

Operations Management

Just-In-Time & Lean System

10.1 The Philosophy of JIT

The **just-in-time (JIT) philosophy** in the simplest form means getting the right quantity of goods at the right place and at the right time. The goods arrive just-in-time, which is where the term *JIT* comes from. Although many people think that JIT is an inventory reduction program or another type of manufacturing process, it is far more than that. JIT is an all-encompassing philosophy that is founded on the concept of eliminating waste. The word *waste* might make you think of garbage, or paper, or inventory.

But JIT considers **waste** anything that does not add value—*anything*. The **broad view of JIT** is now often termed *lean production* or *lean systems*. Its implementation has contributed to the success of many organizations and is used by companies worldwide. The benefits that can be obtained through JIT are so impressive that JIT has become a standard of operations in many industries, including the auto and computer industries. However, JIT is applicable to service organizations as well as to manufacturing and can even be used in your everyday life. JIT is not about any one factor, such as quality or inventory or efficiency. It is an entirely different way of looking at things.

As we will see, JIT is a philosophy that overrides all aspects of the organization, from administrative issues to manufacturing, worker management, supplier management, and even housekeeping. It has contributed to the success of companies like Toyota (called the Toyota Production System or “TPS”) and Honda (called “the Honda Way”), and it can even contribute to success in your own life.

The philosophy of JIT originated in Japan. After World War II, the Japanese set themselves the goal of strengthening their industrial base, which included full employment and a healthy trade balance. Just-in-time (JIT) developed out of the nation’s need to survive after the devastation caused by the war. Although many authors say that the origins of JIT can be traced back to the early 1900s, no one can argue that the philosophy gained worldwide prominence in the 1970s. It was

developed at the Toyota Motor Company, and the person most often credited with its development is Taiichi Ohno, a vice president of the company. JIT helped propel Toyota into a leadership position in the areas of quality and delivery. Since then, JIT has been widely adopted in all types of industries and has been credited with impressive benefits, including significant reductions in operating costs, improved quality, and increased customer responsiveness. Companies such as Honda, GE, Ford, Boeing, Lockheed Martin, Hewlett-Packard, and IBM are among those that have made JIT part of their operations. Even the retailer Zara relies on JIT.

The central belief of the JIT philosophy is *elimination of waste*, but there are other **beliefs that help define JIT philosophy**. These include a broad view of operations, simplicity, continuous improvement, visibility, and flexibility. Next we look more closely at each of these beliefs.

10.2 Eliminate Waste

The underlying premise of JIT is that all waste must be eliminated. Many think that the roots of the philosophy can be traced to the Japanese environment, which lacks space and natural resources. As a result, the Japanese have been forced to learn to use all their resources very efficiently, and waste of any kind is not tolerated. In JIT *waste* is anything that does not add value. **Types of waste** can include material, such as excess inventory to protect against uncertain deliveries by suppliers or poor quality.

Waste can be equipment that is used as a backup because regular equipment is not maintained properly. Other types of waste include time, energy, space, or human activity that does not contribute to the value of the product or service being produced. The concept of waste addresses every aspect of the organization and has a far reaching impact. For example, waste can be found in the production process itself, and JIT requires perfect synchronization in order to eliminate waiting and excess stock. Waste is also found in improper layout that necessitates the transportation of goods from one part of the facility to another. JIT requires a streamlined layout design so that resources are in close proximity to one another and material handling is kept to a minimum. Also, JIT requires compact layouts and increased visibility so that everyone can see what everyone else is doing. Waste can also take the form of poor quality, because scrap and rework cost money and add no value. Total quality management (TQM) programs thus are an integral part of JIT. Waste is also found in unnecessary motion, and JIT requires studying processes to eliminate unnecessary steps.

