



Part One

Introduction

1. The Operations Function
2. Operation and Supply Chain Strategy
3. Product Design

The introductory part of this book provides an overview of the operations and supply chain functions: operations and supply chain strategy and product design. After reading this part, the student should have an appreciation for the importance of the operations function and the supply chain to the firm, the major decisions made within the operations function of a firm and across the operations functions of a supply chain, the linkages of operations and supply chain decisions to other functions, and the need for strategy to guide all operations decision making. New-product design is treated as a cross-functional decision responsibility that precedes the production and delivery of goods or services.



Chapter One



The Operations Function

Chapter outline

- 1.1 Why study operations management?
- 1.2 Definition of operations management and supply chains
- 1.3 Decisions at Pizza U.S.A.
- 1.4 Operations decisions—a framework
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Operations management, as a field, deals with the production of goods and services. Every day we come in contact with an abundant array of goods or services, all of which are produced under the supervision of operations managers. Without effective management of operations, a modern industrialized society cannot exist. The operations function in any organization is the engine that creates profit for the enterprise and underpins the global economy.

Operations managers have important positions in every company. One example is the plant manager who is in charge of a factory. All the other managers who work in the factory—including production and inventory control managers, quality managers, and line supervisors—are also operations managers. Collectively, this group of factory managers is responsible for producing the supply of products in a manufacturing business. Carrying this example one step further, we should also include in the group of operations managers all manufacturing managers at the corporate or divisional level. These managers might include a corporate vice president of operations (or manufacturing) and a group of corporate staff operations managers concerned with quality, production and inventory control, facilities, and equipment.

Operations managers, however, have important responsibilities in service industries as well as in manufacturing companies. In the private sector, operations



“What is OM?”
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Operations managers make important decisions in both manufacturing and service organizations.

managers take leadership roles in hotels, restaurants, airlines, banks, and retail stores. In each of these organizations, operations managers are responsible for producing and delivering the supply of services much as their counterparts in manufacturing produce and deliver the supply of goods. In the government, there are operations managers in the post office, police department, and housing department, to name only a few.

At first glance, it may appear that service operations do not have much in common with manufacturing operations. However, a unifying feature of these operations is that both can be viewed as transformation processes inside organizations that are themselves embedded within supply chains. In manufacturing, inputs of raw materials, energy, labor, and capital are transformed into finished goods. In service operations, the same types of inputs are transformed into service outputs. Managing the transformation process in an efficient and effective manner is the task of the operations manager in any type of organization.

Our economy has shifted dramatically from the production of goods to the production of services. It may come as a surprise that today more than 80 percent of the American workforce is employed in service industries.¹ Even though the preponderance of employment is in the service sector,

manufacturing remains important to provide the basic goods needed for export and internal consumption. Because of the importance of both service and manufacturing operations, they are treated on an equal basis in this text.

In the past when the field was related primarily to manufacturing, operations management was called production management. Later the name was expanded to “production and operations management,” or, more simply, “operations management,” to include the service industries as well. The term “operations management” as used in this text refers to both manufacturing and service industries.

Today, individuals who work in operations and supply chain management can belong to a number of professional societies. These societies provide opportunities to become certified, network with other individuals, and learn about and share best practices (see the Operations Leader box titled “Professional Societies Affiliated with Operations and Supply Chain Management”).

1.1 WHY STUDY OPERATIONS MANAGEMENT?

All businesses want to hire bright people who can make the best decision for the business as a whole, not the best marketing, finance, or operations decision. They want employees who can see the big picture, not a narrow perspective. You will severely limit your career if you take a narrow functional perspective.



Every decision is cross-functional in nature. You will be working with operations and need to understand operations no matter what career path you choose. Operations is a major function in every organization, and the organization where everyone just works with people from his or her own function does not exist. That is why we take a cross-functional perspective in this text to appeal to all majors.

¹ U.S. Bureau of the Census, *Statistical Abstract of the United States*, Washington, DC, 2007 ed.

