

# Implementation of Lean Manufacturing Practices in Diverse Manufacturing Industries

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## Abstract

The purpose of this paper is to review the existing literature on Lean Manufacturing (LM) implementation at industrial level so that its applications and advantages can be revealed in diverse industrial sectors. A narrative literature review was conducted to put the broader picture of LM implementation in various types of industries. Previous studies on LM implementation were reviewed and summarized. Data Analysis was conducted and presented by tables, charts, and graphs. The latest Literature of lean manufacturing illustrates that where ever lean manufacturing is being practiced, no matter at small or large scale, it would yield better results. This asserts SME's and large businesses to practice lean manufacturing in their industrial operations for the persistence in the dynamic market. Limited LM papers are available for each category of industrial sectors and among them maximum of the review papers has been written on specific industrial sectors. Thus, it was highly needed to write a paper by which the collective and broader picture of LM implementation in various types of industries can be depicted. In this regard, literature review on LM implementation in diverse industries (i.e. food, electronics, furniture, automotive, manufacturing, textile and process) was included in this paper.

**Keywords:** lean manufacturing; waste; review; lead time.

## 1. Introduction

Lean manufacturing is the set of techniques which are especially used for the elimination of waste. It is the keen need of an industry to implement these techniques to outperform in the market full of potential competitors. Nowadays, manufacturing is regarded as to produce customized goods. Therefore, it's challenging to design a production plan and effective control especially in mass production (Bhamu & Sangwan, 2014). For a long time, the center point of manufacturing has been primarily absorbed on customer satisfaction or produced according to customer's needs, while never undermine the product quality, its delivery time, and innovation (Abualfaraa et al., 2020). As customers are more aware they demand more variety in goods or services and admiring the quality and faster delivery at a lesser cost. Besides, cost of producing goods or services has been increasing. Moreover, globalization would create competition in the production of goods and services and makes it more challenging (S D et al., 2015) & (Sachdeva et al., 2017). Businesses that are averted from continuous improvement afterward innovative process implementation are likely to practice outdated and cost-ineffective practices (Lopes et al., 2015). Therefore, businesses in search of the methods to get more on less spending. This 21st century is mainly regarded as the century of growth in all space linked to humans for example industrial, social, and scientific knowledge and services (Khalaf Albzeirat et al., 2018).

Nowadays, more and more studies have been carried out to improve systems and process by emphasizing the application of new techniques as total productive maintenance, lean manufacturing, and total quality management. Lean manufacturing has found as a tested technique to address these challenges for many decades (Z. A. Shah & Hussain, 2016). Furthermore, lean manufacturing has been in practice for 60 years (Buer et al., 2018). Its origin is older and introduced in manufacturing late in mid of the 20th century when one of the employees of Eijie Toyota

named Taiichi Ohno presenting the “Just in time” concept to automate the industry (Kleszcz et al., 2019). The term ‘lean manufacturing’ is first used by John Krafcik in International Motor Vehicle program but the term got popularity when it was used in a book named ‘The Machine That Changed The World’ (Bhamu & Sangwan, 2014; Maware & Adetunji, 2019).

Those companies which adopted lean manufacturing are more advanced in terms of process simplification, maintaining a low inventory level of the end product and raw material, and deliver better quality (Kleszcz et al., 2019). In lean manufacturing most commonly adopted practices are: elimination of Bottleneck (Mrugalska & Wyrwicka, 2017b), (Nithia et al., 2015), competitive level of standard (Mrugalska & Wyrwicka, 2017b), cellular manufacturing, continuous improvement concept, cycle time reductions (Nasser et al., 2009), lot size reductions (Nasser et al., 2009), just-in-time production, cross-functional work force (Nasser et al., 2009), preventive maintenance (Abdullah, 2003; Abu et al., 2019), focused factory production (Nasser et al., 2009), total quality management (Mrugalska & Wyrwicka, 2017b), pull system/Kanban (Tiwari & Singh, 2018), quality management programs, and quick changeover techniques. Lean manufacturing would make companies more organized and competitive by removing idle activity, reducing cost, improving companies’ efficiency, and abating cycle time of product manufacturing (Nithia et al., 2015). The lean concept is pertinent to all organizations regardless of their nature of work and level of implementation among different sectors where operations have been conducted in different functional areas irrespective of their size and nature of business (S D et al., 2015); (Kleszcz et al., 2019) & (Mrugalska & Wyrwicka, 2017b).

