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Product Design and Layout Scope in Operation Management

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ABSTRACT:

The range of layout and product design in operational management. Since they include the strategic planning and organization of resources, facilities, and processes to maximize productivity, efficiency, and customer satisfaction, product design and layout are crucial elements of operation management. This research explores the role that product design and layout play in operational management, taking into account factors including ergonomics, process flow, facility design, and product development.

KEYWORDS:

Ergonomics, Facility Design, Layout,Product Design, Product Development, Process Flow.

I. INTRODUCTION

Product design is concerned with the transformation of ideas into reality. As a survival and growth strategy, any corporate organization must conceive, develop, and market new goods. The most difficult problem that firms confront is developing new items and releasing them into the market.Marketing, product development, and manufacturing are the three tasks involved in the complete process of need identification through physical product creation. Product development is the process of translating client wants from marketing into technical specifications and creating the many elements of the product to these standards. Manufacturing is in charge of determining the procedures that will be used to make the product. Development and design of products connects marketing, consumer wants and expectations, and the activities needed to make the product[1], [2].

Process Design

Process design is a macroscopic decisionmaking process for transforming raw materials into final commodities. These considerations include process selection, technology selection, process flow analysis, and facility architecture. As a result, the most critical choices in process design are analysing the workflow for transforming raw material into completed product and selecting the workstation for each step in the workflow.

Production Planning and Control

Production planning and control may be described as the process of planning production ahead of time, determining the precise path of each item, determining the beginning and ending dates for each item, issuing production orders to shops, and monitoring the progress of items based on orders.The expression 'First Plan Your Work, Then Work on Your Plan' summarizes the production planning and control philosophy. Production planning and control functions include planning, routing, scheduling, dispatching, and followup.Planning entails choosing ahead of time what to do, how to do it, when to do it, and who will do it. Planning connects where we are to where we want to go. It allows things to happen that would not have happened otherwise.Routing is the process of selecting the route that each

component of a product will take as it is changed from raw material to completed product. Routing identifies the most efficient route to go from department to department and machine to machine until the raw material is finished.The operational programme is determined by scheduling. Scheduling is described as the determination of the time and date for each operation, as well as the determination of the order of operations to be followed.

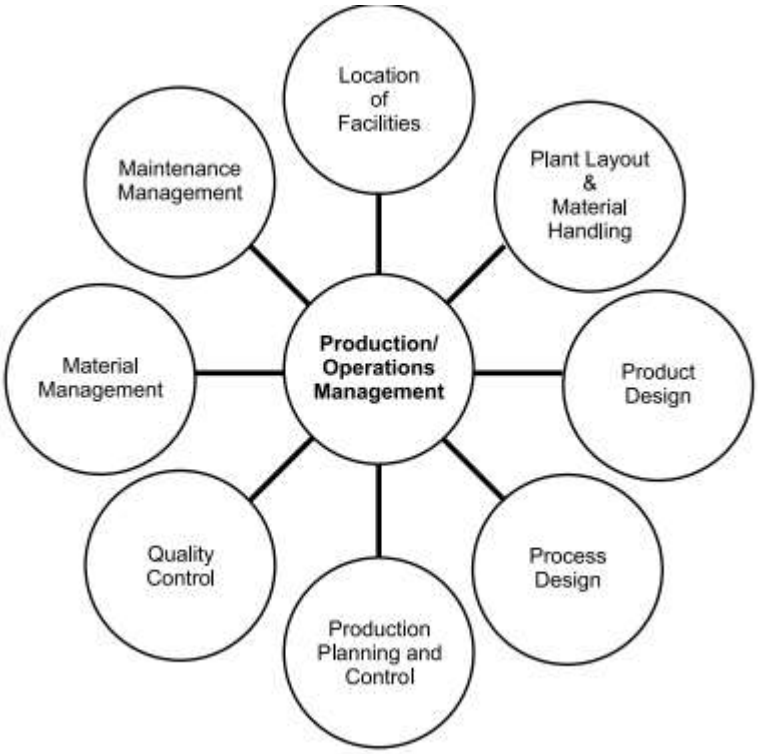

Figure 1: Represent the Scope of production and operations management [Fasrvoicemedia.De].

Dispatching is responsible for initiating procedures (Figure. 1). It grants the essential authorization to begin a certain task that has previously been scheduled under 'Routing' and 'Scheduling'.As a result, dispatching is defined as the release of orders and instructions for the commencement of production for any item in accordance with the route sheet and schedule charts. The objective of followup is to report daily on the status of work in each shop in accordance with a predetermined preform and to explore the reasons of deviations from expected performance.

