OVERVIEW AND DRIVERS OF AGILE MANUFACTURING SYSTEM: A REVIEW

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ABSTRACT

Agile manufacturing is a popularized concept, that has been advocated as the 21st century manufacturing paradigm. Agile manufacturing requires enriching of the customer, co-operating with competitors, organizing to manage change, uncertainty and complexity. The need for a method of rapidly and cost-effectively developing products, production facilities and supporting software, including design, process planning and shop poor control system has led to the concept of agile manufacturing[11]. It is seen as the winning strategy to be adopted by manufacturers bracing themselves for dramatic performance enhancements to become national and international leaders in an increasingly competitive market of fast changing customer requirements. In the recent years, a number of research papers have been published in the area of AM, but there is lack of discussion on main driver used in AMS.

In this paper we discuss the trend follow in manufacturing system with comparison of AMS with other manufacturing system, and find the drivers for agile manufacturing system.

NOMENCLATURE

AMS, Drivers, Agility, Review

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1. INTRODUCTION

Over the past two decades a powerful drive by enterprises and academic institutions has boosted the development and adoption of new manufacturing initiatives to enhance business in an increasingly competitive market. The need for a method of rapidly and cost-effectively developing products, production facilities and supporting software, including design, process planning and shop poor control system has led to the concept of agile manufacturing [11].

Agile manufacturing can be defined as the capability of surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and electively to changing markets, driven by customer-designed products and services [4] It is a new expression that is used to represent the ability of a producer of goods and services to thrive in the face of continuous change. These changes can occur in markets, in technologies, in business relationships and in all facets of the business enterprise [13]. It demands a manufacturing system to be able to produce efficiently a large variety of products and be reconfigurable to accommodate changes in the product mix and product designs. The manufacturing system reconfigurability and product variety are critical in AM. The concept of agility has an impact on the design of assemblies.

This concept is closely related to lean manufacturing, in which the goal is to reduce waste as much as possible. In lean manufacturing, the company aims to cut all costs which are not directly related to the production of a product for the consumer. Agile manufacturing can include this concept, but it also adds an additional dimension, the idea that customer demands need to be met rapidly and effectively. In situations where companies integrate both approaches, they are sometimes said to be using "lean and agile manufacturing."

This paper represent the concept of agile manufacturing and examines the manufacturing parameters and the driving forces behind agility. The paper also reviews definitions of agile manufacturing and proposes a comprehensive definition embracing the competitive foundations of agility and the key concepts of agile manufacturing. In so doing, the paper attempts to address some of the basic requirements for achieving agility. Finally, the paper presents some of the problems to contend with if agility is to be of long-term benefits for prospective agile companies.

2. BACKGROUND OF AGILE MANUFACTURING SYSTEM

Agility, as a concept in manufacturing, was coined by a group of researchers at Iaccoca Institute, Lehigh University, in 1991 [3] to describe the practices observed and considered as important

aspects of manufacturing during their investigation. The group involved many of the senior executives of US companies and the study culminated into a two volume report conveying an industry-led vision for a possible profound shift in manufacturing paradigm. The report was, mainly, on how USA could regain its pre-eminence in manufacturing. It described initiatives in USA, Western Europe and Japan aimed at creating an industrial climate that will ensure competitiveness in the emerging global manufacturing order.

The agile manufacturing paradigm was recommended as holding the potential, if adopted, for the USA to resume a leading role in manufacturing. Included in the report is a view of agile manufacturing enterprise, components, infrastructure and operating mechanisms. It also identified competitive foundation, characteristics, elements and enabling subsystems of agility.

3. TRENDS IN MANUFACTURING SYSTEM

Markets have been changed very quickly, especially in the global economy. Companies which cannot adapt quickly to change have found itself left behind, and once a company starts to lose market share, it can fall rapidly[5]. The goal of agile manufacturing is to keep a company ahead of the competition so that consumers think of that company first, which allows it to continue innovating and introducing new products, because it is financially stable and it has a strong customer support base.

Companies that want to switch to the use of agile manufacturing can take advantage of consultants who specialize in helping companies convert and improve existing systems[8]. Consultants can offer advice and assistance which is tailored to the industry a company is involved in, and they usually focus on making companies competitive as quickly as possible with proved agile manufacturing techniques.