Most of organizations motivated to fewer tools and methods whereas abandoning others. For example, 5S is widely used through manufacturing planning is not often (Z. A. Shah & Hussain, 2016). The evolution methodology in lean manufacturing has been noticeably changed by the last five years. Technological advancement come to gather with descriptive and quantitative data, creating mathematical models and pre-determine calculation that help decision-makers to take decision rightfully whereas the analytic Hierarchy Process was frequently used (Khalaf Albzeirat et al., 2018). In addition, Lean manufacturing creates an environment where all employees of the organization were enthusiasts to deliver qualitative products and abridge delivery time at minimum spending (Kleszcz et al., 2019). As time passed, different tools and techniques have been explored by a well-known researcher in lean manufacturing which successfully transforms the organization as many profitable stories of lean manufacturing are noticed in the literature (Abu et al., 2019).

## 2. Aims and Objectives

Aim of present research was to document the usefulness, drawbacks and loopholes of LM implementation in various types of industrial sectors so that it’s broader picture can be depicted.

- To discuss the challenges and benefits of the LM implementation in various industrial sectors
- To depict the broader and clear picture of LM practices in various industrial sectors
- To discuss the outcomes of LM implementation in various industrial sectors

## 3. Research Methodology

A narrative literature review was conducted to put the broader picture of LM implementation in various types of industries. A narrative review method is used for the analysis of literature. Literature review on the use of technology in the narrative perspective enables a broad understanding of controversies and dilemmas related to the use of technology, as well as the key success factors of implementing and using technologies (Frennert & Östlund, 2018). It help researcher to analyze the debates, outcomes of previous research and existing lack of knowledge and it also suggest the rationales for future research (Ferrari, 2015). In present research, empirical evidences, case studies and review papers on the LM implementation in various industrial sectors were reviewed and summarized.

### 3.1 Data Collection

In the present research, secondary data was used; which was collected from review papers published on the topic of implementation of LM tools and practices in different type of industries. Moreover, the empirical and cross sectional research was also reviewed for the reference and their research evidences were also included and cited in the present research paper. 22 papers were referred from different journals on the subject and their outcomes were discussed in the form of tables and paragraphs.

### 3.2 Data Analysis

Data Analysis was conducted by organizing the obtained secondary data into tables and plotting that into charts. In order to plot the charts, MS excel was used in this research. Research gap was figured out by using the contribution table so that the gap for the present research could easily be highlighted.

### 4. Research Gap and Justification for Selection Of Industries

Number of papers has been published in the many journal regarding the implementation of LM in different industrial sectors but it seems to be shortage of review papers (collective industrial focus). Nasser et al., 2009 conducted the review on the implementation of LM in small and medium enterprises (SMEs) (Nasser et al., 2009) but no review still has been conducted in which outcome of implementation of LM is narrated. Table 1 presents those review papers which were published separately focusing on the different types of industries (i.e. manufacturing, furniture and process industry).

Table 1. Review papers which are published in the scope various industrial sectors

