

# CHAPTER 01

## INTRODUCTION TO OPERATIONS MANAGEMENT

### Teaching Notes

Many students come to this course with negative feelings, perhaps because they have heard that the course includes a certain amount of quantitative material (which many feel uncomfortable with), or perhaps because the course strikes them as “how to run a factory.” Others seem to have very little idea about what operations management is. I view the initial meeting with my classes, and this first chapter, as opportunities to dispel some of these notions, and to generate enthusiasm for the course.

Highlights of the chapter include the following:

1. Operations as one of the three main functional concerns of most organizations.
2. The role and job of the operations manager as a planner and decision-maker.
3. Different ways of classifying (and understanding) production systems.
4. System design versus system operation.
5. Major characteristics of production systems.
6. Contemporary issues in operations management.
7. Operations as essentially managerial (planning, staffing, etc.)
8. The historical evolution of production/operations management.
9. Manufacturing operations versus service operations.

### Reading: The Challenges of Managing Services

1. In comparison to manufacturing industry, services have:
  - a. Less structured jobs.
  - b. Higher customer contact.
  - c. Lower worker skills.
  - d. Low skill entry-level positions.
  - e. Higher employee turnover.
  - f. Higher input variability.
2. Because of the factors listed in the answer to question 1, in service industry it is more difficult to control costs and quality resulting in lower productivity. In addition the risk of customer dissatisfaction is greater and employee motivation is lower.

### Reading: Why Manufacturing Matters

1. Since the U.S. economy is becoming more service based, the percentage of employment in manufacturing is declining while the percentage of employment in service industry is increasing. An agile manufacturer is able to switch quickly and economically from one product to another with very little disruption.

2. Yes, the business leaders and the government officials should be concerned about declining percentage of manufacturing jobs because of a variety of reasons including the following:
  - a. Manufacturing provides 70% of the U.S. exports.
  - b. The average compensation for a worker from manufacturing industry is 20% greater than the average of all workers in the U.S.
  - c. Compared to service industry employees, the manufacturing employees are more likely to have a better benefits package.
  - d. Productivity growth in manufacturing is much higher than productivity growth in the U.S. economy's overall productivity growth.
  - e. Even though manufacturing employment accounts for a smaller portion of the employment for U.S. than the service industry, the manufacturing accounts for more than 50% of the Research and Development in the United States.

### **Operations Tour: Wegmans Food Markets**

1. Customers judge the quality of a supermarket based on:
  - a. Quality of individual products.
  - b. Exterior and interior physical look of the store.
  - c. Effectiveness and efficiency of service personnel.
2.
  - a. Customer satisfaction is the major key to the success of any operation, without it the company cannot survive.
  - b. Forecasting allows the company to plan the workforce levels, purchase quantities, inventory levels and capacity.
  - c. Capacity planning allows the company to balance the trade-off between shortages and excess inventories and between waiting lines and idle time.
  - d. A good location can have a significant impact in attracting customers, thus improving sales.
  - e. Planning and controlling levels of inventory will assist with avoiding stockouts and avoiding excess inventory levels.
  - f. Good layout of the store can assist in maximizing customer service and sales by strategically directing customers through the store. An effective layout can also improve the efficiency of the operations.
  - g. Effective scheduling of company workers and work hours can improve both customer service and efficiency. An effective schedule provides convenient store hours, minimal customer waiting lines and minimal employee idle time.
3. Wegmans uses technology to track inventory and manage its supply chain, which lessens the risk of occurrences of out-of-stock events, and to maintain freshness in its meat and produce departments.

