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A Literature Review on Implementation of Lean Tools in Industries and Enterprises

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Abstract: ***In today's competitive environment, lean manufacturing becomes necessary across all industries. Lean production is a contemporary production technique of the new millennium. Lean manufacturing has varied synonyms just as lean management, lean production. It provides an extensive approach for decreasing the flow of non-value-added activities. Lean manufacturing is an excellent philosophy to minimize the period amongst client orders and supplies are ready for delivery through eradicating waste. Waste (Muda) is implicit like any process or activity that would not be adding value to the finished product or services. Waste is a severe problem emerging in the manufacturing industries; it causes non-value-added steps which do not expedite outstanding products and services. Waste is minimized with the aid of lean manufacturing. It is an integrated system that entails a minimal buffering cost for services offered and manufactured goods. The present research studies in the domain of Lean are examined to comprehend the execution level of several lean tools, benefits of implementation, and obstacles during the execution of Lean are also scrutinized in the reviewing. Several benefits and potential barriers that occur while implementing the lean culture in various organizations have been identified and listed in this paper.***
Keywords: Quality work-life, Lean Manufacturing, Muda, Toyota production system, Kanban, kaizen, JIT, VSM, 5s etc...

I. INTRODUCTION

Lean manufacturing is a crucial technique utilized in diverse sectors in the latest manufacturing practices. At present times, businesses are facing the highest level of competition because of the rise of globalization. In this scenario, to compete in the global market and to remain relevant, organizations have to revise current manufacturing practices by letting go of the conventional approach and apply advanced tools and techniques which are useful for raising their performance, getting more profits, and answering expeditiously to the customer‘s demands. The basic concept of lean production is to supply a quality product while guaranteeing an optimal cost of the product. An approach to lean manufacturing encompasses a wide range of tools and methods; tools are chosen according to the need for the operation. Plenty of parameters furnish the success of lean. The ineffective use of lean methodologies is detrimental to the competitiveness of organizations. However, lean production offers a very favorable environment for waste reduction. The idea of Lean production and the philosophy behind it was inspired by a book: "The Machine that Changed the World: The Story of Lean Production". It was first used by Krafcik (1988). Lean manufacturing is incorporated in the Toyota production system (TPS). Taiichi Ohno was called The Hero of the Toyota Production System. He formulated the seven wastes (Muda) as an element of this system. Taiichi Ohno defined “Muda” as wasted effort because it does not result in a value concerning the product. In case of manufacturing establishments, practicing the Lean methodology results in many benefits such as reduced lead time, change over time and downtime of a particular product, efficient inventory control, and defect reduction i.e. defect-free production. Lean decrees 50% of human efforts [3] due to its reliable methods means that it uses only half of the humanitarian efforts.

A. This Is What Lean Manufacturing Is All About

1) It is a socio-technical system whose primary focus is to reduce waste by eradicating producer, consumer, and internal complexity at the same time.[1]
2) By integrating the work routine of manufacturing and distributing products, services, and expertise through issue analysis and process improvement, lean manufacturing minimizes waste and decreases plant lot sizes. [2]
3) Lean manufacturing methodology strives for high quality product development, low costs, and just-in-time deliveries by reducing the production flow and eliminating waste. Teamwork is central to lean manufacturing. It breaks down organizational barriers by training and motivating people to explore problems and discover solutions as part of their job. [2]

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4) As a socio-technical system, lean manufacturing integrates multiple activities, including production, delivery, and problem identification, and process improvement, to eliminate wasted resources and reduce production sizes. To eliminate waste, it is necessary to simultaneously reduce and minimize supplier, customer, and internal variability. It eliminates organizational barriers and produces highly skilled and motivated workers with a clear understanding of how to investigate problems and find solutions. [2]