Reference	Industry	Outcome
(D. Shah & Patel, 2018)	Manufacturing	Reasons of slow adoption of LM techniques were concluded under the scenario of variable demand and it was indicated to link the production pull signal to the variable demand. This implementation caused less stress at shop floor level but far more stress at the managerial level.
(Sachdeva et al., 2017)	Manufacturing	Different lean tools and methodologies were discussed regarding which the research has been published over the years. Understanding most useful lean tools, their usefulness and benefits and inadequacies were discussed.
(Mehta et al., 2012)	Manufacturing	There are certain hurdles in LM implementation process and which can be managed by effective planning. The main hurdle about this technology is its non-recognition as effective tool.
(Abu et al., 2019)	Furniture	Purpose of LM implementation has been to increase efficiency, to organize and clean up the workplace, and to increase space utilization. The companies have reported problems related to LM implementation are; issues related to employees such as lack of manpower, lack of knowledge related to LM implementation, and resistance of employees to change. Most importantly, there are bigger challenges in the way to implementation i.e. lack of technical know-how, financial resources and training at the early stage.
(Melton, 2005)	Process	LM implementation is not just about changing few steps of process but it is complete innovation of business in terms of supply chain operations, manpower planning and standard operating procedures.
(S D et al., 2015)	Manufacturing	It was indicated by the analysis that continuous flow, kanban and TPS are commonly useful lean tools. Their benefits include, reduced inventory levels and reduced wastage. Involvement of the management was discussed to be the hurdle of LM implementation.
(Nithia et al., 2015)	Manufacturing	It was concluded that besides, LM implementation has many benefits but there are weaknesses also. It rarely focus on the environmental and safety issues.
(Amit et al., 2014)	Manufacturing	Reducing waste and increasing efficiency are most common outcomes of LM implementation. It also reduce machine down time, non-value adding activities and increase productivity. Most importantly, the alignment of labor and management in the constant development of producing higher value adding work is important.

There are total eight papers from which 6 review papers were published only on the implementation of LM tools in manufacturing sector and rest of two papers were published on furniture and process industry; one for each type (see table 1). As it can be seen in above given table that maximum of the review papers has been written on the specific industrial sectors; thus it was highly needed to write a paper by which the collective and broader picture of LM implementation in various types of Lean industries can be depicted. In this regard, literature review on LM implementation in different types of industries (food, electronics, furniture, automotive, manufacturing textile and process industries) was included in the content of present paper.

### 5. Literature Review

The underlined concept of lean manufacturing is to produce something without waste. Further, Waste has seven types namely waste of motion, waste of inventory, waste of overproduction, waste of waiting time, waste of transportation, process waste, waste of defective products (Marasini et al., 2014; Sachdeva et al., 2017). Lean manufacturing provides the best manufacturing system in the 21st century (Z. A. Shah & Hussain, 2016). Melton mentioned six major benefits of lean which are presented in figure 1.

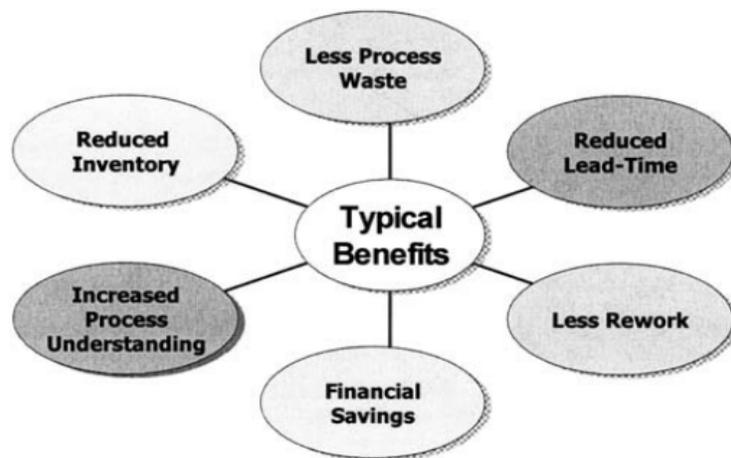


Figure 1. Benefits of lean (Source: (Melton, 2005))

