

# Operations Management

## Historical Development

### 2.1 Why Operations Management?

Business did not always recognize the importance of operations management. In fact, following World War II the marketing and finance functions were predominant in American corporations. The United States had just emerged from the war as the undisputed global manufacturing leader due in large part to efficient operations. At the same time, Japan and Europe were in ruins, their businesses and factories destroyed.

U.S. companies had these markets to themselves, and so the post-World War II period of the 1950s and 1960s represented the golden era for U.S. business. The primary opportunities were in the areas of marketing, to develop the large potential markets for new products, and in finance, to support the growth. Since there were no significant competitors, the operations function became of secondary importance, because companies could sell what they produced. Even the distinguished economist John Kenneth Galbraith observed, *“The production problem has been solved.”*

Then in the 1970s and 1980s, things changed. American companies experienced large declines in productivity growth, and international competition began to be a challenge in many markets. In some markets such as the auto industry, American corporations were being pushed out. It appeared that U.S. firms had become lax due to the lack of competition in the 1950s and 1960s. They had forgotten about improving their methods and processes. In the meantime, foreign firms were rebuilding their facilities and designing new production methods. By the time foreign firms had recovered, many U.S. firms found themselves unable to compete. To regain their competitiveness, companies turned to operations management, a function they had overlooked and almost forgotten about.

The new focus on operations and competitiveness has been responsible for the recovery of many corporations, and U.S. businesses experienced a resurgence in the 1980s and 1990s. Operations became the core function of organizational competitiveness. Although U.S. firms have rebounded, they are fully aware of continued global competition, scarcity of resources, and increased financial pressure. Companies have learned that to achieve long-run success they must place much importance on their operations.

***Historical Milestones*** -When we think of what operations management does—namely, managing the transformation of inputs into goods and services—we can see that as a function it is as old as time. Think of any great organizational effort, such as organizing the first Olympic games, building the Great Wall of China, or erecting the Egyptian pyramids, and you will see operations management at work. Operations management did not emerge as a formal field of study, however, until the late 1950s and early 1960s, when scholars began to recognize that all production systems face a common set of problems and to stress the systems approach to viewing operations processes. Many events helped shape operations management. We will describe some of the most significant of these historical milestones and explain their influence on the development of operations management. Later we will look at some current trends in operations management.

## **2.2 The Industrial Revolution**

The **Industrial Revolution** had a significant impact on the way goods are produced today. Before this time, products were made by hand by skilled craftspeople in their shops or homes. Each product was unique, painstakingly made by one person. The Industrial Revolution changed all that. It started in the 1770s with the development of a number of inventions that relied on machine power instead of human power. The most important of these was the steam engine, which was invented by James Watt in 1764. The steam engine provided a new source of power that was used to replace human labor in textile mills, machine-making plants, and other facilities. The concept of the factory was emerging. In addition, the steam engine led to advances in transportation, such as railroads, that allowed for a wider distribution of goods.

About the same time, the concept of ***division of labor*** was introduced. First described by Adam Smith in 1776 in *The Wealth of Nations*, this concept would become one of the important ideas behind the development of the assembly line. Division of labor means that the production of a good is broken down into a series of small, elemental tasks, each of which is performed by a different worker. The repetition of the task allows the worker to become highly specialized in that task.

Division of labor allowed higher volumes to be produced, which, coupled with the advances in transportation of steam-powered boats and railroads, opened up distant markets.

A few years later, in 1790, Eli Whitney introduced the concept of *interchangeable parts*. Prior to that time, every part used in a production process was unique. Interchangeable parts are standardized so that every item in a batch of items fits equally. This concept meant that we could move from one-at-a-time production to volume production, for example, in the manufacture of watches, clocks, and similar items.

### **2.2.1 Scientific Management**

**Scientific management** was an approach to management promoted by Frederick W. Taylor at the turn of the twentieth century. Taylor was an engineer with an eye for efficiency. Through scientific management he sought to increase worker productivity and organizational output. His concept had two key features. First, it assumed that workers are motivated only by money and are limited only by their physical ability. Taylor believed that worker productivity is governed by scientific laws and that it is up to management to discover these laws through measurement, analysis, and observation.

Workers are to be paid in direct proportion to how much they produce. The second feature of this approach was the separation of the planning and doing functions in a company, which meant the separation of management and labor. Management is responsible for designing productive systems and determining acceptable worker output. Workers have no input into this process—they are permitted only to work. Many people did not like the scientific management approach, especially workers, who thought that management used these methods to unfairly increase output without paying them accordingly. Still, many companies adopted the scientific management approach. Today many view scientific management as a major influence in the field of operations management. For example, *piece-rate incentives*, in which workers are paid in direct proportion to their output, came out of this movement.

