**Topic11: Process Design**

Overview

Operations managers always look for the best way to produce goods or services with the minimum resources and the incurrence of wastage. This is made possible through the development of a production process that meets the customer requirements and product specifications within cost and other managerial constraints.

Learning Outcomes

By the end of this topic, you will be able to:

1. explain the process design is to bring about the transformation of the inputs to become the finished products or the services to meet the customer requirements.
2. distinguish the four possible strategies by which the transformation process can take place in an organisation: process focus, repetitive focus, product focus and mass customization.
3. consider the special approach to service process design to be different from the process design for product in term of involvement of customer interaction and the need to accommodate the requirements of the customer.
4. explain the flexible manufacturing systems (FMS) (also known as computer-integrated manufacturing (CIM), smart factories, advanced manufacturing technology, agile manufacturing or the factory of the future)
5. provide due consideration of the importance of technology advances in conversion process as seen in medicine, food industry, security and education.
6. identify the sustainability of a process design to be dependent on four Rs -rresources, recycling of production materials and component of products, regulations and firm’s reputation.

Introduction

11.1 The four types of process strategies: process focus, repetitive focus, product focus and

mass customization.

11.2 Special considerations for service process design.

11.3 Flexible manufacturing systems (FMS) - computer-aided design (CAD) and computer-

aided manufacturing (CAM) and integrated information network (for decision making)

to represent the highest level of flexible manufacturing.

11.4 Rapid advances in technology are taking place in many fields - medicine, education,

food industry, and security.

**Lecture Notes**

**11. Process Design**

The process design must provide for the best way to produce goods or services with the minimum resources and the minimum incurrence of wastage.

What is a process strategy?

A process (or transformation) strategy is an organisation’s approach to transforming resources into goods and services.

The objective of a process strategy is to build a production process that can meet customer requirements and product specifications within cost and other managerial constraints.

There are four types of process strategy:

1. Process focus
2. Repetitive focus
3. Product focus
4. Mass customization

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| Process focus | Repetitive focus | Product focus | Mass customization |
| Small quantity & large variety of products are produced. | Long runs, usually a standardized product with options, are produced from module (parts/components) | Large quantity and small variety of products are produced. | Large quantity & large variety of products are produced. |
| Equipment used is general purpose. | Special equipment aids in use of an assembly line. | Equipment used is special purpose. | Rapid changeover on flexible equipment. |
| Operators are broadly skilled. | Employees are modestly trained. | Operators are less broadly skilled. | Flexible operators are trained for the necessary customization. |
| There are many job instructions because each job changes. | Repetitive operations reduce training & changes in job instructions. | Work orders & job instructions are few because they are standardized. | Custom orders require many job instructions. |
| Raw material inventories are high relative to the value of the product. | Just-in-time procurement techniques are used. | Raw material inventories are low relative to the value of the product | Raw material inventories are low relative to the value of the product. |
| Work-in-progress is high compared to output. | Just-in-time inventory techniques are used. | Work-in-progress inventory is low compared to output. | Work-in-progress inventory is driven down by JIT, kanban, lean production. |
| Units move slowly through facility. | Assembly is measured in hours and days. | Swift movement of units through the facility is typical. | Goods move swiftly through the facility. |
| Finished goods are usually made to order and not stored. | Finished goods are made to frequent forecasts. | Finished goods are usually made to a forecast & stored. | Finished goods are often build-to-order (BTO). |
| Scheduling is complex and concerned with the trade-off between inventory availability capacity & customer service. | Scheduling is based on building various models from a variety of modules to forecasts. | Scheduling is relatively simple & concerned with establishing a rate of output sufficient to meet sales forecasts. | Sophisticated scheduling is required to accommodate custom orders. |
| Fixed costs tend to be low and variable costs high. | Fixed costs are dependent on flexibility of the facility. | Fixed costs tend to be high & variable costs low. | Fixed costs tend to be high, but variable costs must be low. |

**Comparison of Process Choices**

Each of the processes when properly matched to volume and variety can produce a low-cost advantage. E.g. unit cost can be less in the continuous-process case when high volume exists. But continuous-process is not always used because it is too expensive when volumes are low or flexibility is required.