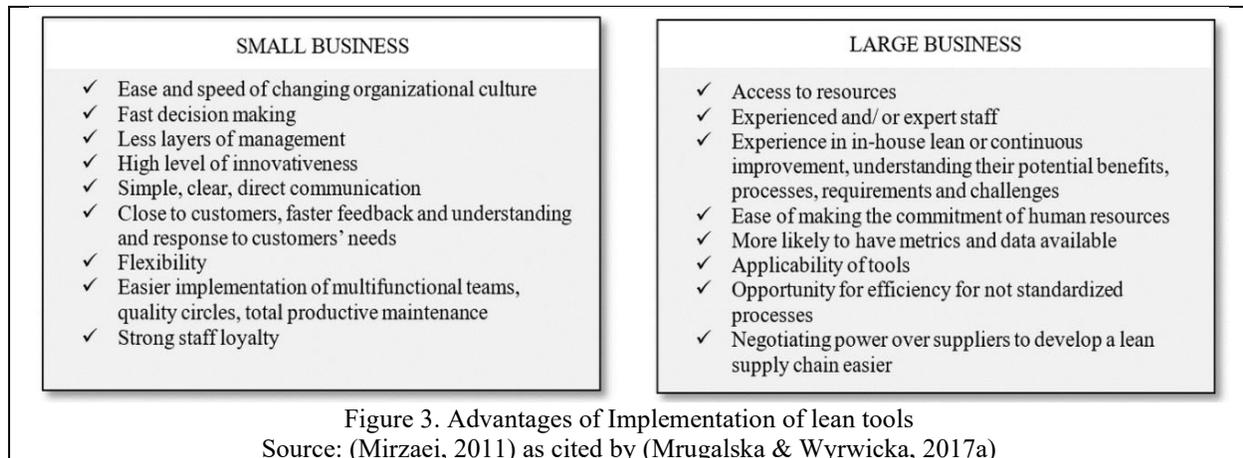
In industrial process lean manufacturing is widely acknowledged for eliminating non-value-added activities, consolidate human in production setup and remains in eager for continuous improvement (Abd El-Aty et al., 2015; Abdullah, 2003; Almani et al., 2017; Bhamu & Sangwan, 2014; Bhaskar, 2012; Bhutta et al., 2017; Chikhalikar & Sharma, 2015; Del Rocio Quesada Castro & Posada, 2019; Dhiravidamani et al., 2018; Kesavan & A. Ramachandran, 2014; Kleszcz et al., 2019; Kumar, 2014; Kumari et al., 2014; Leyva et al., 2018; Mayatra et al., 2015; Mehta et al., 2012; Melton, 2005; Mrugalska & Wyrwicka, 2017a, 2017b; Nasser et al., 2009; Nithia et al., 2015; Pinto & Mendes, 2017; Ramesh Babu et al., 2016; Saleeshya et al., 2012; Santos et al., 2015; D. Shah & Patel, 2018; Sharma et al., 2018; Sundar et al., 2014). Additionally, lean manufacturing meets market demand and services output at maintaining low inventory and eliminating waste: material and non-material waste (Kumari et al., 2014). Further, lean manufacturing also reduces the wastage of time by improving the working pattern of production (Kumar, 2014), (Chikhalikar & Sharma, 2015). Lean manufacturing techniques are specifically progressed from Japanese company particularly from Toyota (Maware & Adetunji, 2019; Nasser et al., 2009; Nordin et al., 2010; S D et al., 2015; Sharma et al., 2018). It is evolved from Toyota under the name of Toyota production system (TPS) than it has become more popular among companies around the world (Kazi & Konstantinos, 2018)(Bhaskar, 2012).

According to (Melton, 2005) Benefits of lean manufacturing includes reduced inventory, increased process understanding, financial savings, less rework, reduced lead time and less process wastage as can be seen in the figure.1. Lean manufacturing (LM) is known as the conceptual framework in the numerous companies since 1990's. The better explanation of lean could be the elimination of waste at the workplace (Del Rocio Quesada Castro & Posada, 2019). It is not only the technique which is manually supported but it is also known for change in organizations' culture across the globe; which is the major factor in the way to productivity and quality improvement (Abd El-Aty et al., 2015). After the review of literature, the contribution of LM in the success of industries of developed world (Japan, United States, Italy and Germany) has been indicated. LM has been implemented only in the companies of developed world (Abu et al., 2019). Literature clearly indicates that the innovational climate in the process industries in these years was an open issue to the lean researchers (Melton, 2005). In most of the industrial growth, 70% to 80% innovation is because of lean thinking (Sharma et al., 2018). Kleszcz et al., 2019 has also reported the numerous barriers in the way to the implementation of tools of lean in the ceramic industry. The barriers included lack of expertise, shortage of staff and the absence of framework for lean implementation in the ceramic industry (Kleszcz et al., 2019).