## **Answers to Discussion and Review Questions**

1. The term production/operations management relates to the management of systems or processes that create goods and/or provide services. These processes involve the planning, coordination, and execution of all activities that create goods and services.
2. The three primary functions are operations, finance, and marketing. Operations is concerned with the creation of goods and services, finance is concerned with provision of funds necessary for operation, and marketing is concerned with promoting and/or selling goods or services.
3. The operations function consists of all activities that are directly related to producing goods or providing services. It is the core of most business organizations because it is responsible for the creation of an organization's goods or services. Its essence is to add value during the transformation process (the difference between the cost of inputs and value and price of outputs).
4. Among the important differences between manufacturing and service operations are:
  - a. The nature and consumption of output.
  - b. Uniformity of input.
  - c. Labor content of jobs.
  - d. Uniformity of output.
  - e. Measurement of productivity.
5.
  - a. The Industrial Revolution began in the 1770s in England, and spread to the rest of Europe and to the U.S. in the late eighteenth century and the early nineteenth century. A number of inventions such as the steam engine, the spinning Jenny, and the power loom helped to bring about this change. There were also ample supplies of coal and iron ore to provide the necessary materials for generating the power to operate and build the machines that were much stronger and more durable than the simple wooden ones they replaced.
  - b. Frederick W. Taylor, who is often referred to as the father of scientific management, spearheaded the scientific management movement. The science of management was based on observation, measurement, analysis, improvement of work methods, and economic incentives. Management should be responsible for planning, carefully selecting and training workers, finding the best way to perform each job, achieving cooperation between management and workers, and separating management activities from work activities.
  - c. Parts of a product made to such precision that each part would fit any of the identical items bring produced. It meant that individual parts would not have to be custom made because they were standardized.
  - d. Breaking up a production process into a series of tasks, each performed by a different worker. It enabled workers to learn jobs and become proficient at them more quickly; avoiding the delays of workers shifting from one activity to another.
6.
  - a. The service sector now accounts for more than 70 percent of jobs in the U.S. and that figure continues to increase.
  - b. Manufacturing is important in that it supplies a large proportion of exports and many service jobs are dependent on manufacturing because they support manufacturing.

- c. Farm products are an example of non-manufacturing goods because there is no production and the products naturally grow without human intervention.
7. Models provide an abstraction and simplification of reality. Mathematical models are the most abstract and most used in operations management. These models are used to assist in various decision-making scenarios. One of the main reasons for building mathematical models is that the experimentation with the model enables the decision-maker to analyze the model and make inferences about a problem without actually manipulating the real situation or problem. Therefore, the experimentation with the mathematical model rather than the actual problem or situation is less time consuming and less expensive.
8. Degree of customization has important implications throughout a business organization. Generally, higher degrees of customization involve more complexity in terms of production or service, involve different forms of layout (arrangement of the workplace), require higher worker skills, and have lower productivity.
- 9.
- a. Initial cost, convenience, parking, taxes, time, repairs, upkeep, etc.
  - b. Cost, technology, productivity, convenience, software applicability, etc.
  - c. Initial cost, repairs, warranty, upkeep, monthly payments and interest, dependability, insurance costs, etc.
  - d. Control of the situation, class participation, perception, image, etc.
  - e. This would depend on the nature of the product or service being offered as well as the type of customer. Computer literate customers might seek a web site. If customers are strictly local, newspaper advertising might be a reasonable choice, especially if potential customers were not actively seeking out the business. Also, if the business is seasonal, newspaper advertising might be preferred.
10. Craft production: involves producing high variety of customized goods, low volume output with skilled workers, and utilizing general-purpose equipment. The main advantage is the flexibility to produce a wide variety of outputs providing many choices for the need of customers. The main disadvantage is its inability to produce at low cost. Examples: tailoring, machine shop, print shop, and landscaping.
- Mass production: involves producing a few standardized goods at high volume of output with low skilled workers utilizing specialized equipment. The main advantage is low cost, efficient production. The main disadvantage is that it does not allow easy changes in volume of output, product or process design. Examples: automobiles, computers, mail sorting, appliances, paper, soft drink bottling, etc.
- Lean Production: involves producing more variety of goods than most production at moderate to high volume of output. It requires high skilled workers, quality, employee involvement, teamwork and flatter organizational structure with fewer levels of management. It combines the advantages of both mass production (high volume, low cost) and craft production (variety, flexibility). Examples: similar to mass production.