B. *Importance*

Nowadays, with a rise in business competition and customers having more and more turbulence regarding quality, it is fundamental for businesses to implement the lean manufacturing methodology to maintain a competitive edge. By utilizing various lean tools, the lean methodology enables us to produce better quality products with higher customer satisfaction. In addition to offering higher quality products and customer satisfaction without spending much money, lean methodologies reduce non-value-added activities' costs with the utilization of appropriate tools and eliminating excess inventory. As a consequence, lean manufacturing reduces seven types of waste that occur frequently in the industry. An example might be transportation, inventory, and motion, and a few others might be over-processing, overproduction, and defects. In addition to reducing the variety of waste produced in a company, lean manufacturing also reduces a company's financial risks. Multiple lean tools and principles are employed to reduce waste, as outlined below: 5s, OEE (overall equipment effectiveness), 8 step practical problem solving (PPS), Pareto analysis, elimination of waste, kaizen, setup time reduction, process mapping, value stream mapping(VSM), kaizen, SPC/control charting, 5 why, automation, continuous improvement, continuous flow, visual control, design for six sigma(DFSS), cellular manufacturing, production leveling, kanban, line balancing, customer feedback, Jidoka, Anova, Work standardization, work simplification, fish born diagram, six sigma, takt time, poka-yoke/ mistake-proofing. These lean tools can be used for different problems; the industry decides which ones are applied and which tools offer maximum benefit.[2] [26]

C. *Implementing Lean in the Workplace*

Following are the steps that should be taken as part of the lean manufacturing methodology to be implemented in the industry.

1) Make your choice of a product or target.
2) Conduct a 'Gemba walk' analysis, for collecting all the data and for understanding the product line and industry.
3) Calculate the highest level of waste or non-value adding by analyzing the data and creating a chart or map, with the help of measuring the number of workers, cycle time, lead time, and inventory. (Additionally, the current state maps method is utilized. Which is the part of Value Stream Mapping)
4) Once the non-value-added or waste activities have been identified, Select the lean tools that will give maximum results, and based on your study, decide which lean tools apply and yield maximum results.
5) Depend on the waste, some of the assured techniques areas:

a) 5s- The process of assessing every aspect of a space, removing unnecessary things, and logically arranging things is part of the process
b) cellular manufacturing- focuses on production,
c) SMED- reduces the time-consuming activities by change over time and setup.
d) JIDOKA- set of practice, and automation with a human touch,
e) poka-yoke - mistake proofing,
f) kaizen- continuous improvement, change for the better

6) The last step is improving the problem and establishing a baseline for the industry to continuous improvement in the future, which will increase profitability.

II. OBJECTIVES

A. To determine the level of Lean implementation
B. Understanding the extent to which Lean is being implemented
C. To examine the benefits of Lean implementation in manufacturing.
D. To evaluate how Lean manufacturing is being implemented
E. Identifying the opportunities and obstacles for implementing lean in manufacturing.

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III. LITERATURE SURVEY

Lean manufacturing is a technique that reduces the amount of human effort required, eliminates defects, and helps to produce high-quality products. According to Dinesh Seth et al. "Lean manufacturing is the systematic identification and elimination of waste." Continuous improvement is the basis of lean manufacturing. [4] Lean management is an umbrella term for lean manufacturing and lean production as defined by Horacio Soriano-Meier et al. With time and the right efforts, a lean manufacturing environment can be achieved.[5] The source of this literature review is Thousands of journals from around the world, as well as conference proceedings, which are included in the World Knowledge Network, identified as the leading citation database. For the review, we considered several reputed journals that have published research on Lean manufacturing aspects. Studies that focus on the awareness of and potential for implementing Lean tools in different sectors are quite abundant in the body of literature related to Lean implementation. Below is a discussion of an important such study.

Rachna Shah et al (2007) Lean manufacturing constitutes an integrated social-technical process. It focuses on reducing and minimizing waste with the help of concurrently reducing and minimizing supplier, customer, and internal variability.

Nordin Norani et al (2010) In this study, more than eleven factors were examined, and the proposed framework of organizational change is intended to provide practitioners with a better understanding of the lean transition and clear guidance to minimize the resistance and conflicts for the implementation of lean and thus improves its probability of success. Based on the results of this study, it was found that lean manufacturing implementation fails due to a lack of effective management of organizational change during a lean manufacturing transformation journey. This data will be used to further empirically investigate and validate the model. Facilitate the transition to lean manufacturing while providing practitioners with unambiguous guidance and/or tools that will minimize resistance and conflicts throughout the journey. Jannies Angelis et al. (2012) A Lean system puts the focus on discrete parts assembly and is a globally competitive standard. The ability of leaders and employees to problem-solve in a proactive fashion is what makes Lean successful. A successful improvement program and the adoption of appropriate practices are contingent upon employee involvement.

