Manufacture Product Design and Process Selection

5

Unit Introduction

The essence of any organization is the products it offers. There is an obvious link between the design of those products and the success of the organization. Organizations that have well –designed products are more likely to realize their goals than those with poorly designed products. Hence organizations have a vital stake in achieving good product design. Product design plays a strategic role in the degree to witch an organization is able to achieve its goals. It is a major factor in customer satisfaction, product quality, and production costs. The customer connection is obvious. The main concern of the customers is the organization's products, which become the ultimate basis for judging the organization. For this the business-people must keep them well aware of the product design and process development. Considering this issue. Topics included in this unit are product design & process basics, product development process, process flow design & process selections and automation.

Lesson One: Manufacturing Product Design & Process Basics

Lesson Objectives
After completing this lesson you will be able to:

- Identify the quality of product
- Explain the concept of manufacturing product design

Quality of Products
Because of tangible nature quality of products can be standardized and measured. Customers tend to measure the performance of products against the following dimensions:

a) **Confirmation to specification:** Either implied in the advertisements or specified in writing, manufacturers promise certain standard for their products. When the customer buy or use the product they expect the product to contain the advertised specifications. For example, a liter of Milk Vita, or a liter and a half of R.C. Cola. So when the customers buy a bottle of R.C. Cola they expect the bottle to contain 1.5 liter of cola.

b) **Value:** Customers expect value in return for the money spent. Higher the money spent for a product, the higher is the expectation of the customer. For example, a Taka 3 *Econo ball pen* is expected to perform much below a Tk 300 Parker ball pen. If the Parker pen lasts long, the customer will feel that the purchase was worth the price. However, if it lasts for a few weeks, the customer would feel that the value was not there.

c) **Fitness of use:** A product is purchased for a specific set of purposes. The customers would always ask whether the product is actually fit for the purpose for which it was purchased. Fitness of use does not only include it mechanical and chemical properties, but also include its appearance, style, durability, reliability, craftsmanship, and serviceability.

d) **After sales service:** Many products are used repeatedly over a period of time. In this process it may need maintenance. Does the seller have the ability to service the machine? For example, computers need newer softwares; printers need replacement ribbons etc. Are these supports available? If not, the product cannot function to its fullest ability, and as such, is of little use to the customers.

e) **Psychological impression:** People often judge a product by its ability to project a special image for them. How the product enhances his image is very important to the customer. A Parker ball pen peeking out of shirt pocket looks better than an Econo pen. Products are often purchased as a result of the image created in advertisement.

Production design
Production design is the structuring of component parts or activities so that as a unit they can provide a specified value. It usually begins with the development of a set of detailed specifications. New product and service ideas come from various sources, including customers, top management, and staff from marketing, research and development, production and engineering. Product selection,

definition and design take on a continuing basis because so many new product opportunities exist. Mainly five factors influencing market opportunities. These are,

1. **Economic change**: This brings increasing levels of affluence in the long run but causes economic cycles and price changes in the short run. Markets require purchasing power as well as people. The available purchasing power in an economy depends on current income, prices, savings, debt, and credit availability.
2. **Sociological and demographic change:** Marketers are keenly interested in the size and growth rate of population in different cities, regions, and nations; age distribution and ethnic mix, educational levels, household patterns, and regional characteristics and movements. This may appear in such factors as decreasing family size. This alters the size preference for homes, apartments, and automobiles.
3. **Technological change:** The most dramatic force shaping people's lives is technology. Technology has released such wonders as penicillin, open-heart surgery, and the birth control pill. Each technology creates major long-run consequences that are not always foreseeable. The contraceptive pill, for example, leads to smaller families, more working wives, and larger discriminatory incomes - resulting in higher expenditure on vacation travel, durable goods, and other things. This makes possible everything from home computers to mobile phones to artificial hearts.

Each technology creates major long run consequences for the related firms.

4. **Political change:** Marketing decisions are strongly affected by developments of political environments. This environment is composed of trade agreements, laws, government agencies, and pressure groups that influence and limit various organizations and individuals in society. This brings about new trade agreements, tariffs, and government contract requirements.
5. **Other changes:** These may be brought about through market practice, professional standards, suppliers, and distributors. Operations managers must be aware of these factors and be able to anticipate changes in products, product volume, and products mix.

Activity: Assume that you manufacture leather products for the domestic as well as international market. Now, what factors will influence your business opportunity? Why? Discuss.