A low-volume, unique, highly differentiated good of service is more economical when produced under process focus; this is the way find-dining restaurants and general-purpose hospitals are organised. Just as all four processes, when appropriately selected and well managed, can yield low cost, so too can all four be responsive and produce differentiated products.

**Requirements to achieve Mass Customization**

**Repetitive Focus**

Flexible people & equipment

Module techniques

Accommodating Responsive

product and process **Mass Customization** supply chains

design

Effective Rapid **Product Focused**

**Process Focused**  scheduling throughput Low variety, high volume

High variety, low volume techniques techniques High utilization (70% to 90%)

Low utilization (5% to 25%) Specialized equipment

General-purpose equipment

The diagram above indicates that equipment utilization in a process-focused facility is often in the range of 5% to 25%. When utilization goes above 15%, moving towards a repetitive or product focus or even mass customization may be advantageous. A cost advantage usually exists by improving utilization, provided the necessary flexibility is maintained. McDonald’s started an entirely new industry by moving its limited menu from process focus to repetitive focus. McDonald’s is now trying to add more variety and move toward mass customization.

Much of the things produced in the world are in small lots e.g. legal services, medical services, dental services and restaurants. This is the result of low equipment utilization and costs are therefore considered high. Why? Reasons: expectation of peak loads, poor scheduling.

**Process Analysis and Design**

When analysing and designing processes, the fundamental question is whether competitive advantage can be achieved. Tools to help the understanding of the complexity of process design and redesign:

1. Flowchart (1st tool) - a schematic or drawing of the movement of material, product or people.
2. Time-function Mapping (also known as process mapping) - a tool for process analysis and design with time included on the horizontal axis. It is actually a flowchart. It helps to identify and eliminate waste, duplication and delay.
3. Value-Stream Mapping (VSM) - a process that helps managers understand how to add value in the flow of material and information through the entire production process. It starts with the customer, the production process and extends to the suppliers. It also show the management decisions and information systems that supports the process.
4. Process Charts - charts use symbols, time and distance to provide an objective and structured way to analyses and record the activities that make up a process. They allow us to focus on value-added activities.
5. Services Blueprinting - a process analysis technique that focuses on the customer and the provider’s interest with the customer. E.g. a customer comes to a car service centre, a warm welcome is given to him and find out the service required of the customer’s car. The customer agrees to have his car to be serviced and he hands over his car key. Next the car is driven by the service person to the workshop. The customer then waits at customer lodge where coffee or tea is serviced with some biscuits and there are newspapers or magazines he can read or watch the TV. As soon as the car has been serviced, the customer is informed and is told of what has been done to the car and when he needs to come again for the next due service. A service bill is presented to him for the necessary payment. The customer pays the bill and gets his car keys. He is shown where his car is parked. The customer gets his car and drives his car out of the service centre. The various activities are recorded according to time.

**Special Considerations for Service Process Design**

Interaction with the customer may affect the process performance adversely. It is important to understand the customer’s unique desire which can create problem with a process and the manager has to design the process to accommodation such situation.

Customer Interaction and Process Design

The 4 quadrants of the figure below provide additional insight on how operations managers design service processes to find the best level of specialization and focus while maintaining the necessary customer interaction and customization. The 10 operations decisions that were introduced in chapters 1 and 2 are applied with a different emphasis in each quadrant.

For instance:

* In the upper quadrant of mass service and professional service, where labour content is high, the manager is expected to focus extensively on human resources. This is often done with personalised services, requiring high labour involvement and therefore significant selection and training issues in the human resources area. This is particularly true in the professional service quadrant.
* The quadrant with low customization tend to (1) standardize or restrict some offerings, as do fast-food restaurants, (2) automate, as have airlines with ticket-vending machines, or (3) remove some services, such as seat assignments, as has Southwest Airlines. Offloading some aspect of the service through automation may require innovations in process design as well as capital investment. Such is the case with airline ticket vending and bank ATMs. This move ti standardization and automation may require added capital expenditure, as well as putting operations mangers under pressure to develop new skills for the purchase and maintenance of such equipment. A reduction in a customization capability will require added strength in other areas.