Azharul Karim et al. (2013) Research was performed on the development of an effective methodology for implementing lean manufacturing strategies and leanness, this research was carried out using the following methodology: analysis of production and process variables, and performance analysis. The use of VSM and MTM together redefined lead time reduction and productivity measurement based on the Lean principle and standard processes.

Chapel et al. (2014) Using data from the manufacturing industry in India, Chapel explored the enablers and barriers in the implementation of Lean principles and lean diffusion. Based on the results, it appears that further research in lean manufacturing is focusing on lean assessment. He worked on multiple criteria decision-making (MCDM) for lean assessment to assess lean performance holistically & the popularity of lean in India; but when it comes to success, it's only the start of the journey. In addition to answering specific questions, leanness requires managers on different levels to assess the degree of implementation and mitigate spending on lean implementation.

Achanga, Pius et al. (2005) determined that there are several critical factors you need to take into account when implementing lean in manufacturing SMEs. The role of leadership, management, finance, organizational culture, skills, and expertise are among the factors to have a positive impact on the development and implementation of a strategy, allowing an organization to have a flexible structure. Sourabh Sharma (2014) the primary objective of this study is to determine whether or not the standardization will enhance the implementation of lean principles, the potential benefits, and limitations of lean standards and certification. To get a good understanding of how standardization will help the Company eliminate major problems in implementing lean tools and principles, it is recommended that the company first consults with lean practitioners. The survey provides them with an opportunity to determine the motives and objectives of individual industry professionals and lean practitioners within particular industries. The distribution of surveys is carried out from lean organizations, corporations, online sources, and other sources (industry journals, literature, authors, academics, and personal contacts). Additionally, the biggest problem of the lean implementation process has been addressed; examples are- Insufficient implementation expertise, no middle management support or inexperience of middle management, the reticence of the employees in the implementation process.

Rakesh Kumar and Vikas Kumar's (2015) Study conducted by authors explore the importance of Lean Manufacturing elements with the intention of determining the significance of Lean Manufacturing especially for the Indian manufacturing industry. The study also lists the following: obstacles encountered, benefits gained, as well as adverse impacts including poor financial decisions, low inventories, over-reliance on Lean guidelines, physical and mental health problems, and a poor product quality.

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Santosh Kumar et al. (2014) describe lean manufacturing as a philosophy aimed at improving manufacturing processes in a continuous cycle of improvement. Their recommendation is to apply lean tools through the method of integrating time monitoring and line balance efficiency that would reduce cycle time on an assembly line, thus enhancing its efficiency.

George L. Hodge et al. (2011) Using lean tools, they researched and identified waste and non-value added activities in US textile industries to increase satisfaction for their customers. According to the author, Lean manufacturing implementation is impeded by many barriers: Reluctance of both shop floor personnel and management to appreciate the change; Employees on the shop floor are unwilling to offer suggestions for improvements; lack of communication inability to integrate marketing, sales, product, and development; shop floor personnel speak different languages; therefore, training must be multilingual.

Gulshan Chauhan et al(2012) This study illustrates waste elimination, Just In Time, and continuous improvement. In an effort to find the significance of implementation, the author uses the SPSS correlation analysis. Several factors are driving Lean Manufacturing, including vertical information systems, function integration, decentralization, cross-functional teams, pull production, Just in Time deliveries, zero defects, continuous integration, and eliminating waste. Just in Time is a top priority after that continuous improvement.

Anna Dorota Rymaszewska (2013) Researchers investigate the challenges associated with implementing lean practices within small and medium-sized enterprises (SMEs). By comparing the different manufacturing environments as well as organizational characteristics, the potential challenges of lean adoption are outlined. ―Doing more with less.‖ Compares between the two industries of boat and furniture. Also considers internal operations/ like Standardization, Material replenishment, Workload leveling, QA, Visual control, Reliable technology. Research identifies Influencing factors as philosophy, know-how, Employee relations, communication, financing, value creation, organizational learning, Hijunka and JIT, and Internal implementation facilitating/ reinforcing factors are communication, partner/suppliers, quality. He adds, 1. The challenge of Long term orientation, 2. The challenge of becoming a learning organization, 3. The challenge of leveling out the workflow. 4. Supplier buyer relations and JIT. 5. Employee empowerment and standardization of the work procedures. The validity of the findings can be improved by adding more empirical evidence.

