Chapter 06: Operations Management in Manufacturing and Service Industries

Every organization—whether it produces goods or provides services—sees Job 1 as furnishing customers with quality products. Thus, to compete with other organizations, a company must convert resources (materials, labor, money, information) into goods or services as efficiently as possible. The upper-level manager who directs this transformation process is called an operations manager. The job of operations management (OM), then, consists of all the activities involved in transforming a product idea into a finished product, as well as those involved in planning and controlling the systems that produce goods and services. In other words, operations managers manage the process that transforms inputs into outputs.

Figure 6.1 "The Transformation Process" illustrates this traditional function of operations management.

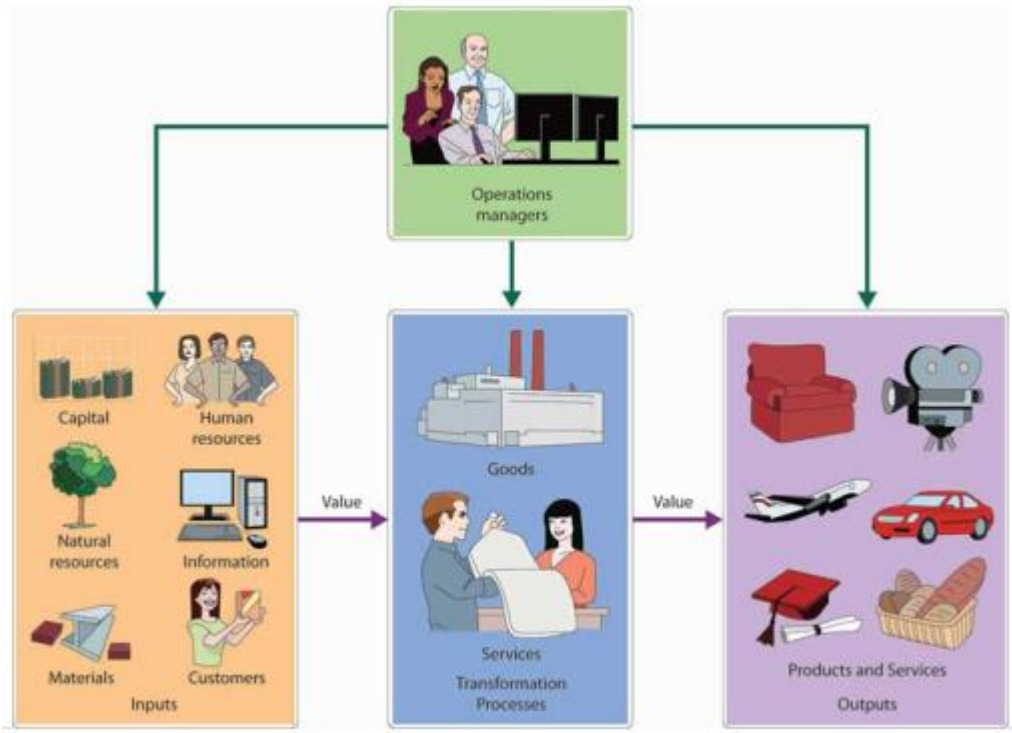

Figure 1 The Transformation Process

6.1. Operations Management in Manufacturing

All manufacturers set out to perform the same basic function: *to transform resources into finished goods*. To perform this function in today's business environment, manufacturers must continually strive to improve operational efficiency. They must fine-tune their production processes to focus on quality, to hold down the costs of materials and labor, and to eliminate all costs that add no value to the finished product. Making the decisions involved in the effort to attain these goals is the job of the operations manager. That person's responsibilities can be grouped as follows:

- Production planning. During production planning, managers determine how goods will be produced, where production will take place, and how manufacturing facilities will be laid out.
- Production control. Once the production process is under way, managers must continually schedule and monitor the activities that make up that process. They must solicit and respond to feedback and make adjustments where needed. At this stage, they also oversee the purchasing of raw materials and the handling of inventories.
- Quality control. Finally, the operations manager is directly involved in efforts to ensure that goods are produced according to specifications and that quality standards are maintained.