**Degree of Customization**

Low High

**Mass Service Professional Service**

Private Traditional orthodontics

Commercial banking banking

High General purpose

Degree of Full service law firm

labour stockbroker Digitized

Boutique orthodontics

Retailing

**Service Factory** Law clinics **Service Shop**

Limited service Specialised

stockbroker hospital

Warehouse and Fast food Fine-dining Hospitals

Low catalogue store restaurants restaurants

Airlines

No frills airlines

* Because customer feedback is lower in the quadrants with low customization, tight control may be required to maintain quality standards.
* Operations with low labour intensity may lend themselves particularly to innovations in process technology and scheduling.

The table below shows some additional techniques for innovative process design in services. Managers focus on designing innovative processes that enhance the service. For instance, supermarket self-service reduces cost while it allows customers to check for the specific features they want, such as freshness or colour. Dell Computer provides another versionof self-service by allowing customers to design their own product on the Web. Customers seem to like this, and it is cheaper and faster for Dell.

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| Strategy | Technique | Example |
| Separation | Structuring services so customers must go wherethe services is offered | Bank customers go to a manager to open a new account, to loan officers for loans and to tellers for deposits. |
| Self-service | Self-service so customers examine, compare and evaluate at their own pace. | Supermarkets and department stores .  Internet ordering |
| Postponement | Customizing or delivery | Customizing vans at delivery rather than at production. |
| Focus | Restricting the offerings | Limited-menu restaurant |
| Modules | Modular selection of service  Modular production | Investment and insurance selection  Prepackaged food modules in restaurant |
| Automation | Separating services that may lend themselves to some type of automation | Automatic teller machines |
| Scheduling | Precise personnel scheduling | Scheduling ticket counter personnel at 15-minute intervals at airlines. |
| Training | Clarifying the service options  Explaining how to avoid problems | Investment counsellor, funeral directors  After-sale maintenance personnel |

***More Opportunities to Improve Service Processes***

1. Layout design - an integral part of many service processes, particularly in retailing, dining

and banking as it provides continuing opportunity for winning orders.

In retailing layout can provide not only product exposure but also customer education and

product enhancement.

In restaurant, layout can enhance the dining experience as well as provide an effective flow

between bar, kitchen and dining area.

In bank, layout provides security as well as work flow and personal comfort.

2. Human resources - services involve direct interaction with the customer, recruiting and

training become important ingredients in service processes. A committed workforce that

exhibits flexibility when schedules are made and is cross-trained to fill in when the process

requires less than a full-time person, can have a tremendous impact on overall process

performance.

**Selection of Equipment and Technology**

The selection of equipment for a particular type of process is important and it provides competitive advantage. Firms have developed unique machines or techniques within established processes that provide an advantage such as flexibility in meeting customer needs, lower cost of production or higher quality of products. Innovation and equipment modification allow for a more stable production process requiring less adjustment, maintenance and operator training. Having specialize equipment helps to gain more orders.

Flexibility in production operation helps to enlarge the scope of processes and therefore it is imperative to look for flexible equipment. Flexibility is defined in terms of time saving, cost saving or providing customer value. This may mean modular, movable, even cheap equipment. It may also mean the development of sophisticated electronic equipment, that allows rapid changes to meet different orders and for mass customization demands.

**Production Technology**

Advances in technology that enhance production and productivity have a wide range of applications in both manufacturing and services. Nine areas of technology are presented below:

1. Machine technology

Are machines for cutting, drilling, boring and milling. They have become more precise and better controlled. They can work faster and are about five times more productive than before. They are smaller in size and use less power. Some machines use water as the lubricant rather than oil-based. They can be electronically controlled in terms of speed, changeover time is reduced, and improved quality production.

1. Automatic identification system (AIS)

Data can be incorporated into the products for identification purposes e.g. ATM machines. The cheaper and pervasive radio frequency identification (RFID) nowbeing accepted. It is an integrated circuitry with its own antennas that use radio waves to send sigals a limited range - usually a few yards. These RFID tags provide unique identification that enables the tracking and monitoring of parts, pallets, people and pets - virtually everything that moves. Uses:

* Nurses reduce errors to hospitals by matching bar codes on medication to ID bracelets on patients.
* RFID tags in agriculture monitor the temperature at which fruits is kept and also track what chemicals and fertilizers being used on the fruit.