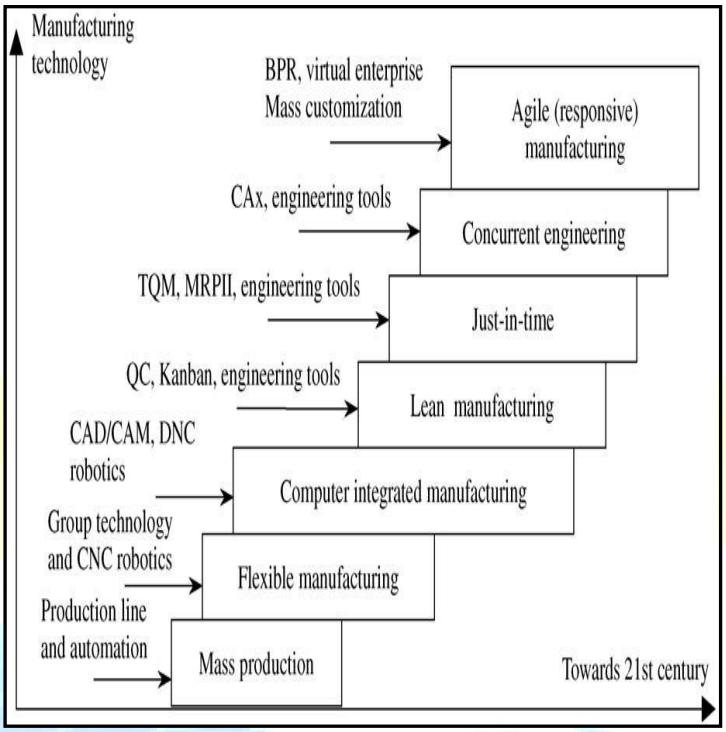

Fig. 3.1 Development in Manufacturing Technology

There is different uniqueness of these manufacturing Systems these have been listed in below table 1

Table 1. System Characteristics

System	Characteristics
Mass Production System	Continuous Flow assembly Line, Interchangeable Parts, Specific and Systematized tasks to workers, Faster Production, High Quality, Low Price, Non customizations of product, Adaptability of Customer to the Product, Low Variety of Products.
Flexible Manufacturing System	Use of automated material handling systems, automatic tool exchanging mechanism, High initial investment, Cost of introducing new models is high, product volume capacity is low, capacity to introduce new model is medium.
Computer Integrated Manufacturing System	Integration of different computer systems, Integrated information flow, Global architecture modeling and accumulating different tasks and providing integrated view, high initial investment.

Lean Manufacturing System	High Throughput, Little Inventory, Minimal Waste, Organized Shop Floor, Workers organized in team with team leader rather than Foreman, Polyvalent Workers, Greater Job Satisfaction, Role of Workers in Improving Process, Synchronized SIPOC for reduction of Inventory, More of the application in Automotive and Electronics i.e. High Volume and Low Variety, Rare applications in High differentiated and Low Volume, More anxiety levels for managers.
Just In Time System	Zero Inventory, High emphasis on eliminating the losses, High sensitive towards customer demand, Increases the work productivity, Reduces operating costs, Improves performance and throughput, Improves quality, Improves deliveries, Increases flexibility and innovativeness
Concurrent Engineering System	Reducing Delivery Time, Emphasizing the response to customer expectations, sequential design flow
Agile Manufacturing System	Customized Product, Employee Empowerment, Leveraging, Virtual Organization, Use of Information and Communication Technology, Use of Electronic Data Interchange, Use of Concurrent Engineering, Proactive Approach, Turbulent market environment, Use of

4. COMPARISON OF AGILE MANUFACTURING SYSTEM WITH OTHER MANUFACTURING SYSTEM

Agile Manufacturing System is evolved because of the several limitation in earlier manufacturing system. In Table 2. we have discussed differences between various manufacturing system.

