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Review on Lean Manufacturing Elements in Manufacturing Industries

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Abstract - Lean manufacturing is an area of interest for academicians, industrialists and practitioners since it improves the competitiveness of manufacturing industries.In today's competitive world, manufacturing industries are emerging at an incredible rate and performance enhancement becomes a significant strategy to accomplish and sustain growth. In this aspect, identification of best practices to assess lean manufacturing is important.Theoriginal equipment manufacturers are making newline compulsions to their suppliers to continuously increase quality and to implement newline Lean Manufacturing tools and techniques as per their volume of production.This newline has created new perspectives and pressure on the small and medium-sized newline enterprises for production of quality products. Many quality concepts and tools are newline available and are used for quality improvements, such as Lean Manufacturing, Six newline Sigma, Lean Six Sigma, etc. newline Lean practices are the recent methods of managing the business and are based on newline the principles of waste management while maximizing quality and flexibility.The newline main aim of the research is the development of Lean Practice Model for Small and newline Medium Scale Manufacturing Enterprises. In this paper we have prsented a deep review on the development of Lean Practice Model for Small and newline Medium Scale Manufacturing Enterprises in the state of Gujarat, India.

Keywords - Lean manufacturing, Lean Practice Model, Manufacturing Enterprises, and Production.

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INTRODUCTION

Introduction of new product to market for semiconductor industry base is a challenge and window to the world market where steep ramp is observe almost immediately after development to catch the market share before being outrun by competitors. In most of the time shorter product life cycle and growing complexity feature lead to greater relevance of ramp up management in factories (Dombrowski, *et al*., 2018). New product launch and to meet customer demand is highly anticipate of companies to grab market share regardless segment that the product fit into. Revenue generated will assist in the company growth and the ability to service its stakeholder commitment internally and externally. However, if this it is not in well consideration, extra amount of financial investment can hinder the financial gain and profit during the initial market launch (Somers & Gupta, 1992). Careful selection of product strategy is adopted by various key expert within and collaborating with external parties range from direct end customer, distributor and industry player. Success of the product launch that will generate revenue that translate into nett profit to satisfy the financial commitment of the company. However, risk arise in this context where, new product launch is not smooth and burdened by the many issues of manufacturing that have risk in offsetting the profit with over run cost. Many existing companies apply the basic focus of element and attempt to master and control the sectors of quality, cost, delivery, morale and safety to stay competitive and afloat of competitors thru applying lean manufacturing tools from other geographical region where the factors determining the successful roll out is not guaranteed. Some effort yielded in improvement, but some may end in not produce result and the effort is translate to wastage cost and delayed shipping required part to customers that result in lower customer satisfaction. Many companies employ lean manufacturing to gain momentum of the new product launch to be profitable, but it is not easy as some neglect after implementation and hence wasted effort after short adaptation (*Wyrwicka*, *et al*., 2016). It is very important to identify the order winning criteria depend on the company position such as size, factory automation and product position (*Somers & Gupta*, 1992).

Nevertheless, as implementing lean manufacturing to new product launch is critical but sustaining for sustainable continuous operation is a need for long term benefit (*Wong& Wong*, 2014). There is no straightforward recipe for smooth flawless implementation that yield in good implementation of lean manufacturing, however if it is able to be implement per the required outcome, it will help to lift the company to be profitable (*Alefari*, *et al*., 2016). Hence it had become more important that we need to research and understand the probable driving factors in the derive of successful implementation that will drive forward of lean implementation at the fundamental level during product design and ramp up phase where the pipeline is develop on foundation of lean manufacturing for minimal wastage start from the very beginning of the product lifecycle.

There are many studies on lean manufacturing implementation and sustainability, but little is touch on lean manufacturing design incorporate in new product development. This research aims to close the gap on understanding and implementation of lean in new product development phase and the benefit in mass production mode. There is existing research available study show in the inability of applying lean in actual industrial roll out and mainly theoretical with general canvassing of theory that do not have sustainable record other than the period of implementation. There are many researches standalone that covering the topics of lean manufacturing in lean product development but there is limited research that relate both of them and application in industry and the sustainability of the efforts. The various lean implementation areas are shown in figure 1.