6.2. Planning the Production Process

The decisions made in the planning stage have long-range implications and are crucial to a firm's success. Before making decisions about the operations process, managers must consider the goals set by marketing managers.

- Does the company intend to be a low-cost producer and to compete on the basis of price?
- Or does it plan to focus on quality and go after the high end of the market?
- Perhaps it wants to build a reputation for reliability.
- What if it intends to offer a wide range of products?

To make things even more complicated, all these decisions involve tradeoffs. Upholding a reputation for reliability isn't necessarily compatible with offering a wide range of products. Low cost doesn't normally go hand in hand with high quality.

With these factors in mind, let's look at the specific types of decisions that have to be made in the production planning process. We've divided these decisions into those dealing with production methods, site selection, facility layout, and components and materials management.

Production-Method Decisions

The first step in production planning is deciding which type of production process is best for making the goods that your company intends to manufacture. In reaching this decision, you should answer such questions as the following:

- How much input do I receive from a particular customer before producing my goods?
- Am I making a one-of-a-kind good based solely on customer specifications, or am I producing high-volume standardized goods to be sold later?
- Do I offer customers the option of "customizing" an otherwise standardized good to meet their specific needs?

One way to appreciate the nature of this decision is by comparing three basic types of processes or methods: make-to-order, mass production, and mass customization. The task of the operations manager is to work with other managers, particularly marketers, to select the process that best serves the needs of the company's customers.

Make-to-Order

At one time, most consumer goods, such as furniture and clothing, were made by individuals practicing various crafts. By their very nature, products were customized to meet the needs of the buyers who ordered them. This process, which is called a make-to-order strategy, is still commonly used by such businesses as print or sign shops that produce low-volume, high-variety goods according to customer specifications.

Mass Production

By the early twentieth century, however, a new concept of producing goods had been introduced: mass production (or make-to-stock strategy) is the practice of producing high volumes of identical goods at a cost low enough to price them for large numbers of customers. Goods are made in anticipation of future demand (based on forecasts) and kept in inventory for later sale. This approach is particularly appropriate for standardized goods ranging from processed foods to electronic appliances.

Mass Customization

But there's a disadvantage to mass production: customers, as one contemporary advertising slogan puts it, can't "have it their way." They have to accept standardized products as they come off assembly lines. Increasingly, however, customers are looking for products that are designed to accommodate individual tastes or needs but can still be bought at reasonable prices. To meet the demands of these consumers, many companies have turned to an approach called mass customization, which (as the term suggests) combines the advantages of customized products with those of mass production.

This approach requires that a company interact with the customer to find out exactly what the customer wants and then manufacture the good, using efficient production methods to hold down costs. One efficient method is to mass-produce a product up to a certain cut-off point and then to customize it to satisfy different customers.

The list of companies devoting at least a portion of their operations to mass customization is growing steadily. Perhaps the best-known mass customizer is Dell, which has achieved phenomenal success by allowing customers to configure their own personal computers. The Web has a lot to do with the growth of mass customization. Nike, for instance, now lets customers design their own athletic shoes on the firm's Web site. Procter & Gamble offers made-to-order, personal-care products, such as shampoos and fragrances, while Mars, Inc. can make M&M's in any color the customer wants (say, school colors).

Naturally, mass customization doesn't work for all types of goods. Most people don't care about customized detergents or paper products. And while many of us like the idea of customized clothes from Levi's or Lands' End, we often aren't willing to pay the higher prices they command.

Facilities Decisions

After selecting the best production process, operations managers must then decide where the goods will be manufactured, how large the manufacturing facilities will be, and how those facilities will be laid out.

Site Selection

In choosing a location, managers must consider several factors:

- To minimize shipping costs, both for raw materials coming into the plant and for finished goods going out, managers often want to locate plants close to suppliers, customers, or both.
- They generally want to locate in areas with ample numbers of skilled workers.
- They naturally prefer locations where they and their families will enjoy living.
- They want locations where costs for resources and other expenses—land, labor, construction, utilities, and taxes—are low.

