



Rationalizing the Lean and Agile Operations to Improve Cost Efficiency: An Approach to Reliability

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ABSTRACT

The combination of lean and agile approaches offers a powerful strategy for organizations seeking to improve cost efficiency and reliability simultaneously. Lean operations provide a solid foundation by optimizing processes and reducing waste, enabling cost savings. Agile methodologies build upon this foundation by enabling organizations to adapt quickly to market changes and customer preferences, ensuring high reliability through continuous feedback and course corrections. In order to explore comprehensively, this study was aimed to investigate the lean and agile operations impact on improving cost efficiency and assessing the reliability in manufacturing industry. Further, this study looked at and analysed the most recent research on using lean and agile supply chains to identify and address various outcomes to be utilized to improve cost efficiency.

1. INTRODUCTION

In today's rapidly evolving business landscape, organizations face the dual challenges of maximizing cost efficiency while maintaining high levels of reliability. This study explores the transformative effects of lean and agile operations on achieving these objectives. Lean principles emphasize the elimination of waste and continuous improvement, while agile methodologies prioritize flexibility and adaptability (Krishnamurthy and Yauch, 2007). Both approaches offer unique strategies to optimize operations, enhance cost efficiency, and improve overall reliability.

Lean operations focus on streamlining processes by identifying and eliminating non-value-added activities, reducing unnecessary inventory, and optimizing resource utilization (Bergmiller and McCright, 2009). By minimizing waste and enhancing efficiency, lean practices can significantly reduce costs while maintaining or

improving product or service quality. This methodology emphasizes the importance of empowering employees at all levels to contribute to process improvements, fostering a culture of continuous learning and innovation (Rachid et al., 2017).

Moreover, lean operations help the business operations to be more efficient and improve the everyday operations of the businesses. Keeping in view the manufacturing industry, lean operations can be significant for the business as can improve the financial performance of an organization as well as improve the efficiency of those organizations (Farooq et al., 2017). Lean operations in the manufacturing organizations helps in the reduction of waste from the process of manufacturing in the manufacturing industry (Negi and Anand, 2014). Organizations can adopt to lean operations by following various practices i.e. TQM,

TPM, JIT, HRM, Low setup, Engaged employees and productive maintenance (Malifete et al., 2018). However, it has been discussed that in today's age, agility has become indispensable for the manufacturing industries. Supply chain reliability is conferred as the extent to which the supply chain exhibits consistent performance. The definition of agility of the supply chain lies in the potential possessed by the company to adapt to the company shifts by internal and external strategic shifts in relation to its clients and suppliers. Markets have become volatile and unpredictable (Yusuf et al., 2014).

The top priority of agile supply chain operations is to fulfill the needs and demands of the customer base by providing consistent delivery of valuable software (Stratton and Warburton, 2003). The manufacturing industry can enhance its strategic versatility by sensing and reacting by the agility of the supply chain and taking steps by altering practices and tactics. It is believed that steps to enhance strategic flexibility can be taken to influence. Agile operations reinforce communication, flexibility, functionality over time consuming business operations.

1.1. Objectives of the Study

A systematic review evaluates and pinpoints an area of interest using the most pertinent research questions that have been specifically established. The cornerstone of the systematic review process is the research questions as followed:

RQ1: How does the implementation of lean and agile operations contribute to cost reduction and improved manufacturing reliability?

RQ2: What are the specific strategies and tools employed in agile operations that lead to enhanced cost efficiency and manufacturing reliability?

RQ3: What are the critical success factors for effectively integrating lean and agile operations to achieve improved cost efficiency and manufacturing reliability?

2. LITERATURE REVIEW

2.1. Relationship between Agile Supply Chain and Reliability

Agile refers to the ability to produce and respond change with the aim to achieve success in a turbulent environment. Agile operations can be

defined as the application of agile principles in a growing business (M. Alzoubi et al., 2021). In other words, agile operations are a broad term that is referred to as the application of agile techniques in the operations and development of the organization (Gaytan et al., 2023; M. El Khatib et al., 2022b). It can be referred to as the readiness to adopt change (Aljumah et al., 2023).