Operations Leader Professional Societies Affiliated with Operations and Supply Chain Management

ASSOCIATION FOR OPERATIONS MANAGEMENT



The global leader and premier source of the body of knowledge in operations management, including production, inventory, the supply chain, materials management, purchasing, and logistics (see www.apics.org for more information).

AMERICAN SOCIETY FOR QUALITY



The world's leading organization devoted to advancing learning, quality improvement, and knowledge exchange to improve business results and create better workplaces and communities worldwide (see www.asq.org for more information).

INSTITUTE FOR SUPPLY MANAGEMENT



The largest and one of the most respected supply management associations in the world, whose mission is to lead the supply management and purchasing profession through its standards of excellence, research, promotional activities, and education (see www.ism.ws for more information).

COUNCIL OF SUPPLY CHAIN MANAGEMENT PROFESSIONALS



The preeminent worldwide professional association for supply chain management professionals, whose vision is to lead the evolving supply chain management profession by developing, advancing, and disseminating supply chain knowledge and research (see <http://cscmp.org> for more information).

As you study operations management, you will find that many of the ideas, techniques, and principles can be applied across the business, not just in operations. For example, all work is accomplished through a process (or sequence of steps). The principles of process thinking found in this course can be applied to all functions. After they graduate, many students find that the ideas learned in operations management are among the most useful in their particular vocational choice.

Finally, operations management is an exciting and challenging field of study. Even those who are not quantitatively oriented will find principles and concepts worthy of study. You are embarking on a journey that is interesting and useful no matter what career you choose.

1.2 DEFINITION OF OPERATIONS MANAGEMENT AND SUPPLY CHAINS

All organizations (for-profit and nonprofit) thrive by producing and delivering a good or a service deemed to be of **value** to customers. Think of value as the tangible and intangible benefits that customers can derive from consuming a good or a service at a price they are willing to pay. For example, value in a pair of shoes may be shoes that are good-looking and comfortable and will last a long time at a price you can afford. What is of value to one customer (or set of customers) may not be of value to another. Flying in first class may be of value to business travelers, but for leisure travelers flying in first class may not be of value because of the price of first-class seats. Value, thus, is always defined in the eyes of the customer (or set of customers).

Organizations that are successful strive to identify the value inherent in the goods or services being offered to customers. They then deploy this understanding to shape the decisions that affect the production and delivery of those goods and services. These decisions have an impact on the design, execution, and performance of operations and should be coordinated with decisions made by managers of the purchasing and the logistics functions.

The **purchasing function** sources inputs into the transformation process of the organization from other for-profit and nonprofit organizations. The **logistics function**, in contrast, is typically responsible for the actual movement of goods and/or services across organizations. Collectively, the operations, purchasing, and logistics functions within an organization manage the supply chain for the goods or services that are consumed by customers.

Most organizations exist as part of a larger supply chain. The **supply chain** is the network of manufacturing and service operations that supply one another from raw materials through manufacturing to the ultimate customer. The supply chain consists of the physical flow of materials, money and information along the entire chain of purchasing, production, and distribution. For example, the food supply chain reaches from the farm to the food processor to the wholesaler and then the retailer. The supply chain links together many different organizations.

In subsequent chapters, we will be discussing the various decisions and decision aids that help operations and the supply chain produce value. An example of an operations leader in producing and delivering goods deemed to be of value at a price customers are willing to pay is Dell Computer Corporation (see the Operations Leader box).

To summarize, the essence of operations management can be stated as follows:

The operations function of an organization is responsible for producing and delivering goods or services of value to customers of the organization. Operations managers make decisions to manage the transformation process that converts inputs into desired finished goods or services.

