Operation Management

MME-1216

Four modules

Dir. B.B. Panni
(3) Make the value flows without intercepts
(4) Let the customer pull value from the producer.
(5) Pursue perfection.

Components of Lean Manufacturing

The following are the components of lean manufacturing:
1. Standardized production
2. Continuous improvement in production.
3. Adoption of JIT in production.
5. Poka Yoke adaption.
7. Single minute exchange die.
8. Flexible workforce.

X ——— X
Module 1

Functional Subsystem of an Organization

An organization consists of four subsystems, viz. Marketing, Production, Finance, and Personnel.

Operation Management

Operation management is the process of managing and transforming various resources used in the production operation subsystem of the organization into value-added products/services in a controlled manner as per the policies of the organization. The set of interrelated activities which are involved in producing certain products is
If the above concept is extended to services management, then the corresponding set of management activities is called operational management.

The management objectives are classified into strategic objectives, tactical objectives, and operational objectives.

5. System concept of production

System is a collection of interrelated entities.

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Input
  Materials
  Labour
  Equipment
  Capital

Transformation

Output
  Good/Services

Operation/Management
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The techniques and procedures used in the Production/Operation Subsystem are as follows:

1. Forecasting
2. Location and layout techniques
3. Product design and analysis
4. Production control techniques
   a. Aggregate planning
   b. Master production schedule
   c. Material requirement planning
   d. Capacity planning
5. Scheduling and control
   a. Line balancing
   b. Line of Balance
   c. Single piece scheduling
   d. Flow shop scheduling
   e. Job shop scheduling
6. Maintenance Management
7. Feedback and control techniques
   a. Cost Quality control
   b. Inventory control
8. Types of Production System
undergoes the same sequence of operations using specialised equipment usually positioned along a production line.

Example: Auto assembly, assembly of TV sets, etc.

Flow shop can be classified into continuous flow shop and intermittent flow shop.

2. **Job Shop** - This is a conventional process in which units of different types of products follow different sequences through different shops. This type of subsystem has more flexibility but this system results in more set-up time, more retooling, elementary computer scheduling, varying quality, etc.

3. **Batch Manufacturing**

   They produce some intermediate varieties of products with intermediate volumes. The volume of any single product may not be sufficient to justify the use of a dedicated set of equipment for its production. The sequence of processes is much narrower than in a job shop.
with a set of well-defined tasks in terms of resources required and time phasing.

Example: Dom Construction, starting new industries etc.

8. Strategic Management —

The process of making decisions about their future in this complex and changing environment is called Strategic Management. This process has two phases:

(i) Formulation of Strategy.
(ii) Implementation of Strategy.

Strategy formulation is concerned with:
- Defining the organization's mission.
- Establishing long and short range objectives to achieve the organization's mission.
- Selecting the strategy to be used in achieving the organizational objective.

Strategy implementation consists of:
- Administration, organizational structure, system, and processes with chosen strategy.

Types of Corporate Strategies:
(i) Stable Growth Strategy.
1. Concentric Diversification.
2. Vertical Diversification.
3. Horizontal Diversification.

3. Endgame Strategies.

4. Retrenchment Strategies.
   - Turnaround Strategy.
   - Divestment Strategy.
   - Liquidation Strategy.

5. Combination Strategy.
   - Simultaneous Strategy.
   - Sequential Strategy.

   A list of generic competitive (at least)
   strategies is as follows:
   - Overall cost leadership strategy.
   - Differentiation strategy.
   - Focus strategy.

   Under these form strategies are
   there:
   1) Marketing Strategies.
   2) Financial Strategies.
   3) Personnel Strategies.
5. **Gross Domestic Product (GDP)**

GDP of a nation is the sum of values of goods and services produced in that nation in a year.

India has very low percent GDP. After liberalization many multinational companies are coming to India to set up their business units here to avail the cheap material and cheap labour. This gives tremendous opportunities to India and hence the growth in the GDP of India.

