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Quality in Manufacturing Systems

New products are increasing global competition among industrial companies. The latest and most effective manufacturing technologies, techniques, processes, and manufacturing systems enable companies to better compete. Companies that understand what their customers need can gain a competitive advantage. Companies can best differentiate themselves in the marketplace through attributes such as quality, price, time-to-market and agility. To acquire such attributes, companies need to concentrate on a manufacturing strategy (production capabilities) consistent with their marketing plan.

Manufacturing systems such as focused factories, lean manufacturing and mass customization are being implemented today by manufacturing companies. Though all these manufacturing systems try to accomplish the ultimate goal of better performance in terms of quality, price, time-to-market and agility, there is some confusion about when to implement each system. There is no single source of information that explains the relationships, similarities or differences between these four manufacturing systems.

- **Focused factories** concentrate on reducing the inconsistent multiple demands placed on a plant and focusing the resources on one precise manufacturing task to achieve better performance.
- **Lean manufacturing** focuses on efficient resource utilization and effective operations to realize productivity, quality and flexibility.
- **Mass customization**, often referred to as a paradigm shift from mass production to customized production, offers a variety of products that satisfy individual customer specifications to optimize the relationship with the customer.

A better understanding of each concept can help decision-makers implement these systems.

Focused Factories

The term 'focused factory' was introduced by Wickham Skinner. According to Skinner, manufacturing units can perform better by focusing on accomplishing one explicit task, with all resources directed to that task, rather than trying to satisfy multiple demands. Skinner argues that a company cannot be successful in all manufacturing performance measures, such as short delivery cycles, low inventory investment, flexibility in product volume and rapid production of different products, at the same time.

Some definitions regarding the focused factory are confusing, so Skinner came up with his own - a factory is focused if the entire set of manufacturing policies and structure is oriented toward one simple manufacturing task. The focus is not on size but entirely on the design of the system. Application of the factory focus concept does not require a specific work environment. A Plant-Within-a-Plant (PWP) structure facilitates the implementation of focused factories in different manufacturing environments.

Lean Manufacturing



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Lean manufacturing is an improvement over mass production. Its features include getting the right product in the first attempt, continuous improvement efforts, quality in products and processes, flexible production and minimizing waste of any kind.

It is called 'lean' because compared to mass production, it uses less of everything - half the human effort in the factory, half the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product in half the time. It also requires half the needed inventory on location, resulting in fewer defects, and produces an ever-growing variety of products.

Unlike agility and mass customization, lean manufacturing works best in moderately stable environments. Since it helps to eliminate waste, it is often referred to as a JIT (Just-in-Time) system with kanban. The system adjusts production based on customers' demands and minimizes Work In Progress (WIP) and finished goods inventory, while kanban coordinates the flow of materials between stages.

Lean manufacturing introduces the basics of agility and mass customization. Any organization with a large amount of inventory and a low response rate to the market that is also facing a quality problem is a long way from achieving agility and mass customization. Introducing lean manufacturing in an organization eliminates waste (including defects) and reduces transportation, inventory, overproduction, waiting time and processing time.

The equipment requirements for lean manufacturing are different from those of other manufacturing systems. In this system, equipment should be simple, reliable and flexible, and automation is minimized unless it is essential.

Lean manufacturing utilizes the concept of machines in manufacturing cells (specific equipment for producing a particular product or a group of products in one area). Machines in manufacturing cells adopt the method of one-piece flow, which involves movement of material from one workstation to another with no inventory. Machines in manufacturing cells also promote flexibility and product variety through small-lot production. Each machine cell arrangement is similar to a focused factory arrangement. Both aim to eliminate all the non-value-added activities and achieve simplicity for the task undertaken.

Eliminating non-value added activities improves productivity, particularly when combined with preventive quality management. Preventive quality management process introduces quality controls to the process to achieve quality at the source and reduce waste by eliminating rework and scrap. When there is a reduction in Work-in Progress (WIP), quality problems are more visible and therefore more easily detectable.

The following are the key features of lean manufacturing:

1. It is a high risk - high return venture that requires management with great discipline and skill.
2. It provides speed and better flow to the manufacturing system through balance and synchronization of operations, but any failure in the value-chain will injure

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synchronization and balance and may even stop production completely. For example, a late delivery of raw materials by a supplier will delay the production and ultimately delay the delivery of the final product to the customer when not managed at the right time in the right way.

3. Its risk can be largely neutralized by a flexible, well-trained workforce, easy-to-build product designs and a supportive, high-performance supplier network.
4. Its potential gains are immense when the system is implemented smoothly.

Limitations to the implementation of lean manufacturing include:

- urban congestion and geographical distances
- supplier management
- shortage of blue-collar workers
- product variety

Adopting a tiered system and establishing trust with suppliers is important for timely deliveries to the production line and for the success of the lean manufacturing system.

Mass Customization

Mass customization is often referred to as a paradigm shift from mass production to customized production. It utilizes technology and management methods to offer product variety and customization through flexibility and quick responsiveness. Therefore, it is a manufacturing system that aims to bring down the cost of producing a variety of products. It is often perceived as an enrichment of lean manufacturing since it also aims to optimize relationships with customers by offering them specific products on a time-competitive basis. However, it is an irrelevant strategy if a company can sell everything it produces.

The strategic importance of this manufacturing system is that customers are greatly concerned about customization that creates a unique value. Examples of companies that successfully implemented mass customization point out that this system is not an extension of continuous improvement, although continuous improvement is a prerequisite. These two concepts are distinct because they have different organizational structures, values, management roles and systems, learning methods and ways of relating to customers.

Features such as the use of computer technology and the collapse of traditional information contribute partially to the success of mass customization. Information Technology (IT) enables communication and information sharing within the value chain at a faster pace, providing quick access to more accurate and timely information on the changing environment.

Mass customization demands a dynamic organization made up of relatively autonomous operating units. It requires the development of modules (specific processes or tasks) that interact with each other or unite in a different sequence for every product or service



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demanded by customers. The whole process is coordinated by an instantaneous, costless, seamless, frictionless system. The whole approach can be summarized as “process postponement, process resequencing and process standardization.

Job descriptions under mass customization are getting broader and broader over time. Employees are compensated on the basis of the diversity of skills they learn and implement while introducing their own unique contributions to the organization’s products and operations. This manufacturing system helps companies offer a high variety of low-cost, high-quality products and services.