Three points in this definition deserve emphasis:

1. **Decisions.** The above definition refers to **decision making** as an important element of operations management. Since all managers make decisions, it is natural to focus on decision making as a central theme in operations. This decision focus provides a basis for dividing operations into parts according to major decision types. In this text, we identify the four major decision responsibilities of operations management as **process, quality, capacity, and inventory**. These decisions provide the framework for organizing the text and describing what operations managers do. We will discuss these decisions in greater detail in subsequent chapters. A hallmark of this book is treating not only decision making within operations but also the connection with other functions in the organization and across the supply chain.
2. **Function.** Operations is a major function in any organization, along with marketing and finance. In a manufacturing company, the operations function typically is called the manufacturing or production department. In service organizations, the operations function may be called the operations department or some name peculiar to the particular industry (e.g., the policy service department in insurance companies). In general, the generic term “operations” refers to the function that produces goods or services. While separating operations out in this manner is useful for analyzing decision making and assigning

Operations Leader Dell Delivers Product and Societal Value

In 1984 Michael Dell founded Dell Computer Corporation with \$1000 in start-up capital and a business model to sell custom-configured personal computers directly to customers while passing along cost savings to customers by cutting out the middlemen. The company ended FY 2008 with \$61.8 billion in revenue, boasts more than 3 million customers, and offers a range of products beyond the personal desktop computer systems that includes mobile computing products; servers, storage, and networking products; printing and imaging products; electronics and accessories; enhanced business and consumer services; and business solutions.

A key to Dell's continuing success is its customer-driven approach to innovation. This approach signals unwavering commitment to delivering new and better products and services that are valued by customers and that address customer needs. The approach begins with listening to the customer via structured interactions, working with strategic partners to deliver innovative and cost-effective solutions to customer needs, and doing so in such a way that the solutions

have an impact on industry standards. This approach explains how Dell has pioneered the direct-selling system to allow customer orders to be placed over the Internet or over the phone and, since 2007, through select retail outlets (e.g., Best Buy, Staples, and Walmart in the United States; Walmart in Canada, Brazil, and Mexico; Carrefour in Europe; Gome in China; Bic Camera, Inc., in Japan; Carphone Warehouse in the United Kingdom). Orders for products, once taken, are assembled in one of Dell's factories and shipped to customers, with the factories carrying very little finished-goods inventory.

Dell today is pursuing environmentally friendly best practices: Its global headquarters campus is now powered by 100 percent green energy; its desk computer systems have been designed to reduce carbon dioxide emissions; Dell was the first computer company to offer free computer recycling to customers worldwide; and its "Plant a Tree for Me" and "Plant a Forest for Me" programs have planted over 100,000 trees to help with global warming.

Source: Adapted from the Dell website: www.dell.com.



- responsibilities, we must also integrate the business by considering the cross-functional nature of decision making in the firm.²
3. **Process.** As was noted above, operations managers plan and control the transformation process and its interfaces. This **process view** not only provides a common ground for defining service and manufacturing operations as transformation processes but is also a powerful basis for the design and analysis of operations in an organization and across the supply chain. Using the process view, we consider operations managers as managers of the conversion process in the firm. But the process view also provides important insights for the management of productive processes in functional areas outside the operations function. For example, a sales office may be viewed as a production process with inputs, transformation, and outputs. The same is true for an accounts payable office and for a loan office in a bank. In terms of the process view, operations management concepts have applicability beyond the functional area of operations. The 3M Company, for example, uses Six Sigma (described in Chapter 9) to improve processes throughout the firm, including processes in human resources, accounting, finance, information systems, and even the legal department. Process improvement is not restricted to operations.

² The "hand shake" symbol in the margin identifies a point of cross-functional emphasis and is designed to illustrate that everyone must work together for an organization to be successful and thrive.

Since the operations management field can be defined by decisions, function, and processes, we will expand on these three elements in detail in this chapter. But first we provide an example of the decisions that would be made by operations in a typical company that makes and markets pizzas in the United States.

1.3 DECISIONS AT PIZZA U.S.A.

Pizza U.S.A., Inc., produces and markets pizzas on a national basis. The firm consists of 85 company-owned and franchised outlets (each called a store) in the United States. The operations function in this company exists at two levels: the corporate level and the level of the individual store.

The major operations decisions made by Pizza U.S.A. can be described as follows:

Process

Corporate staff makes some of the process decisions, since uniformity across different stores is desirable. They have developed a standard facility that is simply sized to fit a particular location. The standard facility incorporates a limited menu with high-volume equipment. As pizzas are made, customers can watch the process through a glass window; this provides entertainment for both children and adults as they wait for their orders to be filled. Because this is a service facility, special care is taken to make the layout attractive and convenient for the customers. The location of facilities is based on a mathematical model that is used to project revenues and costs for particular sites. Each potential site must have an adequate projected

return on investment before construction can begin.