Ratneshwar Singh et al. (2013). Having a Total Productive Maintenance system implemented in a machine shop has the advantage of reducing downtime and improving performance efficiency. TPM is a set of several pillars, such as the 5S, the Jisshu-Hozen, planned and quality maintenance, quality control, safety and health, Kaizen office, and environmental practices which are implemented one by one or applied simultaneously to improve product quality and efficiency with overall equipment performance and equipment service life.

Boppana v. Chaudhary et al. (2012), Taking cases study of creams and ointments as an example in Boppana v. Chaudhary implementing lean manufacturing in a pharmaceutical company. Among the problems in the industry were fixed operating costs and the inability to supply products. The paper guides for improving the operation using lean manufacturing tools and VSM to detect waste causing issues. The VSM method identifies processes that can be classified as either value-added or non-value-added. Use the 5-why method to organize the collected information and create a current state map. By using the 5S lean tool; we can create an improved future state map. By implementing cellular manufacturing we achieved decreased inventory cost, increased customer satisfaction, and on-time delivery. We reduced the cycle time and decreased the non-value-added time.

Taho Yanga, Yiyo Kuob, et al (2014) A study was conducted on fishing net manufacturing facilities. In the end, the author concluded by stating that lean manufacturing is a successful method of reducing costs by eliminating waste in any manufacturing industry. In particular, various lean tools were used with simulation, with the objective of developing and implementing a lean production system. It is primarily concerned with the MAKE TO ORDER (MTO) process which is to be utilized for the regular production shipment. Furthermore, the application of the Value stream mapping (VSM) tool is practiced to generate a future state map, increase service level, reduce cycle time and lead time, as well as providing guidelines on how to implement VSM and factors to consider.

K. Venkataramana (2014) says that lean manufacturing has been implemented by numerous organizations in the last few years to reduce waste. Value stream mapping is used to increase the productivity of crankshafts manufacturing by reducing the cycle time. For the production of crankshafts, there are three assembly lines to choose from. A variety of tools and methods are used by the author to develop a map of the current state of the crankshaft assembly and also develop a future state map that will make it easier to work with the crankshaft assembly also planning for improvements in the assembly process. Three types of Kaizen were applied to improve processes and reduce waste and applied Analytic Hierarchical Process (AHP) for determining process selection and then get the data required to minimize inventories, implement single-piece manufacturing processes, and ensure quick responses to

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clients.

Vinodh et al. (2011) Research in this study focuses on analyzing lean manufacturing practices across industries and finding out what it takes to successfully implement them. Building the measurement and structural models is accomplished using Structural Equation Modelling. A validation process is then conducted using statistical estimates. As part of the data collection process, a questionnaire was developed and analyzed in regards to four enablers, including management accountability leanness, manufacturing management leanness, manufacturing strategy leanness, and technology and workforce leanness. In addition, the current study calculated the R2 value, indicating a strong influence of management responsibility leanness, manufacturing leanness, manufacturing strategy leanness, and technology and workforce leanness on business effectiveness. Finally, a teamwork atmosphere with management that is dedicated, highly trained, and very motivated. Supplier and customer integration within the organization. A culture of creativity and innovation is promoted. A key aspect of lean implementation is streamlining processes and eliminating waste.

P. Arunagiri et al. (2014) A study identifying the most effective lean tools in the automotive manufacturing sector based on weighted average analysis. researchers studied 91 industries, and 30 lean tools were determined to be beneficial by the weighted average method. A 5S approach is the most effective tool in the automobile industry to eliminate waste.

Tomas Rohac et al. (2015) researched plastics health care product facilities. The researchers used a value stream mapping method to apply lean tools - 5-why & Ishikawa charts and reduce production lead times and inventory levels.

Praveen Saraswat et al. (2015) applied the value stream mapping in the bearing industry to reduce inventory and lead time as well as work in process. Their method of implementing value stream mapping is described along with information about value stream mapping. Our objective in this case study is to mitigate work-in-process inventories through the implementation of Lean tools such as 5S and kanban systems.