Therefore some typical design characteristics of products that organizations should consider in relation to demand and capability are:

- *Function*: The new design must properly perform the function for which it is required.
- *Cost:* The total cost cannot be excessive for the market under consideration.
- *Size and shape:* These must be compatible with the function not distasteful or unacceptable to the market.
- *Appearance:* For some applications the appearance of the product or the service is irrelevant; in other instance the appearance is equivalent to function.

- *Quality:* The quality should be compatible with the purpose. Excessive quality may increase cost unnecessarily; insufficient quality leads to complaints and decrease demand.
- *Reliability:* The product should function normally when used and last the expected duration.
- *Environmental impact:* The product should not poise a hazard to the recipient.
- *Productivity:* The product should be predicable with ease and speed.
- *Timing:* The product should be available when expected.
- *Accessibility:* The recipient should be able to obtain the product without difficulty.

The Phases of Product Design

To design is to formulate a plan for the satisfaction of human need. The phases of design are described below (Figure 5.1.1).

A. *Recognition of need:* The designing process begins with recognition of need and deception to do something about it. Recognition of the need and phrasing the need often constitute a highly creative act, because the need may be only an age of discontents, a feeling of uneasiness, or a sensing that something is not right. For example the need to do something about a food packaging machine may be indicated by noise label, by the variation in package weight, and by slight but perceptible variations in the quality of the packaging or wrap.

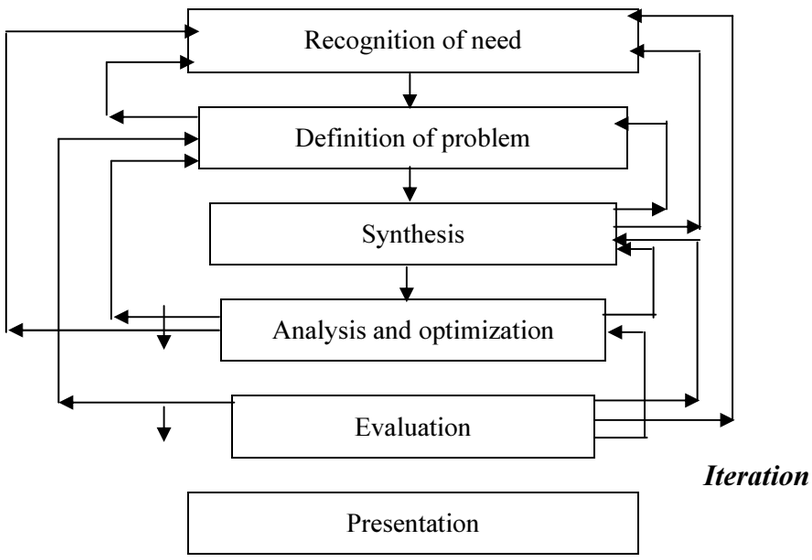

Figure 5.1.1: Phases of Product Design

B. *Definition of the problem:* It must include all the specifications for the product that is to be designed. Specifications are the inputs and output quantities, the characteristics and the dimensions, and all the limitations on these quantities. The specification defines the cost, the number to be manufactured, the expected life, the range, and the reliability. Anything, which limits the designer's freedom of choice, is specification. Firms that are

constantly evolving new designs make extensive use of computer-assisted design (CAD) techniques during this phase. These approaches enable designers to develop and test a multitude of goods or service configurations that could not otherwise be explored.

C. *Synthesis:* After the problem is defined and a set of written and implied specification has been obtained, the next step in design is the synthesis of the optimum solution.

D. *Analysis and optimization:* Synthesis cannot take place without both analysis and optimization, because the product under design must be analyzed to determine whether the performance complies with the specification. The analysis may reveal that the product is not an optimum one. If the design fails either or both of these tests, the synthesis procedure must begin again.

E. *Evaluation:* It is a significant phase of the total design process. Evaluation is the final proof of a successful design. Here the designer wishes to discover:
   - If the design really satisfy the need or needs?
   - Will it compete successfully with similar products?
   - Is it economical to manufacture and to use?
   - Is it easily maintained and adjusted?
   - Can a profit be made from its sale and use? etc.

F. *Presentation:* The designer has also to sale the new idea. The designer should not be afraid of possibilities of not succeeding in a presentation. In fact, occasional failure should be accepted, because failure or criticism seems to accompany every really creative idea. Those willing to risk defeat obtain the greatest gains. In final analysis, the real failure would lie in deciding not to make the presentation at all.

Research & Development in the Product Development Process

R&D efforts may involve basic research, applied research, or development.