Also, Taylor introduced a widely used method of work measurement, *stopwatch time studies*. In stopwatch time studies, observations are made and recorded of a worker performing a task over many cycles. This information is then used to set a time standard for performing the particular task. This method is still used today to set a time standard for short, repetitive tasks.

The scientific management approach was popularized by Henry Ford, who used

the techniques in his factories. Combining technology with scientific management, Ford introduced the *moving assembly line* to produce Ford cars. Ford also combined scientific management with the division of labor and interchangeable parts to develop the concept of *mass production*. These concepts and innovations helped him increase production and efficiency at his factories.

### **2.2.2 The Human Relations Movement**

The scientific management movement and its philosophy dominated in the early twentieth century. However, this changed with the publication of the results of the **Hawthorne studies**. The purpose of the Hawthorne studies, conducted at a Western Electric plant in Hawthorne, Illinois, in the 1930s, was to study the effects of environmental changes, such as changes in lighting and room temperature, on the productivity of assembly-line workers. The findings from the study were unexpected: the productivity of the workers continued to increase regardless of the environmental changes made. Elton Mayo, a sociologist from Harvard, concluded that the workers were actually motivated by the attention they were given. The idea of workers responding to the attention they are given came to be known as the *Hawthorne effect*.

The study of these findings by many sociologists and psychologists led to the **human relations movement**, an entirely new philosophy based on the recognition that factors other than money can contribute to worker productivity. The impact of this new philosophy on the development of operations management has been tremendous. Its influence can be seen in the implementation of a number of concepts that motivate workers by making their jobs more interesting and meaningful. For example, the Hawthorne studies showed that scientific management had made jobs too repetitive and boring.

**Job enlargement** is an approach in which workers are given a larger portion of the total task to do. Another approach to giving more meaning to jobs is **job enrichment**, in which workers are given a greater role in planning. Recent studies have shown that environmental factors in the workplace, such as adequate lighting and ventilation, can have a major impact on productivity. However, this does not contradict the principle that attention from management is a positive factor in motivation.

### **2.2.3 Management Science**

While some were focusing on the technical aspects of job design and others on the human aspects of operations management, a third approach, called **management science**, was developing that would make its own unique contribution. Management science focused on developing quantitative techniques for solving operations problems. The first mathematical model for inventory management was developed by F.W. Harris in 1913. Shortly thereafter, statistical sampling theory and quality control procedures were developed.

World War II created an even greater need for the ability to quantitatively solve complex problems of logistics control, for weapons system design and deployment of missiles. Consequently, the techniques of management science grew more robust during the war and continued to develop after the war was over. Many quantitative tools emerged to solve problems in forecasting, inventory control, project management, and other areas. A mathematically oriented field, management science provides operations management with tools to assist in decision making. A popular example of such a tool is linear programming.

### **2.3 The Computer Age**

In the 1970s the use of computers in business became widespread. With computers, many of the quantitative models developed by management science could be employed on a larger scale. Data processing became easier, with important effects in areas such as forecasting, scheduling, and inventory management. A particularly important computerized system, material requirements planning (MRP), was developed for inventory control and scheduling. Material requirements planning was able to process huge amounts of data in order to compute inventory requirements and develop schedules for the production of thousands of items, processing that was impossible before the age of computers.

Today the exponential growth in computing capability continues to impact operations management. **Just-in-Time Just-in-time (JIT)** is a major operations management philosophy, developed in Japan in the 1980s, that is designed to achieve high-volume production using minimal amounts of inventory. This is achieved through coordination of the flow of materials so that the right parts arrive at the right place in the right quantity; hence the term *just-in-time*.

However, JIT is much more than the coordinated movement of goods. It is an all-inclusive organizational philosophy that employs teams of workers to achieve continuous improvement in processes and organizational efficiency by eliminating all organizational waste. Although JIT was first used in manufacturing, it has been

implemented in the service sector, for example, in the food service industry. JIT has had a profound impact on the way companies manage their operations. It is credited with helping turn many companies around and is used by companies such as Honda, Toyota, and General Motors. JIT promises to continue to transform businesses in the future.

## **2.4 Total Quality Management**

As customers demand ever higher quality in their products and services, companies have been forced to focus on improving quality in order to remain competitive.