Roba Salem et al. (2015) used online metrics to assess lean concepts, principles, tools, and techniques across different industries in Qatar, to determine the level of lean awareness along with perceptions regarding lean benefits and challenges. An online survey was conducted among 333 organizations from a variety of sectors, including oil and gas, academic institutions, and service sectors. According to research, there is a difference in how lean principles are perceived and appreciated by different industries. Also, Lean thinking must be given greater credit by industries in Qatar to strategically accelerate current efficiencies while managing global competition.

Pratik Chikhalikar et al (2015) study examined the implementation of lean methods in an engine manufacturing unit in India. Using lean tools, the research pinpointed crucial time horizons and timeframes for implementing the tools. Study results revealed that the most significant factors influencing the process of lean implementation. There are several problems with the operation, such as poor information dissemination, transportation issues, varying wastes, Material flow, inefficient inventory management, Bottleneck operation. List of Lean tools practiced- Single Minute Exchange of Die(SMED), Kaizen, Total Productive Maintenance, JIT, 6 sigmas, Kanban, 5S.

Sudipta Chowdhury et al (2015) targeted the Indian furniture manufacturing industry to investigate how production could be improved. The implementation of numerous lean strategies included Single-Minute Exchange of Dies and Genchi Gembustu Gemba. In the end, the results indicated a significant reduction in processing time for each lot, as well as an increase in financial terms. Higher multifactor productivity of 2.26 was also observed in the study, which demonstrates an overall increase in equipment effectiveness. The furniture manufacturing industry can successfully implement lean strategies, as proven by the results of this study.

Yusef Larteb et al (2015) research concluded that the key determinants of the success of lean implementation include high-level managerial involvement and commitment, adequate time and appropriating resources for improvement projects, supportive management, demonstrating strong leadership, and a program that facilitates employee development. A structured questionnaire was used and seven features of lean implementation measures were assessed: individual demarches, managerial commitment, resource allocation, effective communication, structural methodologies, multifunctional teams, and continuous performance monitoring.

Neha Verma et al (2015) conducted a study where she investigated waste-related problems such as the cause of equipment failure and bottleneck problems, so as to implement lean manufacturing in small-scale industries. To increase productivity, the process was analyzed according to the following factors: reducing non-value-added tasks, inventory management, reject prevention, downtime, set time, and eliminating unnecessary activities. The company neither invested in the purchase or installation of new

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machines nor was any increase in work speed or effort expected of the operators; only procedures and layouts were altered to streamline the manufacturing process.

Richard lee Storch et al (1999) discuss lean ship design and production citing continuous and uniform processes as key elements of lean ship construction. Efforts must be made to develop and implement build strategies incorporating the appropriate breakdown of activities, especially in times of block breakdowns, regardless of design convenience. Providing an integrated and balanced approach across the hull, outfit, and painting processes; consistent workflows across the manufacturing process; optimal use of group technology. Work-in-process (WIP) inventory level, leveling factor index, and throughput are the metrics proposed for monitoring lean process flows in ship production.

Dave et al (2015) tackled Lean Construction with the support of IT and communication systems. As reported in the study, applying techniques such as lean principles, process modeling, and process analysis techniques, manufacturing maintains effective and efficient processes.- Standardizing processes across the industry will have a significant impact on the efficiency of processes.

Rakesh Kumar et al (2014) suggest that despite lean manufacturing having the potential to improve organizational performance, many Indian businesses still use it as an improvement tool rather than integrating it into their everyday work processes as a culture. By focusing on full-service culture as an organizational ethos, performance can be significantly improved. In essence, replace the batch production process with a one-piece or single-piece flow approach. Schedules are created at one point, during which the material is pulled throughout the value stream, and the flow rate is determined by the customer. Work in process (WIP) inventory drops due to fewer materials waiting to be processed between workstations, Quality checks become a regular part of the production process, eliminating the need for line inspectors to approve each product. Production and supply are replaced with customer demand as the basis for manufacturing. The main issue in India for lean implementation is the top management issues, and the top leadership policies and attitudes must be changed. Advised to promote the involvement of senior leaders to create a learning culture within the organization and to maximize communication to organize the industry by implementing Lean Manufacturing.