In this research paper, there were eight types of industries on which the research papers were collected in the context of implementation of LM practices. Three research papers discussed the implementation of LM tools in food industry, one paper was on electronic and process industry each, two papers were on SMEs, furniture, and manufacturing industry each, 7 research papers were on the automotive sector and last four papers were on textile industry (see figure. 2).



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Since, the challenges and barriers of the LM implementation in the small and large business are different thus the benefits and advantages are also different. In figure. 3 the advantages of lean tools in the small and large scale business are described in bullet points. The figure. 3 was taken from (Mirzaei, 2011) as cited by (Mrugalska & Wyrwicka, 2017a).

## 6. Implementation of Lean Manufacturing in Industrial Sectors

### 6.1 Food Industry

Major factors for lean implementation in food industry were reported to be leadership, financial support and commitment of managers; the application is lean in industrial world in continuously increasing because of customers' and competitors' pressure (Del Rocio Quesada Castro & Posada, 2019). Moreover, in micro and small firm of the food sector of Medellin, implementation level of LM techniques were evaluated by Castro and Posada, 2019. A questionnaire was used in the research for data collection from the production chief; it was included with nine techniques and the variable of administration by the approval of which firms' productivity can be improved. Kaizen, PokaYoke and visual factory were indicated to be the extraordinary practices of LM. Moreover, it was suggested to the firm, minimum sales must be increased to 139 (20%) in order to improve the sector's efficiency without changing employees (Del Rocio Quesada Castro & Posada, 2019).

Lopeset al., 2015 implemented LM tools in the 2 food and beverage Portuguese industries. LM tools and techniques were implemented in the production system of the corresponding companies. Achievements after the implementation of LM were noteworthy and particularly it inspires the culture of continuous improvement and lead times are reduced by the increasing the production flexibility (Lopes et al., 2015).

## **6.2 Electronics Industry**

Abd El-Aty et al., 2015 implemented principles of LM at the electronics industry of Egypt (assembly line of sunny Egypt Company). Among the various products of mentioned company, LCD 32" model was benchmarked to be improved. Many parameters were indicated to be improved i.e. Lead time (reduced by 35%), cycle time (reduced by 17%), raw materials which found in the production line (reduced by 28%), WIP (reduced by 48%), inventory (reduced by 35%), number of workers (reduced by 15%) and number of non-conforming products (reduced by 71%). Furthermore, valued added and non-value added time were increased and decreased respectively (Abd El-Aty et al., 2015).

## **6.3 Small and Medium Enterprises**

Marasini et al., 2014 developed a lean implementation model which was cheap and could be easily understood; the model was developed for industries (small scale industries) of investment between 50-100million and were with the employment of 20-40 employees. Moreover, it was for those industries in which the involvement of engineer was quite less and all the operations were used to be supervised by chief technicians and foremen (Marasini et al., 2014). Oliveira and Junior, 2019 conducted a partial implementation of LM in the small and medium enterprise (SME) which was suffering from the international competition (Chinese companies). This implementation was conducted in furniture sector of Brazil with the objective to improve the productivity and the results indicated that the productivity was increased by 27% in the drilling department (Gazoli de Oliveira & da Rocha Junior, 2019).

## **6.4 Furniture industry**

Falah Abu et al., 2019 conducted a comprehensive review on the issues of lean implementation in furniture industry of Malaysia. Conclusively, three tools of lean (5S, training of employees and quality control) were found to be implemented in Malaysian wood and furniture companies (Abu et al., 2019). Kumari et al., 2014 target a small scale company and the appropriate methods were selected in order to improve the productivity levels; the ultimate objective of research was elimination of wasteful and non-value added operation in various service and production processes. The goal behind the mentioned objective was to gain the satisfaction of customers. Cellular layout was implemented at the case company with breakthrough machine and results indicated that industry's production was increased and at the same time inventory levels decreased. Other benefits of the implementation were efficient use of space, minimization of machines, decreased number of labor to meet the customers' demand (Kumari et al., 2014).