There are two primary components of supply chain agility, according to the investigator, i.e., Sensing and answering. Sensing's power is related to the capacity of an individual company to define the environmental shift (M. El Khatib et al., 2022a). Agility empowers the capacity to respond to the changes (AlDhaheri et al., 2023). It enables the power to the company to effectively withstand the changes in the market with effective strategies and regulation (Muhammad Turki Alshurideh et al., 2022c; H. Alzoubi et al., 2022).

Agility enforces cooperation in order to provide the organization with a competitive advantage. Agile operations are customer-focused (Ahmad Ibrahim Aljumah et al., 2022a; T M Ghazal et al., 2023a; Gulseven and Ahmed, 2022). Whereas, agile supply chain operations encompass market sensitivity, networking, virtuality, and process integration (Mubeen et al., 2022). The sensitivity is the capability to analyze the ultimate needs of the customer (Alzoubi, H MALhamad et al., 2021; El Khatib et al., 2021). The networking of an agile supply chain is the capability to form a network alliance and carry forward manufacturing operations so that dynamic and volatile customer demand can be addressed (Abudaqa et al., 2022; Mohammed T. Nuseir et al., 2022).

The virtuality refers to effectively seek demand for improved customer satisfaction (M. T. Alshurideh et al., 2023b). Supreme integration is necessary for internal operating procedures (H. M. Alzoubi et al., 2022b). The main focus of an agile supply chain is to develop strengths to withstand changes and adhere to emerging opportunities (Farrukh et al., 2023; Yasir et al., 2022). The body of the agile supply chain consists of strategic, logistic, marketing, production, collaboration, supply and demand, and information technology.

2.2. Concept of Reliability

Supply chain reliability can be described from two perspectives. The qualitative perspective of supply chain reliability explained the term as smooth

operations of the supply chain when the partial failure occurs (Ahmed and Nabeel Al Amiri, 2022; Khatib et al., 2016). The quantitative perspective of supply chain reliability can be illustrated as the possibility to allow the maximum flow from the beginning to the end node. According to (A I Aljumah et al., 2022a; B. Kurdi et al., 2022), reliability is the removal of the number of defective products from the system during manufacturing process (M. T. Alshurideh et al., 2023c). Reliability is a crucial factor in SCM operations because reliability induces cost reduction and high productivity (T M Ghazal et al., 2023b; M. El Khatib et al., 2021; Sakkthivel et al., 2022; Tariq et al., 2022a). The notion of reliability enforces the delivery of the products with the right quality and quantity and on time. Reliability in supply chains also reduces the probability of major breakdown (M. T. Alshurideh et al., 2023d).

2.3. Relationship between Lean Operations and Reliability to improve Cost Efficiency

Agile supply chain (ASC) is designed to fit in the rapidly changing market situations. It has been widely observed that agile SCM operations have a direct association with reliability. According to (Tariq et al., 2022b), an agile supply chain (ASC) is aimed at fulfilling customer's needs (Ahmed et al., 2022; El Khatib et al., 2020a; T M Ghazal et al., 2023c).

It has been suggested that there is a positive relationship between agile supply chain ASC operations and reliability (Alshawabkeh et al., 2021). It has been observed that product reliability and quality are the two main factors that define customer satisfaction (Akour et al., 2021). It is believed that the reliability and maintainability of the manufacturing process yield to the development of cost-efficient products (M. T. Alshurideh et al., 2023a). It has been discussed that customer-oriented supply chains focus on response time reliability and lead time reliability as it is directly related to the customer's loyalty and business operations (Abudaqa et al., 2021; Nuseir and Aljumah, 2020).

In the view of (Al-Marroof et al., 2022b; El Khatib and Ahmed, 2019), the reliability provides a guaranty of efficient and secure movement of commodities and products.