Within the design parameters established by the corporate operations staff, the store managers seek to improve the process continually over time. This is done both by additional investment in the process and by the use of better methods and procedures, which often are developed by the employees themselves.

Managers of the pizza stores are responsible for hiring, training, supervising, and, if necessary, firing workers. They must decide on exact job responsibilities and on the number of people needed to operate the store. They also advertise job openings, screen applications, interview candidates, and make the hiring decisions. They must measure the amount of work required in relation to production and also evaluate the performance of each individual. Man-

agement of the workforce is one of the most important daily responsibilities of the store manager. Note that we consider the workforce an integral part of the process.

Quality

Certain standards for quality that all stores must follow have been set by the corporate staff. The standards include procedures to maintain service quality and ensure the quality of the pizzas served. While service quality is difficult to measure, the quality of the pizzas can be specified more easily by using criteria such as temperature at serving time and the amount of raw materials used in relation to standards, among others. Service-quality measures include courtesy, cleanliness,



Pizza U.S.A. satisfies its customers by carefully managing the four key decision areas in operations.

Operations Leader Typical Jobs and Careers in Operations and Supply Chain from Monster.com

PRODUCT PLANNING MANAGER

Epson America, Inc., is the U.S. affiliate of Japan-based Seiko Epson Corporation, a global technology company at the forefront of technological revolutions



in imaging, robotics, precision machinery, and electronics. It is seeking to hire a product planning manager to oversee the Branded Logistics Operation to ensure that customer product and service needs are met while minimizing cost. The individual will be responsible for maintaining an adequate supply of product to include hardware, parts, and components. The individual will produce a monthly procurement plan based on monthly sales, forecasts, days of supply, and inventory levels. Bachelor's degree or equivalent and 5 to 8 years of progressive experience in a similar position are required.

MATERIALS MANAGER/PRODUCTION CONTROL

AMRESCO, a sales, service, and manufacturer of high-quality biochemicals and reagents for molecular biology, life sciences, clinical, and histology areas of research, seeks a materials manager to oversee the materials master scheduling, planning, logistics, and warehousing functions. The materials manager will participate in budgetary activities, refinement of existing policies and procedures, monitoring of benchmark data, evaluation of proposals, selection of suppliers, and managing key supply chain relationships. The ideal candidate will have 10 years of materials experience, with significant work experience in materials planning and purchasing. The candidate should possess knowledge of materials management methods and procedures, as well as be familiar with Visual Lean, MRP, and JIT methods of planning and controlling materials. A BS/BA required; MBA and/or CPIM preferred.

CONTINUOUS IMPROVEMENT MANAGER

American Greetings has an opening for a continuous improvement manager. This position will manage the integration of lean principles into the day-to-day

operation of the facility. Works with plant leadership to formulate strategies. Designs, develops implementation plans for various lean/Six Sigma applications, processes, and tools. Leads and drives lean initiatives to deliver efficiency and quality improvements. Develops, sources, and conducts necessary training in techniques and processes to build knowledge and skills of the workforce. Devises and implements appropriate continuous improvement metrics. The ideal candidate will have 5 to 6 years of experience as a process engineer or business process consultant or related experience involved in designing process flows, Six Sigma projects, and team facilitation. Bachelor's in engineering/business required.

DIRECTOR OF HEALTH CARE OPERATIONS

We are a nonprofit corporation with the mission to provide excellent primary health care to residents. We are currently seeking a director of health care operations. As a member of the senior management team, this position is responsible for all aspects of managing day-to-day operations and supervision of nursing and ancillary medical staff. This position assists the CEO with long- and short-term planning for special program needs, meeting grant requirements, and development and orientation of clinical programs and services.

