



ORIGINAL RESEARCH PAPER

Management

WORLD CLASS MANUFACTURING

KEY WORDS:

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ABSTRACT

This paper presents a literature review of the characteristics of a new form of work organization, known as world-class manufacturing (WCM). This paper focuses on the World Class Manufacturing, an innovation program based on Continuous Improvement, that provides the elimination of all types of waste and loss of production through the involvement of all levels and all departments. The Well-known WCM methodologies and techniques are TPM, Kaizen, cellular manufacturing, Kanban, TQM, zero defects, Reduction of setup time, Six Sigma, JIT, and Lean Manufacturing. Idea of using above techniques is to focus on operational efficiency, reducing wastage and creating cost efficient organization.

Introduction

Manufacturing process are the means which changes over raw materials into a final product. The manufacturing process starts with the product design, and materials specification from which the product is made. These materials are then go through manufacturing processes to become the required product.

World class fabricating is an accumulation of ideas, which set standard for creation and assembling organization to follow. World class manufacturing is a process driven approach where different methods and philosophy are utilized as a part of one combination or other. It involves the responsibility of ensuring that business operations are proficient as few resources as required and effective in terms of meeting customer requirements.^[1]

Production management

Production management implies planning, organizing, coordinating and controlling of production activities.

Production management manages changing over raw materials into finished goods or products. It unites the 6M's i.e. men, money, machines, materials, methods and markets to fulfill the needs of the customers.

Production management manages basic decision-making with the assistance of production processes so the subsequent goods or service is delivered according to specification and by the schedule demanded.^[2]

Production systems can be classified as:

1. Job Shop Production
2. Batch Production
3. Mass Production
4. Continuous Production

Classification of plant layout

1. Process lay out
2. Product lay out
3. Combination lay out
4. Fixed position lay out
5. Combination Layout

Material management

Definition

It is concerned with planning, organizing and controlling the flow of materials from their initial purchase through internal operations to the service point through distribution.^[3]

Aim of Material management

To get

1. The Right quality
2. Right quantity of supplies
3. At the Right time
4. At the Right place
5. For the Right cost

Key objectives of Material Management are :

- 1) To purchase at the desired price, consistent with desired quality and service.
- 2) To maintain a high inventory turnover, by reducing excess storage, carrying costs and inventory losses occurring due to decays, obsolescence and pilferage.
- 3) To maintain continuity of supply, preventing interruption of the flow of materials and services to users.
- 4) To maintain the specified material quality level and a consistency of quality which licenses efficient and effective operation
- 5) To develop reliable alternate sources of supply to promote a competitive atmosphere in performance and valuing
- 6) To minimize the overall cost of procurement by improving the efficiency of operations and process

Materials planning and control

Materials required for any operation depend on the sales forecasts and production plans.

This includes estimating the individual requirements of parts, planning materials spending plan, estimating the levels of inventories, scheduling the orders and monitoring the performance in relation to production and sales.

Bill of materials (BOM)

A bill of materials or product structure is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-segments, parts and the amounts of each expected to manufacture an end product.^[4]

Good Receipt Note (GRN)

Each part has its Quality, Quantity and documentation attributes known as GRN (Goods Receipt Note).

Goods Receipt Note is set up by the Stores/Warehouse Department for bookkeeping the receipt of goods obtained from providers. At the point when GRN is set up in a product, Inventory is updated with amount and esteem. It will also update the financial records by charging Purchases A/c and Crediting the Supplier's (Vendor's) A/c.^[5]

Production Planning

Production planning is one part of production planning and control managing essential ideas of what to produce, when to deliver, the amount to produce, etc. It includes taking a long-term view at overall production planning.

Objectives of production planning are as follows:

- To ensure right quantity and quality of raw material, equipment, etc. are available during times of production.
- To ensure effective utilization of capacity with forecast demand at all the time.
- It reduces overall production cost by driving in productivity.^[6]

Inventory control

It implies stocking sufficient number and sort of stores, with the goal that the materials are accessible at whatever point required and wherever required. Logical stock control brings about ideal adjust.

Functions of inventory control

To give greatest supply benefit, predictable with most extreme effectiveness and optimal investment Stock control can be characterized as the "coordination and supervision of the supply, storage, circulation, and recording of materials to keep up amounts satisfactory for current client needs without excessive supply or misfortune."^[7]

Inventory Turnover Ratio

The inventory turnover proportion is an effectiveness proportion that shows how adequately stock is managed by comparing cost of goods sold and average inventory for a period. This measures how frequently normal stock is "turned" or sold during a period.