Research & Development (R&D) refers to organized efforts that are directed toward increasing scientific knowledge or product (and process) innovation. Most of the advances in semiconductors, medicine, communications, and space technology can be made attributed to R&D efforts at college and universities, research foundations, government agencies and private enterprises. R&D efforts may involve basic research, applied research, or development. *Basic research* has the objective of advancing the state of knowledge about a subject, without any near-term expectation of commercial applications. *Applied research* has the objective of achieving commercial applications**.** *Development* converts the results of applied research into useful commercial applications. Basic research, because it does not lead to near-term commercial applications. The cost of R&D can be high. Kodak, for example spends an average of $2 million a day on R&D. Large companies in the automotive, computer communication industries spend even more. Even so, critics say that many US companies spend too little on R&D, a factor often cited in the loss of competitive advantage.

Activity: For your leather products do you think R&D is needed? Why or why not? Discuss.

Product Analysis and Testing

Product analysis and testing is the determination of how well the product's actual quality, performance, and costs conform to the design objectives. If, for example, customers' desires are not satisfied, the product may be doomed to failure, even though it is of high quality and low cost. Detailed design concerns the product's functional, form, and production design. *Functionally* the product must have the characteristics to perform the desired functions in a reliable manner. The process relates to the physical packaging of the products, which tends to be more critical for consumer goods than for industrial goods. *Production design* is concerned with how the product is produced. Alternative machines and sequences are typically available. Designers must plan the assembly or production sequence in a manner such that the specified quality is delivered within acceptable costs.

Value engineering efforts are usually undertaken to reduce costs by standardizing and simplifying product. *Standardization* offers economic benefits, for the use of uniform and interchangeable parts reduces production and inventory costs. Standardized designs are more easily mass-produced and more economically maintained. Product *simplification* efforts are aimed at reducing unnecessary variety in the product line by reducing the number and variety of products. Design dictates a majority of the production costs and deserves much attention. Successful products must ultimately satisfy technical, market and cost criteria. If any one is not met, the product should be quickly revised, updated or replaced by another.

Discussions questions

1. Comment on the following products life cycles: wooden pencils, paper clips, nails, knives, forks and spoons, drinking glasses.
2. Identify various stages for the following products: Slide rules, black and white television, computers, and calculators.
3. How can CAD help in product specification?
4. Why does Kodak spend two million dollars a day on R&D? How can it help the company?

Lesson Two: The Product Development Process

Lesson Objectives
After completing this lesson you will be able to:

- Explain the strategies for New Product Development and Introduction
- Discuss different stages of product development process

Developing a new product is a major undertaking that has various identifiable stages. As development progresses through each phase, its risk and potential are scrutinized, both technically and business wise. Product development helps a product or service attain success. This includes marketability, manufacturability and serviceability. Product's developments give a number of benefits. These include:

- *Reduced complexity of the product* – By developing a product the uses of the product can be made easier.
- *Additional standardization of components* – Standardization offers benefits to consumers and producers alike. Uniform pricing code label has meant greater efficiency.
- Improved job design
- *Improvement of functional aspects of the products* – the products can be improved by adding something else like 'games in the mobile phone set' to offer higher utility to the customer.
- *Improved job safety* – It means decreasing the probability of hazard with the product.
- *Improved maintainability (serviceability) of the product* – the maintenance of the product can be made easier and economical.

Strategies for New Product Development and Introduction
There are three fundamental ways to view the new product introduction process; it may be seen as market driven, technology driven or inter-functional in nature.

1. **Market driven:** According to this view *You should make what you can sell*. In this case, the market determines new products with little regard to existing technology and operations processes. Customers' needs are the primary (or only) basis for new product introduction. According to this view, one can determine the types of new products, which are needed through market research. These products are then produced.

Customers' needs are the primary or only basis for new product introduction.

2. **Technology driven:** This approach would suggest *You should sell what you can make*. Accordingly new products should be driven from production technology, with little regard for the market. It is marketing's job to create a market and to "sell" the products that are made. This view is dominated by vigorous use of technology and simplicity of operations changes. Through aggressive R&D and operations, superior products are created which have a natural advantage in the market place.

Technology driven view is dominated by vigorous use of technology and simplicity of operations changes.

3. **Inter-functional view:** In this view, new product introduction is inter-functional in nature and requires co-operation among marketing, operations, engineering, and other functions. The new product development process is neither market driven nor technology driven but determined by a coordinated

Inter-functional view is determined by a coordinated effort between functions.

effort between functions. The result should be new products which needs market and at the same time are compatible with existing operations. Using this approach, the new product design will fall somewhere between *making what you can sell* and *selling what you can make*. The inter-functional view usually produces the best results. It is also the most difficult approach to implement because of inter-functional rivalry and friction. New product introduction, therefore, is viewed as a continuum of possibilities, as shown in Figure 5.2.1.