VICE PRESIDENT OF GLOBAL OPERATIONS AND SUPPLY CHAIN

A global manufacturer of consumer packaged goods selling to 90 countries around the world and with manufacturing facilities in the USA, Europe, and Asia is seeking a vice president of global operations and supply chain. This individual will be responsible for global management of manufacturing/production, inventory, storage and shipping, quality, global sourcing, and facilities. The ideal candidate will have had a minimum of 5+ years experience in a manufacturing environment working in both supply chain and production roles.

Source: Abstracted from www.monster.com in March 2009.

speed of service, and a friendly atmosphere. Each Pizza U.S.A. store manager must carefully monitor quality internally and with suppliers to make sure that it meets company standards. All employees are responsible for quality in their jobs to ensure that service quality and food quality are “produced at the source” by the employees themselves.

Capacity

Decisions about capacity determine the maximum level of output of pizzas. First, when the initial location and process decisions are made, the corporate staff fixes the physical capacity of each facility. Individual store managers then plan for annual, monthly, and daily fluctuations in service capacity within the available physical facility. During peak periods, they employ part-time help, and advertising is used in an attempt to raise demand during slack periods. In the short run, individual personnel must be scheduled in shifts to meet demand during store hours.

Inventory

Each store manager buys the ingredients required to make the recipes provided by corporate staff. The store managers select their own suppliers from a list approved by the corporation and decide how much flour, tomato paste, sausage, and other ingredients to order and when to place orders. Store operators must carefully integrate purchasing and inventory decisions to control the flow of materials in relation to capacity. They do not want to run out of food during peak periods or waste food when demand is low. Supply chain management is an important part of keeping all materials in stock when needed.

Because Pizza U.S.A. is only one example of an operation, students often ask: What do operations managers do in more general terms? The Monster.com Operations Leader box provides examples of five typical operations management and supply chain positions and describes the associated decision-making responsibilities. The descriptions have been greatly simplified, perhaps oversimplified, for purposes of illustration.

As the Operations Leader box indicates, there are a great variety of management positions in operations and the supply chain. These range from first-level supervisory positions to middle- and top-management positions with considerable responsibility. These positions also cut across all the aspects of operations and apply to both manufacturing and service operations.

There are many opportunities for international employment in operations management since operations are located around the world. Many operations in other countries are seeking to implement world-class best practices, and so what is learned in this course can be applied globally.

1.4 OPERATIONS DECISIONS—A FRAMEWORK

The four decision groupings showcased in Pizza U.S.A. provide a framework to understand the various decisions that operations managers have to make. Although many different frameworks are possible, the primary one used here is a conceptual scheme for grouping decisions according to decision responsibilities. In this framework, similar decision responsibilities concerning facilities or inventories, for example, are grouped together. This novel and useful decision framework is summarized in Table 1.1.

