needed. How a product is designed and the design of the components and materials themselves can have a significant impact on this process. In particular, product packaging and transportation requirements need to be incorporated into the design process. For example, if inbound components are packaged in containers with a standard quantity of 50 but only 30 components are needed to meet production requirements, then waste will occur. Additionally, product and component design must have consideration of transportation and internal materials handling methods to ensure that cost-efficient, damage-free logistics performance can be achieved. Similar design considerations must be made for the finished product itself.

Performance-Based Logistics[14]

Initiated by the U. S. Department of Defense (**DoD**), a new approach to dealing with suppliers called *performance-based logistics* has recently emerged. PBL is used to buy what the military has traditionally referred to as logistics support. The most interesting aspect of PBL is that the military buys performance outcomes instead of what has historically been individual transactions defined by product specifications.

Historically, the DoD told contractors what products to produce, when to produce them, and what activities to perform, and then paid them upon completion. In this

[14] This section is based on Kate Vitasek and Steve Geary, "Performance Based Logistics," *World Trade* (June 2008), pp. 62–65.

traditional arrangement, the more the contractor produced, the more money it made. With PBL, the government simply tells the contractor what the desired outcomes are and lets the supplier determine the best way to meet those requirements. The government has found PBL to be an effective means for obtaining higher quality while simultaneously achieving lower cost. While PBL has been limited thus far to government purchasing, it is expected that business organizations may begin to adopt the practice in the future.

Table 4.2 summarizes the critical relationships between customer accommodation, manufacturing/procurement, and logistical requirements. The framework is useful in positioning how logistical requirements flow from the customer accommodation, manufacturing, and procurement strategies.

Summary

Managing logistics in the supply chain requires an interface between logistics, procurement, and manufacturing strategies.

A primary concern of procurement and manufacturing is product quality, a prerequisite for any firm that desires to be a global competitor. In fact, product quality has several different dimensions. It can mean reliability, durability, product performance, and conformance to engineered specifications. From a customer's perspective it may also include aspects of product features, aesthetics, or serviceability. World-class companies have implemented Total Quality Management programs in all their activities in an effort to achieve quality from their customer's perspective.

Procurement in an organization is charged with responsibility for obtaining the inputs required to support manufacturing operations. The focus is multidimensional, attempting to maintain continuous supply, minimize leadtimes from suppliers and inventory of materials and components, and develop suppliers capable of helping the organization achieve operating goals. Procurement professionals are focused on the Total Cost of Ownership as contrasted solely on purchase price. This requires careful consideration of trade-offs between purchase price, supplier services and logistical capability, quality of material, and how the material impacts costs over the life cycle of the finished product. Procurement strategies

TABLE 4.2 Strategic Integration Framework

Customer Accommodation	Manufacturing	Procurement	Logistics
Focused:	Make-to-Order (MTO):	B2B	Direct Fulfillment:
One-on-one strategies	Maximum variety	Discrete quantities	Time postponement
Unique product/service offerings	Unique configuration	Supplier-managed inventory	Small shipment
Response-based	Flexible manufacturing		
	High variety		
Segmental:	Assemble-to-Order (ATO):	B2B	Form and Time
Limited size	Wide variety	JIT	Postponement:
Customer groups	Quick changeover		Warehouse ATO
Differentiated products	Product customization		Combination direct and warehouse fulfillment
Mixed response and anticipatory	High variety and volume		Consolidated shipment
Mass Marketing:	Make-to-Plan (MTP):	B2B	Warehouse Fulfillment:
Anticipatory	Long product runs	Commodity	Full stocking strategy
Little product differentiation	Focus low cost	Auction	Assortment mixing
	High volume/low variety	E-procurement	Volume shipment

require consolidation of purchase volumes into a small number of reliable suppliers. Such strategies include efforts to integrate supplier and buyer operations to achieve better and lower-cost overall performance.

Manufacturers balance product volumes, varieties, and capacity with customer requirements and constraints. The processes employed reflect alternative strategies related to MTP, ATO, or MTO. In turn, the strategic choice impacts customers in terms of total experienced leadtime. Lean principles focus on eliminating waste and more closely matching manufacturing capabilities with customer demand.

In Chapters 3 and 4, strategic considerations related to customer accommodation, procurement, and manufacturing have been discussed in terms of their combined impact on logistical requirements. A number of important trade-offs were identified. The fundamental point is that isolated optimization of any specific functional area without considering cross-functional impact and requirements is not likely to result in integrated performance. Information technology is the focus of Chapter 5.

Challenge Questions

1. Using television receivers as an example, how could three different brands be perceived by different consumers as being the best quality brand in the market?
2. Why does the contemporary view of procurement as a strategic activity differ from the more traditional view of "purchasing"?
3. How can strategic procurement contribute to the quality of products produced by a manufacturing organization?
4. Explain the rationale underlying volume consolidation. What are the risks associated with using a single supplier for an item?
5. How does lowest TCO differ from lowest purchase price?
6. What is the underlying rationale that explains why firms should segment their purchase requirements?
7. Explain how constraints in manufacturing are interrelated with a company's decisions regarding volume and variety.
8. Why would a company's cost of manufacturing and procurement tend to increase as the firm changes from an MTP to an MTO strategy? Why would inventory costs tend to decrease?
9. How does a firm's marketing strategy impact its decisions regarding the appropriate manufacturing strategy?
10. Explain how logistics performance is crucial to JIT.