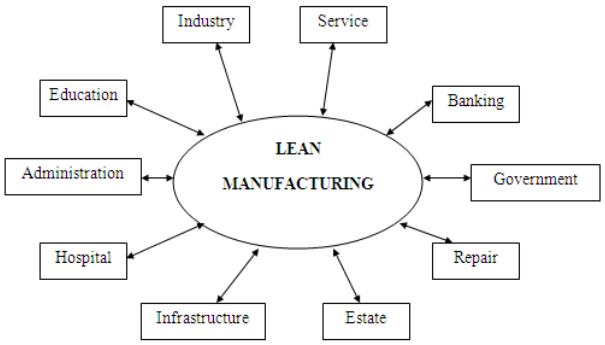

Fig. 1: The significant areas Lean manufacturing implementations

LITERATURE REVIEW

New Product development ramp is the event where newly develop product is transferred from the development to the operation team for mass manufacturing. Product is transferred from development teamtotheoperationtoproduceandshiptoendcustomerwhichneedacclimatizeanyopenconflicting factors. There is whole new challenge face to bring the product for mass manufacturing as the global market competitiveness and shorter life cycle (*Dombrowski, et al*., 2018). Effort is highly needed to ensure that existing manufacturing line is able to adapt and produce part which cover vast resources thatincludeoperationmanagementteam,qualityengineeringmanagement,andshopfloorstaffsuchas supervisor,lineoperators,engineers,technicianandlinetrainertobeabletobetrainedfortheeffective operation.Inthecomplexenvironment,thereismixofsuccesscriteriathatiscrucialtosuccessandthis research aim to exploit and determine the model with use of lean manufacturing influence to keep the valuestreamrelevanttocustomerandnotoverengineerwithirrelevantleanwastes.Intheresearchnew product ramp involve learning curve to the new product operation by management and stressed on the effect of socialization among personnel integration to sustain operations management performance (*Wong & Wong*, 2014). Shorter manufacturing cycle time is becoming crucial to customer regardless of the market segment and hence new approach and integration is needed for company to stay competitive.Rampupisimportantphaseofproductionwherehighcomplexityenvironmentisinvolved and need stable management of ramp as project to market competition (*Dombrowski*, *et al.,* 2018). Howeverimportantoftherampupphasemanyofthesesourcesdesignatedishighandincreasethecost and lower down the profitability with uncertainty in the outcome. Effective ramp up will bring benefit thru effective management of latest functionality, robustness of product in tandem with quality to company in addressing the complexity of scenarioface.

New product moving to mass manufacturing required effort is no easy task for manufacturing and even tougher for semiconductor industry where it need to juggle between multiple industry qualification, cost competitiveness and time to market where effort is translating to sales revenue for the companies. Semiconductor factories, contract manufacturing factories had been well accustoming with new product introduction to the manufacturing line but issues were arise to throughout out the manufacturing phase. Flawless ramp where the context of manufacturability of the product is mass mode is not achieve and multiple change management in executed along the production phase to get the product on track, this would translate to high accounted man hours to debug and fine tuning the production line in make shopfloor tools optimized and capable to produce. The dimension of product development in lean

dimension would cover the reduction of waste in the build processes and contribute to the lean of processes (*Wahabet al.,* 2017) Interconnect between data flow and availability for decision making for both working level and management in the transition phase is highly crucial. While doing the fine tuning, human morale may be affected of constantly work in pressure to enable line effectiveness. Human integration is thru relational model interaction unify common objective to achieve set goal (*Wong & Wong*, 2014). Motivation and interaction tool to use by personnel will play a key part to contribute the flawless ramp of new product and this can overlap to implementation lean manufacturing for sustainable operation.