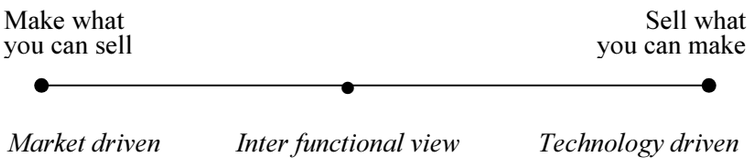

Figure 5.2.1: Strategies for product development and introduction

Stages of Product Development Process

The product development process undergoes a number of stages in the Figure 5.2.2. These are shown below.

a. Needs identification: Once a product idea surfaces, it must be demonstrative that the product fulfils some consumer need.

b. Advanced product planning (Feasibility study)**:** The next major hurdle for a product is its feasibility study. The purpose here is to anticipate whether the product can be successful or not. This comprehensive review involves

- A technical assessment of the ability to produce – this is a kind of self-assessment from the organization viewpoint of its production capabilities that the existing technology and technological support within the organization permit.
- A preliminary assessment of the market – a clear assessment of the current situation of the rapidly changing market situation is needed. The firm must have the idea about its current and potential customers, its competitors; above all the present market demand. It includes preliminary market analysis, creating alternative concepts for the product, searching for if any comparative benefit is there to market the product.
- An evaluation of the economics of the proposed product and process – the technological capabilities, the preliminary market analysis including sales projections and economic analysis including estimates of operating cost, overhead and profitability, may suggest abandoning a technologically attractive new idea.

It includes preliminary market analysis; creating alternative concepts for the product; clarifying operational requirements; establishing design criteria and estimating logistics requirements for producing, distributing and maintaining the product in the market.

c. Advanced design: Basic and applied researchers investigate technical feasibility and identify in greater detail and the trade offs in product design. Promising design alternatives are evaluated to determine whether design supports analytical testing, experimentation, physical modeling, etc.

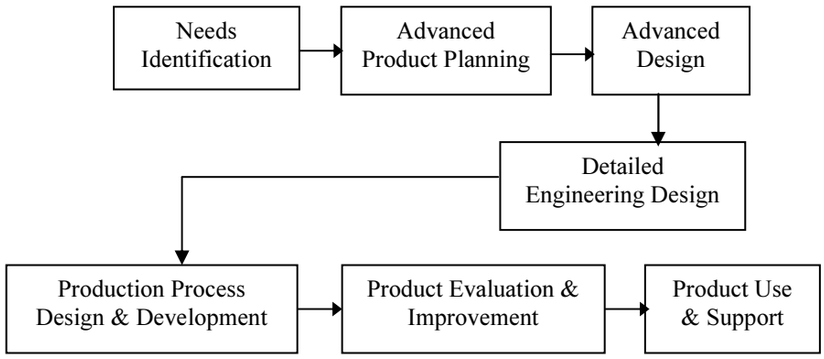

Figure 5.2.2: Product development process

d. Detailed engineering design: This stage is a series of detailed engineering activities to develop the product, the components, the materials, the sizes, the shapes and so on. This process typically involves analysis, experimentation and data collection to find design that meet several design objective:

- *Design for function* – The product is supposed to work as intended. The product has to be capable of satisfying customer needs. That is the product can fulfill the customer want from the product.
- *Design for reliability* – The product will perform consistently .The statistical measure of the probability that a product will not fail in use for many occasions, and then we can say that the product is reliably designed.
- *Design for maintainability* – The product should be so designed that its maintenance is easier and economical.
- *Design for safety* – The product should be so designed that the probability of defect or accident is very less. The product will perform with minimum hazard to the user and the environment.
- *Designs for producibility* – Products are desired to be produced at intended cost and volume. It is a key concept for manufactured goods. Ease of fabrication and assembly is important for cost, productivity, and quality.

e. Production process design and development: Working with the detailed product design, engineers and manufacturing specialists prepare plans for materials acquisitions, production, warehousing, transportation and distribution. This stage involves planning too, for production and control system, computer information system and human resource system.

f. Product evaluation and improvement: In this stage field performance and failure data, technical breakthroughs in materials and equipment, and formal research all are used to monitor, analyze and redesign the product.

g. Product use and support: An important stage of product development considers support for the consumer who uses the product. Support system might:

- Educate users on specific applications of the product,
- Provide warranty and repair service,
- Distribute replacement parts, or
- Upgrade the product with design improvements.