Giuliano Almeida Marodin et al (2015) analyzed the severity of risks that can affect the lean manufacturing implementation strategy and suggested a classification would help sort through the variables. For the research presented here, the researcher used diverse sources of evidence like discussions, inspections, and examination of records. Furthermore, the study categorized the risks that affect Lean Implementation into three categories: process management of LPI, middle- and upper-level management support, and shop floor engagement. The primary focus was on the classification of risks and the relationship between them. Following the identification of 14 risks, an exploratory factor analysis (EFA) was used to analyze the collected data. It is important to also note these study's limitations. First of all, external risks were not incorporated into LPI, only internal ones. Additionally, the document does not mention response and monitoring as stages of risk management.

Rahul Sindhwani et al. (2015) In a study it was found that Lean improves the relationship between manufacturers and consumers by adapting to consumer requirements that have recently arisen. Seven common metrics such as Overproduction, Overprocessing, Networking issues, Backlogs, and Transportation are usually set as parameters. There were several tools and techniques used to reduce waste. They were Pull system/KANBAN, VSM,5s. The lower frame production rate was increased by utilizing lean and agile principles such as pull systems and value streams. A pull system is a way of recognizing that rates need to be raised. With the aim of achieving the target cycle time, VSM was performed to identify constraints and one-piece flows.

Ramune Ciarniene et al (2014) Lean enterprise refers to a practice of considering all unproductive efforts as waste, a waste is to be avoided as much as possible. Typically, a "lean enterprise" is a process that focuses on eliminating waste that does not add value to the end product. This study uncovers the difficulties and barriers that must be overcome with the aim of lean to be implemented efficiently. Various types of barriers have been identified in the research: the process challenge, the people challenge, and the sustainability challenge. It was recommended that instead of paying sufficient attention to personal issues, first use the tools and techniques. True constraints come from issues related to human motivation, trust, and commitment. In addition, top management must understand and comply with LI; a third thing is to incorporate LI into the company's business strategy.

Nirav Patel et al (2015) consider LEAN MANUFACTURING to be a valuable business strategy, and it has established itself as an influential management tool capable of effectively improving business processes, improving process operations, and reducing non-value-added procedures. The VSM offers a wide range of features combined with material handling steps and information flow, among other useful data. There were four major parameters used in the analysis: Cost Rate, Material Cost, Duration (min), and their interconnection with money and time. Several tools were implemented, including Process activity mapping, Demand amplification mapping, quality filter, production variety funnel, and value-adding time profile. VSM works in every sector, from hospitality to manufacturing to automotive to machining and casting to transportation and so on.

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Shams Rahman et al (2010) The purpose of the study is to determine the extent to which LM practices are deployed by Thai manufacturing companies and the impact they have on the operating performance of those companies. The operational performance is measured by four parameters such as quick delivery compared to competitors, the unit cost of products relative to competitors, overall productivity, and customer satisfaction. Three constructs—JIT, Removal of Waste, and Flow management—are found to be crucial. It identified 13 out of 21 practices as lean practices. Companies remain committed to maintaining a higher level of resources and a higher volume of finished products and do not seem to be becoming leaner in their operations despite a higher number of materials and finished goods available.

Kashif Mahmood's (2014) research is designed to help clarify how the LP approach can assist in enhancing productivity and reducing costs while maximizing customer value and minimizing waste during the production process. An organizational system's productivity is influenced by its ratio (usually an index) between output (goods and/or services) and input (resources) utilized to produce that output. The inputs are usually divided into labor, capital, material (inventory), and energy. A lean effort is successful when it addresses Quality, Cost, Flexibility, Delivery reliability, and Delivery time. Another important factor that enables lean to become more effective in assisting the workforce to strengthen their welfare, motivation, and influence. Reducing stress, improving competence, improving cooperation, reducing frustration, improving customer communication, widening and developing tasks, improving safety at work, enhancing job security are all examples. An organization must be capable of changing its entire structure, not just one part of it. If anyone of these departments resists this change, Lean will not last. This includes Sales, Logistics, Marketing, and Product Development.