This measures how frequently normal inventory is "turned" or sold over a period. At the end of the day, it gauges how often an organization sold its aggregate average inventory over the year.

An organization with \$1,000 of average inventory and sales of \$10,000 adequately sold its 10 times over.

This proportion is imperative since add up to turnover relies upon two principle segments of execution.

The first component is stock purchasing.

If larger amounts of inventory are purchased during the year, the company will have to sell greater amounts of inventory to enhance its turnover. If the company can't sell these greater amounts of inventory, it will incur stockpiling costs and other holding costs.

The second component is sales.

Sales need to coordinate inventory purchase generally the inventory will not turn successfully. That is the reason the purchasing and sales divisions must be tuned in to each other.

Formula

$$\text{Inventory turnover ratio} = \frac{\text{cost of goods sold}}{\text{average inventory}}$$

Inventory Management

Inventory management regulates the flow of products from manufacturers to distribution centers. A key capacity of inventory management is to keep a detailed record of each new or returned item as it enters or leaves a distribution center.^[8]

Materials Requirement Planning (MRP)

Material requirements planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes. It schedules material deliveries based on sales forecasts.

An MRP system is intended to simultaneously meet three objectives:

- 1) Ensure materials are accessible for production and products are available for delivery to customers.
- 2) Maintain the lowest possible material and product levels in store
- 3) Plan manufacturing activities, delivery schedules and purchasing activities.

Supply chain management

Supply chain Management has been characterized as the "Design, planning, execution, control, and monitoring of supply chain activities with the goal of making net value, building a competitive infrastructure, utilizing overall logistics, synchronizing supply with demand.

Supply chain Management is the management of the flow of goods and services, involves the movement and storage of raw materials, of work-in-process inventory, and of finished goods from point of origin to point of consumption.

Supply Chain Management (SCM) is the stream of materials, data, and funds as they move in a procedure from provider to manufacture to distributor to retailer to shopper. Supply Chain Management includes organizing and coordinating these streams and objective is to decrease inventory.^[9]

Logistics

Logistics is the management of the stream of things between the point of origin and the point of utilization keeping in mind the end goal to meet requirements of clients or partnerships.

Logistics is the way toward arranging, executing, and controlling systems for the proficient and viable transportation and storage of items, including services and related information, from the point of origin to the point of utilization. The Logistics of physical things for the most part includes the incorporation of data stream, material handling, production, bundling, stock, transportation, warehousing, and frequently security. Logistics includes distinguishing planned merchants and providers, and deciding their adequacy and openness.^[10]

Logistics management

Logistics Management is a production network administration part that is utilized to meet client requests through the arranging, control and execution of the viable development and storage of related information, goods and services. Logistics Management includes various components, including:

- Selecting fitting sellers with the capacity to give transportation offices
- Choosing the best routes for transportation
- Discovering the most competent delivery method by utilizing programming and IT assets^[10]

Vendor-managed inventory (VMI)

Vendor- Managed Inventory (VMI) is a group of plans of action in which the purchaser of an item gives certain information to a provider (merchant) of that item and the supplier takes full responsibility for maintaining agreed inventory of the material, ordinarily at the purchaser's utilization area.

A Third-party logistics provider can likewise be included to ensure that the purchaser has the required level of stock by adjusting the demand and supply gaps. VMI makes it less likely that a business will accidentally wind up plainly out of load of a decent and diminishes stock in the inventory network.

The producer gets electronic information (normally by means of EDI or the web) that discloses to him the merchant's deals and stock levels. The producer is in charge of making and keeping up the stock arrangement. Under VMI, the producer creates the order*, not the wholesaler.^[11]

Milk-run

Milk-run is described as an idea that is a sequential collection of goods from different sources and the direct service to the customers without intermediate handling features of the products.

On the round trips are either goods gathered from several suppliers and transported to one customer, or products collected from one supplier and transported to several customers.

A milk run ensures that that minimum distance is travelled and the maximum demand is carried into the truck so as to meet both the demand requirement and effective transportation with least cost. This is applied where the load is scattered in many different places and in smaller units.^[12]

Total Productive Maintenance (TPM)

Total Productive Maintenance (TPM) is a maintenance program which includes a recently defined concept for maintaining plants and equipment. The objective of the TPM program is to extraordinarily increase production while, at the same time, increasing employee morale and job satisfaction.

