

Lean and Agile Manufacturing as productivity enhancement techniques - a comparative study

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Abstract: *With the beginning of globalization of the market in 21st century, the manufacturing organization felt strongly challenges from their competitors. These challenges lead the organizations for the changes such as reduced product life cycle, minimum production cost and responding to diverse needs of customers. To respond the customer requirement and increasing customer satisfaction many organization adopted process improving techniques such as Lean or agile manufacturing. This paper briefly explores to the concept lean manufacturing and agile manufacturing with their similarities and differences including limitation of the concepts. The paper proposes an approach which emphasizes to response customer requirement and increase customer satisfaction. The paper also focuses on methods to detect, analyze and improve the problems and dysfunctions in process through process interaction, including maintaining the result efforts.*

Key words: *Lean Manufacturing, Agile Manufacturing, Waste Minimization*

I. Need of Lean manufacturing or agile manufacturing.

Today industries severe the challenges and competitive market pressures, including globalization,

Competition and cooperation, diversity of customer requirements, due to the globalization of the market industries are restructuring and reengineering themselves to overcome the challenge of customers, seeking high quality, low-cost products and be responsive to their specific unique and rapidly changing needs. To respond customer requirement and to minimize overall cost two new systems of doing business in manufacturing have evolved in the recent decade's lean manufacturing and agile manufacturing.

Lean focuses on elimination source of wastes (muda) that arise in processes. Lean principles are adopted in many enterprises, including Japanese enterprises for controlling the resources in accordance with the customers' needs and to reduce cost through unnecessary waste (including the waste of time) [1]. Agility addresses new ways of running companies to meet these challenges and is based not only on responsiveness and flexibility but also on cost and quality of goods and services that the customers are prepared to accept. According to Gupta and Mittal Agile Manufacturing is "a business concept that integrates organization, people and technology into a meaningful unit by deploying advanced information technologies and flexible and nimble organizational structures to support highly skilled, knowledgeable and motivated people" [2]. There is no standard framework for implementation of Lean and Agility, some company have adopted Lean tools to be part of Agility programs, while some lean consultants have started agile manufacturing to be part of the Lean. This approach helps to improve process and reduce the waste that arises in process.

II. Basic Concept of Lean Manufacturing

Lean Manufacturing is a systematic approach for identifying and eliminating waste in operations through continues improvement for doing everything more efficiently, reducing the cost of operating system and fulfilling the customer desire for maximum value at the lowest price [3]. Within a lean manufacturing production system such as the "Toyota production System" (TPS) there is a base operating methodology, utilized by manufacturers in Japan under the heading of Genba Kanri [4]. These basic operating rules have been developed over many years in several Japanese companies to the point where they are now implicit in manufacturing operations.

Toyota Production System (TPS) which was relabeled as Lean manufacturing by Womack, Jones, and Roos [5] in their book "The Machine That Changed the World" has influenced the manufacturing practices around the world. The fundamental of TPS is to eliminate wastes and produce only the items that needed at the required time and in the required quantities. Principles of lean are universal as they are broadly accepted by many manufacturing operations and have been applied successfully across many disciplines [6]. It has become an integrated system composed of highly inter-related elements and a wide variety of management practices, including Just-in-time, quality system, work teams, cellular manufacturing, etc. The main purpose of implementing lean manufacturing is to increase productivity, reduce lead time and cost, and improve quality, thus providing the upmost value to customers. [7]. Seven important wastes in lean are as follows:

Overproduction, Waiting, Unnecessary transport, Over processing or incorrect processing, Excess inventory, Unnecessary movement, and Defects or rework [7].

III. Basic Concept of Agile Manufacturing.

Agile manufacturing is a term applied to an organization that has created the processes, tools, and training to enable it to respond quickly to customer needs and market changes while still controlling costs and quality. Agile manufacturing is seen as the next step after Lean manufacturing in the evolution of production methodology.

In the beginning of globalization of the market in 21st century the agile manufacturing paradigm was formulated in response to the constantly changing 'new economy' and as a basis for returning to global competitiveness. Agile manufacturing (AM) has emerged after lean production the word agile is used means the ability fast thinking with a clever method and in fact it is concept of maximum flexibility and an agile organization should be able to respond to possible changes that may occur in the organization. A lot definitions provided about agility, but in general we can say agility is responding to available challenges in business environment that this challenge is via change and uncertainty to the business environment. A key feature of agility organization is flexibility [8].

