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Applications of Lean Manufacturing Techniques in various organizations: A Review

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Abstract : Lean manufacturing is a philosophy which guides the organizations in order to improve their productivity by way of eliminating various kinds of waste. The major industrial organizations in the world have adopted these techniques to improve their efficiency and productivity. Depending on type of organization and specific requirement lean tools such as Just in time (JIT), SMED, visual management, 5S, Value Stream Mapping (VSM), kanban etc. can be employed to improve the efficiency. This paper presents a review of literature on the applications of lean manufacturing techniques in various organizations considering research papers published during last 10 years (2007-2017) in leading international and national journals. It has been observed that lean techniques have been adopted by manufacturing industries at large scale. Second major user is found to be the automobile industry. A very little literature is available on use of Lean tools in textile industry, process industry, metal and glass industry, agriculture industry, plastic industry etc.

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1. Introduction : The present scenario of highly competitive global marketplace has resulted in reduced profit margin of majority of the business organizations in the world. Organizations are facing several problems such as wastage of resources during production, environmental pollutions, high production cost and low production rates etc. To survive in the highly competitive market the companies have to optimize production processes by reducing various wastes such as material, man power and time and by improving overall plant efficiency. These challenges have motivated the organizations and researchers to find the solutions or ways to continuously improve the productivity with minimum possible cost for sustainable growth of the organizations.

In the past few years, a philosophy termed as "Lean Manufacturing" has emerged which can guide the manufacturing organizations to improve their productivity by way of optimizing the processes and eliminating various types of wastes. The concept of lean was originated in Japan after the second world war. The lean manufacturing (LM) basically is a Toyota production system that has evolved at Japan. According to Shah and Ward (2007), Lean Manufacturing (LM) is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer and internal variability. Bhamu and sangwan (2014) have presented a large number of definitions in their research paper. According to Krafcik (1988), compared to mass production it uses less every thing-half the human effort in the factory, half the manufacturing space, half the investment in the tools, half the engineering hours to develop the new product in half the time. Womack (1990) defined the lean to be a dynamic process of change driven by systematic set of principles and best practices aimed at continuous improvement.

2. The Present work

The primary purpose of the present work is to identify the effective lean practices which are being adopted by the industries now a days. The work also deals with assessing the usefulness of various tools such as Just in time (JIT), SMED, visual management, 5S, Value Stream Mapping (VSM), kanban etc. in various types of industries. In addition to this the present work also aims at identifying the research gap in this area for this purpose the research papers published during last 10 years (2007-2017) in leading international and national journals have been procured and reviewed. The papers are classified in some groups according to tools used, types of industry and the years of publications and reviewed critically.

3. Literature review

3.1 Previous literature reviews

The concept of lean was originated in Japan after the second world war when Japanese were trying hard to rebuild devastated facilities in order to improve production efficiency. Toyota produced automobiles with lesser inventory, human effort, investment by implementing these concepts. The concepts of lean manufacturing provides the manufacturers a competitive edge by reducing cost and improving productivity and quality. Several researchers have documented quantitative benefits of lean implementation such as improvement in production lead time, processing time, cycle time, set up time, inventory, defects and scrap, and overall equipment effectiveness. Shah and Ward (2007) addressed the confusion and inconsistency associated with ''lean production and attempted to clarify the semantic confusion surrounding lean production by conducting an extensive literature review using a historical evolutionary perspective in tracing its main components. Simllarly, Bhamu and Sangwan (2014), Sundar et al. (2014), Hartinia and Ciptomulyonob (2015), Kumar and Kumar (2015), Hilda and Javier (2016) and Zahraee (2016) presented literature review on lean manufacturing and attempted to identify research gap and studied the effects of employing lean concepts in various organizations on overall productivity and work environment.

3.2. Lean Fundamentals

In order to develop a sustainable Lean Production System (LPS), Knowledge management within the organizations plays a vital role. According to Dombrowski et al. (2012), LPS implementation offers too many possible knowledge flows. A decentralized, role-specific approach can help to identify adequate methods of knowledge management. Study related to implementation of lean in larger and small organization, identification of relevant principles of lean leadership had been carried out by Bhasin (2012), Dombrowski and Mielke(2013), Matt and Rauch (2013), Moeuf et al. (2016) and Alefari etal.(2017). Antosz and Stadnicka (2017) concluded that any companies (55%) still do not implement the LM philosophy whereas the companies which have implemented the LM philosophy use mostly 5S method (29%).