The process of product development described thus far can be thought of as a funnel or filter. A great many ideas originate at the beginning; but only a few are successfully introduced to the market as product. Product development is very important because of the fact that among the few products introduced in the market, and only a small percentage of them become successful in the long run.

Discussion questions

1. Under what circumstances might a market driven approach or a technology driven approach to product design be the best approach?
2. Describe the steps that might be in writing and producing a play. Compare these steps to the product development steps.
3. Why is inter-functional cooperation important for product development?

Lesson Three: Process Flow Design & Process Selection

Lesson Objectives
After completing this lesson you will be able to:

- Identify the differences between process, product and repetitive focus
- Explain different types of process selection
- Discuss different types of production process

The Process Flow Design
A process is the approach that an organization takes to transform resources into goods and services. The objective of a process strategy is to find a way to produce goods that meet customer requirements and product specifications within cost and other managerial constraints. There are mainly three types of processes. These are,

a. *Process focus*: Low-volume and high variety processes are process focused. It is also known as intermittent processes. The facilities are organized around process. The layout and supervision have a process focus.

Table 5.3.1: Comparison among Process, Repetitive & Product focus

Process Focus	Repetitive Focus	Product focus
a. Small quantity and large verity of products are produced. b. Operators must be more broadly skilled. c. There are many job instructions because each job changes are different. d. Raw material inventories are high relative to the value of the product. e. Work in process is high compared to output. f. Finished goods are usually made to order and not stored. g. Fixed costs tend to be low and variable costs high. h. Costing, often done by the job, is estimated prior to doing the job, but known only after the job.	a. Long runs, usually a standardized product with options, are produced from modules. b. Employees are modestly trained. c. Repetitive operations reduce training and changes in job instructions. d. Just-in-time procurement techniques are used. e. Just-in-time inventory techniques are used. f. Finished goods are made to frequent forecasts. g. Fixed costs are dependent on flexibility of the facility. h. Costs are usually known, because of extensive prior experience.	a. Large quantity and small variety of products are produced. b. Operators are less broadly skilled. c. Work orders and job instructions are few, because they are standardized. d. Raw materials inventories are low relative to the value of the products. e. Inventory of work-in-process is low compared to output. f. Finished goods are usually made to a forecast and product flows. g. Fixed costs tend to be high and variable costs low. h. Because fixed costs are high, costs are highly dependent on utilization of capacity.

b. *Product focus*: High-volume, low-variety processes are product focused. The facilities are organized around products. They are also called continuous processes. They have very long, continuous production runs. Such products include paper, tin, etc.

c. *Repetitive focus*: The repetitive process line is the classic assembly line. Repetitive processes use modules. Modules are parts or components previously prepared often in a continuous process. The repetitive process is widely used, including the assembly of virtually all automobile and household appliances. Fast-food firms are an example of a repetitive process using modules.

Process Selection

In the manufacturing the product, the process selection refers to the way an organization chooses to produce its goods. Essentially it involves choice of technology and related issues. And it has major implications for capacity planning, layout of facilities, equipment, and design of work systems. Figure 5.3.1 provides an overview of where process selection fits into system design. Process selection occurs when new products or services are being planned. However it also occurs periodically due to technological changes in equipment**.**

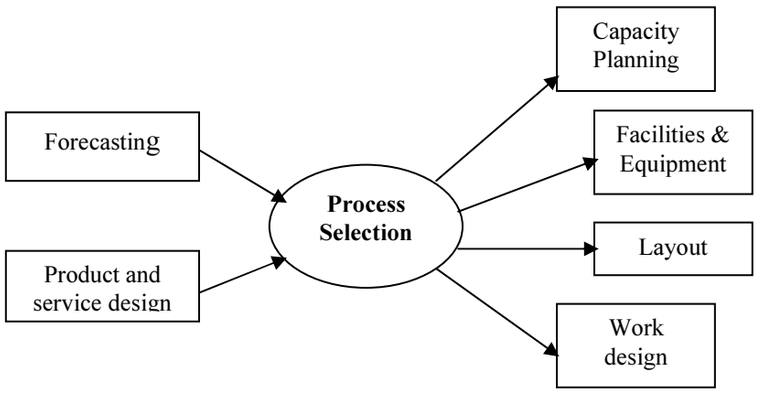

Figure 5.3.1: Product selection

In the processing system the continuous and intermittent processing have some key differences which affect- how these systems are managed. The following sections highlight the key differences between the processing systems.

