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A Conceptual Review of the Adoption of Lean Philosophy Tools in Manufacturing Companies

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Abstract

Purpose: The purpose of the study were to review lean philosophy practices prevailing in the manufacturing companies; to explore the various tools of lean practices existing in the manufacturing Companies and to investigate the obstacles towards implementing lean and to determine the critical success factors of lean tools.

Design/methodology/approach: The study is qualitative in nature, and it is based on a study of lean literature from the knowledge web, journals, and conference proceedings. This article goes over the fundamentals of lean philosophy and its applications in manufacturing companies, techniques, tools, benefits, and obstacles in the manufacturing business. It takes into account the target articles and specifics of web information connected to lean practice that was only published in 2015 and later. The major findings were summarized based on these sources.

Findings: The results of this paper reveals that there are various tools for implementing lean philosophy such as Just in time (JIT), Kanban, Total Productive Maintenance (TPM), Key Performance Indicator (KPI), Overall Equipment Effectiveness (OEE), Kaizen, DMAIC, 5s and Value Stream Mapping (VSM). Manufacturing companies benefit from lean tools in a variety of ways, including reducing deficits, lowering production costs, motivating and involving employees to improve their performance, and maintaining a quality system. However, before deploying any form of lean tool, companies need to be aware that a lack of confidence and knowledge from top management, lack of lean culture, ineffective internal communication system, and a failure to analyse before implementing change are the major challenges that have been identified while applying lean tools. Therefore, establishing an effective communication system, providing adequate employee training and education, considering employee feedback, and establishing a strong top management system to maintain a high level of quality, taking all possible steps to change the minds of employees, are critical to the success of implementing lean philosophy.

Research limitations/implications: This is a qualitative study that relies on secondary data from the literature review, empirical studies, and case studies and does not include a quantitative aspect, such as a survey. The research can help to expand the knowledge of more lean tools, benefits, and important success factors in order to make future improvements.

Social Implications: The paper will assist the manufacturing companies, researchers, academicians, and Lean practitioners to understand the lean philosophy, tools, and obstacles and consider the key to success before approaching any tools.

Originality / Value: The ambiguity of lean procedures grows in the industrial business due to a lack of literature. As a result, this article will assist lean practitioners, scholars, and academicians in comprehending real-world techniques, tools, and challenges, as well as success criteria for adopting lean philosophy. As a result, this study will serve as a foundation for future research.

Keywords: Lean Concept, Lean Benefits, Lean Tools, Lean Obstacles, Success Factors.

Introduction

Having high production efficiency, producing high-quality products, ensuring timely delivery to market, lowering costs, and generating profit are all top concerns for any manufacturing firm. Further, the ultimate goal

of a manufacturer is customer satisfaction, which may also be attained by delivering a high-quality product on time and at a reasonable price. Meeting these priorities has become difficult for many in today's competitive global economy, especially given the expectations and problems facing the manufacturing industry. Manufacturing industries face issues such as lowering operating costs, market inconsistency, competitiveness, and ever-increasing expectations.

Lean Philosophy Concept

Lean management is a way of thinking and behaving that can be applied to various types of organizations, industries, and services. Toyota developed lean management in Japan and implemented it in its factories in the 1970s. It is a management methodology that focuses on lean operations. It is most commonly utilized in the automotive industry. Lean management is defined as a company's entire workforce participating in the battle against waste by eliminating all non-profitable activities. As a result, the goal is to do more, faster, and better (Daniels, 2017). The process of a corporation migrating from an old style of thinking to lean thinking, as described by lean experts and practitioners, is dependent on a large variety of factors.

Lean manufacturing allows businesses to save costs, eliminate waste, boost productivity, maintain high quality, and yet earn profit by establishing a continuous flow of people, materials, and information (Smith, 2017). Lean manufacturing may succour any business in navigating challenging times. Lean is a mind-set that emphasizes continuous improvement and waste removal in order to maximize performance in terms of productivity, quality, lead times, costs, and customer delight. The Lean method, to put it simply, produces high-quality work with the least amount of money, resources, and time. Lean is the concept of efficient manufacturing operations that grew out of the Toyota Production System in the middle of the 20th century. It is founded on the principle of defining value from the customer's perspective and continuously improving the manner in which value is supplied by removing any inefficient or non-value-adding resource utilization. Lean manufacturing is the future of the manufacturing business, and lean practice is one of the most effective ways deployed by manufacturers around the world to improve their competitiveness (Kumar et al., 2018).

