Lean Transformation and Implementation

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The application of Lean Manufacturing (LM) in both the service and manufacturing industries has demonstrated improvements in organizational performance. Other benefits obtained from LM implementation include improved flexibility, profitability, and efficiency; continuous improvement in processes; reduced production costs; improved customer satisfaction; enhanced just-in-time production (JIT); ergonomic improvements for employees; and increased product reliability. This success implies that Lean is universal and is not a fad that will pass away. Furthermore, recent research shows that LM is a base upon which new technologies such as Industry 4.0 can be built.

Keywords: Lean Manufacturing ; Lean implementation

1. Introduction

Previous research has shown that LM affects production processes, which improves the three pillars of sustainability: economic, social, and environmental [1][2][3]. For example, LM enhances cost-cutting measures during the production process by reducing the number of non-value-added activities, which leads to improved economic performance [4]. In addition, LM practices such as value stream mapping (VSM) boost environmental performance by identifying and charting the use of raw materials, water, and energy by manufacturing processes [5]. On the other hand, LM supports social performance by enhancing safe working conditions and promoting kaizen, which ameliorates employees' safety and occupational health [6].

Although many success stories about LM have been recorded, many organizations find it challenging to transform and sustain LM [7][8][9]. Difficulties may occur due to poor training and a lack of understanding of the philosophy. Teaching Lean is one of the crucial areas linked to the successful adoption of Lean. The authors in [10] described teaching Lean as providing a modus operandi of how LM practices and principles are disseminated to professionals and students for use in their organizations. Many consulting firms have been formed to train companies to implement LM. However, most consulting firms that train organizations to implement Lean practices do not explain the importance of creating an enabling environment. Additionally, some Lean consultants describe only the benefits of Lean adoption while not explaining how their training has helped manufacturing organizations [11].

The Institute of Research for Technology Development (IR4TD) at the University of Kentucky partnered with Toyota in 1994 to train students and industry professionals in Lean through its TRUE LEAN™ training programs. This program helps by disseminating knowledge and experience related to the Toyota Production System (TPS), employing facilitators who have worked as managers or who are working for Toyota. In addition, the trainees have an opportunity to tour the Toyota plant in Georgetown, Kentucky, where they can visualize and experience the TPS in action. The TRUE LEAN™ training program has a laboratory where the participants can practice the tools they learned in class. This laboratory serves as a learning factory [10][12]. The TRUE LEAN™ program also provides training on the "people side of True Lean" and is referred to as the cultural DNA of True Lean, without which Lean cannot be maintained. Though the training highlights the practical implementation of Lean through developing Lean culture in participants, some companies still face challenges in maintaining Lean. The authors in [13] reported that about 70% of manufacturing organizations in North America had implemented LM; however, only one in four organizations has obtained satisfactory results

The extant research describes several challenges and obstacles faced by organizations when implementing LM. The authors in [14] cited that the major problem faced by organizations during LM implementation is steering the path to change, as well as removing and overcoming obstacles. The authors in [15] categorized Lean implementation challenges into two groups: barriers to LM adoption and problems faced during LM implementation. This study highlighted the fact that the obstacles to Lean adoption were a lack of top and middle management support, workers' resistance to adopting the new philosophy, and a lack of technical know-how regarding how to adopt LM. These authors reported that some organizations believe that LM is complex and challenging to adopt. Some organizations lack time to implement the philosophy [16][17][18][19]. Recent research has also shown that some organizations do not perceive the benefits of adopting

LM [19][20]; thus, they treat it as a gimmick and a fad that will pass away. In addition, the authors in [15] reported that challenges faced during LM implementation include poor worker relations and the inability of employees to change their behavior, causing them to go back to their old ways of doing things.

The authors in [21] investigated the significant difficulties involved in sustaining Lean in one of the Fortune 500 manufacturing plants in Eastern USA. The study revealed that the employees felt that poor communication existed between the top management and the employees. Additionally, employees believed that the top management did not value coaching, which made the maintenance of LM difficult. The authors of another study [22] investigated the barriers to Lean implementation and the difficulties in sustaining this philosophy in manufacturing organizations in Pennsylvania and Virginia. The research outcomes indicated that LM adopters and non-Lean adopters faced challenges such as the resistance of employees and management to change and a lack of technical know-how for Lean implementation. The authors in [17] concluded that challenges for Lean adoption in wood industries were backsliding to the old ways of performing processes and a lack of technical knowledge, which contributed 61% and 41%, respectively.