Agile manufacturing is an approach to manufacturing which is focused on meeting the needs of customers while maintaining high standards of quality and controlling the overall costs involved in the production of a particular product. This approach is geared towards companies working in a highly competitive environment, where small variations in performance and product delivery can make a huge difference in the long term to a company's survival and reputation among consumers.

In fact the main origin of "agility" as a concept in business and work is rooted in flexible manufacturing systems. At first was thought the path toward flexibility in production and manufacturing is move from automation towards create ability for rapid changes such as reducing the startup time and thus faster reaction to changes in product mix or volume. Soon after this theory about flexibility in the production was extended greater fields of business).a organization for responding to changes occurs in its business requires ability that called agility and is including speed, flexibility, competence and accountability [8].

IV. Comparison between Lean and Agile Manufacturing.

'Lean manufacturing' and 'Agile manufacturing' sound similar, but they are different. Lean manufacturing is a response to competitive pressures with limited resources. Agile manufacturing, on the other hand, is a response to complexity brought about by constant change. Lean is a collection of operational techniques focused on productive use of resources. Agility is an overall strategy focused on thriving in an unpredictable environment. Focusing on the individual customer, agile competition has evolved from the unilateral producer-centered customer-responsive companies inspired by the lean manufacturing refinement of mass production to interactive producer-customer relationships [9]. Table below shows the comparison of lean and agile manufacturing on various factors [9],[10],[11],[12],[15].

Factors	Lean Manufacturing	Agile Manufacturing
History and Origin	Since late 1940s Japan –Toyota Japan	Since early 1990s Iacocca university (USA)
Initial investment cost	• Low	• Medium
Goal	<ul style="list-style-type: none"> • To remove waste • Understanding what customers see as "value" • Eliminate everything that does not add value 	<ul style="list-style-type: none"> • Enhance enterprise flexibility and responsiveness • Thrive in a fast-paced, uncertain, environment
Focus	<ul style="list-style-type: none"> • Primary focus on the avoidance of waste in order to improve productivity. • Focusing on all enterprise operations, processes and functions • Emphasis on creating robust value propositions and value exchanges among stakeholders • Managing complex interdependencies throughout the networked enterprise (information flows, knowledge sharing, network-wide learning & capability-building 	<ul style="list-style-type: none"> • Primary focus on achieving efficiency. • Concentration on effective enterprise integration to support manufacturing • Focus on delivering high-quality, low-cost & innovative tailored solutions to customers • Creating virtual organizations, as needed, to reduce cost & cycle time
Participation in an organization	Everybody in organization (cross functional teams)	• Top-down directive process led by top management
Core concept and methodology	• Adopt a holistic view of the networked enterprise	<ul style="list-style-type: none"> • Anticipate and meet customer needs • Deliver tailored solutions to customers

	<ul style="list-style-type: none"> • Stress long-term thinking • Deliver customer pulled best lifecycle value • Eliminate waste towards the goal of creating value • Ensure stability and synchronized flow • Develop collaborative relationships and mutually-beneficial network-wide governance mechanisms • Foster a culture of continuous learning • Evolve an efficient, flexible & adaptive enterprise 	<ul style="list-style-type: none"> • Evolve adaptive, flexible & efficient enterprise • Establish virtual organizations • Enhance ability to thrive in a fast-paced & uncertain environment
Techniques and tools	Analytical tools like, <ul style="list-style-type: none"> • Value stream mapping • 5-S • One piece flow • Pull system • Cells • Kanban • Visual controls • Set Up reduction 	Agile uses a set of tool kit primarily taken from lean. Some lean tool being used in agile development are <ul style="list-style-type: none"> • Multitasking • Kanban • Empowerment • Visual management
Primary benefits	Lean = Reduce flow time Improve flow reduce manufacturing cost	<ul style="list-style-type: none"> • Continuously changing its approach to satisfy its customers
Secondary benefits	<ul style="list-style-type: none"> • Less waste • Faster throughput • Improved quality • Less inventory 	<ul style="list-style-type: none"> • Innovative designs based on the customers' demands • Wider variety for the customer to choose • Responds quickly to emerging crisis
Limitation	It is Culture and cannot be brought overnight due to which lean manufacturing cannot gives quick results	Inadequate attention to internal factors, and absence of implementation methodology.