11. Workers may not like to work in a lean production environment because there are fewer opportunities for employee advancement, more worker stress due to higher levels of responsibility and greater variability and expansion of job requirements.
12.
  - a. Matching supply and demand is an important objective for every business organization. Undersupply can result in dissatisfied customers, potential loss of business, and opportunity costs. Oversupply can potentially result in additional cost to store the excess, the need to sell the excess for a reduced cost, or the cost to dispose of the excess.
  - b. Managing a supply chain is important for several reasons, including matching supply and demand, reducing transportation costs, achieving a competitive advantage, managing inventories, and achieving supply chain visibility.
13. There are four basic sources of variation:
  1. The variety of goods or services being offered: The greater the variety of goods and services, the greater the variation in production or service requirements.
  2. Structural variation in demand, such as trends and seasonal variations. These are generally predictable. They are particularly important for capacity planning.
  3. Random variation. This natural variability is present to some extent in all processes, and it also present in demand for services and products, and cannot generally be influenced by managers.
  4. Assignable causes of variation: Variation caused by defective inputs, incorrect work methods, out of adjustment equipment, and so on. This type of variation can be reduced or eliminated by analysis and corrective action.

Variations can be disruptive to operations and supply chain processes, interfering with optimal functioning. Variations result in additional cost, delays and shortages, poor quality, and inefficient work systems. Poor quality and product shortages or service delays can lead to dissatisfied customers and damage an organization's reputation and image.

14. The reasons for doing unethical things vary from person to person and from one situation to another. Some of the possible reasons are listed below:
  - a. The decision-maker cannot recognize his or her action as unethical because of a lack of morals or understanding or lack of sensitivity towards a given issue.
  - b. Even though the decision-maker recognizes his or her behavior or action as unethical, he or she justifies it based on self-rationalization that involves justice theory. For example, the decision-maker may think that the consequences of his or her decision is not going to hurt other people or organizations in the short run but the potential long term effects may be devastating.
  - c. The decision-maker knows that his or her action is unquestionably unethical. However, the type of ethical behavior required is not in the personal portfolio of the decision-maker and ethics in general is not important to him or her.
  - d. The decision-maker does not think he or she will be caught.
  - e. The self-interest of the decision-maker outweighs the ethical considerations.

15. Value added is defined as the difference between the cost of inputs before the transformation process and the value or the price of output after the transformation process. In a manufacturing process as the inputs are transformed to outputs, value is added to products in a number of different ways. The value adding can take many different forms. For example, value can be added by changing the product structurally (physical change) or transporting a product (a product may have more value if it is located somewhere other than where it currently is).
16. Outsourcing can result in lower costs, the ability to take advantage of others' expertise, and allow businesses to focus on their core business. Outsourcing generally results in layoffs and some loss of control. Also, outsourcing to companies in other nations may result in problems due to cultural or language differences, and increased shipping times for products.
17. Sustainability refers to service and production processes that use resources in ways that do not harm ecological systems that support both current and future human existence. Business organizations are increasingly facing sustainability regulations as well as pressures from environmental groups to act responsibly toward the environment. Some organizations are capitalizing on their "green" efforts in their advertising.

### **Taking Stock**

1. When we decide to take an action there are usually consequences of that action and advantages and disadvantages of taking that action. In other words, before we make a decision, we must weigh the pros and cons of that decision. Trade-offs involve weighing of pros and cons regarding a particular decision. For example, if a decision-maker decides to increase the level of inventory, he or she has to consider the trade-off between increased level of customer service and the additional inventory carrying cost.
2. It is important for the various functional areas to collaborate because collaboration will lead to improved communication among the departments (functions) that in turn will improve the performance of the firm. Collaboration will reduce the chance of sub-optimization by a functional area due to the possibility that a particular functional area does not have enough information about the other areas and their constraints or decisions.
3. Answers will vary.

### **Critical Thinking Exercise**

1. There are many implications due to the differences between service and manufacturing operations. For example, in a service firm, since the degree of customer contact is high, we have to make sure that employees are better trained in customer service than employees in a manufacturing industry. In a pure-service industry firm, we will build a lot of slack in scheduling because of the uncertainty of input.
2. That would depend on whether supply was too large or too small. If there is over capacity, try to increase demand through advertising and/or price reductions. If output (goods) can be stored, and future demand is expected to be higher, store excess output for future demand. If supply is too small, options might be to outsource, work overtime, or hire temporary workers. If there are few or no competitors, increase prices.