Lean practices contribute to the long-term competitiveness of industries by allowing them to accomplish more with fewer resources by eliminating non-value-added operations while maintaining efficiency and profitability (Kafuku, 2019). Lean focuses on retaining value with less effort, with the ultimate goal of offering perfect value to customers through a waste-free value generation process. It is commonly acknowledged that top management commitment is critical to the successful deployment of lean manufacturing. The lean journey is long and management commitment eventually wanes. Further, staff participation in everyday improvements is crucial to the implementation's success. In lean production systems, lean leadership can be thought of as a technique for sustaining and enhancing staff performance (Alefari & Salonitis, 2017). This is accomplished by enabling each employee to reach his or her full potential and thereby make the most significant contribution possible (Skhmot, 2017). The goal is to improve the efficiency of processes by utilizing the company's existing methods, techniques, and practices (Daniels, 2017).

Any company, whether manufacturing or service, will survive and maintain its competency if it is flexible enough to respond to customer needs in a consistent and systematic manner, adding value to the product (Palange and Dhatrak, 2021). The quality of the services is always considered a major contribution to achieving efficiency, better services, and ensuring continuous improvement (Al-Qayoudhi et al., 2017). Shakil and Parvez (2018) stated that lean manufacturing is a good method as it helps in improving a process without spending more money on machining, technology, and human training, especially for labour-intensive businesses like the sewing industry, etc. Durakovic et al. (2018) found that lean tools are a good source of competitive advantage that is relevant to a wide range of industries, and their development and discussion are rapidly progressing.

Application of Lean Philosophy in Manufacturing Companies

Lean improves product quality, employee satisfaction, and increases profit by waste reduction, resulting in a business that is better positioned to survive well into the future. Lean manufacturing principles aim to optimize supply value, by reducing waste and focusing on continuous improvement. The principles of lean manufacturing may be extended to suit any industry. Lean is generally linked with the manufacturing business and it may be used in any industry. Adopting Lean manufacturing concepts has benefited businesses of all sizes. Lean practitioners recognize that optimization is a constant process and that the best approach to achieving continuous improvement is to make small, long-term adjustments. Implementing lean in the manufacturing sector is not easy. Lean is more than a collection of tools to be utilized; it is also a new

management strategy known as the lean philosophy. Several things must be taken into account when implementing it. There are a lot of parties with competing interests who must be considered during the process. There are several barriers to lean adoption, such as staff involvement and commitment to change, company awareness of lean, etc.

According to Singh et al. (2018), lean manufacturing is a management technique that focuses on incremental improvements in operations, in improving the performance of present manufacturing system operations. The manufacturing industry employs a variety of lean methodologies including just-in-time production, a most critical component of lean manufacturing. Kafuku (2019) claimed that manufacturing planning and control, new product development, concurrent engineering, workforce management, customer relationship, and supplier relationship are the factors for the adoption of lean practices. Al Qayoudhi et al. (2021b) claimed that effective communication, top management encouragement, employee involvement, and a favourable organizational climate were the most critical criteria identified for the successful implementation of continuous improvement (CI) techniques in the manufacturing companies of Oman. Although the concept of lean is now generally understood, putting it into practice always has obstacles (Salonitis and Tsinopoulos, 2016).

The Various Lean Tools

There are various popular tools of lean available and use by the company. The tools included in our discussion can be explained briefly as follows:

- **Just in Time (JIT):** The primary assumption of Just-in-time manufacturing is to produce things only when needed in order to eliminate all sorts of waste in the production process. It is an inventory strategy that is utilized to keep track of stock in storage. Rather than carrying a huge inventory at one time, it includes obtaining items from suppliers as and when they are needed (Barlow, 2015). Companies use this inventory technique to improve efficiency and avoid waste by acquiring products only as needed for the manufacturing process, lowering inventory expenses (Banton, 2021).
- **Kanban:** It is a methodology developed in the 1940s by Toyota Corporation managers (Sergreev, 2016). Kanban's primary concept is the workflow displayed on a huge board with several columns. Work is represented on the board by a card or ticket, and the board is divided into columns, each column on the board symbolizes a particular stage of the work process, and as work progresses, the card representing a job is moved from one column to the next to keep track of progress and completion (Vectors Solution, 2020).
- **Total Productive Maintenance (TPM)**: TPM is a high-level maintenance philosophy that has sparked a lot of academic research and analysis. TPM is one way to increase production performance by focusing on maintenance and involving everyone in the company (Prabowo et al., 2018). It is made up of a set of recommendations compiled by the Japan Institute of Plant Maintenance in order to prevent system failures and improve procedures (Nosel, 2021).
- **Key Performance Indicator (KPI):** Key performance indicators are a mechanism for establishing criteria for measuring performance and assessing success, as well as determining whether a desired future state has been achieved or any additional action is required for that (Winter, 2017). It is a quantitative metric of how the company team is progressing towards important business objectives (Martins, 2021).
- **Overall Equipment Effectiveness (OEE)**: A framework for calculating the loss of productivity in a manufacturing process (Shah & Patel 2018). OEE is an efficient and smooth-flowing production system strategy that has become a prominent trend in managerial techniques around the world (Lakho et al., 2020; Maintainx, 2020). OEE is an effective instrument that can be combined with other tools and approaches for continuous development (Prasetyo and Veroya, 2020).
- **Kaizen**: It is a Japanese concept that encourages continual progress via constant effort and employee participation (Perico et al., 2019). Kaizen improves certain areas of a company by involving senior management and lower-level staff in daily changes, knowing that many small changes can add up to significant outcomes (Janjić et al., 2020; Safety Culture, 2022).
- **DMAIC:** It is a process-improvement strategy that is based on data. The abbreviation DMAIC stands for Define, Measure, Analyze, Improve, and Control (Jayanth et al., 2020). It is a five-phase technique for enhancing a wide range of organizational processes, including software development, manufacturing, and others (Tanner, 2022).
- **5s:** Everything has its place, and everything must be in its place, under good working condition, and should be available as and when required. Thus, the 5s are detailed as:

Sort - Remove anything that is not required, Set in order - Arrange the remaining elements, Shine - Keep the workspace clean and inspect it, Standardize - Create guidelines for the items, and Sustain - follow the rules regularly (Verese et al., 2018).

- **Value Stream Mapping (VSM)**: This process begins with current state mapping, which depicts the flow of materials, production processes, and, if necessary the interactions between manufacturers, suppliers, and dealers towards providing products to clients. After that, there will be a proposed future state map with its advantages (Palange and Dhatrak, 2021). Because of the predictable volume and repeatable product type, VSM has proven effective in large-scale manufacturing (Mudgal et al., 2020).

Statement of Research Problem

Many of the proposed lean tools and techniques need to be validated to confirm that they are implemented correctly in different organizations (Khan et al., 2020). The most significant challenge in implementing lean is the lack of understanding of the idea as some companies hire consultants to have a better chance of succeeding (Christiansen, 2018; Durakovic et al., 2018). Some businesses may not follow lean concepts as the lack of literature adds to the ambiguity around lean's appropriateness in the process industry (Salonitis and Tsinopoulos, 2016). Unawareness of lean tools and techniques, and lack of knowledge and education are the prime reasons for not implementing such lean concepts in manufacturing firms as many companies still struggle in implementing the lean philosophy (Panwar et al., 2016; Sanchez-Ruiz et al., 2020). The lack of awareness of literature and the ambiguity of implementing lean philosophy in manufacturing companies without clarity were the primary reasons for the study.

Research Questions

1. What are the lean philosophy practices prevailing in manufacturing companies?
2. What are the various tools of lean practices existing in the manufacturing Companies?
3. What are the obstacles and critical success factors of lean tools?

Research Objectives

1. To review lean philosophy practices prevailing in the manufacturing companies.
2. To explore the various tools of lean practices existing in the manufacturing Companies.
3. To investigate the obstacles towards implementing lean and to determine the critical success factors of lean tools.

Literature Review

Identification and ranking of the elements of management are important for the success of any manufacturing company (Salonitis and Tsinopoulos, 2016). Lean manufacturing concepts can help in figuring out how to implement these changes without upsetting the work teams (Maxwell, 2020). Lean is a technique of working to increase business efficiencies and reduce wasteful activities that affect corporate results (Simplilearn, 2021).