TPM (Total Productive Maintenance) is a comprehensive way to equipment maintenance that strives to achieve perfect production. Operators perform Preventive Maintenance functions they have been trained to perform to maximize the operational efficiency of equipment.^[13]

Why TPM:

- No Breakdowns and Improves quality
- No Small Stops or Slow Running
- No Defects and No unplanned downtime
- No Accidents
- Increase Productivity

Total quality management (TQM)

Total quality management can be summarized as a management system for a customer-focused organization that includes all employees in continual improvement. TQM can reduce costs throughout an association, particularly in the regions of scrap, rework and in field service.^[14]

Eight principles of total quality management

1. Customer-focused
2. Total employee involvement
3. Process-centered
4. Integrated system
5. Strategic and systematic approach
6. Continual improvement
7. Fact-based decision making
8. Communications

Quality Control

Quality control is a procedure through which a business tries to ensure that product quality is maintained or improved and manufacturing errors are reduced or eliminated.

Quality control requires the business to create an environment in which both management and employees strive for perfection. This is done by training personnel, creating benchmarks for product quality, and testing products to check for statistically significant variations.^[15]

The seven Quality tools are

1. Cause-and-effect diagram (also known as the "fishbone" or Ishikawa diagram)
2. Check sheet
3. Control chart
4. Histogram
5. Pareto chart
6. Scatter diagram
7. Stratification (alternately, flow chart or run chart)

KAIZEN

"Kaizen" refers to a Japanese word which signifies "improvement" or "change for the better". Kaizen is defined as a continuous effort by each and every employee (from the CEO to field staff) to ensure improvement of all processes and frameworks of a specific association. Kaizen brings continuous small improvements in the overall processes and eventually aims towards organization's success. Japanese feel that numerous small continuous changes in the systems and policies bring effective results than few major changes.

Kaizen process aims at continuous improvement of processes in manufacturing sector as well as in other departments also. Executing Kaizen tools is not the responsibility of a single individual but involves each member who is directly associated with the organization. Each individual, regardless of his/her designation or level in the hierarchy needs to contribute by incorporating small improvements and changes in the system.

The process of Kaizen encourages Japanese companies to surpass every single other competitor by sticking to certain set approaches and guidelines to eliminate defects and ensure long term superior quality and eventually customer satisfaction. kaizen aims to eliminate waste (lean manufacturing).^[16]

KANBAN

Kanban is a scheduling system for lean manufacturing and just-in-time manufacturing (JIT). Kanban is an inventory-control system to control the supply chain. Taiichi Ohno, an industrial engineer at Toyota, created Kanban to enhance manufacturing efficiency.

Kanban is one technique to achieve JIT. Kanban is sometimes referred to as a "pull system." Kanban became an effective tool to support running a production system as a whole, and an excellent way to promote improvement. One of the main benefits of Kanban is to establish an upper limit to the work in process inventory, avoiding overloading of the manufacturing system.

Kanban is a visual system for managing work moving through a procedure - the "value stream". It is a system for visualizing work, reducing waste by restricting work in-progress, and maximizing customer value.^[17]

POKA-YOKE

Poka-yoke is actually the initial phase in truly **error-proofing** a system.

Error-proofing is a manufacturing technique of anticipating errors by designing the manufacturing process, equipment, and tools so that an operation truly cannot be performed incorrectly.

A poka-yoke is any mechanism in a lean manufacturing process that enables an equipment operator avoid mistakes (Poka). Its purpose is to eliminate product defects by anticipating, correcting, or drawing attention to human errors as they occur. The concept was formalized, and the term adopted, by Shigeo Shingo as part of the Toyota Production System.^[18]

Toyota Production System (TPS)

The practical expression of Toyota's people and customer-oriented philosophy is known as the Toyota Production System (TPS).

TPS has three desired outcomes:

- To provide the client with the highest quality vehicles, at least conceivable cost, in a timely manner with the shortest possible lead times.
- To provide members with work satisfaction, employer stability and reasonable treatment.
- It gives the company flexibility to react to the market, achieve profit through cost reduction activities and long-term prosperity.

TPS strives for the absolute elimination of waste, overburden and unevenness in all areas to enable individuals to work easily and efficiently. The foundations of TPS are based on standardization to ensure a safe technique for operation and a consistent approach to quality.

Toyota members seek to continually improve their standard processes and procedures in order to ensure maximum quality, improve efficiency and eliminate waste. This is known as kaizen and is connected to every sphere of the company's activities.

The TPS organizes manufacturing and logistics for the automobile manufacturer, incorporating communication with suppliers and customers. The system is a major forerunner of the more generic "lean manufacturing". Taiichi Ohno and Eiji Toyoda, Japanese industrial engineers, developed the system in the vicinity of 1948 and 1975.