Vujica Herzog et al (2014) found that the developed variables are useful both for understanding lean concepts and determining whether manufacturing systems have implemented new lean processes. During the research, three phases were identified: A literature review was conducted intending to identify the major dimensions of LM manufacturing; 2. A questionnaire design, pre-test on experts, and a pilot study were conducted - the survey contained 59 items, arranged according to Likert scales, beginning with 'strongly disagree' and ending with 'strongly agree'; 3. Analyses of reliability and validity followed by the analysis of the resulting data were conducted. Three different Validity can be measured based on the following factors: content validity, criterion-related validity, and construct validity. Several variables are associated with lean: on-time deliveries, supplier cooperation, fewer parts, and cleanliness inside the building. Teamwork and employee cooperation are the remaining variables.

Naga Vamsi Krishna Jasti et al (2014) According to research, there is an existing lean product development framework that can be applied to implementing a learning management system. A questionnaire survey was used to analyze validity and reliability. Cronbach's alpha value was used to determine who the respondents were from the top and middle management. Two broad categories can be drawn from LPD, namely: 1. researcher/academic-based; 2. consultants/experts-based. According to the study, forty elements are represented in eight frameworks, which play a critical role in implementing LPD frameworks.

Roslin, E. N., Shahadat et al (2014) Using Visual Production Management, researchers identify five kinds of waste associated with the sewing line process, stated as defective fabrics, inventory, overproduction, transportation, and waiting. Techniques such as layout redesign, line balancing, and quality control at the source can be applied to lean manufacturing. A future-state value stream map is created based on the impact of implemented lean techniques on production. Approximately 96% of wastes are reduced by the Poka-yoke method, accompanied by a 43% decrease in lead time. In this instance, it is essential to define process measures and quantify processing costs. The productivity of an operation line is determined by the number of line operators and cycle time of the product. To increase worker efficiency, line targets, workstation targets, and work productivity will be evaluated independently, by calculating cost per hour. The line balancing concept is tested and Each line will be weighed before the layout is redesigned. The layout will be completed. Lean is possible Without high investments in technology, machine tools, or manpower.

IV. SUMMARY AND CONCLUSION

Many industries and organizations use the technology of lean manufacturing. Based on this literature review, this hypothesis appears to hold true. Enterprises in the manufacturing sector are hugely influenced by Lean philosophy. Several manufacturing institutions utilize Lean practices. Most organizations cite the benefits of lean business operations as improving productivity, reducing wastes, and improving inventory management. In regards to lean applications in manufacturing, there is a significant amount of literature available that provides a comprehensive evaluation of existing lean practices, including research conducted throughout the domain. Although sometimes a lack of adequate research is observed from an Indian perspective. Based on the findings of this survey, we states that lean initiatives of successful businesses focus on the elimination of waste and active participation of all employees in the manufacturing activities and processes.

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Employees have a significant role in overall lean methods adaptation, according to much of the literature studies. The most important obstacle mentioned in lean culture research is unproductive employee participation. The main constraint in lean industries is the unproductive engagement of employees. An analysis of a variety of research papers or literature indicates that there are certain lean tools widely used in a variety of organizations. Examples could be Gemba Walk, Kaizen, Kaizen, Value Stream Mapping, Kanban, Standardizing Work, TPM/TPS, continuous smooth flow/ cell design, JIT, Mistake-Proofing, SMED-Single Minute Exchange Die, Visual Management/Control, etc. We reviewed different papers on lean manufacturing and selected some of the best from all domains to apply lean manufacturing. These include the automobile industry, pharmaceutical company, color industry, cottonseed oil industry, health care hospitals. Numerous studies suggest that Lean methodologies have additional advantages. The research appears to suggest that many of the Lean techniques presented here are also characterized by various typical benefits as well as "hidden" benefits. Evidence observed in the literature backs up this hypothesis. Reduction in fatigue and stress, a culture shift, and a reduction in traceability time are some of the many hidden benefits. Some typical benefits include waste elimination, cost reduction, rework reduction, lower inventory levels, and lead time reduction. Despite Lean's many benefits, some obstacles prevent it from becoming more widely adopted. Lean implementation is hindered by some of the major factors such as poor psychology, lack of responsibility, financial problems, inadequate education and training, and demand volatility. All industries must now adopt lean principles to remain competitive since this has become an increasingly necessary part of remaining in business. Beyond doubt, adopting lean principles has now become necessary for all industries with the objective of remaining competitive. The time has come for every industry to discard conservative attitudes and adopt lean tools to improve working practices. A broader cultural shift is also required for the Service-Oriented industry to save the livelihoods of its workforce. Thus, this study concludes that various lean tools may be applied in different industries, but the 5s tool and Value stream mapping technique are the most effective techniques for detecting waste and improving processes. Moreover, lean manufacturing techniques are applicable to any industry, resulting in many benefits.