**Total quality management (TQM)** is a philosophy—promulgated by “quality gurus” such as W. Edwards Deming—that aggressively seeks to improve product quality by eliminating causes of product defects and making quality an all-encompassing organizational philosophy. With TQM, everyone in the company is responsible for quality.

Practiced by some companies in the 1980s, TQM became pervasive in the 1990s and is an area of operations management that no competitive company has been able to ignore. Its importance is demonstrated by the number of companies achieving ISO 9000 certification. ISO 9000 is a set of quality standards developed for global manufacturers by the International Organization for Standardization (ISO) to control trade into the then-emerging European Economic Community (EEC). Today ISO 9000 is a global set of standards, with many companies requiring their suppliers to meet the standards as a condition for obtaining contracts.

### **2.4.1 Business Process Reengineering**

Business process **reengineering** means redesigning a company’s processes to increase efficiency, improve quality, and reduce costs. In many companies things are done in a certain way that has been passed down over the years. Often managers say, “Well, we’ve always done it this way.” Reengineering requires asking why things are done in a certain way, questioning assumptions, and then redesigning the processes. Operations management is a key player in a company’s reengineering efforts.

### **2.4.2 Flexibility**

Traditionally, companies competed by either mass-producing a standardized product or offering customized products in small volumes. One of the current competitive challenges for companies is the need to offer to customers a greater variety of product choices of a traditionally standardized product. This is the challenge of **flexibility**. For example, Procter and Gamble offers 13 different

product designs in the Pampers line of diapers. Although diapers are a standardized product, the product designs are customized to the different needs of customers, such as the age, sex, and stage of development of the child using the diaper. One example of flexibility is **mass customization**, which is the ability of a firm to produce highly customized goods and services and to do it at the high volumes of mass production. Mass customization requires designing flexible operations and using delayed product differentiation, also called postponement. This means keeping the product in generic form as long as possible and postponing completion of the product until specific customer preferences are known.

### **2.4.3 Time-Based Competition**

One of the most important trends within companies today is **time-based competition**—developing new products and services faster than the competition, reaching the market first, and meeting customer orders most quickly. For example, two companies may produce the same product, but if one is able to deliver it to the customer in two days and the other in five days, the first company will make the sale and win over the customers. Time-based competition requires specifically designing the operations function for speed.

### **2.4.4 Supply Chain Management**

Supply chain management (SCM) involves managing the flow of materials and information from suppliers and buyers of raw materials all the way to the final customer. The network of entities that is involved in producing and delivering a finished product to the final customer is called a supply chain. The objective is to have everyone in the chain work together to reduce overall cost and improve quality and service delivery.

Supply chain management requires a team approach, with functions such as marketing, purchasing, operations, and engineering all working together. This approach has been shown to result in more satisfied customers, meaning that everyone in the chain profits. SCM has become possible with the development of information technology (IT) tools that enable collaborative planning and scheduling. The technologies allow synchronized supply chain execution and design collaboration, which enables companies to respond better and faster to changing market needs. Numerous companies, including Dell Computer, Wal-Mart, and Toyota, have achieved world class status by effectively managing their supply chains.

SCM is as important in the service industry as it is in manufacturing, even in pure service industries such as the creative arts. Consider the publishing industry, which

is responsible for delivering the creative art of literature to readers. In the traditional publishing supply chain, the publisher is typically responsible for all the functions involved in transforming the author's literary creation into a tangible product to be placed on a bookshelf. This includes editing, printing, distribution, inventory management, and marketing. Many writers have seen the traditional publishing supply chain as a setback to maintaining control and innovation over their art. Large publishing houses maintain control of many critical functions of the supply chain, resulting in the commoditization of the literary arts being sold in chain-type retailers.

The net effect is often a homogenization of titles and writers across stores, creating a best-seller list that does not necessarily reflect literary merit. This, in turn, produces a barrier for writers who have in fact created something highly personal out of the "sweat and travail of the human spirit" (Faulkner, Nobel Prize acceptance speech). One novelist has innovatively overcome the large supply chain barrier between author and bookshelf. John Wood wrote an award-winning play at the age of 18 and his first novel, *Minister's Son*, at the age of 21, after which he decided to form his own publishing company. By doing this, John Wood enabled himself to maintain control of all aspects of his art, including retaining artistic editorial prerogatives, such as choosing to print his writing in unique styles, rather than resorting to the same font and formatting dictated by a publishing house. This freedom is uniquely important to an artist such as Wood, who modifies his writing style to suit the subject and genre.