Quality Control

Quality Control QC is described as a method for maintaining a desired degree of quality in a product or service. It is the methodical regulation of numerous aspects that impact the product's quality. Quality control focuses on defect avoidance at the source and depends on a good feedback system and corrective action mechanism.Quality control is also described as that industrial management strategy through which consistent acceptable quality products are created. It is the full set of actions that assures the business produces highquality goods at the lowest possible cost.The primary goals of quality control are as follows: to increase the company's profitability by making the product more acceptable to consumers, i.e., by offering longer life, higher utility, maintainability, and so on.

1. To lower company costs by reducing defectsrelated losses.
2. To accomplish manufacturing interchangeability on a broad scale.
3. To create highquality goods at a low cost.
4. To assure customer happiness with products or services of excellent quality, and to develop consumer goodwill, confidence, and the manufacturer's reputation.
5. To guarantee quality control, do inspections as soon as possible.
6. To monitor variance throughout production.

Materials Management

Materials management is the component of management that is largely concerned with the acquisition, control, and use of materials required, as well as the flow of products and services associated with the manufacturing process, with certain preset goals in mind.The following are the primary goals of materials management:

1. To reduce material costs.
2. Purchasing, receiving, transporting, and storing supplies in an efficient and costeffective manner.
3. Reduce expenses by simplicity, standardization, value analysis, import substitution, and so on.
4. Identifying new sources of supply and cultivating friendly relationships with them in order to secure consistent supply at affordable pricing.
5. Reduce inventory investment for use in other productive activities and generate high inventory turnover rates.

Maintenance Management

1. In contemporary industry, equipment and machinery constitute a critical component of the whole production effort.
2. As a result, their inactivity or downtime is quite costly.
3. As a result, regular maintenance of the plant equipment is critical.
4. To achieve minimal breakdown and maintain the plant in excellent functioning order at the lowest feasible cost. To maintain the equipment and other facilities in such a state that they can be operated at full capacity without interruption.
5. To assure the availability of the equipment, structures, and services necessary by other divisions of the factory to execute their responsibilities at the best possible return on investment.

II. DISCUSSION

When TI Cycles restructured its manufacturing facilities, it adopted Group or Cellular Layout to increase production efficiency. Sundaram Fasteners claims a Cellular Layout with worldclass production cost control. So, what exactly is Cellular Layout It is a design that is built on group technology ideas. It is a hybrid of process and product planning that integrates the best features of each. Traditional layouts, as well as product and process layouts, are at opposite ends of the spectrum. If the case calls for it, the method employed to arrive at a group arrangement may potentially result in one of the following two extremes[3]–[5].

According to the group technology concept, components that are similar in design or manufacturing procedures are grouped into a single family known as a partfamily. A specific cluster of machines called ‘machine cells' is designated for each partfamily. In general, all of the processing needs of a certain partfamily are accomplished in its associated machine cell, avoiding the need for the component to be transferred between cells.Cellular Layouts and Group Technology may be coupled to manufacture families of components more inexpensively than standard process or product layouts. Data is acquired in order to find components with comparable properties that are also made similarly. Groups of products may be established based on similarities in their design external characteristics such as size, shape, usage, and so on or similarities in their production process. This is a timeconsuming and laborious process that may be completed using the following methods:

1. Visual inspection approach for categorizing objects based on design similarities, which is easy to use yet inaccurate.
2. Evaluation of design and manufacturing data for grouping objects based on design similarities, which is more difficult to execute but much more accurate than visual examination.
3. Item production flow analysis for grouping goods based on manufacturing Notes process commonalities.

This identification and coding is the group technology chart. This equipment is grouped together and designated for these components. A process layout, which is typical of work shops, is modified to a tiny welldefined product layout to some degree. This collection of equipment is known as a cell, and the arrangement of cells is known as a Cellular Layout.To be economical and practical in the long run, the machines must be closely grouped, and the cell must be flexible in its capacity mix and large enough so that any absent employee does not shut it down, yet small enough for employees to identify with the cell and understand the products and equipment.Cell manufacturing is also a component of Flexible Manufacturing Systems FMS. In essence, it is FMS with some manual procedures. The Cellular Layout principles are used in FMS because they make it easier to process large amounts of information due to the decomposed manufacturing system; it is easier to manage operational facilities compared to functional manufacturing due to cell size limitations; and technological compulsions frequently necessitate grouping some operations such as forging machines and heat treatment units.