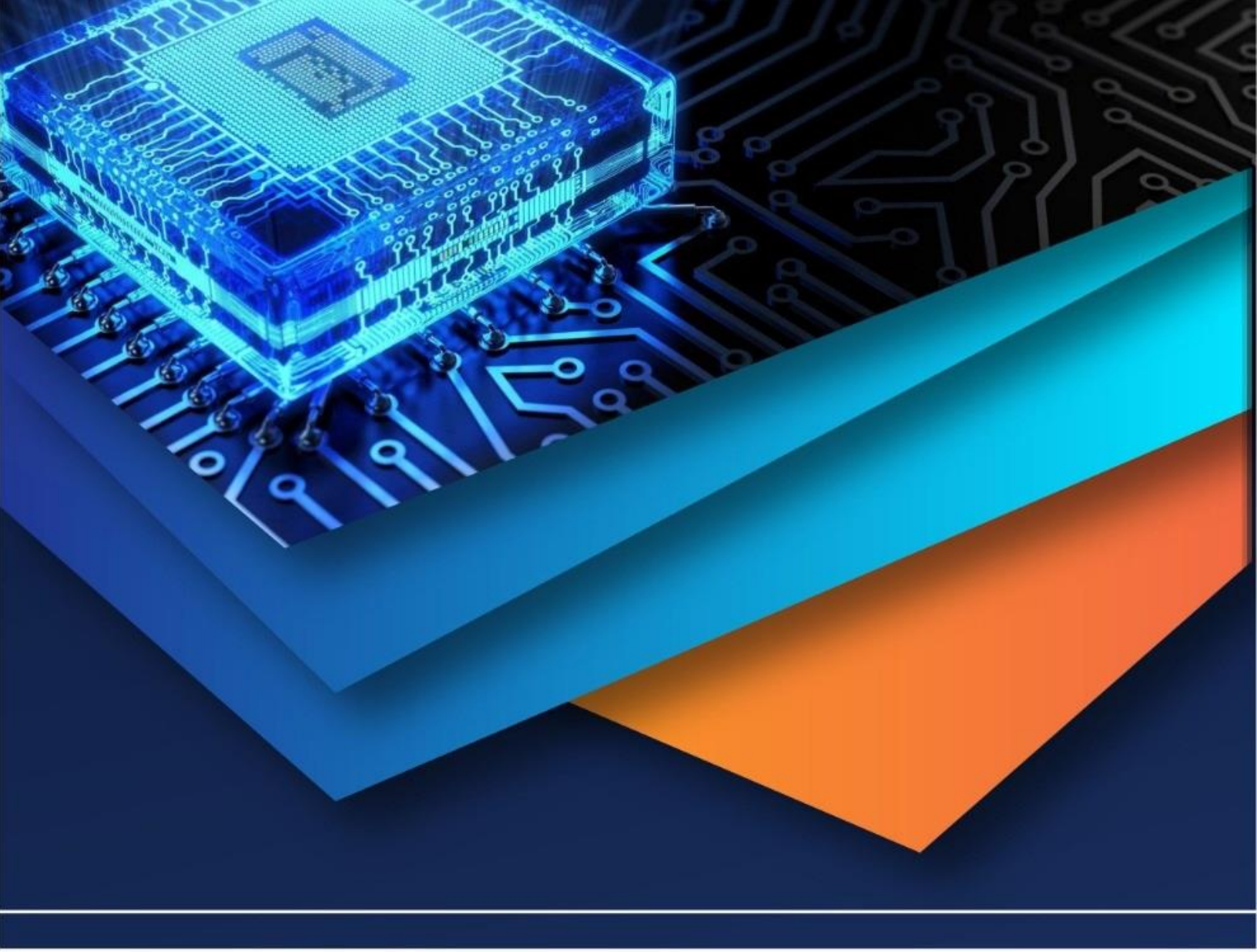
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