Table 2: Relative Differences

Characteristics	Mass	FMS	CIM	Lean	Agile
Emphasis on eliminating the losses	Low	Low	Medium	High	High
Loss of production level	Medium/ High	Medium	Low	High	Flexible
Sensitivity to consumer demand	Low	Medium	High	Medium	High
Needs of expert employees	Low	High	High	Medium	High
Loss of business cooperation	Low	Low	Medium	Low	High
Initial Investment	High	High	Low	Medium	Medium
Cost to Introduce New Models	High	Medium	Low	Low	Low
Time to introduce new models	Low	Medium	High	Medium	Low
Prod. Volume Capability	High	Low	Low	High	Medium
Equipment usability	High	High	Medium	High	Medium
ICT	Low	High	Medium	Medium	High

5. DRIVERS OF AGILE MANUFACTURING SYSTEM

The main driving force behind agility is:

- Change in market requirement
- Adjustment in response to the prevailing market circumstances.

In this section the changing manufacturing requirements that have culminated in a broad spectrum of competitive criteria will be briefly reviewed. Intimate understanding of the requirements of modern manufacturing is important in order to set a proper agenda for strategy implementation[15].

The issues discussed below relate to :

- **Automation And Price/Cost Consideration,**
- **Widening Customer Choice And Expectation,**
- **Competitive Priorities,**
- **Integration And Proactivity**
- **Achieving Manufacturing Requirements in Synergy.**

5.1 Automation and price/cost consideration

The difficulty on manufacturing has always been dictate by the market. The post World War II period was characterized by relatively high demand and an inability to supply. The increase in demand after the war created extended backlogs of customer orders which served as firm orders on which material planning could be based [15]. Quality and speed were not of considerable significance as consumers were scrambling for the available products on offer. Price was the dominant factor that determined customer's preferences [4]. This encouraged massive automation of production processes with resultant mass production of goods. The single most important objective of manufacturing was mass production of goods at lower prices.

5.2. Widening customer choice and expectation

The changing market and shift in customer preferences in favor of quality gave birth to the 1980s' quality struggle. This led to aggressive and exceptional focus on quality while maintaining competitive price. Increasing customer expectation in the form of strong taste for quality helped intensify the attention devoted to product quality initiatives[6]. Pursuit of quality by manufacturers was also complemented by the army of researchers and consultants who popularized quality related concepts such as total quality management (TQM), statistical process control (SPC), and quality function deployment (QFD).

5.3. Competing priorities

Several criteria for competitiveness have emerged within the first half of the 1990s. These competitive priorities include responsiveness, new product introduction, delivery, flexibility, quality, concern for the environment and international competitiveness. The market place has turned into “battlefields”. [12]

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5.4. Integration and proactivity

The long traditional paradigm of manufacturing management is largely reactive. In a highly competitive market manufacturers must be able to act proactively. A proactive manufacturer will integrate with customers and help identify their problems and requirements and also acquire capabilities just ahead of need [9,10]. In this way, proactivity offers strategic advantage for competing in the turbu{1lence of the global market. The strategic capabilities afforded by proactivity is strongly dependent upon the integration and co-ordination in the enterprise that the strategic manufacturing systems must be efficiently integrated and coordinated [9].

5.5. Achieving manufacturing requirements in synergy

The flexibility of production machinery as well as employees and the organization are required for a corporate-wide flexible strategy. To remain competitive, manufacturers are required to produce products at lower cost, high quality and with decreasing lead time. In addition, they must remain proactive and innovative[7]. A successful company must therefore acquire the capability to achieve and explore the competitive advantage in synergy. Integration both of a

technical and social nature, of technology, machinery, functions, strategies, people and management, lies at the foundation of these competitive capabilities.

The competitive advantage will have to be achieved using the best resources available to an organization or a group of organizations. A common theme that runs through the scenario depicted above is change. Successful organizations must be able to foresee, adapt and respond to change using tactical initiatives to achieve strategic objectives. It is important to engage in creatively initiating change and to become proficient in it. [11]

6. CONCLUSION

Agile manufacturing may be new as a concept but aspects of the practices embodied in agility are already in place separately, it can also be seen as combination of Lean Manufacturing and Flexible Manufacturing systems. Now it's important to understand that various key elements of Lean Manufacturing and Flexible Manufacturing systems can be helpful in successful implementation of Agile Manufacturing System. The agile manufacturing company needs to integrate design, engineering, and manufacturing with marketing and sales, which can only be achieved with information and communication technology (ICT).

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