While the phrase Cellular Layout is a novel one, the phenomena is not. Large job shops have grouped equipment for highvolume items or specific clients for decades. Similarly, assembly lines may arrange machines by type in order to produce or alter a wide range of components that 'feed into' the main assembly line.Managers must extensively examine historical practices as a reference to modifying the industrial environment when contemplating a new approach such as Cellular Layout.Baggage distribution employing Ushaped conveyor belts is prevalent at each airport's arrival area. Traditional longitudinal assembly lines are giving way to Ushaped assembly lines, particularly in Cellular Layouts. It is not only beneficial, especially when there is a single worker in the line who is responsible for all workstations, but it also takes up less room. The line's U form reduces the worker's walking distance by almost half.Uneven workstation hours are typically the outcome of assembly line balancing. Flexible line design, such as the Ushaped line with job sharing, might aid in resolving the imbalance and are a frequent solution to this issue. The Japanese employ the near proximity of workstations to enable workers to assist a fellow worker in catching up, so promoting worker collaboration. Matsushita Electric Co. of Japan has successfully deployed Ushaped manufacturing lines with a single worker in the line. Moreover, since the entrance and departure locations of the material on the line are close together, the Ushaped line decreases material handling. A cart that transports raw materials to the queue may return the completed items in a single round.

Advantages and Disadvantages

Cellular Layouts provide the benefit of increasing overall performance by cutting costs and boosting ontime delivery. Quality should improve as well, albeit this may need other interventions in addition to the layout modification. Additional benefits are as follows:

1. Reduced workinprocess inventories
2. Lower material handling costs.
3. Shorter production flow times.
4. Simplified material and lab our scheduling.
5. Quicker setups and fewer tooling changes.
6. Better functional and visual control.

The following are some drawbacks:

1. Limited manufacturing flexibility.
2. It has the potential to increase unplanned downtime since machines are devoted to cells and may not be utilized all of the time unless the forecasting system in place is exceptionally precise.
3. There is also the possibility that the Cells may become obsolete as goods and processes evolve, and the disruption and expense of switching to cells can be substantial.
4. As operator responsibility grows, behavioral components of management become more important.

Combination Layout

With increased demand on production flexibility to satisfy customer requirements, new types of assembly lines, such as mixed model lines, have emerged. A mixedmodel line produces numerous goods belonging to a single family, such as the several automobile models made by Maruti Udyog Ltd. A singlemodel line, on the other hand, produces just one model with no variants; mixedmodel production allows a facility to accomplish both highvolume production and product diversity.This method is also utilized by JIT manufacturers such as Toyota; its goal is to fulfil demand for a wide range of goods while avoiding the accumulation of large stockpiles. Toyota Motor Company does mixedmodel balancing by averaging the output per day in the monthly production schedule grouped by specifications and dividing by the number of working days.The cycle time of each distinct specification vehicle is determined throughout the manufacturing sequence during each day. Different specification cars are instructed to follow each other in order for all specification vehicles to emerge at their own cycle time.This complicates scheduling and increases the need of clear communication regarding the precise items to be manufactured at each station. Other models must be used with caution so that certain stations are not overloaded for an extended period of time. Notwithstanding these challenges, the mixedmodel line may be the only viable solution when product factories need a wide range of customer choices, since volumes may not be large enough to support a separate line for each model.

Warehouse or Storage Layout

Lean Manufacturing was designed to do away with warehousing. While this has seldom happened, the nature of warehousing often shifts from storage dominance to transaction dominance.Moreover, the trend towards offshore sourcing has raised the need for storage and its role in the supply chain.Warehousing serves as a buffer between incoming shipments between suppliers and outgoing orders from consumers. Consumers often place orders in configurations that are incompatible with the warehouse providers' capabilities. The quantity of storage required is determined by the difference between incoming and outgoing shipment patterns.The relative dominance of selecting or storing activity is one element to good design. The needs for these two warehouse tasks are diametrically opposed.Methods that improve space utilization tend to complex and inefficiently pick, while vast storage spaces increase distance and decrease picking efficiency. Little stocks in specialized, proximate areas are required for optimum selecting. This is detrimental to storage efficiency. To some extent, automation of picking, storage, handling, and information may compensate for these contradictory needs[6]–[8].

III. CONCLUSION

Operation management includes elements such as product design and layout. Customer demands, functionality, and cost considerations are taken into account throughout the design process, resulting in welldesigned products that improve operational effectiveness and customer happiness. Operations are simplified, productivity is increased, and a safe and comfortable work environment are all benefits of layout design, facility design, process flow optimisation, and ergonomics. Organisations may acquire a competitive edge, satisfy consumer expectations, and achieve operational excellence in today's dynamic business climate by comprehending and putting into practise excellent product design and layout practises.

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