10.3 A Broad View of Operations

Part of the philosophy of JIT is that everyone in the organization should have a **broad view of the organization** and work toward the same goal, which is serving the customer. In traditional organizations, it is very easy for employees to focus exclusively on their own jobs and have a narrow view of the organization that includes only their assigned tasks. Companies whose employees have a narrow view become production-oriented, forgetting that individual tasks and procedures are important only if they meet the overall goals of the company. One example is an employee who will not help a customer with a problem, saying, “It’s not my job.” This might occur at a grocery store when a customer asks for the location of an item from an employee who is “only responsible for stocking shelves.” A broad view of operations involves understanding that all employees are ultimately responsible for serving the customer.

10.3.1 Simplicity

JIT is built on **simplicity**—the simpler the better. JIT encourages employees to think about problems and come up with simple solutions. Although this may seem easy and crude, it is actually quite difficult. It is often tempting to solve an organizational problem using a complex and perhaps expensive method. It is far more difficult to think of a simple solution that goes directly to the root of the problem. The value of simple solutions is demonstrated by a company whose delivery truck was lodged in a passageway because it was too high to pass through. Many costly and complex solutions were being considered, such as getting a smaller truck or expanding the height of the doorway. After a bit of thought, an employee came up with a simple solution: reduce the air in the tires to bring down the height of the truck. The solution worked.

10.3.2 Continuous Improvement

A major aspect of the JIT philosophy is an emphasis on quality. **Continuous improvement**, called **kaizen** by the Japanese, in every aspect of the operation is a cornerstone of this philosophy. Continuous improvement applies to everything from reducing costs to improving quality to eliminating waste. To understand the full impact of continuous improvement, try answering this question: When has JIT been implemented fully? The answer: Never. The reason is that an organization is never perfect and can always be improved in some way.

A number of companies are utilizing a powerful JIT approach called the “kaizen blitz.” This is an improvement tool that utilizes cross-functional teams to plan and deliver improvements to specific processes during two- or three-day marathon

sessions. This process allows a small group of people to concentrate on a bite-size chunk of the problem for a short period of time. Companies find that a kaizen blitz can quickly deliver dramatic and low-cost improvements to processes.

10.3.3 Visibility

Part of the JIT philosophy is to make all waste **visible**. Waste can be eliminated only when it is seen and identified. Also, if we see waste we can come up with simple solutions to eliminate it. When waste is hidden we forget about it, which creates problems. Think about the closets in your home. Because the closet doors are closed, we often forget the clutter and junk we have inside. Now imagine that the closet doors were open and the inside was visible to us and everyone else. Certainly it would remind us that we need to eliminate the clutter.

JIT facilities are open and clean, with plenty of floor space. There is no clutter, and everyone can see what everyone else is doing. No one can hide extra inventory in a corner of his or her office or take a short nap in the afternoon. Also, part of the JIT philosophy is that a cluttered environment creates confusion and disrespect toward the workplace. By contrast, a clean and orderly environment creates calm and clear thoughts. Just because space is available, it should not automatically be filled. Visibility allows us to readily see waste. We can then eliminate it.

10.3.4 Flexibility

JIT was based on the need for survival, and survival means being **flexible** in order to adapt to changes in the environment. A company can be flexible in many ways. First, flexibility can mean being able to make changes in the volume of a product produced. JIT accomplishes this by keeping the costs of facilities, equipment, and operations at such a low level that breaking even typically is not a problem.

A second way in which a company can be flexible is by being able to produce a wide variety of products. Although this is difficult to achieve, JIT systems are designed with the ability to produce different product models with different features through a manufacturing process that can easily switch from one product type to another by flexible workers who can perform many different tasks. Part of the JIT philosophy is to design operations that are highly efficient but flexible in order to accommodate changing customer demands.

10.4 Elements of JIT

Now that you understand the core beliefs that define the philosophy of JIT, let's look at the major elements that make up a **JIT system**. Three basic elements work together to complete a JIT system: *just-in-time manufacturing*, *total quality*

management, and *respect for people*. Often, it is assumed that JIT refers only to just-in-time manufacturing. However, this is only one element of JIT. Each of the three elements is dependent on the others to create a true JIT system.