- They look for locations with a favorable business climate—one in which, for example, local governments might offer financial incentives (such as tax breaks) to entice them to do business in their locales.

Managers rarely find locations that meet all these criteria. As a rule, they identify the most important criteria and aim at satisfying them. For instance, a company wants to sell ski products worldwide. This company's site selection includes (1) proximity to the firm's suppliers, (2) availability of skilled engineers and technicians, and (3) favorable living conditions. These factors were more important than operating in a low-cost region or getting financial incentives from local government. Because this company needs skilled employees. And this company distributes its products throughout the world, so proximity to customers was also unimportant.

Capacity Planning

Now that you know where you're going to locate, you have to decide on the quantity of products that you'll produce. You begin by forecasting demand for your product. To estimate the number of units that you're likely to sell over a given period, you have to understand the industry that you're in and estimate your likely share of the market by reviewing industry data and conducting other forms of research.

Once you've forecasted the demand for your product, you can calculate the capacity requirements of your production facility—the maximum number of goods that it can produce over a given time under normal working conditions. In turn, having calculated your capacity requirements, you're ready to determine how much investment in plant and equipment you'll have to make, as well as the number of labor hours required for the plant to produce at capacity.

Like forecasting, capacity planning is difficult. Unfortunately, failing to balance capacity and projected demand can be seriously detrimental to your bottom line. If you set capacity too low (and so produce less than you should), you won't be able to meet demand, and you'll lose sales and customers. If you set capacity too high (and turn out more units than you should), you'll waste resources and inflate operating costs.

Facility Layouts

The next step in production planning is deciding on plant layout—how equipment, machinery, and people will be arranged to make the production process as efficient as possible. In this section, we'll examine four common types of facility layouts: process, product, cellular, and fixed position.

The process layout groups together workers or departments that perform similar tasks. Goods in process (goods not yet finished) move from one workstation to another. At each position, workers use specialized equipment to perform a particular step in the production process.

To better understand how this layout works, we'll look at the production process at the Vermont Teddy Bear Company. Let's say that you just placed an order for a personalized teddy bear—a "hiker bear" with khaki shorts, a white T-shirt with your name embroidered on it, faux-leather hiking boots, and a nylon backpack with sleeping bag. Your bear begins at the furcutting workstation, where its honey-brown "fur" coat is cut. It then moves to the stuffing and sewing workstation to get its insides and have its sides stitched together. Next, it moves to the dressing station, where it's outfitted with all the cool clothes and gear that you ordered. Finally, it winds up in the shipping station and starts its journey to your house.

In a ***product layout***, high-volume goods are produced efficiently by people, equipment, or departments arranged in an assembly line—that is, a series of workstations at which already-made parts are assembled. Just Born, a candy maker located in Bethlehem, Pennsylvania, makes a product called Marshmallow Peeps on an assembly line. First, the ingredients are combined and whipped in huge kettles. Then, sugar is added for color. At the next workstation, the mixture—colored warm marshmallow—is poured into baby-chick–shaped molds carried on conveyor belts. The conveyor-belt parade of candy pieces then moves forward to stations where workers add eyes or other details. When the finished candy reaches the packaging area, it's wrapped for shipment to stores around the world.

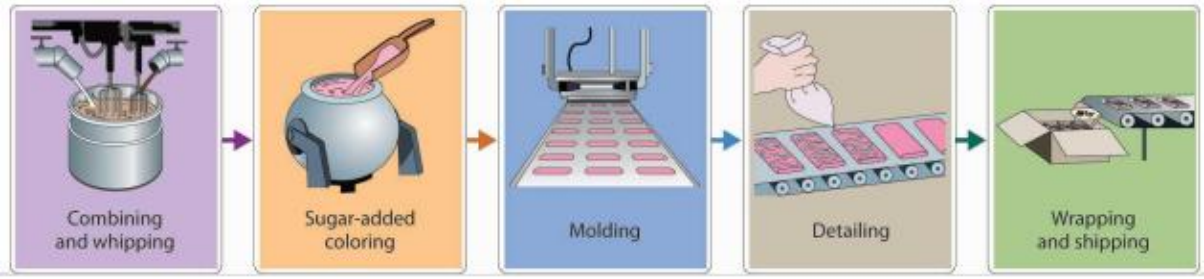

Figure 2 Product Layout at Just Born, Inc.