1. Process content

It is the use of information technology to monitor and control a physical process. It is used to measure the moisture content and thickness of paper as it travels over a paper machine at thousands of feet per minute or to determine and control temperatures, pressures and quantities in petroleum refineries, petrochemical processes, cement plants, steel mills, nuclear reactors and other product focused facilities.

1. Vision systems

The system is a combination of video camera and computer technology in inspection role. Visual inspection is an important task in most food-processing and manufacturing organizations as well for other purposes.

1. Robots

They are mechanical devices that use electronic impulses to activate motors and switches to perform tasks that are especially monotonous or dangerous or those that can be improved by the substitution of mechanical for human effort. They are used for accuracy, consistency, speed, strength or power can be enhanced. Robots do 98% of the welding and most of the painting on some automobiles.

1. Flexible manufacturing systems (FMS)

This system uses an automated work cell controlled by electronic signals from a common centralized computer facility. The central computer provides instructions to each workstation and to the material-handling equipment (which moves material to that station). An FMS is flexible because both the material-handling devices and the machines themselves are controlled by easily changed electronic signals (computer programmes). Operators simply load new programmes, as necessary, to produce different products. The result is a system that can economically produce low volume but high variety.

1. Computer-integrated manufacturing (CIM)

Flexible manufacturing systems (FMS) can be extended backward electronically into the engineering and inventory control departments and forward to the warehousing and shipping departments. This is called the ‘computer-integrated manufacturing’. In this way, computer-aided design (CAD) generates the necessary electronic instructions to run a numerically controlled machine. In a computer-integrated manufacturing environment, a design change initiated at a CAD terminal can result in that change being made in the part produced in the shop floor in a matter of minutes.

FMS and CIM are reducing the distinction between low-volume/high-variety and high-volume/low-variety production. Information technology is allowing FMS and CIM to handle increasing variety while expanding to include a growing range of volumes.

**Technology in Services**

Rapid advances in technology are taking place in the service sector. These range from electronic diagnostic equipment at auto repair ships, to blood- and urine-testing equipment in hospitals, to retinal security scanners at airports and high-security facilities. They also extend to the hospitality industry and fast-food industry like McDonald’s, in education, wholesale/retail trade, transportation, airlines, healthcare, restaurants, financial services, utilities and government.

**Process Redesign**

It is the fundamental rethinking of business processes to bring about dramatic improvements in performance. Effective process redesign relies on re-evaluating the purpose of the process and questioning both purpose and underlying assumptions. It works only if the basic process and its objectives are re-examined.

It also involved focusing on those activities that cross-functional lines. Redesign casts aside all notions of how the process is currently being done and focuses on dramatic improvements in cost, time and customer value. The process any be anyone; a factory layout, a purchasing procedure, a new way of processing credit applications or a new order-fulfilment process.

**Sustainability**

The sustainability of a process design depends on four Rs:

1. The resources used by the production process:

Resources (human, financial and materials) are the primary inputs used by the production process (operation).

1. The recycling of production materials and product components:

Recycle - three things can be done to a waste: burn, bury or reuse it. The first two bring about the destruction of the waste and serves no useful purpose but may create pollution to the environment. Recycling of the waste requires reuse of the waste material for useful purpose and brings about an economic benefit.

1. The regulations that apply:
2. Regulations - laws and regulations affecting transportation, waste and moose are proliferating and can be as much of a challenge as reducing resource use. Firms must abide by the legal requirements of the host nation and the society. Firms have to design, redesign and invest substantial human and financial resources. Another sustainability issue is evaluating and reducing the carbon footprint. It deals with the greenhouse gasses released from farming, cattle and decaying forest but also by manufacturing and services.
3. The firm’s reputation.

Reputation - firms that do not meet the expectations of the society will be difficult to

sustain their existence. Firms that established ethical practices and showed social

responsibility are welcomed by the society and achieved sustainable position.