The Benefits of Lean Philosophy in Manufacturing Companies

In the global market with fierce competition, implementing lean manufacturing and tools method helps to improve business and outperforms the competition, and the advantages include improved customer service, easy management, improved quality, fewer defects, reduced waste, and financial benefits (Pejak, 2015). When the employees' are overburdened with needless tasks, it has a detrimental impact on morale, and the more quality productivity can tune an organization to be successful (MK North America, 2017). As per Al Qayoudhi et al. (2021a), Omani manufacturing companies that use structured CI programs have fewer product recalls, which leads to higher total sales and shorter processing times. Smith (2017) stated that lean implementation emphasizes the importance of optimizing workflow through strategic operational procedures while reducing and eliminating waste, whether in the process, equipment, or inventory in eight ways. Just-in-time (JIT) can save money, minimize waste, and eliminate the need for the organization to have large volumes of inventory on hand whereas the Kanban tool can improve development flow control, provide excellent work visibility, and improve communication between team members (CPE Articles, 2021; Riaz, 2019). Using Total Productive Maintenance (TPM) tool will result in fewer problems, delays, and faults, as well as lower costs and better equipment processing parameters (Agustiady and Cudney, 2018). According to Gough (2017), KPIs can assist the company in clarifying its present business position and performance expectations, engaging people in company goals, and identifying inefficiencies. OEE will lower production costs to increase competitiveness, simplify overall performance visualization, establish consistent benchmarks, and maximize employee performance (Tlists, 2019). Applying Kaizen will improve productivity, promote employee aspirations to improve their performance (Prayuda, 2020). Bass (2017) confirmed that DMAIC provides a road map for solutions, ensuring correct benchmarks towards finding solutions to complex challenges. 5s assist organizations in developing a framework by identifying visible and critical process waste, making processes safer and more productive (Makwana and Patange, 2019). Further VSM allows the mapping and analysis of process chains and the identification of improvement

opportunities (Khan et al., 2020). It is a quick and easy technique to identify and eliminate wastage (Stadnicka and Litwin, 2019).

Obstacles of lean Philosophy in Manufacturing Companies

There are factors contributing to the failure of lean adoption, such as lack of urgency or permitting too much complacency, the lack of strong coalition, lack of vision, failure to eliminate roadblocks in the way of the new vision, failure to achieve short-term victories, and failure to effectively embed changes in the organizational culture (Alefari et al., 2017). Pereira et al. (2017) claimed that the biggest difficulties in implementing lean in businesses are operational reluctance to change, slow response to market changes, and lack of resources. Further, the time lag of obtaining materials from the supplier while the company might be having large/unexpected order in hand, and natural disaster disrupting the flow of goods from suppliers to the company – might also disrupt such implementations (CPE Articles, 2021). As far as Kanban tool is concerned, upper management is not always confident in its capabilities, and there is a lack of experience and knowledge in dealing with the process (Riaz, 2019). The resistance to change, lack of lean culture, and the pressure from the top management have also been identified as barriers in implementing TPM (Agustiady and Cudney, 2018). The absence of an effective communication system, unachievable KPI goals, the absence of a KPI Action plan, and the lack of KPI measurements were the factors blockading the KPI tool implementation (PDA group, 2021). Also, the obstacles using the OEE lean tool are the absence of actionable insight for OEE improvement and the lack of key events and data points (Tlists, 2019). Further, the barriers in the implementation of Kaizen tool include lack of participation from the employees and the management support, lack of formal commitment, and a lack of knowledge (Sraun & Singh, 2017). Using DMAIC might lead to some challenges, such as the organization failing to analyse before implementing the improvements (Bass, 2017). Employee resistance to change and a confusing communication structure may impede usage of 5s tools (Makwana and Patange, 2019). Lack of support, as well as dealing with product and process complexity, are all barriers to moving forward with VSM (Khan et al., 2020).

Research Methodology

This study is qualitative in nature and is based on the literature review of the earlier studies. The secondary data was used to develop the theoretical framework and gain a better understanding of the research issue. The literature review was conducted using Google Scholar and web knowledge search. Secondary data was gathered through computerized databases such as Emerald, Elsevier, Science Direct, Taylor & Francis online, and indexed journals. Table. 1 illustrates the key words used for the search in Google Scholar with a custom range from 2015 to 2022. The key words in the search were ‘lean manufacturing concept’, ‘lean tools’, ‘lean success factors’ and ‘lean obstacles’. The research takes into account the target articles as well as the knowledge web, which were only published in 2015 and later. As a result, the important findings were summarized and decided.