Both product and process layouts arrange work by function. At the Vermont Teddy Bear Company, for example, the cutting function is performed in one place, the stuffing-and-sewing function in another place, and the dressing function in a third place. If you're a cutter, you cut all day; if you're a sewer, you sew all day: that's your function. The same is true for the production of Marshmallow Peeps at Just Born: if your function is to decorate peeps, you stand on an assembly line and decorate all day; if your function is packing, you pack all day.

Arranging work by function, however, isn't always efficient. Production lines can back up, inventories can build up, workers can get bored with repetitive jobs, and time can be wasted in transporting goods from one workstation to another. To counter some of these problems, many manufacturers have adopted a ***cellular layout***, in which small teams of workers handle all aspects of building a component, a "family" of components, or even a finished product. Each team works in a small area, or cell, equipped with everything that it needs to function as a selfcontained unit. Machines are sometimes configured in a U-shape, with people working inside the U. Because team members often share duties, they're trained to perform several different jobs. Teams monitor both the quantity and the quality of their own output. This arrangement often results in faster completion time, lower inventory levels, improved quality, and better employee morale. Cellular manufacturing is used by large manufacturers, such as Boeing, Raytheon, and Pratt & Whitney, as well as by small companies, such as Little Enterprise, which makes components for robots.

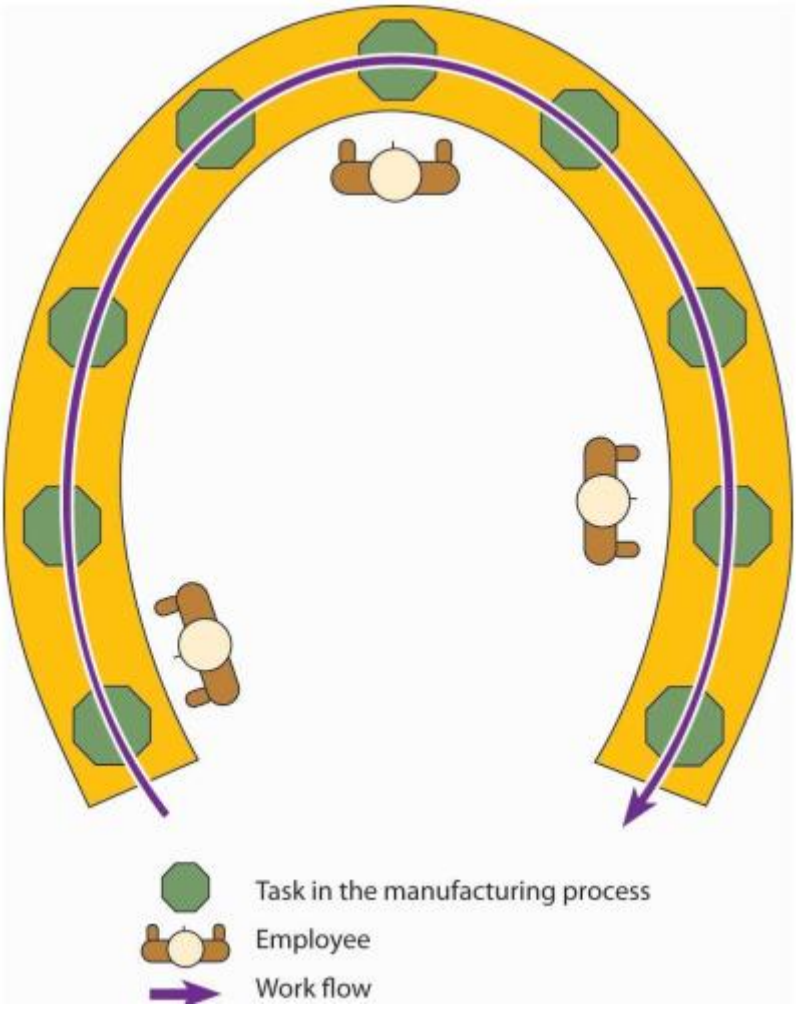

Figure 3 Cellular layout

It's easy to move teddy bears and marshmallow candies around the factory while you're making them, but what about airplanes or ships? In producing large items, manufacturers use fixed-position layouts10 in which the product stays in one place and the workers (and equipment) go to the product. This is the arrangement used by General Housing Corporation in constructing modular homes. Each house is constructed at the company's factory in Bay City, Michigan, according to the customer's design. Because carpenters, electricians, plumbers, and others work on each building inside the climate-controlled factory, the process can't be hindered by weather. Once it's done, the house is transported in modules to the owner's building site and set up in one day.

Managing the Production Process in a Manufacturing Company

Once the production process is in place, the attention of the operations manager shifts to the daily activities of materials management, which encompass the following activities: purchasing, inventory control, and work scheduling.

Purchasing and Supplier Selection

The process of acquiring the materials and services to be used in production is called purchasing (or procurement). For many products, the costs of materials make up about 50 percent of total

manufacturing costs. Not surprisingly, then, materials acquisition gets a good deal of the operations manager's time and attention.

As a rule, there's no shortage of vendors willing to supply parts and other materials, but the trick is finding the best suppliers. In selecting a supplier, operations managers must consider such questions as the following:

- Can the vendor supply the needed quantity of materials at a reasonable price?
- Is the quality good?
- Is the vendor reliable (will materials be delivered on time)?
- Does the vendor have a favorable reputation?
- Is the company easy to work with?

Getting the answers to these questions and making the right choices—a process known as supplier selection—is a key responsibility of operations management.

E-Purchasing