10.4.1 Just-in-Time Manufacturing

JIT is a philosophy based on elimination of waste. Another way to view JIT is to think of it as a philosophy of *value-added manufacturing*. By focusing on value-added processes, JIT is able to achieve high-volume production of high-quality, low-cost products while meeting precise customer needs. **Just-in-time manufacturing** is the element of JIT that focuses directly on the production system to make this possible.

Many aspects of JIT manufacturing combine to provide a performance advantage. Later in the chapter we will look at some aspects of JIT manufacturing in more detail. First, let's take an overall view. The manufacturing process in JIT starts with the final assembly schedule, often called the *master production schedule*, which is a statement of which products and quantities will be made in specific time periods. The master production schedule is usually fixed for a few months into the future to allow all work centers and suppliers to plan their schedules. For the current month, the schedule is "leveled," or developed so that the same amount of each product is produced in the same order every day.

The reason traditional systems produce large quantities of one type of product before switching to production of another is high **setup cost**. This is the cost incurred when equipment is set up for a new production run. Setup includes activities such as recalibrating and cleaning equipment, changing blades, and readjusting equipment settings. Because setup costs are high in traditional systems, the objective is to produce as many units of a product as possible before having to incur the setup cost again.

Of course, that means incurring a high inventory cost because of the extra goods that are kept in storage. JIT systems have been very efficient at reducing setup costs, which is a key to the success of JIT manufacturing. Setup times have been reduced from hours to mere seconds, and the goal is to reduce them to zero. Low setup times mean that small lot sizes of products can be produced as needed and that production lead times will be shorter.

The ultimate goal of JIT is to produce products in a lot size of 1. A major aspect of JIT manufacturing is its view of inventory. JIT manufacturing views inventory as a

waste that needs to be eliminated. According to JIT, inventory is carried to cover up a wide variety of problems, such as poor quality, slow delivery, inefficiency, lack of coordination, and demand uncertainty. Inventory costs money and provides no value. Inventory also hurts the organization in another way: it does not allow us to see problems. According to JIT, by eliminating inventory we can clearly identify problems and work to eliminate them. The rocks in the stream represent problems. When the water in the stream covers the rocks, we cannot see what they are. By reducing the amount of water in the stream (by reducing inventory), we can finally identify the problems. However, identifying the problems is not enough—we have to solve them. In sum, JIT manufacturing is an efficiently coordinated production system that makes it possible to deliver the right quantities of products to the place they are needed just in time.

10.5 ISO 9000 Standards

Increases in international trade during the 1980s led to the development of universal standards of quality. Universal standards were seen as necessary in order for companies to be able to objectively document their quality practices around the world. Then in 1987 the International Organization for Standardization published its first set of standards for quality management, called **ISO 9000**. The purpose of the International Organization for Standardization (ISO) is to establish agreement on international quality standards. It currently has members from 91 countries, including the United States. It created ISO 9000 to develop and promote international quality standards.

ISO 9000 consists of a set of standards and a certification process for companies. ISO 9000 certification demonstrates that companies have met the standards. The standards are applicable to all types of companies and have gained global acceptance. In many industries ISO certification has become a requirement for doing business. Also, ISO 9000 standards have been adopted by the European Community as a standard for companies doing business in Europe.

In December 2000 the first major changes to ISO 9000 were made, introducing the following three new standards:

- ISO 9000:2000, *Quality Management Systems—Fundamentals and Standards*: Provides the terminology and definitions used in the standards. It is the starting point for understanding the system of standards.
- ISO 9001:2000, *Quality Management Systems—Requirements*: This is the standard for the certification of a firm's quality management system. It is used to

demonstrate the conformity of quality management systems to meet customer requirements.

- ISO 9004:2000, *Quality Management Systems—Guidelines for Performance*: Provides guidelines for establishing a quality management system. It focuses not only on meeting customer requirements but also on improving performance.