It has been highlighted by (Varma et al., 2023) that the agile supply chain is suitable for the

manufacturing industries that face considerable demand uncertainty and agility makes it possible to create a flexible plan (Mohammed T. Nuseir et al., 2022). It has been emphasized that measuring the reliability of a supply chain is a crucial element in the development of resilient chains (Muhammad Turki Alshurideh et al., 2022a). Several studies have shown that the reliability attribute of the supply chain is one of the most preeminent factors for measuring and evaluating the performance of agile supply chains (Aljumah et al., 2020; Amiri et al., 2020; Arshad et al., 2023). The findings of the studies revealed that the existence of faults in loading, unloading, or payment documentation and the presence of defects caused a decrease in the reliability of the supply chain (R. S. Al-Marroof et al., 2021a).

Many researchers have suggested that reliable delivery, flexibility, and high-quality products are significant elements for the manufacturing industries (El Khatib and Ahmed, 2020). It has been stated that supply chain networks are subjected to vulnerability in which the reliability manages the operations (Al-Kassem et al., 2012; A I Aljumah et al., 2022b; Lee et al., 2023). Moreover, the implementation of supply chain agility in the manufacturing organization provides proactiveness as it maintains the quality of the products which reduces the defects from the system (A. Al-Marroof et al., 2021; Blooshi et al., 2023).

The reliability of the supply partner is crucial in agile supply chains as it raises vulnerability in the supply chain (H. M. Alzoubi et al., 2022e). The disruption in the whole network is caused by the failure of the supply partner in meeting its high responsiveness and flexibility needs (Aljumah et al., 2021a; H. M. Alzoubi et al., 2022a; Mat Som and Kassem, 2013). These unwanted disruptions can pose severe damage to the agile supply chain (El Khatib and Opulencia, 2015). The decision-makers of the manufacturing companies are paying more attention to the supply chain structure and design while making strategies to undermine the potential threat and probability of disturbance in the agile chain and improvement of the reliability of the whole ASC (R. S. Al-Marroof et al., 2021b; Taher M. Ghazal et al., 2023).

Every manufacturing industry aims to achieve high flexibility and responsiveness which cannot be possible without ensuring reliability in the system

(Al-Kassem et al., 2013; Aljumah et al., 2021b; H. M. Alzoubi et al., 2020). Vulnerability and huge disruption in the whole network are caused as a result of the failure of the supply partner to meet its delivery schedule (M. Alshurideh et al., 2023). The decision-makers of the manufacturing industries decide whether they are willing to make an investment in scarce resources for the improvement of reliability of partners for eliminating the less reliable partners from the agile chain. (I. A. Akour et al., 2022; Al-Dmour et al., 2023; Nadzri et al., 2023) asserted that decision-making of production and buying coordination to balance real demand with current demand providing and independently minimizing their own risk of disruption (Al-Kassem, 2014; El Khatib et al., 2020b; Nuseir et al., 2021). Decisions on preparation and configuration are done by configuring the reliability of the ASC supply chain. Two simple incentive mechanisms were outlined for purchasers to enhance the reliability of their suppliers, namely a deal for quantities only and a subsidy (Al-Marroof et al., 2022b).

2.4. Impact of Agile supply chain operations on reliability

There is plenty of research on agile supply chain (ASC) and SC reliability found in the literature. Empirical studies signified the importance of reliability in the supply chain. Numerous studies have analyzed the impact of agile SC operations on reliability (Al-Marroof et al., 2022b; El Khatib et al., 2019). Researchers have used statistical approaches to configure the effect of the agile supply chain on reliability (Aziz et al., 2023; Mat Som and Kassem, 2013; M T Nuseir et al., 2022a). It has been observed that the frequent increase in agile operations has impacted the overall reliability of the project. Many researchers have suggested that the agile supply chain offers more advantages to the manufacturing industry as compared to a lean supply chain in terms of flexibility and adaptability (Nuseira and Aljumahb, 2020). Many multinational companies including Colgate-Palmolive and Johnson & Johnson have adopted agile SCM due to the variety of benefits it offers along with reliability (H. M. Alzoubi et al., 2022f; B. Al Kurdi et al., 2022a; Nuseir and Elrefae, 2022). Many researchers have emphasized that reliability plays a crucial role in the agile supply chain (ASC). (Al-Kassem, 2017; Alzoubi and Ahmed, 2019; M T