Table 1. Literature Review Search Criteria

#	key words used in the search	Papers found in Google Scholar	Papers downloaded and studied	Papers considered for the study
1	Lean manufacturing concept	55,100	40	4
2	Lean Tools	760,000	70	12
3	Lean success factors	181,000	43	4
4	Lean benefits	117,000	30	4
5	Lean obstacles	41,600	28	5
Total number of papers considered for the study				29

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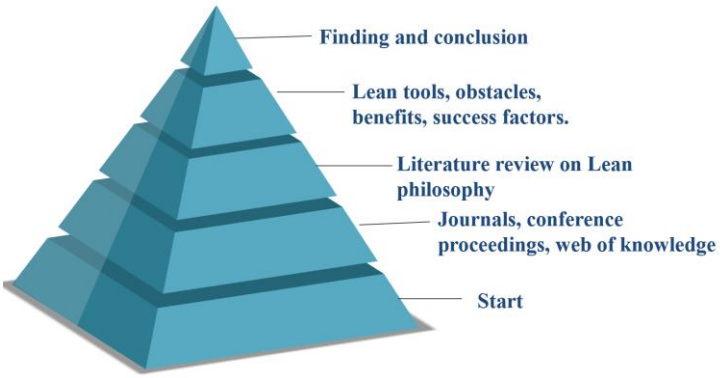

Figure 1 Research Methodology Steps

Findings

From the literature review, it can be observed that Lean manufacturing employs a variety of lean tools to increase production and efficiency by maximizing resource utilization.

Table 2 Lean Philosophy Tools

#	Tools
1	Just In Time (JIT)
2	Kanban
3	Total Productive Maintenance (TPM)
4	Key Performance Indicators KPIs
5	Overall Equipment Effectiveness (OEE)
6	Kaizen
7	DMAIC
8	5s
9	Value Stream Mapping (VSM)

However, JIT, Kanban, TPM, KPIs, OEE, Kaizen, DMAIC, 5s, and VSM are some of the most widely used lean tools as indicated in Table 1.

Table 3 Lean Tools Benefits and Obstacles

Lean Tool	Benefits	Obstacles
Just in Time	• Spend less money • Minimize wastages • There is no need to keep a lot of goods in stock	• Potentially, the supplier won't be able to deliver the items on time • Huge and unexpectedly order • A natural disaster could disrupt the delivery of resources from suppliers to the company
Kanban	• Provide excellent work visibility • Improve teamwork and communication • The Control of the development flow will be improved	• Upper management has no confidence • Lack of Knowledge in dealing with the process

Total Productive Maintenance (TPM)	• There will be fewer breaks, stoppages, and defects • Minimize costs • Improves the efficiency of the equipment	• Resistance to change. • There is a lack of Lean culture. • Top management pressure.
Key Performance Indicators KPIs	• KPIs aid in the clarification of the existing state of the company's strategic objectives • Involve employees with company aims • Help to specify inefficiencies within the Company	• Lack of proper communication system. • Unattainable KPIs goals. • No KPIs action plan. • Lack of measuring KPIs
Overall Equipment Effectiveness (OEE)	• Minimize production costs to gain a competitive advantage • Visualize total performance in an easier manner • There is a unified benchmarks system. • Increase employee productivity	• No actionable insight for OEE upgrading • Key events and data points are missing
Kaizen	• Productivity increases at a faster rate • Encourages the staff and • Aspiring them in improving their performance • Allowing the staff to contribute to the company's improvement	• Lack of staff involvement • Inadequate formal commitment • No support from top management • Kaizen is not well understood
DMAIC	• Provide a solution road map • Ensure accurate Standards • Find solutions to complex problems	• Failure to conduct a comprehensive analysis before implementing the improvement
5s	• Assists in the development of a framework for organizations • Reveals visible and critical waste of the operations • Make procedures more secure and productive • Increase the production flexibility	• Resistance to change • No clear communication system between employee
Value Stream Mapping (VSM)	• Allows to find and analyze process chains • Helps in the identification of potential areas for development • Eliminate waste	• lack of support in handling the product and process • Time-dependent dynamics are complicated

From Table 3, it can be observed that the main benefits of lean tools are waste reduction, cost reduction, and increased overall efficiency. However, depending on the nature of each lean tool, there will be benefits that can be reaped from these tools. In JIT, the company will not need to keep a lot of goods on hand. As well, Kanban will lead to improving the control of development flow. Breaks, stoppages, and defects will be

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reduced as a result of TPM. OEE will have a unified benchmarking system to increase efficiency. Moreover, Kaizen allows the staff to contribute to the company's improvement. DAMIC provides a solution road map as well. While 5s can make the procedure more secure, in contrast, putting lean tools into practice still presents some obstacles, i.e., a lack of a strong communication system and a lack of lean knowledge. Specifically, the company may face resistance to change in using TPM and 5s, lack of management support in Kanban, unexpected orders in JIT, and a lack of measuring the company's KPs.