Technology is changing the way businesses buy things. Through e-purchasing (or eprocurement), companies use the Internet to interact with suppliers. The process is similar to the one you'd use to find a consumer good—say, a forty-two-inch plasma high-definition TV—over the Internet. You might start by browsing the Web sites of TV manufacturers, such as Sony or Toshiba, or electronics retailers, such as Best Buy. To gather comparative prices, you might go to a comparison-shopping Web site, such as MySimon.com, which displays information on hundreds of brands and models. You might even consider placing a bid on eBay, an online Marketplace where sellers and buyers come together to do business through auctions. Once you've decided where to buy your TV, you'd complete your transaction online, even paying for it electronically.

Inventory Control

If a manufacturer runs out of the materials it needs for production, then production stops. In the past, many companies guarded against this possibility by keeping large inventories of materials on hand. It seemed like the thing to do at the time, but it often introduced a new problem—wasting money. Companies were paying for parts and other materials that they wouldn't use for weeks or even months, and in the meantime, they were running up substantial storage and insurance costs. Most manufacturers have since learned that to remain competitive, they need to manage inventories more efficiently. This task requires that they strike a balance between two threats to productivity: losing production time because they've run out of materials, and wasting money because they're carrying too much inventory. The process of striking this balance is called inventory control, and companies now regularly rely on a variety of inventory-control methods.

Just-in-Time Production

One method is called just-in-time (JIT) production: the manufacturer arranges for materials to arrive at production facilities just in time to enter the manufacturing process. Parts and materials don't sit unused for long periods, and the costs of "holding" inventory are significantly cut. JIT, however, requires considerable communication and cooperation between the manufacturer and the supplier. The manufacturer has to know what it needs, and when. The supplier has to commit to supplying the right materials, of the right quality, at exactly the right time.

Material Requirements Planning

Another method, called material requirements planning (MRP), relies on a computerized program both to calculate the quantity of materials needed for production and to determine when they should be ordered or made. Let's say, for example, that you and several classmates are planning a fund-raising dinner for the local animal shelter. First, you estimate how many people will attend—say, fifty. Next, you plan the menu—lasagna, garlic bread, salad, and cookies. Then, you determine what ingredients you'll need to make the food. Next, you have to decide when you'll need your ingredients. You don't want to make everything on the afternoon of the dinner; some things—like the lasagna and cookies—can be made ahead of time. Nor do you want to buy all your ingredients at the same time; in particular, the salad ingredients would go bad if purchased too far in advance. Once you've made all these calculations and decisions, you work out a schedule for the production of your dinner that indicates the order and timing of every activity involved. With your schedule in hand, you can determine when to buy each ingredient. Finally, you do your shopping. Though the production process at most manufacturing companies is a lot more complex than planning a dinner (even for fifty), an MRP system is designed to handle similar problems. The program generates a production schedule based on estimated output (your food preparation timetable for fifty guests), prepares a list of needed materials (your shopping list), and orders the materials (goes shopping).