Continuous and Semi-continuous Processing

High volumes of standardized output are produced by continuous processing systems.

High volumes of standardized output are produced by continuous processing systems. The ultimate continuous processing systems produce a simple product such as flour or sugar. Generally, these products are measured on a continuous basis rather than counted as discrete units. Industries that use continuous processing are sometimes referred to as process industries. Products of process industries include plastics, chemicals, petroleum, grain, and steel. Other examples include liquid and powder detergents, and water treatment. The output of the system is highly standardized. Semi continuous processing produces outputs that allow for some variety; products are highly similar but not identical. Example includes automobiles, television, computers, calculators, cameras and video equipments. This form of processing is often referred to as repetitive manufacturing.

Intermittent Processing

When systems handle a variety of processing requirements, intermittent processing is used. Volume is much lower than in continuous system.

Intermittent systems are characterized by general-purpose equipments that satisfy a variety of processing requirements, a narrow work span of supervision than for most continuous systems.

Intermittent systems are characterized by general-purpose equipments that can satisfy a variety of processing requirements, semiskilled or skilled workers who operate the equipment, a narrow work span of supervision than for most continuous systems. One form of intermittent processing occurs when batches, or lots, of similar items are processed in the same manner (e.g., food processing). A canning factory might process a variety of vegetables; one run may be sliced carrots, the next green beans, and the next corn beets. All might need similar process of washing, sorting, slicing, cooking, and packing, but the equipment needs to be cleaned and adjusted between runs.

Another form of intermittent processing is done by a job shop which is designed to handle a great variety of job requirements than batch processing .Lot sizes vary from large to small, even a single unit. What distinguishes the job shop operation from batch processing is that the job requirements often vary considerably from job to job. Examples of intermittent processing are textbook publication, bakeries, health care systems, and educational systems. In some cases the outputs are made for inventory (clothing, automobile tires); in others, they are destined to meet customer needs (health care) or specifications (special tools, parts, or equipment).

Activity: What are the fundamental differences between continuous and intermittent processing? Why and how these two are important for your leather products? Discuss.

Types of Process

Process technologies are broadly of five types according to its unique operating characteristics, problems, and challenge. These five types are Job shop, Batch, Assembly line and Continuous and Project. The following discuss these types of process in detail.

Job shop technology is suitable for a variety of custom–designed products in small volumes.

i. **Job shop:** Job shop technology is a process technology suitable for a variety of custom–designed products in small volumes. Job shop technology is appropriate for manufactures of small batches of many different products. It is also considered as intermittent processing systems because small quantities are produced.

Batch technology is a process technology suitable for a variety of products in varying volumes.

ii. **Batch**: Batch technology is a process technology suitable for a variety of products in varying volumes. Batch technology is a step up from job shop technology in terms of products standardization, but it is not as standardized as assembly line technology. Within the wide range of products in the batch facility, several are demanded repeatedly and in large volumes. These few dominant products differentiate batch facilities from job shops. The system must be flexible for the low-volume/high-variety products, because it is meant for those many jobs which are performed with frequent shifting from one job to another. This system has a high to moderate variety range. Many food items are produced by batch system.

iii. **Assembly Line:** Assembly line technology is a process technology suitable for a narrow range of standardized products in high volumes. Assembly line (or simply line) technology is for facilities that produce a narrow range standardized products. Laundry appliances are a representative example. Since the product designs are relatively stable, specialized equipment, human

skill and management systems can be developed and dedicated to the limited range of products and volumes. Beyond this range, the system is inflexible. Automobiles, for example are produced in Assembly Line system.

iv. **Continuous:** Continuous process is suitable for producing a continuous flow of products. Chemical plants and oil refineries exemplify users of continuous flow technology. Materials and products are produced in continuous, endless flows rather than in batches or discrete units. The product is highly standardized, as are all of the manufacturing procedures, the sequence of product buildup, materials and equipment. Continuous flow technology affords high-volume, around- the-clock operation with the capital-intensive, specialized automation. It produces large volumes of one highly standardized item. There is no processing variety. Sugar is produced by a continuous processing system.

Continuous process is suitable for producing a continuous flow of products.

v. **Project:** Project technology is suitable for producing *one-of-a-kind* products. Project technology deals with products that are tailored to the unique requirement of each customer. A construction company, with its many kinds and sizes of projects, is an example. Since the products cannot be standardized, the conversion process must be flexible in its equipment capabilities, human skills and procedures. The conversion process features problem solving, teamwork, and coordinated design and production of unique products. It is suitable for handling complex jobs consisting of unique sets of activities that must be completed in a limited time span. Examples include large or unusual construction projects, new product development or promotion, space mission, and disaster relief efforts.