Table 4 Success Factors of the Lean Tools

Lean Tool	Success Factors
Just in Time	• At each production station, small quantities of raw materials can be kept • Accurate forecasting is required to properly stock basic supplies
Kanban	• Provide Sufficient training • The organization's upper management must take every potential effort to change the employees' mindset
Total Productive Maintenance (TPM)	• Efficient communication System • TPM's functionality is supported and aided by top management
Key Performance Indicators KPIs	• Appropriate communication • Visible and achievable KPIs • Strong and efficient KPIs measuring • Consider employee feedback
Overall Equipment Effectiveness (OEE)	• Product quality • Availability • The efficiency of the performance
Kaizen	• Changes and employee ideas are initiated and evaluated • Effective support from Management and employee • Construct an effective evaluation system • Developing a strong internal communication system
DMAIC	• Effective and valid analysis before the implementation steps of the improvements
5s	• Employee education is important • Apply examples and a framework to assist successfully • Employees should be able to talk about potential issues
Value Stream Mapping (VSM)	• Good experience using it • Adequate Knowledge of the techniques • Appropriate internal communication System

Table 4 reveals that there are certain Lean success factors for implementing these tools. Strong communication systems and employee involvement are generally key success factors for implementing lean tools. Specifically, an accurate forecast in JIT is required to properly stock basic supplies. Furthermore, providing sufficient training for Kanban is very important for the success of the procedures. TPM's functionality should be supported and aided by top management as well. The company should have visible and achievable KPIs. Moreover, the company must ensure the availability of resources for implementing OEE. As well, Kaizen should have a constructive and effective evaluation system. DMAIC should have an effective and valid analysis before the implementation steps, and 5s should apply examples and a framework to assist successfully. Moreover, VSM should have adequate knowledge of the techniques.

Table 5 Lean Tools Functions

No	Lean tools	Main function
1	Just in time (JIT)	Produce things only when needed in order to eliminate all sorts of waste in the production process
2	Kanban	Managing visually an organization's workflow
3	Total Productive Maintenance (TPM)	Increase production performance by focusing on maintenance and involving everyone in the company
4	Key Performance Indicators (KPI)	Establishing criteria for measuring performance and assessing the success
5	Overall Equipment Effectiveness (OEE)	Calculating the loss of productivity in the manufacturing process.
6	Kaizen	Encourages continual progress via constant effort and employee participation
7	DMAIC	Define, Measure, Analyse, Improve, and Control
8	5s	Put everything in its place in good working order, and available anytime it is needed
9	Value Stream Mapping (VSM)	Analyze a production process as it is an important part of regular workflow maintenance

Table 5 above demonstrated that each lean tool has a specific function to perform. Lean tools, in general, are intended to improve delivery systems and processes by eliminating waste, increasing productivity, and meeting customer expectations.

Conclusion

From the above findings, it can be confirmed that lean philosophy is one of the most important methodologies employed by manufacturing industries around the world to maximize profit. Strong communication, top management motivation, employee involvement, and a positive organizational atmosphere are the essential variables found in the literature for the effective deployment of lean applications in manufacturing companies. The most popular tools which can be applied are JIT, Kanban, TPM, KPIs, OEE, Kaizen, DMAIC, 5s, and VSM. As a result, lean tools are a proven method for improving organizations and maintaining competitive advantages. In addition, there are various benefits that the company will gain by implementing lean, such as improved management systems, improved product quality, decreased defects, financial benefits, and reduced waste.

It is broadly accepted that senior management commitment is of great importance for implementing lean. However, manufacturing companies face several difficulties, including a lack of confidence and understanding from senior management, a lack of a lean culture, a lack of a clear communication system, and a failure to undertake an analysis before adopting improvements. Finally, it is recommended that companies, before approaching any type of lean tool, consider the success factors of implementing lean tools such as employee involvement, maintaining a level of quality, commitment to change, top management support, building a strong communication system, providing sufficient training and education program about lean tools, and maintaining an effective evaluation system.

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