## **6.5 Automotive Sector**

Sachdeva et al., 2017 conducted a case study on the LM implementation principles in industry of auto parts. The products of the industry were manufacturing automotive lighting for two, four wheeler vehicles and off road vehicles. Implementation of LM was carried out for lead time optimization of tail lamp. After the implementation of mentioned techniques the customers' demand was used to be completed on time. Furthermore, implementation of LM techniques resulted in reduction of cycle time, lead time and throughput time, less manufacturing cost, increased productivity of labour and line efficiency, increased quality of the products, increased worker's safety, timely delivery of products and most importantly the satisfaction of customers (Sachdeva et al., 2017). (Rajput *et al.*, 2020) & (S. Kumar *et al.*, 2020) conducted the research about LM implementation in automobile industries. Dhiravidamaniet al., 2018 carried out his research in the foundry department of automobile parts manufacturing company, in which the tools of LM were implemented with the objectives of reducing defects and improving productivity. They have discussed the theorized implementation of practices of Lean i.e. total productive maintenance (TPM); Kaizen and value stream mapping. Increased performance was indicated by the average core rejections, air lock problem and sand leakage (Dhiravidamani et al., 2018).

Nordin et al., 2010 conducted their research on the implementation of LM in automotive industries of Malaysia. Data collection instrument was questionnaire. They studied the drivers and barriers which have an impact on LM implementation. According to them, driving factors for LM implementation were the customer focus and achievement of continuous improvement in the firm. Lack of understanding the concepts of lean and attitude of shop floor employees were indicated to be the barriers for delayed implementation of LM (Nordin et al., 2010).

Pérez-Pucheta et al., 2019 researched on the problem of an automotive company and it was the greater delivery time of finished goods to its national and international customers. The research demonstrated the integration of VSM (administrative/productive) and A3 report helps in the identification and elimination of waste in the delivery process (Pérez-Pucheta et al., 2019). Babu K et al., 2018 validated the lean principles' effectiveness systematically by using the simulation software. Input for the software was material flow. Possibility of much improvement in the manufacturing components was indicated by the results of simulation (Ramesh Babu et al., 2016).

Tiwari and Singh, 2018 researched on the way to implement LM. Inventory level reduction was focused at the top along with all other wastages (waiting time, over production, more than needed transportation, processing, motion and defected products. After the implementation the LM tools, the company was awarded as corporate 'Engine of the year' and became the role model for the other companies in the context of lean (Tiwari & Singh, 2018).

Smith. 1999 improved the supply chain's operational effectiveness in Automotive sector in Europe by using LM tools. Optimal routes for internal and external supply chain logistics were evaluated for the elimination of delays. Non-permanent stocking areas for material buffer within the internal logistics were planned and implemented. Results indicated that suggested inventory control policy would result in the saving of almost \$200,000 and almost \$1,000,000 would be saved from one time stock liquidation (Smith, 1999).

## 6.6 Manufacturing Industry

Ramachandran and Kesavan, 2014 conducted the comparison between cycle time and takt time and cycle time was indicated to be greater. In this regard, welding process capability was needed to be improved so that the customer demand could be achieved. Welding process was improved by replacing the machine and improving the weld shop's layout. After the mentioned improvement, cycle time reduced from 29sec to 15sec. Production was increased by 66.7% by elimination of non-value added activities (Kesavan & A. Ramachandran, 2014).

Abdullah, 2003 addressed the application LM in steel industry and developed the simulation model after conducting the value stream mapping of the current scenario and outputs of model were analyzed (Abdullah, 2003). LM implementations are getting popularity in the manufacturing industries of Pakistan (Khan, Memon and Soomro, 2020; Khan, Shaikh and Marri, 2020; M.A. Khan *et al.*, 2020; Muhammad Ali Khan *et al.*, 2020). (Sahito *et al.*, 2020) conducted the research about LM implementation in pharmaceutical manufacturing industries. (P. Kumar *et al.*, 2020) & (Mughal *et al.*, 2020) explored the potential of six sigma & lean six sigma and (Virk *et al.*, 2020) & (Lakho *et al.*, 2020) explored the potential of TPM & OEE in manufacturing industries.