6. **World Class Manufacturing**

World Class manufacturing concept is a recent origin. The following attributes of World Class manufacturing are aimed to fulfill the customer demand:

1. Product with high quality.
2. Product with competitive price.
3. Products with enhanced features.
4. Products in wider variety.
5. Products delivered within shorter lead times.
6. Products delivered on time.
5. Line Balancing

The main objective of flow control in a flow shop is to balance the assembly line. The assembly line is represented in the form of a precedence diagram. Sample of this is here:

The precedence diagram specifies the order or sequence in which the activities must be performed. Each circle is a node and the number inside each circle identifies a particular operation. The number outside the circle represents the duration of the operation. Arrows indicate the direction of flow operation.

Cycle Time = Production Time / Demandperiod
8 Objective of Assembly Line Balancing:

The objective of assembly line balancing is to subdivide the network into several subnetworks without violating the precedence relationships and allocating operations to each station without exceeding the cycle time.

This type of problem comes under combinatorial category. Here we have to use some heuristics for this purpose.

1. Ranked Positional Weight (RPW) method
2. CONSOL method

(1) Rank Positional Weight Method

This method assigns those jobs first whose followers have the longest total time. The positional weight of a work element is its sequent processing time plus the processing times of all the following work elements. In this, the work element with the highest positional weight is selected and assigned to the current station. The generalized algorithm stated earlier can be used.
Using the maximum rank positional weight as the selection criterion.

Example: Page 186. DPM, Poonen-Selvan.

§ The COMSOLAL Algorithm

The computer operations for assembly line (COMSOLAL) celedas developed by Arcus. Here a simulation method is used. We can choose the solutions that satisfy our need the most.

The following conditions must be satisfied:

(i) All its immediate predecessors are already assigned.
(ii) Its processing time is less than or equal to the maximum cycle time.

Unlike RPW method, COMSOLAL is an iterative method. This algorithm is demonstrated using the assembly network example given in RPW method.

Example. DPM, Poonen-Selvan, p. 188.

Model For Assembly Line Balancing:
The objective is to assemble all workstations to minimize the number of work stations and maximize the balancing efficiency.
S. Integer Programming Model to Minimize Number of Work Stations.

Here an integer programming model to minimize the number of work stations is presented. The notations used here are as follows:

\[ A_i \] - a non-negative integer variable which is the earliest station number in which task \( i \) is assigned (\( A_i \) indicates that the task \( i \) is not assigned at any station).

\( c \) - cycle time.

\( N \) - Number of tasks to be assigned.

\( H \) - Highest station number (equal to \( N \)).

\( z \) - Task number (1 \( \leq z \leq N \)).

\( j \) - Station number (1 \( \leq j \leq N \)).

\( T_i \) - Time required to perform task.

\( W_j \) - The set of all tasks which can be assigned to station \( j \) by viola-

\( t_j \) task precedence constraints.

\( W_j^* \) - The subset of task \( i \in W_j \) that are actually assigned to station \( j \).

\( P_i \) - The set of tasks which must immediately precede task \( i \).

Minimize \( z = \sum_i A_i \).

Subject to \( \sum_{i = z}^{z + W_j} T_i \leq c, \ j = 1, 2, 3, \ldots \ N \).
In the above model,

(1) The objective function minimizes the number of workstations or equivalently, An, which is the station to which the unique terminal task N is assigned.

(2) Constraints set (1) ensures that the sum of the task times assigned to each station is less than or equal to the cycle time C.

(3) Constraints set (2) ensures that all predecessors of a given task are assigned to some preceding station on the critical path before it is started.

Model to minimize scheduling delay.

Here a model is developed to minimize scheduling delay. The details are discussed in DCM, Panneerselvam p191.