Table no 1 .Comparison of Lean and agile manufacturing

V. Similarities and differences between lean and agile manufacturing.

Basically, both lean and agile manufacturing are suited for modern managers who desire to increase business sustainability and revenue. They both must be decided on early in the manufacturing planning process, as they affect all aspects of the process. The other similarities between both the systems are as follows. [13], [14].

- Both are designed to keep companies competitive.
- Both start with customer demands.
- Both required top management commitment
- Both can have extraordinary results.
- Both concentrate on minimization of Total lead-time
- Both deliver the best results when more, rather than fewer employees are involved.

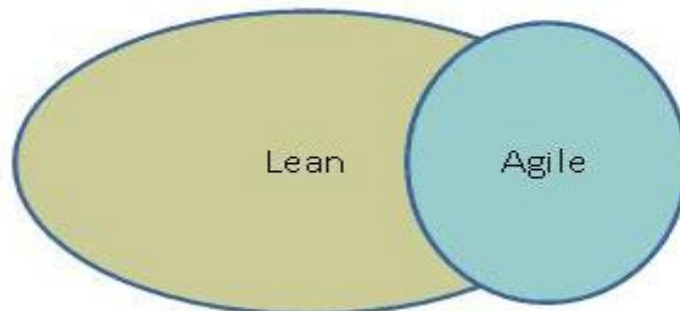


Fig No 1 Similarities and differences between lean and agile manufacturing.[10]

As per as the difference are concerns Lean was conceptualized much before agile due to which Lean has a wider scope and can be applied to any industry. Lean manufacturing focuses on reducing costs, allowing companies greater price flexibility. Agile manufacturing focuses on responding quickly to unexpected customer requests, allowing companies to capitalize on the highest possible number of sales opportunities. Production

configuration for agile manufacturing uses fewer people, relying more on automation and modular design than lean manufacturing, which relies heavily on people. Regarding inventory, lean manufacturing requires a higher inventory of smaller parts, while agile manufacturing requires a lower inventory due to modular design. The modular design also makes agile manufacturing systems more ready to adapt to customization requests [10].

VI. Implementing lean or Agile

For any organization, the first step in implementing Lean or Agile Manufacturing is deciding to use the methodology. Once the leadership of an organization believes that they can benefit from using Lean or Agile the organization can decide a standard plan to implement the systems. Both the Lean and Agile Manufacturing have some common steps for implementation. The table below shows the basic steps for implementing lean or Agile Manufacturing [11], [15].

Implementing Lean manufacturing	Implementing Agile Manufacturing
• Management commitment.	• Management commitment.
• Train core team.	• Top-down directive process led by top management
• Understand value from customer perspective.	• Emphasis on enterprise integration, training & education, and empowered teams
• Set aggressive improvement goals.	• Building effective information infrastructure
• Identify and removal waste.	• Forming virtual organizations
• Constantly improve the process.	• Mostly internally managed process, with possible support from outside

Table no 2 Implementation Comparisons of Lean and agile manufacturing

VII. Barriers to implementations

When we are thinking to implement the lean manufacturing or Agile Manufacturing in any industry there are several barriers to implement it. The old ways of working is the biggest problem, followed by employee resistance. Therefore, the major roadblocks of implementing these systems in the any companies seem to be the “people” factor. Following data represent the major limitations in implementation of Lean or Agile Manufacturing in the organization [15].

7.1 Cultural limitations.

- Fear of job loss to the workers from employer.
- Time pressure from management.
- Resistance to change old working habits.
- Lack of trust on management.
- Poor communication between employer and employees.

7.2 Knowledge limitations.

- Lack of training to the workers.
- Lack of knowledge in management as well as among team members.
- Lack of team skill among the team.

7.3 Management limitations

- Lack of leadership.
- Unprofessional management behavior.
- Lack of management commitment to the workers.
- Lack of hands on involvement from management.

VIII. Conclusion

From the above research it is clear that to respond to customer requirement and to increasing customer satisfaction lean and agile manufacturing technology is regarded as one of the most important manufacturing techniques. As the huge amount of information about the tools and technique of Lean and agile manufacturing is available, but many people do not understand and realize the basic differences and goals of each system. It should be noted that lean and agile manufacturing, each one holds its own advantages and strengths and weaknesses. The organization must be aware that change does not happen overnight; the result from implementing such a system may come slowly. This paper helps to understand the basic concept of Lean and agile manufacturing with their similarities and differences and can guide the organizations for selecting either to implement Lean or agile manufacturing system to solve their existing problems.

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