On the other hand, the authors in [23] found that lack of support for LM implementation by the top management negatively impacted Lean sustenance in an electronics manufacturing company in the USA. The authors in [24] also investigated the challenges of implementing Lean for SMEs in America. Their study indicated that the most significant challenge for non-Lean SMEs and somewhat Lean SMEs was changing the company culture. On the other hand, the Lean SMEs reported that the employees tended to backslide to the old way of performing work. The present study is different from the previous research conducted on LM implementation barriers in the USA because it uses data collected from various states and diverse industries in North America. The authors of [21][23] only analyzed barriers to implementing LM after collecting data from a single organization. The authors in [17] collected data from wood industries only, whereas [24] used SMEs only. According to the authors' knowledge, this is the only study that has been conducted to investigate the challenges in adopting LM across various manufacturing industries using data collected from different states in North America. Additionally, the authors ranked the LM implementation challenges according to the most critical barrier to lean adoption, which can help new organizations that want to implement LM.

2. Lack of Proper Training

Many organizations worldwide have implemented LM, but not all have successfully obtained favorable results. The authors in [17] stated that most companies might reduce costs through Lean adoption; however, very few companies can outperform Toyota Motor Corporation in terms of profitability, market growth, and quality. The authors in [25] reported that most companies proclaim a breakthrough after implementing only one LM project and before cultivating a culture of continuous improvement. On the other hand, [26] showed that LM is a complicated system that uses different practices and philosophies and thus requires adequately trained employees. Proper training will make employees understand how their work affects the whole production process; therefore, they strive to improve their work environment. Through good training, the worker is given the necessary skills to solve problems individually or as a team. Furthermore, good training will make workers know what is expected from them to sustain Lean through commitment and improvements in performance.

Lean coaches and trainers lead the Lean implementation process since they know its practices, and principles [27][28][29]. Their role involves initiating the Lean methodology, organizing the teams, and setting up key performance indicators that help to track the results and progress of the implementation of Lean principles. In addition, good training causes employees to change their work mindset, thus infusing a new culture into the workplace. Ideally, Lean training should start with coaching the management team on Lean strategy deployment [30]. This will enable them to understand the purpose of LM, hence understanding their role during Lean deployment. Unfortunately, the extant research has shown that most organizations lack Lean experts [20][31][32] who have competencies to drive and manage Lean implementation. Another challenge is a shortage of supervisory, managerial, and workforce skills to support Lean implementation [19]. Furthermore, some organizations do not know the existing Lean trainers and coaches [32][33]. For example, the significant challenges faced by Indian SMEs during Lean adoption were poor training [20] and inadequate training [34].

3. Resistance of Management to Change

Empirical research has shown that management commitment and support are critical success factors for Lean adoption [13][35][36][37][38][39][40][41]. Therefore, leadership should provide strategic leadership by clearly communicating the LM implementation goals, stimulating employee interest in the philosophy, and steering the project [23]. Additionally, the leadership should respect employees and acknowledge every effort they put into improving the process. Thus, the role of

management is to provide financial support during LM adoption [42][43][44] and to train and empower employees to improve their processes continuously [45].

A study [31] of three process engineering industries revealed that these organizations did not implement Lean because top management believed that the philosophy was unnecessary; hence, they could not commit financial resources to training employees. The significant barriers to LM adoption are leadership resistance to change [22]; poor leadership drive [46]; and poor communication, support, and commitment [16][32][33]. Some leaders also lack knowledge of LM [34]; thus, they do not understand how the philosophy improves strategic business goals.