Project technology is suitable for producing *one-of-a-kind* of products.

Matching the Process and Product

A key concept in process selection is the need to match product requirement with process capabilities. The difference between success and failure in production can sometimes be traced to choice of process.

Table 5.3.2: Matching the process with product variety, equipment flexibility and volume requirements

Product Variety	**High**	**Moderate**	**Low**	**Very Low**
Equipment Flexibility	High	Moderate	Low	Very Low
Low volume	Job Shop			
Moderate Volume		Batch		
High volume			Repetitive Assembly	
Very High volume				Continuous Flow

Selecting the process and managing existing operation is an important responsibility of managers. For new products, decision makers should make every attempt to achieve a matching of product and process requirements. For on going operations a manager should examine existing processes in light of product variety, equipment flexibility and volume requirements

Discussion quotations

1. Why are the continuous processes so much more efficient but less flexible than intermittent processes? Give three reasons.
2. Why is product variety concern in developing a product?
3. The project process is typically used for skyscraper construction. Does this lead to higher costs? Could more efficient processes be used? If so, how?

Lesson Four: Automation

Lesson Objectives
After completing this lesson you will be able to:

- Discuss the importance of Automation
- Explain Automation and mechanization alternatives

Automation means the use of automatic equipment and machines to do work previously done by men. Automation issues are more related and important to the manufacturing process. Think of a cutting machine of a garment factory. This machine cuts a huge amount of cloth at a time. In every sector machines make the work easy and short. Technology is a powerful tool in developing competitive advantage via both product and process strategy. The firms that achieve the most success at using technology as competitive advantage are organizations that:

Automation means the use of automatic equipment and machines to do work previously done by men.

- Plan for a more distant time horizon
- Have a narrow product line, i.e., they *stick to their knitting* and know their product and customer exceedingly well.
- Have strong internal technical capabilities that are tied to their strategic analysis.
- Have consistent and stable strategic management, i.e., they seem to be better at implementing the changes necessary for effective use of technology.

Now the question is what degree of technological change, mechanization, and automation is strategically better for any organization? Responding correctly to this question is often critical to the survival of the business. It takes experience and wisdom to make such a decision. However some of the mechanization alternatives that business face today are:

A. Flexible Manufacturing systems (FMS)
B. Computer aided design (CAD) & Computer aided manufacturing (CAM)
C. Robotics
D. Automated Guided Vehicles (AGVs)
E. Computer integrated manufacturing (CIM).

A. Flexible manufacturing systems (FMS)
An FMS is a process technology that can produce a moderate variety of products in modest volumes, and can do so quickly and with high quality. Operating costs and tools can be reduced with an FMS. But an FMS requires very large capital investments in equipment, planning and control system and human resources. A flexible manufacturing system (FMS) is an arrangement of machines interconnected by a transport system. The transporter carries work to the machines on pallets or other interface units so that work-machine registration is an accurate, rapid and automatic system. A central computer controls both machines and transport. CAD and CAM systems have provided the means to design and plan the physical processes that will be needed to manufacture the product. This is carried out on the factory floor in a way which gives raise to

minimum cost and maximum flexibility, by using the technology called Flexible Manufacturing Systems (FMS). It is generally appropriate when:

- All products are variations of a stable basic design
- All products utilize the same family of companies
- The number of components is only moderate (10 to 50)
- The volume of each component is moderate, but in sizes as small as one unit.

B. Computer aided design (CAD) and Computer aided manufacturing (CAM)

The CAD or CAM is use of a computer to develop the geometry of a design. Product design is greatly enhanced through the use of Computer Aided design (CAD). CAD techniques are now used in mechanical engineering and electrical engineering. Where CAD is used, a design engineer starts by developing a rough sketch. The designer then utilizes a graphic display to construct the geometry of a design. When a geometric definition is completed, a sophisticated CAD system will allow the designer to determine various kinds of engineering data, such as strength or heat transfer. CAD will also allow the designer to ensure that parts fit together so there will be no interferences when parts are subsequently assembled. Proctor and Gambler used CAD when designing its Crest Toothpaste pump dispenser.

CAD will also allow the designer to ensure that parts fit together so there will be no interferences when parts are subsequently assembled.