John Wood's storylines engage the controversial social issues of today, as well as grapple with the timeless and universal elements of the human condition. He uses a rich array of literary tropes and an inimitable sense of imagery in his writing. In addition to maintaining his artistic freedom, John Wood has been able to retain full legal rights of his own work.

## **2.5 Global Marketplace**

Today businesses must think in terms of a **global marketplace** in order to compete effectively. This includes the way they view their customers, competitors, and suppliers. Key issues are meeting customer needs and getting the right product to markets as diverse as the Far East, Europe, or Africa. Operations management is responsible for most of these decisions. OM decides whether to tailor products to different customer needs, where to locate facilities, how to manage suppliers, and how to meet local government standards. Also, global competition has forced companies to reach higher levels of excellence in the products and services they offer. Regional trading agreements, such as the North American Free Trade



Agreement (NAFTA), the European Union (EU), and the global World Trade Organization (WTO), guarantee continued competition on the international level.

### **2.5.1 Sustainability and Green Operations**

There is increasing emphasis on the need to reduce waste, recycle, and reuse products and parts. This is known as *sustainability* or *green operations*. Society has placed great pressure on business to focus on air and water quality, waste disposal, global warming, and other environmental issues. Operations management plays a key role in redesigning processes and products in order to meet and exceed environmental quality standards. The importance of this issue is demonstrated by a set of standards termed ISO 14000. Developed by the International Organization for Standardization (ISO), these standards provide guidelines and a certification program documenting a company's environmentally responsible actions.

### **2.5.2 Electronic Commerce**

Electronic commerce (e-commerce) is the use of the Internet for conducting business activities, such as communication, business transactions, and data transfer. The Internet, developed from a government network called ARPANET created in 1969 by the U.S. Defense Department, has become an essential business medium since the late 1990s, enabling efficient communication between manufacturers, suppliers, distributors, and customers. It has allowed companies to reach more customers at a speed infinitely faster than ever before. It also has significantly cut costs, as it provides direct links between entities.

The electronic commerce that occurs between businesses, known as **B2B (business-to-business)** commerce, makes up the highest percentage of transactions. The most common B2B exchanges occur between companies and their suppliers, such as General Electric's Trading Process Network. A more familiar type of e-commerce occurs between businesses and their customers, known as **B2C (business-to-customer)** exchange, as engaged in by on-line retailers such as Amazon.com. E-commerce also occurs between customers, known as **C2C (customer-to-customer)** exchange, as on consumer auction sites such as eBay. E-commerce is creating virtual marketplaces that continue to change the way business functions.

### **2.5.3 Outsourcing and Flattening of the World**

Outsourcing is obtaining goods or services from an outside provider. This can range from outsourcing of one aspect of the operation, such as shipping, to outsourcing an entire part of the manufacturing process. The practice has rapidly grown in recent years. Management guru Tom Peters has been quoted as saying,

“Do what you do best and outsource the rest.” The convergence of technologies at the turn of this century has taken the concept of outsourcing to a new level. Massive investments in technology, such as worldwide broadband connectivity, the increasing availability and lower cost of computers, and the development of software such as e-mail, search engines, and other software, allow individuals to work together in real time from anywhere in the world. This has enabled countries like India, China, and many others to become part of the global supply chain for goods and services and has created a “flattening” of the world. Such “flattening,” or leveling of the playing field, has enabled workers anywhere in the world to compete globally for intellectual work.

The result has been the outsourcing of virtually any job imaginable. Manufacturers have outsourced software development and product design to engineers in India; accounting firms have outsourced tax preparation to India; even some hospitals have outsourced the reading of CAT scans to doctors in India and Australia. The “flattening” of the world has created a whole new level of global competition that is more intense than ever before.

#### **2.5.4 Today’s Operations Management Environment**

Today’s OM environment is very different from what it was just a few years ago. Customers demand better quality, greater speed, and lower costs. In order to succeed, companies have to be masters of the basics of operations management. To achieve this ability, many companies are implementing a concept called **lean systems**. Lean systems take a total system approach to creating an efficient operation and pull together best practice concepts, including just-in-time (JIT), total quality management (TQM), continuous improvement, resource planning, and supply chain management (SCM).

The need for efficiency has also led many companies to implement large information systems called **enterprise resource planning (ERP)**. ERP systems are large, sophisticated software programs for identifying and planning the enterprise-wide resources needed to coordinate all activities involved in producing and delivering products to customers. Applying best practices to operations management is not enough to give a company a competitive advantage.