TABLE 1.1 Operations Decisions—A Framework

Operations Decision	Focus	Examples
1. Process	<ul style="list-style-type: none"> Process-related decisions determine the physical process or facility used to produce the product or service and the associated workforce policies and practices. Many of these process-related decisions are long-range in nature and cannot be reversed easily, particularly when heavy capital investment is needed. It is therefore important that the physical transformation process be designed in relation to the long-term strategic posture of the organization and the capabilities of the workforce. Transformation processes must also be improved continually once they are designed. This requires the cooperation of the workforce and the ideas of all employees. Since many process-related decisions require large capital investments, financial managers are concerned with the investments in assets required by the operations function. Human resource managers are concerned with the recruiting, hiring, staffing, and evaluation decisions concerning the people employed in operations. The operations function typically manages more employees and physical assets than does any other function in the firm. 	<ul style="list-style-type: none"> What type of equipment and technology should be deployed? How should materials flow be designed and managed? What should the layout of the facility be? What specific tasks are to be performed by front-line operators? When should shift changes occur?
2. Quality	<ul style="list-style-type: none"> Quality-related decisions affect the quality of the goods or services produced and delivered to customers. These decisions determine whether and to what extent customer specifications can be satisfied. The operations function is responsible for the quality of goods and services produced. Quality-related decisions must ensure that quality is designed and built into all stages of producing and delivering goods and services to customers. Quality is an important operations responsibility, but it requires total organizational support. Managers from all functions should be concerned with quality and should participate in setting the specifications for all new products and in defining the levels of customer service required. Continuous quality improvement is now a key responsibility of all managers. 	<ul style="list-style-type: none"> What should the level of quality standards be for goods or services? Which workers need training? Should incoming inspection from suppliers be used? How should ongoing process performance be monitored?
3. Capacity	<ul style="list-style-type: none"> Capacity-related decisions are aimed at providing the right amount of resources at the right place at the right time. Long-range capacity is determined by the size of the physical facilities built by the firm and its suppliers or by outsourcing the product to a reliable supplier. In the short run, capacity sometimes can be augmented by subcontracting, extra shifts, or rental of space. Capacity planning, however, determines not only the size of facilities but also the proper number of people in operations. Staffing levels are set to meet the needs of market demand and the desire to maintain a stable workforce. In the short run, available capacity must be allocated to specific tasks and jobs in operations by scheduling people, equipment, and facilities. 	<ul style="list-style-type: none"> Where should facilities be located? How large should the facility be? How many shifts should be operated? How should queues be designed and managed? What priority rule should be used to select jobs for processing? What activities can be outsourced or subcontracted?
4. Inventory	<ul style="list-style-type: none"> Inventory-related decisions in operations determine the type and level of inventory to be held against uncertainties. Inventory control systems are used to manage materials from purchasing through raw materials, work in process, and finished-goods inventories. Inventory managers decide how much inventory is needed, where to locate the inventory, and a host of related decisions. They manage the flow of materials within the firm and within the supply chain. 	<ul style="list-style-type: none"> What type of materials should be kept in inventory in-house? How should inventory be monitored—internally or by vendors? What should the replenishment quantities be? How frequently should replenishment occur? Who should hold the inventory?

Careful attention to the four operations decisions in the framework is the key to the management of successful operations. Indeed, the well-managed operations function can be defined in terms of this operations decision framework. If each of the four groupings of operations decision is aligned properly and well integrated with the other functions of the organization, the operations function can be considered well managed.

In the past, some students felt that operations management was a hodgepodge of techniques and methods—that there was no central theme. The operations decision framework was designed specifically to overcome this problem. Each major section of this text is devoted to one of the four decision categories.³ The framework thus provides an integrating mechanism for the text.

1.5 CROSS-FUNCTIONAL DECISION MAKING

As we have indicated, the operations function is a critical element in every business organization. No business organization can survive without it. The operations function is one of the three primary functions, along with marketing and finance. In addition, an organization has supporting functions that include human resources, information systems, and accounting. Some organizations also have separate purchasing and logistics functions that support operations. In others, the operations, purchasing, and logistics functions are joined together to become the supply chain function. We discuss this in more detail in Chapter 10 on supply chain management.



Managerial decision making is cross-functional in nature.



Functional areas are concerned with a particular focus of responsibility or decision making in an organization. The marketing function is typically responsible for creating demand and generating sales revenue; the operations function is responsible for the production of goods or services (generating supply); and finance is responsible for the acquisition and allocation of capital. Within for-profit businesses, functional areas tend to be closely associated with organizational departments because businesses typically are organized on a functional basis. Supporting functions are essential to provide staff support to the three primary functions.

Every function must be concerned not only with its own decision responsibilities but with integrating decisions with other functions. The four types of operations decisions, for example, cannot be made separately; they must be carefully integrated with one another and, equally important, with decisions made in purchasing, marketing, logistics, finance, and other parts of the organization. Going back to Pizza U.S.A., if marketing wishes to change the price of pizza, that is likely to affect sales and the capacity needs of operations and the amount of ingredients (materials) used. Also, if finance cannot raise the necessary capital, operations may have to redesign the process to require less capital or manage pizza-related inventories more efficiently. This in turn may affect the response time to serve customers, costs, and so on.

Decision making is therefore highly interactive and systemic in nature. Unfortunately, functional silos have developed in many organizations and impede

³ Students have called these four categories QPIC, pronounced “Q Pick.”