4. Resistance of Workers to Change

The workers form the backbone of any manufacturing organization [47]. Workers perform specific tasks, and they should be adequately trained to understand their processes well. Thus, workers are the drivers for any Lean deployment. The level of skills possessed by employees depends on the training they receive from coaches/trainers and team leaders. A study [48] revealed that employees in Lithuanian companies were committed to seeking organizational objectives related to the adoption of Lean and thus were actively involved in kaizen activities. Resistance of employees to change may be caused by a lack of understanding of the purpose of the philosophy [22]. Proper training stimulates the intrinsic motivation for employees to continuously improve their processes and solve problems that arise within their work environment [49]. The challenges to the successful adoption of LM include the reluctance of workers to remove hurdles in their workplaces [34], the resistance of employees to be trained, and their non-Lean habits [19], which in turn inhibit the sustenance of LM. Additionally, Lean fails when workers feel that their work is not valued because the top management is not listening to them [33].

5. Insufficient Financial Resources

Manufacturing organizations need financial resources to hire Lean coaches to train top management and employees [42]. Money is also required to buy machinery and materials and motivate employees through incentives. A study [50] of manufacturing companies in the United Kingdom revealed that the lack of adequate funding for small enterprises was a significant challenge for Lean adoption, whereas medium and large enterprises were not affected by a lack of financial challenges. Similarly, authors such as [31] and [20] corroborated that SMEs lack a budget dedicated toward Lean implementation during the early stages of Lean adoption.

The authors in [51] stated that companies must consider capital expenditures for buying machinery; thus, they may only see positive returns after this initial high cost. Therefore, when organizations set aside money for LM implementation, they must know that it might take time to reap the benefits of adopting Lean. Because of that, researchers have reported that many organizations lack the financial resources to implement Lean [17][18][19][32][46][52].

6. Cultural Barriers

Formulating and sustaining a Lean enterprise requires a considerable change in leadership and employees' behavior, culture, and attitudes [53]. However, this behavioral change may be difficult to attain; thus, organizations hire external Lean coaches/ trainers who instill behavioral changes through training [54]. In addition, the changes in culture and attitude require every person in the organization to forsake their comfort zone and change how they relate to one another. Individuals also need to change the ways in which they perform specific tasks. Thus, cultural changes involve the ability of the top management to be accountable and to lead by example.

On the other hand, employees should have the mindset that their processes can be continuously improved [55]. Employees should be trained to love their work and their organizations. The ability of Toyota to teach their employees to envy their working environment and their organization enables them to outperform their competitors [56]. The idea is to focus on workforce development [57], rather than on results (increased productivity/ quality) [58]. The authors in [22] stated that organizational culture strongly influences Lean implementation failure or success since the transformation process continues endlessly, thus requiring employees who are dedicated to their work. Several studies have shown that lack of change in organizational culture is the most significant challenge in Lean transformation [18][20][31][32][33][46].

7. Lean Is Complex to Implement

Lean manufacturing has its roots in the automobile industry, in which the production system is repetitive and discrete. The authors in [31] stated that it is challenging to implement LM in other production systems, such as the process industry,

because it is tailor-made for discrete industries. Research on 120 Indian process industries revealed that Lean adoption in this sector is very low [31]. On the other hand, [59] corroborated that Lean is complex in industries with characteristics different from the discrete and repetitive sectors, such as the automobile industries. Furthermore, [17] revealed that 23% of the responding organizations that were part of the Wood Component Manufacturing Association in the USA believed that LM is difficult to implement. Additionally, Bamford and Forrester [46] concluded that Lean was difficult to implement in a food manufacturer in the United Kingdom due to supplier unreliability and incorrect data exchange across the supply chain, which caused a decrease in work in progress.

8. Lack of Understanding of the Benefits of Implementing LM

Several studies have highlighted the benefits of adopting LM [60][61][62][63][64]; however, some companies have not been persuaded [50][65]. Furthermore, the measurement of the perceived benefits of LM adoption has also caused problems [50] since LM depends on non-financial performance measures rather than cost measurements and other traditional performance measures [66]. As a result, some organizations that use these traditional methods may conclude that Lean does not cause any improvement. In addition, [67] stated that researchers have proposed different performance measurement models such as simulation, graphical, qualitative, and quantitative models, causing confusion as to how organizations can measure Lean performance.

Several studies have shown that some organizations do not understand the benefits of LM. For example, the major barrier in a US manufacturing firm was the evaluation of the impact of LM, since the top management was not objective in reporting performance [22]. In addition, another study [19] revealed that 13.5% of the manufacturing organizations in India which had not implemented LM cited that they could not measure the benefits of LM implementation.

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