Module III

S. Maintenance Planning and Control.

Objective - As a firm wants to be competitive, it has to balance the business competitiveness, it has to make decisions on whether to replace the equipment or to retain old equipment by taking into account the cost of maintenance and depreciation or to acquire.
5. Types of Maintenance

Maintenance activities can be classified as:
- (1) Preventive Maintenance (PM)
- (2) Breakdown Maintenance

![Graph showing Total Cost, Costs, and Level of Maintenance Activity]

5. Basic Reasons for Replacement

There are two reasons:
- (1) Physical Impairment
- (2) Obsolescence

Physical impairment refers only to changes to the physical condition of the machine itself.
Obsolescence is mainly due to improvement of the tools and production, mainly due to changes in technology.

It is not economical to produce products with the same machine under only one type.
So, machines are to be replaced periodically.
The replacement study can be classified into two categories:

(a) Deterministic type of items that deteriorate with time.

(b) Simple probabilistic model for items which fail completely.

8. Determination of Maintenance Crew Size

In breakdown maintenance, breakdowns occur to be attended immediately by maintenance mechanics, otherwise it could lead to stoppage of production.

So, determination of maintenance crew size is an important decision.

The crew size can be achieved by using mathematical models or simulations.


In this case, the determination of number of maintenance mechanics using analytical queuing model is demonstrated through an example.
5. Total Productive Maintenance (TPM)

TPM is a management system for optimizing the productivity of manufacturing equipment through systematic equipment maintenance involving employees at all levels. This involves maintenance being done by employees at all levels. The goal of TPM is to significantly increase production while at the same time increasing employee morale and job satisfaction.

5. Objectives of TPM

1. Creating collective culture resulting in attainment of max efficiency.
2. Ceasing the system so as to prevent losses and to reach zero defect and zero breakdown in the manufacturing process.
3. Involving the entire work force from bottom to top.
4. To obtain zero losses by integrating the activities of teams with the production system.
§ Wastes Eliminated in TPM

TPM eliminates 6 big losses which are as follows:

1. Breakdown, which can result in long expensive repair.
2. Setups and changeovers, which can take much longer time than needed.
3. Idling and minor stoppages, which are hard to quantify and add up to big losses.
4. Reduced equipment speed, which results in gradual determination of equipment cycle times.
5. Start-up losses, which can take much time to steady state after a change.

§ Equipment Maintenance Techniques

TPM uses four equipment maintenance techniques.

These are:

1. Preventive maintenance
2. Corrective
3. Maintenance prevention
5. **Benefits of TPM**

   The following benefits can be achieved by TPM:
   
   1. Increased equipment productivity.
   2. Reduced equipment downtime.
   3. Increased plant capacity.
   4. Lower maintenance and production cost.
   5. Improved return on investment.
   6. Rectified customer complaints.
   7. Reduced accidents.
   8. Improved teamwork and a less adversarial approach between production and maintenance.
   9. General increased involvement of the work force, etc.

5. **Pillars of TPM**

   TPM has 8 pillars which contribute to its success. These are:
   
   1. 5S.
   2. Ji-kyu Hozen (Autonomous maintenance)
   4. Planned maintenance.
   5. Quality maintenance.
Module IV

§ Modern Production Management Tools

1. Just In Time Manufacturing

The primary objective of JIT is to achieve zero inventory within an organization as well as throughout the entire supply chain.

Basic Principles of JIT

The key theme of JIT is to work without buffer stock. To achieve this objective, identify every point in the organization where buffer stock normally occurs. Then critically examine the reasons for such stock.

The following reasons are there for maintaining high stock:

1. Unpredictable deliveries
2. Poor quality from suppliers
3. Increased variety of materials
4. M/C breakdown
5. Labour absenteeism
6. Frequent M/C setting
7. Variation in operators capability
8. Schedule changes
To avoid high stock system, cause-remedy may be taken in to consideration.

Another way of achieving JIT, the computer system may be adopted.