In *Alaskari. et al.*(2012) raises awareness of the vision of managers. The main aim is to develop lean philosophy and develop an understanding level of the hypothetical foundations of organizational culture. In the machine that changed the world.

In *Anand et. al.* (2008) claim that the implementation of an approach will change almost everything in all industries - options for consumers, the nature of work and the wealth industry by combining the benefits of art and mass production. Lean tactic contains several methods; its purpose is to improve the quality, efficiency, and responsiveness to customers. Lean as a concept has evolved over time.

In *Anchanga, et. al.* (2006)defines Lean Production as an initiative, which aims to reduce waste of human effort, inventory, time to market and production space to respond to customer demand and produce the highest quality products in the world," the most well-organized and inexpensive way. The curiosity in constant development led to the concept of a learning of the organization and opens new opportunities for improvement and achieves long-term sustainability. In direction to demonstration the development of the idea of Lean from the original application of the first major use as a technique to target today's culture to improve organizational learning, the four steps in the development of the Strategy reading are discussed in detail:

In *Anderson et. al*. (1987) classified four types of organizational learning are mentioned. The steps in the development of lean philosophy are related to the different stages in the growth of organizational closure. (Fiol and Lyles, 1985) in accordance (Hines, Holwe and Rich, 2004) defines organizational learning as the process of improving actions through better knowledge and understanding.

"Knowledge Organization" is the first type of organization. Respond to the first phase of the approach slope, that is, the cellular cells and plant assembly lines. It is categorized by main lean consciousness as the confidence that there is an improved way of performing the things is established. This principal step is often comparable to approach the scientific management of *Max Weber* (1964) and *Frederick Taylor* (1996). This phase covers up the first span of poor education between 1980 -1990. Stand for a policy that applies the tools and techniques, methods. The original source of lean thinking at the time was the automotive industry.

"Understanding the organization" is the second type of organization run by clarifying and communicating the core values and management methods to strengthen the corporate culture. Different Enterprises in this particular period in the mid of nineties are influenced that lean is to apply the method of best practices, but this only happens on the factory floor. At the end of the decade until 1999 begins repositioning of lean thinking can be used in a wider range of industrial environments (*Womack et. al,* 1996). It is the commencement of awareness to find solutions to the individual company and its improvements along the value chain.

Table 1: Frameworks/tools used for lean manufacturing practices

Sl. No.	Author(s)	Data type	Frameworks/Tools used	Application industries
1.	Arnheiter & Maleyeff (2005)	Crisp	Lean Six sigma	Manufacturing organizations
2.	Singh *et al.* (2006)	Fuzzy	FAHP	Steel industry
3.	Anand & Kodali (2008)	Crisp	Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE)	Valve manufacturing enterprise
4.	Anand & Kodali (2009)	Crisp	Analytic Hierarchy Process (AHP)	Medium sized valve manufacturer
5.	Sawhney *et al.* (2010)	Crisp	Failure Mode and Effects Analysis (FMEA)	Manufacturing industries
6.	Vinodh *et al.* (2011)	Crisp	AHP	Modular switch manufacturing organization
7.	Boran *et al.* (2011)	Fuzzy	Fuzzy-Analytic Network Process (ANP)	Suppliers of automobile components
8.	Vinodh & Kumar Chintha (2011)	Fuzzy	FQFD	Electronic switch manufacturing company

9.	Mohanraj *et al.* (2011)	Crisp	VSM-Quality Function Deployment (QFD)	Indian pump manufacturing industry
10.	Yu *et al.* (2012)	Fuzzy	Fuzzy-AHP	Stereo manufacturers
11.	Cil & Turkan (2013)	Crisp	ANP	Cylinders, locks and other industrial component manufacturing company
12.	Wong *et al.* (2014)	Crisp	ANP	Semiconductor manufacturing company
13.	Souza & Carpinetti (2015)	Crisp	FMEA	Woodendoor and window manufacturer
14.	Roghanian & Alipour (2018)	Fuzzy	Fuzzy-AHP- QFD-Promethee	Automotive part manufacturers

LEAN MANUFACTURING TOOLS AND TECHNIQUES

Various tools and techniques have been proposed by industrialists and researchers to deal with wastes. They include cellular manufacturing, JIT, continuous improvement, production smoothing, Total Productive Maintenance, standardization of work, kanban, one piece flow, Overall Equipment Effectiveness, poka-yoke, Value Stream Mapping and other waste reduction techniques. For existing companies, once the wastes are identified, then suitable waste reduction techniques can be adopted.