3.3 Lean management

Rubio and Corominas (2008) proposed a model for analyzing the decision to introduce a reverse-logistics system for remanufacturing used products. The model found to be useful to examine the effects of modifying the capacity of the system by establishing a process of economic recovery of used products. Similarly Fercoq et al.(2013), Wahab etal.(2013) and Welo and Ringen (2016) worked on developing models for assessing lean techniques. Cortes et al. (2016) presented framework to overcome difficulties to evaluate the leanness of a manufacturing system. Kogel and Becker (2016) had presented a design support tool for new lean production systems which consists of three elements with a strong interaction.

3.4 Lean in manufacturing

It is observed that lean concept has been widely adapted by manufacturing sector in order to improve productivity. A case study of the manufacturing sheet metal stamping process was presented by Choomlucksana et al. (2015). Mostafa et al. (2015) proposed a roadmap to apply lean thinking in the maintenance process. Soltana and Mostafa (2015), Widiasih et al. (2015), Fahad et al.(2017), Panwar et al. (2017) and Sajan et al. (2017) had focused their research on employing lean concepts and identifying its effects on productivity in different types of manufacturing organizations. Mourtzis et al. (2016) identified initial lean rules and their classification into categories that represent the organization of an enterprise. Omogbaia and Salonitisa (2016) presented a methodology that uses Discrete Event Simulation (DES) to model lean practices within a manufacturing system. Nawanir et al. (2016) carried out a study which postulates that LM implementation contributes significantly to the enhancement of business performance (BP).

3.5 Lean in automobile sector

Saurin and Ferreira (2009) presented guidelines for assessing lean production (LP) impacts on working conditions either at a plant or departmental level, which were tested on a harvester assembly line in Brazil. The impacts detected in that line may provide insights for other companies concerned with balancing lean and good working conditions. Nordin et al. (2010) explored the extent of lean manufacturing implementation in Malaysian automotive

industries. Arunagiria and Gnanavelbabub (2014) conducted a survey in 91 automobile industries to find the highly impacted lean tools. Kolberg and Zühlke (2015) presented an overview over existing combinations of Lean Production and automation technology. Santos et al. (2015) applied some methods of analysis process by the correlation with implementation of Lean Manufacturing and working conditions in ergonomics.

3.6 Lean in plastic industries

Plastic molding industries can be considered under the SMEs. Most of the small scale plastic industries manufacture their products without seeking the help of lean techniques. Thus it is important to know the present state of art regarding use of lean techniques. Rosnah et al. (2012) carried out research which addressed the implementation of lean principles and tools in a small and medium scale industry focusing on the Plastic Injection molding operation. Khan and Dalu (2016) found that very few industries aware about the lean manufacturing and also the over production and defects/rework to be the major wastes in these industries. Desai et al.(2017) concluded that the critical defects, such as, short molding, contamination; injection point and flash can be reduced from the process.

3.7 Lean in health care sector

Dickson et al. (2009) carried out research to determine, whether the adoption of lean principles by an Emergency Department (ED) improves the value of emergency care delivered. The implementation followed a six-step process of Lean education, ED observation, patient flow analysis, process redesign, new process testing, and full implementation. Kimsey (2010) observed that use of this methodology had increased teamwork, created user friendly work areas and processes, changed management styles and expectations. Spagnol etal. (2013) analyzed international studies on lean thinking in the field of health care.

3.8 Lean in construction, dairy and software industries

Staats et al. (2011) examined the applicability of lean production to knowledge work by investigating the implementation of a lean production system at an Indian software services firm. They identified a significant challenge to use ideas from lean production in a knowledge-based industry: lack of repetition. Second, empirical examination suggested that manufacturing-based principles are applicable to knowledge work. Third, descriptive analysis was used to examine how the challenges identified above, were overcome. Aziz and Hafez (2013) discussed principles, methods, and implementation phases of lean construction showing the waste in construction. Arslankayaa and Atayb (2015) described the implementation of maintenance management and lean manufacturing techniques at the maintenance workshop in order to eliminate the losses due to breakdowns.

3.9 Implementation of 5 S

In the daily work of a company, 5-S maintains organization and transparency which are essential to a smooth and efficient flow of activities. Successful application of lean methods also improves the work conditions and encourages workers to improve their productivity and reduce waste, unplanned downtime, and in-process inventory. 5-S helps to reduce non-value adding time, increase productivity and improve quality. Several researchers have conducted research study to explore its utilization and applications in different areas. Aomar (2011), Khedkar et al. (2012), Ghodrati and Zulkifli (2013), Ramesh et al. (2014), Gupta et al. (2015) and Shaikh et al. (2015) found that by applying 5-S principles, significant improvement in the productivity and good working environment can be achieved. Ramdass (2015) suggested that the best way to make the 5-S principles an integral part of plant culture is to develop a plant-wide programme. Randhawa and Ahuja (2017) suggested that 5S approach is a continuous journey and should not be treated as a short term program.