3. Computer Integrated Manufacturing

Integrating all the manufacturing activities using computer is called Computer Integrated Manufacturing. They are two aspects:

- They are organized part and operational part.

(1) Organized Part:
- Corporate Services
- Finance
- Business planning
- Manufacturing

(2) Operational part:
- These consist of the following:
  (i) Computer aided engineering (CAE)
  - Computer aided process planning (CAP)
  - Computer aided design (CAD)
  - Materials resource planning (MRP)
  (ii) Computer aided manufacturing
Flexible Manufacturing Assembly (FMA)

Direct Numerical Control (DNC)

Data Acquisition System (DAS)

1. Production data acquisition
2. Machine data acquisition

- Area Computer (AG)
- Cell Computer (CC)

Different types of computers which are used in CIM as followed.

(a) Mainframe
(b) Mini computers
(c) Microcomputers
(d) Personal computers
(e) PLCs
(f) Robotic computers
(g) Work stations

5. Total Quality Management

The goal of any industry to provide a product or service at the most economical cost, with ensuring full customer satisfaction. This can be achieved by TQM.

The scope of TQM is applied to

...
- Marketing
- Engineering
- Purchasing
- Manufacturing
- Mechanical
- Shipping
- Installation and Product Service

Benefits of TAM

Customer Satisfaction
Economic Improvements

Customer Satisfaction Oriented Benefits
- Improvement in product quality
- Improvement in product design
- Improvement in product flow
- Improvement in quality consciousness
- Improvement in product service
- Improvement in market place acceptance

Economic Improvement Oriented Benefits
- Reduction in operating costs
- Reduction in operating losses
- Reduction in field service costs
- Reduction in liability exposure

Fundamental aspects affecting quality
1. Market
2. Money
3. Management
4. Men
5. Motivation
6. Materials
7. Machines and mechanisms
8. Modern information methods
9. Marketing product requirements

Quality control activities during production cycle.

They can be achieved and divided into:
- New design control
- In coming materials control
- Product control

New design control
- Selling quality products
- Engineering quality products
- Manufacturing quality parts

Incoming materials control
- Buying quality materials
- Receiving quality materials
- Manufacturing quality parts
- Shipping quality products.
- Installing and delivering quality products.

Operating quality costs.
These can be classified into:
- Costs of control.
- Costs of failure to control.

Costs of control.
They can be classified into:
1. Cost of prevention.
2. Cost of appraisal.

Cost of prevention.
The following activities represent cost of prevention:
- Quality planning.
- Process control.
- Design and development of quality information equipment.
- Quality training of workforce.
- Product design verification.
- System development.

Cost of appraisal.
The following are done:
- Test and inspection of purchased material.
- Laboratory acceptance testing.
- Inspection.
- Quality audits
- Maintenance and calibration of quality information test.
- Product engineering reviews.
- Field tests.

Costs of failure to control: Tuts can be categorized:
1. Cost of internal failure
2. Cost of external failure

**ISO 9000 Series**
ISO 9000 standards expects firms to have a quality manual that meet ISO guidelines, documents, etc.
They have five international standards:
1. ISO 9000
2. ISO 9001
3. ISO 9002
4. ISO 9003
5. ISO 9004.

**Objective Tasks**
Selection and use of quality management and quality assurance standards.
It has 89 elements covering design, development, production, applicable for many industries etc.
ISO 9002 - It has 18 elements covering production and installation. It has some 9001 without the first two tasks.

ISO 9003 - It has 12 elements covering final inspection and testing for laboratories and warehouses.

ISO 9004 - This provides guidelines to the water front the quality management and quality assurance.

Benefits of ISO 9000 Series:

1. This gives competitive advantage on the global market.
2. Consistency in quality.
3. Documentation of quality procedure.
4. It ensures adequate and regular quality training for all members of the organization.
5. Helps the customers to have cost effective purchase procedure.
6. Helps in increasing productivity.