These three standards are the most widely used and apply to the majority of companies. However, ten more published standards and guidelines exist as part of the ISO 9000 family of standards. To receive ISO certification, a company must provide extensive documentation of its quality processes. This includes methods used to monitor quality, methods and frequency of worker training, job descriptions, inspection programs, and statistical process control tools used.

High-quality documentation of all processes is critical. The company is then audited by an ISO 9000 registrar, who visits the facility to make sure the company has a well-documented quality management system and that the process meets the standards. If the registrar finds that all is in order, certification is received. Once a company is certified, it is registered in an ISO directory that lists certified companies. The entire process can take 18 to 24 months and can cost anywhere from \$10,000 to \$30,000. Companies have to be recertified by ISO every three years.

One of the shortcomings of ISO certification is that it focuses only on the process used and conformance to specifications. In contrast to the Baldrige criteria, ISO certification does not address questions about the product itself and whether it meets customer and market requirements. Today there are over 40,000 companies that are ISO certified. In fact, certification has become a requirement for conducting business in many industries.

10.6 ISO 14000 Standards

The need for standardization of quality created an impetus for the development of other standards. In 1996, the International Standards Organization introduced standards for evaluating a company's environmental responsibility. These standards, termed **ISO 14000**, focus on three major areas:

- **Management systems** standards measure systems development and integration of environmental responsibility into the overall business.
- **Operations** standards include the measurement of consumption of natural resources and energy.
- **Environmental systems** standards measure emissions, effluents, and other waste

systems. With greater interest in green manufacturing and more awareness of environmental concerns, ISO 14000 may become an important set of standards for promoting environmental responsibility.

In this chapter we have discussed the meaning of TQM and the great benefits that can be attained through its implementation. Yet there are still many companies that attempt a variety of quality improvement efforts and find that they have not achieved any or most of the expected outcomes. The most important factor in the success or failure of TQM efforts is the genuineness of the organization's commitment. Often, companies look at TQM as another business change that must be implemented due to market pressure without really changing the values of their organization. Recall that TQM is a complete philosophy that has to be embraced with true belief, not mere lip service. Looking at TQM as a short-term financial investment is a sure recipe for failure.

Another mistake is the view that the responsibility for quality and elimination of waste lies with employees other than top management. It is a "let the workers do it" mentality. A third common mistake is over- or under reliance on statistical process control (SPC) methods. SPC is not a substitute for continuous improvement, teamwork, and a change in the organization's belief system. However, SPC *is* a necessary tool for identifying quality problems. Some common causes for TQM failure are:

- Lack of a genuine quality culture
- Lack of top management support and commitment
- Over- and under reliance on statistical process control (SPC) methods

Companies that have attained the benefits of TQM have created a quality culture. These companies have developed processes for identifying customer-defined quality. In addition, they have a systematic method for listening to their customers, collecting and analyzing data pertaining to customer problems, and making changes based on customer feedback. You can see that in these companies there is a systematic process for prioritizing customer needs that encompasses the entire organization.

10.7 Quality Management (TQM)

The second major element of JIT is **total quality management (TQM)**, which is integrated into all functions and levels of the organization. The foundation of JIT is to produce the exact product that the customer wants. Quality is defined by the customer, and an effort is made by the whole company to meet the customer's

expectations. Quality is an integral part of the organization; it permeates every activity and function. The benefits of JIT cannot occur if the company is not working toward eliminating scrap and rework. Traditional quality control systems use the concept of *acceptable quality level (AQL)* to indicate the acceptable number of defective parts. In JIT there is no such measure—no level of defects other than zero is acceptable. Poor quality is considered a waste in JIT. Quality defects lead to scrap, rework, servicing returned parts, and customer dissatisfaction. Quality defects cost money and can lead to lost customers. In JIT the entire organization is responsible for quality. Rather than hide poor quality or blame it on others, it is everyone's goal to uncover and correct quality problems.

The concept of **quality at the source** is part of JIT. The objective is not only to identify a quality problem but to uncover its root cause. Simply identifying and removing a defective product does not solve the problem. If the cause of the problem is not identified, the problem will keep repeating itself. For example, a quality control check in a bakery might reveal that pies are overcooked and burned.