The basic MRP focuses on material planning, but there's a more sophisticated system—called manufacturing resource planning (MRP II)—that goes beyond material planning to help monitor resources in all areas of the company. Such a program can, for instance, coordinate the production schedule with HR managers' forecasts for needed labor.

6.3. Graphical Tools: PERT and Gantt Charts

Because they also need to control the timing of all operations, managers set up schedules: They select jobs to be performed during the production process, assign tasks to work groups, set timetables for the completion of tasks, and make sure that resources will be available when and where they're needed. There are a number of scheduling techniques. We'll focus on two of the most common—Gantt and PERT charts.

Gantt Charts

A Gantt chart, named after the designer, Henry Gantt, is an easy-to-use graphical tool that helps operations managers determine the status of projects. Let's say that you're in charge of making the "hiking bear" that we ordered earlier from the Vermont Teddy Bear Company. is a Gantt chart for the production of one hundred of these bears. As you can see in the figure, it shows that several activities must be completed before the bears are dressed: the fur has to be cut, stuffed, and sewn; and the clothes and accessories must be made. Our Gantt chart tells us that by day six, all accessories and clothing have been made. The stuffing and sewing, however (which must be finished before the bears are dressed), isn't scheduled for completion until the end of day eight. As operations manager, you'll have to pay close attention to the progress of the stuffing and sewing operations to ensure that finished products are ready for shipment by their scheduled date.