2.10 Implementation of Value Stream Mapping (VSM)

Value stream mapping (VSM) is one of the popular lean methods which aims to provide suitable ways to identify waste in an organization and to find an appropriate way to eliminate them. Abdulmalek and Rajgopal (2007)

adopted VMS for the process sector for application at a large integrated steel mill. They demonstrated a detailed simulation model which can be used to evaluate basic performance measures and analyze system configurations. Seth et al. (2008), Singh and Sharma (2009), Vinodh et al. (2010), Singh et al.(2011), Rahani and Al-Ashraf (2012), Singh and Singh (2013), Vinodh et al. (2015) Rohani and Zahraee (2015), Venkataraman et al. (2014) Vamsi et al. (2014) and Librelato et al.(2014) applied VSM in different industries and found that significant reduction in lead time, processing time, WIP and manpower requirement can be achieved.

Lasa et al. (2008) showed that the VSM is a valuable tool for redesigning the productive systems according to the lean system. Basu and dan (2014) used Value stream mapping (VSM) methodology as a data-driven decision-making tool to identify the constraints in the current state and subsequent states. Gurumurthy and Kodali (2011) developed simulation models using QUeuing Event Simulation Tool. Vinodh et al. (2013) reviewed the literature on lean manufacturing and VSM. Their study indicates that, significant improvement in lean characteristics. Folinas et al. (2013) presented a systematic approach for determining the waste in the agri-food supply chains. Brown et al. (2014) and Matt (2014) carried out case studies in order to assess the performance of industries after applying VSM as a lean tool.

Haefner et al. (2014), Edtmayr et al. (2016), Edtmayr et al. (2016), Toivonen and Siitonen (2016), Aziz et al. (2017) and Huang and Tomizuka (2017) attempted to combine other tools with VSM to enhance the productivity. Verma and Sharma (2016) developed energy value stream mapping to address the non productive energy consuming processes.

2.11 Ergonomic Issues and barriers in Lean Manufacturing

Kaya (2015) conducted a study which deals with design of work place and Ergonomics in garment enterprises. The author tried to evaluate the work place environments of the business in Istanbul, Bursa and Corum. Cirjaliu and Draghici (2016) presented a comprehensive literature review regarding the possible impact, both positive and negative, of Lean Manufacturing on the occupational ergonomics. Lodgaard etal. (2016), AlManei etal.(2017) and Salonitis and Tsinopoulos (2016) discussed about drivers and barriers to the implementation of lean.

4. Conclusions from Literature review

In order to find the latest development in the area of lean manufacturing, research papers published during last 10 years (2007-2017) in leading international and national journals were reviewed. The main idea was to identify the key area where lean manufacturing was employed. Figure 2.1 represents the sector wise distribution of research papers published during the year 2007-2017. It is clear from the Fig. 2.1 that Lean techniques have been adopted by manufacturing industries at large scale. Second major user is found to be the automobile industry. A very little literature is available on use of lean tools in textile industry, process industry, metal and glass industry, agriculture industry, plastic industry etc. It has also been observed that the Value Stream Mapping (VSM) has been accepted by majority of organizations as a lean tool for improving their productivity.

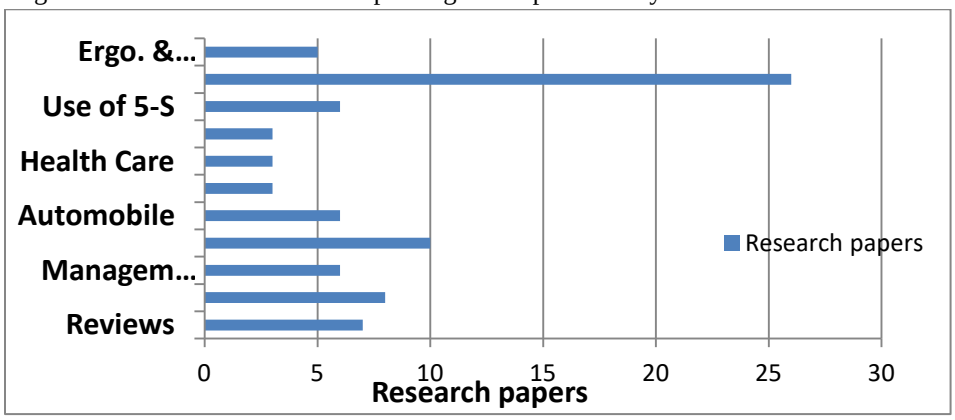

Fig. 2.1 Sector wise published research papers during the year 2007-2017 on lean manufacturing

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