Quality at the source tells us to identify the cause of the problem, such as an incorrect temperature setting or too long a baking time. Simply removing the burned pies does not eliminate the cause of the problem; overcooking will continue to occur. The concept of continuous improvement is embedded in quality, which means that the company must continuously and actively work to improve.

In JIT continuous improvement governs everything, from reducing the number of defects to lowering setup costs and lot sizes. For example, when implementing a JIT program, we cannot expect to eliminate inventories immediately. Continuous improvement tells us that we must do it gradually, slowly identifying and solving problems and then reducing inventory appropriately. However, continuous improvement goes beyond JIT manufacturing. It includes improvement of worker skills, supplier quality and relationships, and even the performance of management.

10.7.1 The Role of Management

Just as the role of production employees is different under JIT, so is the role of management. Actually, it can often be difficult for management to truly accept the new role of production employees as being responsible for duties that traditionally were performed exclusively by management. However, in successful JIT environments managers realize that all employees are on the same team and that a higher level of worker responsibility means more success for the firm as a whole.

The role of management is to create the cultural change necessary for JIT to succeed. This is one of the most difficult tasks of JIT. It involves creating an organizational culture that provides an atmosphere of close cooperation and mutual trust. Remember that JIT relies on ordinary workers to independently solve production problems and take on many tasks. To be able to do this, employees must be problem solvers and be empowered to take action based on their ideas. Workers must feel secure in their jobs and know that they will not be reprimanded or lose their jobs for being proactive. They must also feel comfortable enough to discuss their ideas openly.

It is up to management to develop an incentive system for employees that rewards this type of behavior. In the JIT environment, the role of managers becomes more of a supporting function. Managers are seen as facilitators and coaches rather than “bosses.” Their job is to help develop the capabilities of employees, to teach, make corrections, help individuals develop their skills, and serve as motivators. They assist with teamwork and problem solving. Managers are also responsible for providing motivation and necessary recognition to employees. Their job also includes sharing information such as profitability and performance results, as well as making sure ample time is scheduled for all the activities employees must perform. Remember that the additional activities, such as quality control charting, maintenance, and working in teams, are not done during “free time” but during regular work hours.

10.7.2 Benefits of JIT

The benefits of JIT are very impressive. For this reason, many companies rush to adopt JIT without realizing all that is involved. Many of these companies do not reap the benefits because they do not take the time to implement the culture necessary for JIT to succeed. A recent study of JIT benefits has found that over a five-year period companies using JIT have experienced an 80–90 percent reduction in inventory investment, an 80–90 percent reduction in lead time, a 75 percent reduction in rework and setup, a 50 percent reduction in space requirements, and a 50 percent reduction in material handling equipment.

The first implementation of JIT took place at the Toyota Motor Company in Japan in the early 1970s. Thus, much of what we have learned about JIT comes from Toyota’s experience. Since then, hundreds of companies have successfully implemented JIT, including Ford, General Electric, IBM, 3M, Nissan/Renault, and many others. One of the greatest benefits of JIT is that it has changed the attitude of many firms toward eliminating waste, improving responsiveness, and competing based on time.

Time-based competition is one of the primary ways in which companies operate today, and JIT is what makes it possible. Even companies that have not implemented JIT have had to make some changes in order to compete in a world that has left behind many traditional ways of doing business.

The large benefits JIT can bring to a company are demonstrated by the success achieved by Alcoa, a leader in the aluminum industry. Alcoa's accomplishment included reducing inventories by more than a quarter of a billion dollars in 1999 while increasing sales by almost \$1 billion. This was a direct benefit of implementing Toyota's JIT system just a year earlier. In 1998, Alcoa found itself ill-prepared to meet customer needs. It was piling up inventory, yet not providing what the customer wanted. Alcoa turned to a full JIT "pull" manufacturing system. Benefits quickly began to appear at facilities all over the country. For example, an extrusion plant in Mississippi lost money in 1998 but within a year was capable of delivering customer orders in two days.