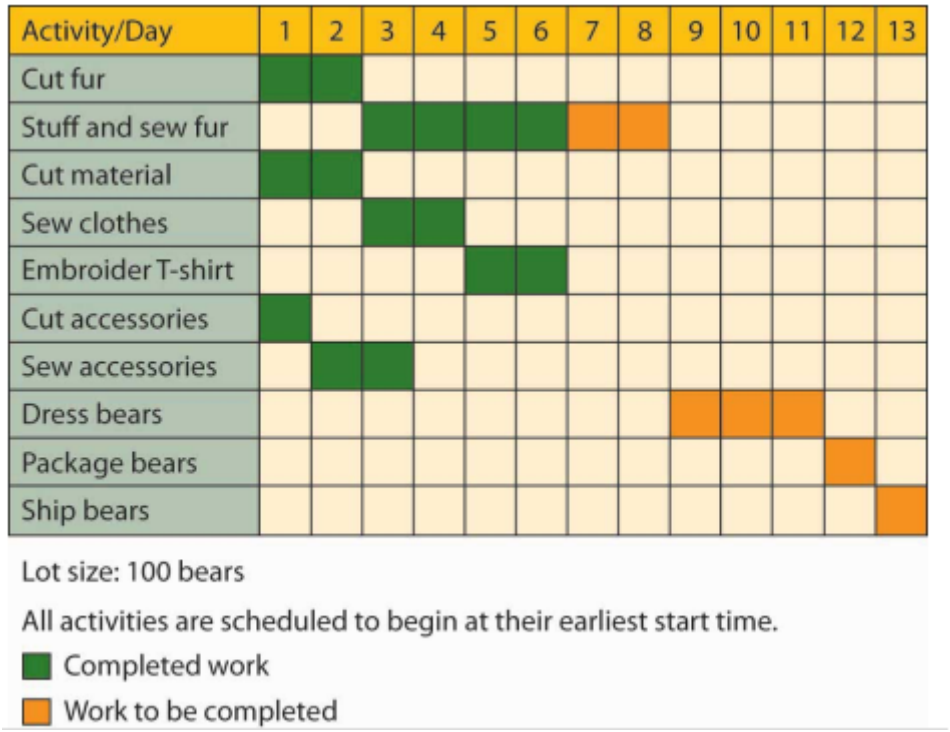

Figure 4 Gantt Chart for Vermont Teddy Bear

PERT Charts

Gantt charts are useful when the production process is fairly simple and the activities aren't interrelated. For more complex schedules, operations managers may use PERT charts20. PERT (which stands for Program Evaluation and Review Technique) is designed to diagram the activities required to produce a good, specify the time required to perform each activity in the process, and organize activities in the most efficient sequence. It also identifies a critical path: the sequence of activities that will entail the greatest amount of time. Figure 4 "PERT Chart for Vermont Teddy Bear" is a PERT diagram showing the same process for producing one "hiker" bear at Vermont Teddy Bear.

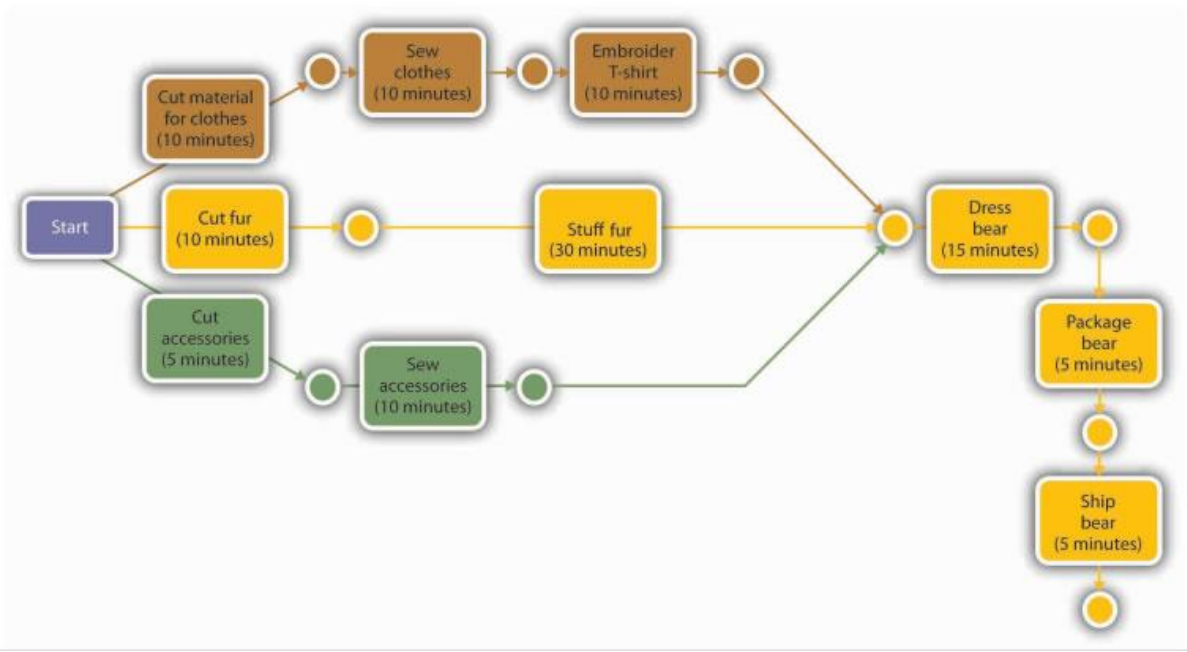

Figure 5 PERT Chart for Vermont Teddy Bear

Our PERT chart shows how the activities involved in making a single bear are related. It indicates that the production process begins at the cutting station. Next, the fur that's been cut for this particular bear moves first to the stuffing and sewing stations and then to the dressing station. At the same time that its fur is moving through this sequence of steps, the bear's clothes are being cut and sewn and its Tshirt is being embroidered. Its backpack and tent accessories are also being made at the same time. Note that fur, clothes, and accessories all meet at the dressing station, where the bear is dressed and outfitted with its backpack. Finally, the finished bear is packaged and shipped to the customer's house.