3. Innovations might be product or service related, or process related. These typically involve added cost and time for training and possibly new equipment or equipment changes, and potential changes for the supply chain (e.g., new suppliers, new delivery requirements, etc.) New products or services will also probably involve new advertising campaigns or other promotions, and the need for consumer education. Consumers will have to adjust to new products or services, and may have some difficulty if innovations entail increased complexity.
4. a. Business people make unethical decisions for a variety of reasons including the following:
  1. Pressure from superiors
  2. Pressure for stakeholders
  3. Not being informed
  4. Keeping the company afloat
- b. There risk for unethical behavior including the following:
  1. getting reprimanded
  2. getting fired
  3. losing reputation

### **Memo Writing Exercise**

1. Having a joint meeting with Marketing and Finance will allow:
  - a. Different departments to have a mutual understanding of each others' roles and functions.
  - b. Enable the firm to break down barriers between departments.
  - c. Enable the departments to cooperate on problems of mutual interest.
  - d. Utilize specialized expertise of each department to solve problems facing the firm.
  - e. Integration of the functions so that there are no unnecessary functional silos, no miscommunication between departments. The improved relationship between the departments should also result in improved employee morale.
2. The following factors must be considered:
  - a. The cost of the new network.
  - b. The service contract and support systems associated with the new network.
  - c. Training requirements of the new network.
  - d. The features and capabilities of the new network as compared to the old one.
  - e. The perceived customer end user satisfaction.
  - f. The complexity of transition from the old network to the new network.
  - g. The cost and available features of other competing similar networks.
3. An environmentally responsible manufacturing company's response to the situation would be:
  - a. We need to inform our neighbors about what happened.
  - b. We need to investigate the affects of the spill and estimate the funds and resources necessary to clean it.
  - c. We need to make specific plans to clean it up.

- d. We need to investigate the reasons why the spill occurred so that it will not happen again.
- 4. In the short run, the cleanup will most likely have an adverse affect on our profits. However, in the long run the investigation/clean up will provide us with the following:
  - a. Environmentally conscious reputation/image.
  - b. Protection from lawsuit/litigation/investigation from our neighbors or the EPA.
  - c. The knowledge about the reasons for the spill so that it can be prevented in the future.

### **Case: Hazel**

- 1.
  - a. Timing: not too late but not too soon.
  - b. Coverage: does not leave streaks.
  - c. Length of grass: not too long but not too short depending on the weather and time of year.
  - d. Trimming and clean-up (details).
- 2.
  - a. Number of yards, number of mowers, number of workers, time to mow a given area, regular maintenance, weather, length of growing season, time between necessary mowing.
  - b. Mowers, parts, fuel, lubricants, fertilizer, chemicals, tools, etc.
  - c.
    - 1) Lawns, type of work, regular maintenance, workers.
    - 2) Weather, illness, overloads, emergencies, breakdowns.
  - d. Very important. Repeat business would be greatly affected and new business depends on word of mouth and reputation.
  - e. Oil change, blade sharpening, motor tune-up, mower and filter clean up, etc.
- 3.
  - a. Responsibility, possibly security, fringe benefits, regularity of work hours, can't pass the buck to someone else, decision-making, etc.
  - b. Responsibility, financial investment, work load, hiring of more employees, possibility of greater government regulation, personnel problems tend to increase and a general increase in all administrative work.
  - c. Risk involved in starting a new type of business using new technology and making it successful, learning curve involved in the area of e-commerce, additional work load, hiring of more employees in the area of Web design, computer programmers, etc.
- 4.
  - a. Advantages
    - 1) Could increase the business because less time would be required between mowing to keep the grass shorter and reduce the amount of clippings.
    - 2) She could start a new pick-up service and/or a new composting service.
  - b. Drawbacks