We have seen that JIT affects every aspect of the organization. Therefore, the implementation of a true JIT system requires a complete cultural change for the organization. To implement JIT successfully, a company does not need sophisticated systems. What is needed are correct attitude, employee involvement, and continuous improvement. A change of such profound magnitude needs to be driven by top management. JIT implementation cannot succeed if it is done only by middle or lower management.

Implementation needs to start with a shared vision of where the company is and where it wants to go. This vision needs to consider everyone who has a stake in the company, including customers, employees, suppliers, stockholders, and even the community in which the company is located. Once the vision has been developed, it is up to top management to create the right atmosphere. Managers need to involve workers in a meaningful way and not merely give lip service to the concept. Part of the change in atmosphere should consist of breaking down the barriers between departments and instilling "we" thinking in place of an "us-versus-them" attitude. Reward systems should be put in place to reward ideas and team cooperation.

A "champion" for JIT implementation must be designated, whether it is a plant manager, the CEO, or a steering committee. The purpose is to have a person or group oversee all the steps necessary in implementing such a large change. This person or group will be responsible for reviewing progress, addressing any problems that may develop, making sure ample resources are available, and

ensuring that a proper reward system is in place. Another job of the JIT champion is sharing results with everyone in the company. Such information is not shared with production workers in traditional systems. However, in JIT, sharing of this type of information with everyone in the company is considered a key to success and is done frequently and regularly. Financial information cannot be kept secret if everyone is to work together and share in the benefits.

10.7.3 Implementation Process

In making specific changes in JIT manufacturing, some changes need to be implemented before others. Not all things can or should be changed at once. Following is a sequence of steps that should be followed in the implementation process:

- 1) **Make quality improvements.** Usually it is best to start the implementation process by improving quality. The reason is that quality is pervasive and all the JIT objectives are dependent on quality improvement.
- 2) **Reorganize workplace.** Reorganizing the workplace is the next step. This means proper facility layout, cleaning and organizing the work environment, designating storage spaces for everything, and removing clutter.
- 3) **Reduce setup times.** The next step is to focus on reducing setup times, which will involve manufacturing and industrial engineering. It will require analysis of current setup procedures, elimination of unneeded steps, and streamlining of motions. Workers will need to be trained in the proper setup procedures.
- 4) **Reduce lot sizes and lead times.** Once setup times have been reduced, the focus is on reducing lot sizes and lead times. This in turn will reduce the inventory between workstations and free up space. The empty space will contribute to visibility.
- 5) **Implement layout changes.** The next step is to arrange equipment and workstations in close proximity to one another and to form work cells.
- 6) **Switch to pull production.** After the preceding changes have been implemented, it is time to switch to pull production. Changing from a push system to a pull system, including worker training, needs to be planned very carefully. However, the change needs to be made at once because a production facility cannot use a push and a pull system at the same time.
- 7) **Develop relationship with suppliers.** Changes in relationships with suppliers should be among the last steps implemented. Demands for smaller and more frequent deliveries should be instituted gradually.

By now you should understand that JIT is made up of many ideas that define its philosophy. Because of that, implementation of JIT is complicated. Most companies are so eager to receive the benefits of JIT that they jump in and begin making changes without thinking them through. Often, company executives will learn that for JIT implementation to succeed inventory needs to be eliminated, so they begin ordering reductions in inventory. This unplanned approach can have disastrous effects. Inventory is there to cover up problems. Unless the problems are solved first, simply reducing inventory can completely halt production.

Finally, when it comes to implementation, remember that the concept of continuous improvement is an integral part of JIT. This means that the implementation process will not start and end in definite time periods. Rather, it will be a gradual process. Reductions in inventory have to be preceded by improvements in quality, changes in layout, reductions in setup times, and worker training. As improvements are made, inventory can be reduced. As new problems become visible, they must be solved before further reductions in inventory are made. This is an ongoing, gradual process. Implementation is never complete because improving performance is a never-ending task.