## 6.7 Textile Industry

It is quite difficult to implement Lean tools in such an environment where the operations are conducted on the automatic machines. Textile industry is one of those environments. Saleeshya and Raghuram, 2012 took the challenge of implementing LM techniques in the textile sector. Combination (Kanban, Kaizen, 5S, visual controls and poka yoke) of different tools of LM was implemented at the case company for the improvement of processes. Achievement potential scores of situations before and after the implementation were presented by the help of radar diagrams. Setup time, change over time and process time were analyzed and colors were used in order to identify the volume mix; workforce was empowered by the use of kaizen and quality circles (Saleeshya et al., 2012). (Khan, 2018) mentioned the applications of LM in textile industries. LM wastes in textile industries need to be targeted by appropriate LM practices (Khan, Khatri and Marri, 2020; Khan, Marri and Khatri, 2020a, 2020b).

Leyva et al., 2018 also researched to reduce waste in the textile sector by the use of LM tools. The scenario to be improved was diagnosed by using theory and LM philosophy. Major problem at the case company was non-fulfilment of orders up to 31%; the value added and non-value added activities were separated and current value stream mapping was elaborated. Tools' prioritization was made in the variables i.e. time, cost and implementation feasibility. Non-value added activities were reduced by the implementation of 5S; and the cycle time various processes i.e. cutting, stamping and packing. Furthermore, cycle time of pajamas was reduced by the implementation of manufacturing cell; after its implementation, production capacity was increased from 1080 pajamas/month to 1964 pajamas/month. In this way, production capacity was increased by 23% from the market demand and the percentage of non-fulfilled order was decreased to 0 (Leyva et al., 2018).

Shah and Hussain, 2016 explored the LM practices' implementation in the Pakistan textile sector. It was indicated that, textile sector was at the starting stage of implementation of lean; and the companies lack at understand the lean

concept. Greater than 50% of the participant companies were at the stage of change in terms of LM. Practices of lean production are significantly associated with the type and size of the company in textile sector and company's age has nothing do with lean. The barriers which were faced by the participant companies in the implementation period were lack of awareness for the implementation of lean, culture of company, shortage of communication and resistance of employees (Z. A. Shah & Hussain, 2016).

## 6.8 Process Industry

Santos et al., 2015 correlated LM implementation and ergonomic working conditions in the process industry. Statistical analysis included quantitative and qualitative variables. Quantitative variables included products with same volume and minimum employees; and qualitative variables were improve products' quality, timeliness, faster and accuracy. Interviews were conducted to see the benefits of implemented tool and thus data was collected. The objectives of reducing waste and increasing productivity were achieved by the technique of continuous improvement. As a result, ergonomic conditions at the workplace were improved and due to this employees' wellbeing and productivity were improved (Santos et al., 2015).

## 7. Discussion

The purpose of this paper is to review the existing literature on lean manufacturing implementation at industrial level so that its applications and advantages can be revealed in the different industrial sectors especially in those in which production is more dependent on the workforce as compared to machines. As mentioned earlier in the introduction section, waste is reduced by LM implementation, efficiency and overall system effectiveness increased. Practices of lean production are significantly associated with the type and size of the company in textile sector and company's age has nothing do with lean. The barriers which were faced by the participant companies in the implementation period were lack of awareness for the implementation of lean, culture of company, shortage of communication and resistance of employees (Z. A. Shah & Hussain, 2016).