Originally called "just-in-time production", it builds on the approach made by the founder of Toyota, Sakichi Toyoda, his son Kiichiro Toyoda, and the engineer Taiichi Ohno.

The main objectives of the TPS are to design out:

- Overburden (muri) Inconsistency (mura)
- Eliminate waste (muda)

The most significant effects on process value delivery are achieved by planning a process capable of delivering the required results easily; by designing out "mura" (inconsistency).

It is also crucial to ensure that the process is as flexible as necessary without stress or "muri" (overburden) since this generates "muda" (waste).

Finally, the tactical improvements of waste reduction or the elimination of muda are very valuable.^[19]

Jidoka

In Japanese 'jidoka' simply means automation. At Toyota it signifies 'automation with a human touch'. In 1902 Sakichi Toyoda invented the world's first automatic loom that would stop automatically if any of the threads snapped. This principal, jidoka, of designing equipment and processes to stop and point out issues immediately when they sense a problem is a central concept of TPS.

The most visible appearance of 'automation with a human touch' at the Altona plant is the andon cord situated above the line. The presence of the andon cord permits any Team Member to intervene and bring production to a halt if abnormalities occur.

The Toyota Production System has acquired the rule began by Henry Ford of breaking down work into simple steps and distributing those steps amongst employees on the line. But employees in the Toyota system are in charge of their own jobs.

Through their teams, they run their own worksites. They identify opportunities for making improvements and take the initiative in implementing those improvements in co-operation with management.^[19]

SIX SIGMA

Six Sigma at numerous associations basically implies a measure of quality that strives for near perfection.

Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving toward **six standard deviations** between the mean and the nearest specification limit) in any process – from manufacturing to transactional and from product to service.

The statistical representation of Six Sigma describes quantitatively how a process is performing.

To achieve Six Sigma, a process must not produce more than 3.4 defects per million opportunities. A Six Sigma defect is defined as anything outside of customer specifications.

Six Sigma sub-methodologies

Six Sigma DMAIC process

- Define
- Measure
- Analyze
- Improve
- Control

It is an improvement system for existing processes falling below specification and looking for incremental improvement.

Six Sigma (sometimes stylized as 6σ) is a set of techniques and tools for process improvement. It was introduced by engineer Bill Smith while working at Motorola in 1986. Jack Welch and Lenka Rozporka made it integral to his business strategy at General Electric in 1995.

A six sigma process is one in which 99.99966% of all chances to produce some feature of a part are statistically expected to be free of defects.

(3.4 defective features per million opportunities).^[20]

Six Sigma 5S

5S represents Japanese words that describe the steps of a workplace organization process. English equivalent words are shown in parenthesis

- 1) Seiri (Sort)
- 2) Seiton (Straighten, Set)
- 3) Seiso (Shine, Sweep)
- 4) Seiketsu (Standardize)
- 5) Shitsuke (Sustain)

In simple terms, the five S methodology helps a workplace remove items that are no longer needed (sort), organize the items to optimize efficiency and flow (straighten), clean the area in order to more easily identify problems (shine), implement color coding and labels to stay consistent with other areas (standardize) and develop behaviors that keep the workplace organized over the long term (sustain).^[21]

The 7 wastes consist of

1. Defects
2. Overproduction
3. Transportation
4. Waiting
5. Inventory
6. Motion
7. Processing^[22]

Lean Manufacturing

Lean Manufacturing focuses on lead time reduction.

It is refined by the elimination and reduction of waste. The instruments reveal areas of opportunity and guide the prioritization of improvements.^[23]

Cellular Manufacturing

A manufacturing approach in which equipment and workstations are arranged to encourage small lot, continuous flow production. In a manufacturing cell, all operations that are important to produce a component or sub assembly are performed in close proximity, often times in a U-shaped layout.^[24]

Conclusion

The above concepts showed that by utilizing the ideas and techniques of World Class Manufacturing, better outcomes can be achieved, which further inspire employees to perform better.

The result of the implementation of this concept and its methods is saved money, greater motivation of the people, greater security at the workplace, better order and discipline in the workplace and greater cooperation among workers.

The introduction of the WCM concept and its methods brings the organization the increase of efficiency and effectiveness and that the ventures should look at this implementation as a challenge to further progress.

Total Quality Management (TQM) and Total Productive Maintenance (TPM), are such popular initiatives utilized by the manufacturing organizations in collaboration as Organizational Performance Improvement Techniques.

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