- 1) It may complicate and/or increase the cost of the clean-up operations.
5. Yes, since Hazel promised the part-time workers bonus of \$25 for good ideas and since this idea appears to hold promise, Hazel should honor her promise and pay the student \$25. However, in the future she might want to make the bonus offer contingent on continuing employment at the time of implementation of the idea because after becoming aware that the idea was successfully implemented, the idea may become an attractive option for the competitor. In addition, she might want to include a confidentiality clause or a statement in the employment contract of the workers regarding not sharing proprietary information that may be useful to competition.
6.
  - a. Weather, worker absences due to illness, vacations, extra requests from customers, new customers, and lost customers.
  - b. At times she will have excess capacity while at other times she will have too little regular capacity to handle the workload.
  - c. Revise schedules, work overtime if regular capacity is insufficient and/or hire additional workers, if capacity exceeds demand layoff workers or find something else productive for them to do such as maintenance of equipment, training, etc.
7. Use hand tools instead of power tools, and recycle grass clippings. Factors to take into account include cost savings, quality, risk of injury, job completion times, training, reduction in pollution (air and noise), and energy savings.

### **Enrichment Module I: Mathematical Models**

Mathematical models represent and solve problems by using a system of mathematical symbols, expressions and relationships. One of the main reasons for building mathematical models is that the experimentation with the model enables the decision-maker to analyze the model and make inferences about a problem without actually manipulating the real situation or problem. Therefore, the experimentation with the mathematical model rather than the actual problem or situation is less time consuming and less expensive. The “what if” capabilities of most well designed models provide the decision-maker with important information and knowledge about a real problem. After obtaining valuable information from a model, the decision-maker will now have a stronger basis for making the correct judgment call or the right decision. In other words, the knowledge gained from a mathematical model can be used to make better decisions about real problems without experimenting with the real situation. In the absence of the information provided by a mathematical model, the decision-maker increases the risk associated with experimenting with the real problem.

The value of a mathematical model depends on how closely it approximates the real problem. However, it is not desirable for mathematical models to include relationships or details that are not closely related to the core problem. In many cases the real-world problem contains an overwhelming amount of detail. In designing models, one needs to make sure that the important factors and conditions affecting the real-world problem are incorporated while the unnecessary or less important details associated with the problem are excluded. In other words, the mathematical model does not have to provide an exact or a very close duplication of the real situation. However, it needs to provide better results or information than can be obtained by common sense. In general, assuming the model utilizes only the necessary and relevant information regarding a problem or a situation, the more closely it represents the true situation, the more accurate the results and conclusions will be.

In developing a mathematical model, we generally consider the following:

1. a mathematical function that describes the problem's objective.
2. definition of variables.
3. relevant assumptions.
4. constraints or restrictions placed on the problem.
5. model inputs.
  - a. controllable inputs (decision variables).
  - b. uncontrollable inputs (conditions or factors beyond the control of the decision-maker).
6. preparation of the data for the model (specification of the values of all uncontrollable inputs).

Mathematical modeling consists of the following steps:

1. Model Building: Development of the model including the specification of the controllable variables, environmental conditions, assumptions and mathematical statement of the model.
2. Data Gathering/Preparation: Collecting and preparing the data required by the model for easy execution (solution) of the real world problem.
3. Model Solution: Determining the values of decision variables.
4. Model Testing: Repeated execution of the model under different scenarios to make sure that it is accurate.
5. Model Implementation: Application of the model to a real world problem.
6. Model Analysis and Redevelopment: Assessment of the model and making necessary changes based on the results of model solution, model testing, and implementation.
7. Preparation of Managerial Report: Summarization of the pertinent information in simple terms for the appropriate stakeholders.

### **Enrichment Module II: Environmentally Responsible Manufacturing**

Environmental concerns have traditionally not been a major concern of operations managers. However, partially as a result of the efforts of Environmental Protection Agency (EPA), there has been increased regulation of manufacturers (i.e., American Clean Air Act). In addition, the expectations of the public, employees and customers are forcing industries to develop less polluting and more environmentally conscious ways of manufacturing that emphasize waste prevention, elimination and reduction.

Environmentally responsible manufacturing involves emphasizing pollution control and reduction of waste. Recycling of products and designing of products and parts that can be reused is a major part of environmentally responsible manufacturing. Manufacturing companies are learning that effective operations management includes environmental responsibility. As a result, many companies are considering the environmental impact of their decisions much more than they used to.