On the other hand the CAM is the use of information technology to control machinery. Once the product has been designed, it needs to be manufactured. Manufacturers are increasingly using machine tools which are numerically controlled (programmable). As a result it is critical for the investment in CAD and Computer Aided Manufacturing (CAM) technology to be fully integrated.

Activity: Do you think for designing your leather products you need CAD or CAM? Why or why not? Discuss.

Benefits of CAD/ CAM

There are several benefits to the CAD/ CAM approach:

- Product quality. CAD provides an opportunity for the design to investigate more alternatives, potential problems, and dangers.
- Shorter design time: Since time is money, the shorter the design phase, the lower the cost.
- Production cost reductions: Lower inventory cost, more efficient use of personnel through improved scheduling and faster implementation of design changes lower costs. Group technology as a part of CAD/CAM further reduces the costs.
- Database availability: Consolidating current accurate product data everyone is operating from the same information. This results in cost reductions.
- New range of capabilities: For instance, the ability to rotate and depict objects in three dimensional form, to check clearances, to relate parts and attachments, to improve use of numerically controlled machine tools- all provide new capability for manufacturing. This is a major benefit of CAD/CAM.

C. Robotics

A robot is a programmable machine, which means that a sequence of move scan be preset to be repeated time after time, then reset again to perform another set of moves. When robots are part of a transformation system, they usually provide the movement of material between machines, They may also be used effectively to perform tasks that are especially monotonous or dangerous, or where the task can be enhanced by the substitution of mechanical for human effort. This would be the case where consistency, accuracy, speed or the necessary strength or power can be enhanced by the substitution of machines for people.

The primary advantage of robots over humans is that robot performance never varies. The robot shows the work each day and is just as consistent on a Monday morning and on a Friday evening as every other hour of the week. A robot does not get tired or become distracted. Robots can perform variety of specialized tasks and sequences to precise specifications, and they require less plant space than do alternative production processes.

D. Automated Guided Vehicles (AGVs)

Automated guided vehicles are electronically guided and controlled carts used in manufacturing to move parts and equipment. They are also used in offices to move mail and in hospitals and in jails to deliver meals.

E. Computer Integrated Manufacturing (CIM)

Computer integrated manufacturing is an important and effective means of achieving productivity improvements which must be seriously considered by manufacturing companies wishing to become and remain competitive, and which should be encouraged in the national interest so that application of appropriate technology can improve our ability to compete in international markets and against cheaper, high quality imports in the domestic market.

A manufacturing system in which electronically controlled machines are integrated with robots, transfer machines, or automated guided vehicles create a complete manufacturing system. CIM centers around a shared database for four primary manufacturing functions: engineering design, manufacturing engineering, factory production and information management.

Case Analysis

Blessings of Digital technology

Dr. Mamun, Associate Professor of I.B.A., was speaking on a seminar on *Blessings of Digital technology.* He said, it was not so long ago when the aristocrats of the society used to listen to the song in a gramophone record. It was a symbol of luxury at that time. Then came the time of the Cassette player. Now this is the age of Digital technology. We are already introduced and well habituated to compact disks and approaching to very recently developed Digital audio tapes .The manufacturing companies made this possible because of being aware of the opportunities of the new product in the market. It was a coordinated effort of judging the existing market opportunity and utilizing the latest technology.

Case questions

1. What may be the motive behind the step-by-step development of this new product?
2. Justify your perception on the strategy of these products introduction.

Case Analysis

The Orion Group of Industries

Mr. Rahman M.P. is the member of parliament of Palashpur. He is the chairman of Orion group of industries. Polashpur is a very under-developed and high density area and the local people are almost illiterate. . He promised before the last election that he would set-up a manufacturing industry here for the employment of the local people. He said 80% of the workers of the factory would be employed locally. The next election is very near and he decided to immediately start construction of the factory. Mr. Rahman is in an important meeting with Mr. Ali, Mr. Reza and Mr. Zia about what they will manufacture. Mr. Ali, the G.M. of the company has a paper of company future expansion plan and said that we have to make choice among the three products X, Y, Z. The technical manager Mr. Zia informed the chairman that product X has a lot of variety. It is a very profitable one, product Y is a standardized product and needs to be produced in large volume and product Z is a product, which will be produced with latest and very sophisticated technology. Mr.Rahman said to the operation manager, “Mr.Reza, you know that I have two other places where I shall immediately set-up factories. So plan for the most suitable product here. I want no loss.”

Case question

1. In your opinion which product should Mr. Rahman suggest? Why?

Discussions questions

1. How can CAD help a design engineer in product design?
2. What are the advantages of CAD & CAM?
3. Write down the applications of CIM.