Steps in ISO 9000 registration.
2. Preparation of quality manual to cover all the elements in the selected model.

3. Preparation of procedures and shop floor instructions which are used at the time of implementation.

4. Self auditing to check compliance of the selected model.

5. Selection of a registration and making application to obtain the certificate.

6. **Poke Yokke**

   This means *a mistake preceding*. The poke yoke devices are developed based on the answers to the following questions related to products:
   - What is the defect?
   - When is the defect discovered?
   - What are the standard elements involved in making the part?
   - What mistakes were made?
   - Why are the mistakes made?

Classification of poke yoke.
Steps for pole yoke

- Select a pilot process area or trouble some area of the facility of interest.
- Ask the workers to make a list of the most common mistakes that result in the loss of materials.
- Workers should use Pareto analysis to rank order these errors.
- Workers should define errors according to their importance and impact on the process and the environment.
- Workers should develop pole yoke devices in consultation with engineers.
- The implementation team should analyze the errors, frequency, and other issues before applying any pole yoke method.

Benefits and Limitations of Pole Yoke

Benefits -
- Reduction in waste and associated machinery as nonconforming material is identified at each stage rather than on inspection stage between
Improvements in customer satisfaction
- Improvement in employer-employee relationships
- Encourages more involvement of operators and team members.

Limitations:
- Increases the time of production.

5. Kaizen:

Kaizen means continuous improvement.
Kai - change, Zen - good.

For any organization, three things should happen simultaneously: i.e., maintenance, innovation, and Kaizen.

Key elements of Kaizen:
1. Elimination of waste and inefficiency
2. The Kaizer 5S framework of good housekeeping
3. Standardization

Steps to implementation in 5S Kaizen

1. Defining the project goal and identifying the problem
2. Forming the team
Guide lines of Kaizen Team:

- Get to Gemba (real life problem)
- Get hands on experience
- Get the facts about Gemba
- Abandon fixed ideas
- Focus on processes and not on person
- Ask what can we do today?
- Ask why? time times he classified with the answer available and take the root cause corrective action.
- Think 'can do' and how to make it work.
- Form multi-disciplinary teams.
- Assign one full time Kaizen manager per 200 employees and one Kaizen workdesk per 200 employees eventually.

Benefits of Kaizen:

- Realization of immediate results
- Incorporation of visual action oriented tools
- It fosters communication amongst employees
- Facilitates team concept within organization.
Business Process Engineering.

This is defined as the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, and speed of products/services delivered/provided by an organization.

Steps of BPR

1. Development of processes with a clear determination of process objectives.
2. Definition of processes to reengineered.
4. Identification of information technology applications.
5. Design of prototypes and implementation.

Application of BPR

It can be applied to all situations where dramatic improvement is required.
Supply Chain Management

In the global competitiveness, the customer can source any goods and services from anywhere in the world. This objective can be met through proper Supply Chain management. One can call the Supply Chain management as the re-integrated logistic system.
5. **Lean Manufacturing**

This is a systematic approach to identify and eliminate wastes of all non-value added activities through continuous improvement that is being adopted by world-class, high-performance firms to produce remarkable results. The traditional manufacturing way of thinking has been "Cost + profit = selling price." But in the global competitive environment, customers increasingly influence the selling price of a product. Hence, a lean way of thinking:

\[
\text{Selling price} - \text{Cost} = \text{Profit}
\]

The only way to survive in the market is to decrease cost by eliminating all forms of wastes.

Lean manufacturing achieves the following:

1. **Reduction in cycle time.**
2. **On-time deliveries.**
3. **Improvement in quality.**
4. **Reduction in scrap/rework.**

Steps for Lean Manufacturing.
(3) Make the value flow without r'intercept.
(4) Let the customer pull value from the producer.
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Components of Lean Manufacturing.
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1. Standardized production.
2. Continuous improvement on production.
3. Adoption of JIT on production.
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