The reason is that in today’s information age best practices are quickly passed to competitors. To gain an advantage over their competitors, companies are continually looking for ways to better respond to customers. This requires them to have a deep knowledge of their customers and to be able to anticipate their demands. The development of **customer relationship management (CRM)** has

made it possible for companies to have this detailed knowledge. CRM encompasses software solutions that enable the firm to collect customer-specific data, information that can help the firm identify profiles of its most loyal customers and provide customer-specific solutions. Also, CRM software can be integrated with ERP software to connect customer requirements to the entire resource network of the company.

Another characteristic of today's OM environment is the increased use of **cross-functional decision making**, which requires coordinated interaction and decision making among the different business functions of the organization. Until recently, employees of a company made decisions in isolated departments, called "functional silos." Today many companies bring together experts from different departments into cross-functional teams to solve company problems. Employees from each function must interact and coordinate their decisions, which require employees to understand the roles of other business functions and the goals of the business as a whole, in addition to their own expertise.

## **2.6 Operations Management in Practice**

Of all the business functions, operations is the most diverse in terms of the tasks performed. If you consider all the issues involved in managing a transformation process, you can see that operations managers are never bored. Who are operations managers and what do they do? The head of the operations function in a company usually holds the title of vice president of operations, vice president of manufacturing, V.P., or director of supply chain operations and generally reports directly to the president or chief operating officer.

Below the vice president level are midlevel managers: manufacturing manager, operations manager, quality control manager, plant manager, and others. Below these managers are a variety of positions, such as quality specialist, production analyst, inventory analyst, and production supervisor. These people perform a variety of functions:

- 1) analyzing production problems,
- 2) developing forecasts,
- 3) making plans for new products,
- 4) measuring quality,
- 5) monitoring inventory, and
- 6) developing employee schedules.

Thus, there are many job opportunities in operations management at all levels of the company. In addition, operations jobs tend to offer high salaries, interesting work, and excellent opportunities for advancement. Many corporate CEOs today have come through the ranks of operations. For example, the third president and CEO of Wal-Mart from January 2000 to January 2009, H. Lee Scott, came from a background in operations and logistics. Also from the operations background are the former CEO of Home Depot, Bob Nardelli, and the former CEO of Lowe's, Robert Tillman.

As you can see, all business functions need information from operations management in order to perform their tasks. At the same time, operations managers are highly dependent on input from other areas. This process of information sharing is dynamic, requiring that managers work in teams and understand each other's roles.

## **2.7 Marketing**

Marketing is not fully capable of meeting customer needs if marketing managers do not understand what operations can produce, what due dates it can and cannot meet, and what types of customization operations can deliver. The marketing department can develop an exciting marketing campaign, but if operations cannot produce the desired product, sales will not be made. In turn, operations managers need information about customer wants and expectations. It is up to them to design products with characteristics that customers find desirable, and they cannot do this without regular coordination with the marketing department.

### **2.7.1 Finance**

Finance cannot realistically judge the need for capital investments, make-or-buy decisions, plant expansions, or relocation if finance managers do not understand operations concepts and needs. On the other hand, operations managers cannot make large financial expenditures without understanding financial constraints and methods of evaluating financial investments. It is essential for these two functions to work together and understand each other's constraints.

### **2.7.2 Information Systems (IS)**

Information systems (IS) is a function that enables information to flow throughout the organization and allows OM to operate effectively. OM is highly dependent on information such as forecasts of demand, quality levels being achieved, inventory levels, supplier deliveries, and worker schedules. IS must understand the needs of OM in order to design an adequate information system. Usually, IS and OM work

together to design an information network. This close relationship needs to be ongoing. IS must be capable of accommodating the needs of OM as they change in response to market demands. At the same time, it is up to IS to bring the latest capabilities in information technology to the organization to enhance the functioning of OM.

### **2.7.3 Human Resource Managers**

Human resource managers must understand job requirements and worker skills if they are to hire the right people for available jobs. To manage employees effectively, operations managers need to understand job market trends, hiring and layoff costs, and training costs.

### **2.7.4 Accounting**

Accounting needs to consider inventory management, capacity information, and labor standards in order to develop accurate cost data. In turn, operations managers must communicate billing information and process improvements to accounting, and they depend heavily on accounting data for cost management decisions. Engineering and other disciplines that are not in the business field are also tied to operations. Operations management provides engineering with the operations capabilities and design requirements, and engineering, in turn, provides valuable input on technological trade-offs and product specifications. These are essential for the product design process. The coordinated interaction and decision making between all these functions and OM are needed for success in today's competitive environment. It is also important to extend this coordination to organizations that make up a supply chain, such as suppliers, manufacturers, and retailers.