Saleeshya and Raghuram, 2012 analyzed Setup time, change over time and process time and used colors in order to identify the volume mix; workforce was empowered by the use of kaizen and quality circles (Saleeshya et al., 2012). Abdullah, 2003 developed the simulation model after conducting the value stream mapping of the current scenario and outputs of model were analyzed (Abdullah, 2003). Marasini et al., 2014 developed a lean implementation model which was cheap and could be easily understood and that model was developed especially for the small scale industries (Marasini et al., 2014). Oliveira and Junior, 2019 implemented LM furniture sector of Brazil with the objective to improve the productivity and the results indicated that the productivity was increased by 27% in the drilling department (Gazoli de Oliveira & da Rocha Junior, 2019). Ramachandran and Kesavan, 2014 improved welding process by replacing the machine and improving the weld shop's layout. After the mentioned improvement, cycle time reduced from 29sec to 15sec. Production was increased by 66.7% by elimination of non-value added activities (Kesavan & A. Ramachandran, 2014). Castro and Posada, 2019 used Kaizen, Poka Yoke and visual factory in the food industry which were indicated to be the extraordinary LM practices. They suggested to the firm, minimum sales must be increased to 139 (20%) in order to improve the sector's efficiency without downsizing or increasing number of employees [40]. Lopes et al., 2015 reduced lead times and increased production flexibility by the implementing LM tools in food and beverage industries (Lopes et al., 2015). Abd El-Aty et al., 2015 decreased non-value added times and increased value added times in the electronics industry (Abd El-Aty et al., 2015). Oliveira and Junior increased productivity by 27% in the drilling department of the one of the furniture industry of Brazil by just partial implementation of LM (Gazoli de Oliveira & da Rocha Junior, 2019). Kumari et al., 2014 implemented cellular layout in one of the furniture industry by which they decreased the inventory levels and increased production; moreover, the efficient space utilization, minimization of machines and labor were also in the achieved benefits (Kumari et al., 2014). Sachdeva et al., 2017 implemented LM techniques in auto-parts manufacturing plant; which resulted in reduction of cycle time, lead time and throughput time, less manufacturing cost, increased productivity of labour and line efficiency, increased quality of the products, increased worker's safety, timely delivery of products and most importantly the satisfaction of customers (Sachdeva et al., 2017). Burgos, 2018 implemented LM tools in textile sector, by which production capacity was increased by 23% from the market demand and the percentage of non-fulfilled order was decreased to 0 (Leyva et al., 2018). Santos et al., 2015 achieved the objectives of reducing waste and increasing productivity by implementing the technique of continuous improvement; after implementation, ergonomic conditions at the workplace were improved and due to this employees' wellbeing and productivity were improved (Santos et al., 2015).

## 8. Conclusion

In the modern world of technology and the smart techniques, companies are needed to renovate their routine work at offices, production floors and the manual work of each employee (small or big). This paper is the presentation of review of literature on the topic of lean manufacturing which is the famous waste reducing technique for the manufacturing, process and service industries. It was indicated from the literature review nowadays lean manufacturing if being implemented at the large scale in manufacturing industries and at the same time, the bakeries are also reported to be user of lean manufacturing. From this it is clear that slowly and gradually the small, medium and large businesses are compelled to simplify their process for the survival in this diversified market. Since, it is the popular waste eliminating technique thus it was used for the elimination of non-value added activities (Abd El-Aty et al., 2015). It has been used for improving the line efficiency and production capacity, and quality of products (Leyva et al., 2018), minimizing labor requirements and inventory levels in manufacturing sector (Kumari et al., 2014). Furthermore, for the sake of efficient space utilization and layouts it has been proved to be an extraordinary technique. At the other hand, it also contributes in the minimization of lead times in various industrial sectors. It also result in timely delivery of products, improved workers' safety and on the top, satisfaction of customers (Sachdeva et al., 2017).

## 9. Future Implications

Major barriers in the way to LM implementation are lack of top management support, financial, managerial and leading support (Del Rocio Quesada Castro & Posada, 2019). In this regard, research can be conducted by which the barriers and challenges of LM implementation can be highlighted and accordingly the framework can be suggested for its reasonably easy implementation.

## Acknowledgement

The authors are very thankful to their supervisors, colleagues and well wishers at the department of Industrial engineering & management and Mehran UET, Jamshoro, Sindh, Pakistan to motivate and guide them.

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