Cellular Manufacturing

Cellular manufacturing is one of the bases for an industry to become a lean organization. The resources like men, machine and equipment are arranged inside a cell which is dedicated for a specific operation. This ensures smooth flow of parts, components and materials throughout the process. Great reductions in operating costs and high utilization of resources can be achieved along with the floating volume and mixed variety of products (*Iraniet al.* 1999). This can be attained by clustering similar kind of products and processes with similar operation sequence. Hence there would be a reduction in changeover time.

Kaizen and 5S

Continuous improvement is one of the primary techniques in lean manufacturing. Kaizen is a Japanese word for continuous improvement and has become the globally accepted management principle. There are many opportunities in manufacturing organizations for continuous improvement programs like reducing inventory, defects and NVA activities. 5S is a primary tool of continuous improvement for waste reduction attempts. It is coined using five Japanese words Seiri, Seiton, Seiso, Seiketsu and Shitsuke which mean sort, set-in-order, shine, standardize and sustain correspondingly (*Feld* 2000). The primary objective of 5S is to eliminate wastes. Some forms of wastes are surplus raw materials, inventory, defects, scrap, defective tools and outdated holding and guiding equipment (*Monden* 2011).

Just-In-Time (JIT)

JIT is a management philosophy that focuses mainly on eliminating wastes. The wastes like WIP inventory, defects and unplanned delivery of parts are addressed by it (*Shah & Ward* 2003). JIT is the modification of internal processes to deliver right material at right time with right quantity to meet the sudden changes in demand patterns.The major wastes eliminated by JIT system are inventory and overproduction. The parts are transported and produced in smaller lots based on the customer need, thus it avoids stagnation of raw material, WIP and finished goods inventory within the stations of shop floor. The parts are produced only in requirements based on numbers; hence overproduction could be avoided under JIT system.

Production Smoothing

To reduce the wastes through lean manufacturing, it is essential to have control over the processes at higher level. Production smoothing is one of the techniques to meet this objective. Japanese use the word “Heijunka” for production smoothing wherein the production is maintained at constant level as much as possible by the continuous efforts of product manufacturers (*Womacket al.* 1990). This technique is followed in Toyota production system with an aim of keeping the production cost down by producing cars not more than the actual requirement. To produce the right number of parts or products with effective utilization of resources, the production schedule must be made as smooth as possible. In a workplace, if parts are not kept at constant levels, it may lead to wastes like WIP inventory.

ADVANTAGES OF LEAN MANUFACTURING

- The inventory levels can be brought down to nearly nil, thus reducing costs.
- Transitions between various designs take only a few minutes.
- This enables an increased flexibility and better response to customer requirements.

CONCLUSION

Requirement of planning, commitment, methodology, learning and safety seems to be main obstructions which can be appeared while implementing the Lean Manufacturing. In this paper we have prsented a deep review on the development of Lean Practice Model for Small and newline Medium Scale Manufacturing Enterprises in Gujarat in India. The most importanttechniques of lean manufacturing of cellular technology, Just In Time and kaizen are briefed. The objectives of lean manufacturing are explained briefly. It also focusses on provision of guidelines and techniquesfor exploring and implementation of lean manufacturing

in thedifferent organizations to increase the productivity, efficiency andquality and to ensure thelow costs of the products. Thus lean manufacturing is to beadoptedinthe industries to minimize the wastages.

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