Nuseir et al., 2022b) argued that for the construction of a responsive and flexible agile supply chain (ASC), reliability is highly significant. Several studies have emphasized that the reliability of involved parties is vital to ensure a smooth flow of operations (H. M. Alzoubi et al., 2022c; Khan et al., 2022; Nuseir and Aljumah, 2022). The researcher further added that reliability provides manufacturers to gain customer satisfaction and competitive advantage in the volatile market (Al-Awamleh et al., 2022). (Hani Al-Kassem, 2021) conjectured that in order to make ASC reliable and responsive the way the partners involved should be considered (Nuseir et al., 2020). He further added that agility is the successful element of the operations in which reconfigurable resources are integrated and raise adequate practices in an environment full of knowledge to offer customer-oriented products in the rapidly evolving market. It has been enforced that the reliability of the agile supply chain (ASC) constructs can be analyzed through dynamic programming modeling (Almasaeid et al., 2022; Khatib et al., 2022). Researchers have proposed several approaches in order to construct reliable agile supply chains. (Bawaneh et al., 2023) categorized agile SC reliability into six categories supreme, ideal, satisfactory, inferior, unsettling, and vulnerable causing. (Ahmad Ibrahim Aljumah et al., 2022b; H. Alzoubi et al., 2020) conducted research on SC reliability with the application of network techniques to increase the reliability of a complex ASC system with the application of performance index to determine the quality level of the supply network. (B. Al Kurdi et al., 2022b) asserted that ASC and adaptability increase organizational performance (M. Alshurideh et al., 2022). The researcher suggested that the sharing of information and resources of agile SC enhances flexibility. The agile supply chain is accountable for quick reactions to demand variations (A I Aljumah et al., 2022a). The agile supply chain enables the power to attract competitive market opportunities by aligning knowledge, and relationships between the partners (Al-Marroof et al., 2022a; Muhammad Turki Alshurideh et al., 2022b; Nuseir, 2020). It has been emphasized that the ASC approach is developed to acquire the capability to quickly and cost-effectively respond to environmental turbulence and unpredictable changes that occur in the markets (Akour et al., 2023; Al-Kassem et al.,

2012; El Khatib, 2015; Louzi et al., 2022a). Nowadays manufacturing companies are showing great interest in the induction of reliability in the supply chains to enhance the overall performance of the company (A I Aljumah et al., 2022a; Rachid et al., 2017). It is becoming a part of corporate goals. Many companies are employing techniques such as reliable centered maintenance (RCM) in order to overlook logistics and supply chain systems (M T Alshurideh et al., 2022; El Khatib and Ahmed, 2018). It has been emphasized that reliability cannot be denied at any phase of the operation cycle (H. M. Alzoubi et al., 2022d). Reliable partner involvement, procurement of products, and equipment lead to top quartile performance (I. Akour et al., 2022; Alzoubi et al., 2019; Kassem and Martinez, 2022). Many researchers have suggested that companies should reconsider their supply chain and use information sharing between the units to acquire agile supply chains (E. Khatib et al., 2021; Louzi et al., 2022b; Nuseir, 2021). It has been suggested that manufacturing industries can achieve agility by investing in developing their abilities related to information technology to enable seamless communication and quick sharing of information across the supply chain (Aityassine et al., 2022).

3. METHODOLOGY

The literature on lean and agile operations in manufacturing industry research was thoroughly reviewed in this study. To begin with, a qualitative analysis was done to pinpoint the major theories. The overlapping themes and keywords were further validated using quantitative studies. Key developments in focus, methodology, and theories or frameworks were also reported in order to answer the raised questions for the proposed study. The results were addressed in the context of current advancements in the major lean and agile component bodies for future work. Additionally, this research offers a concise roadmap for future review studies that may look into multifaceted intervention in the broad stream.

3. EMPIRICAL ANALYSIS

The objective to explore and find the most recent strategies and practices, following research questions has justified in accordance with recent studies, literature, and articles.

RQ1: *How does the implementation of lean and agile operations contribute to cost reduction and improved manufacturing reliability?*

One of the main benefits of lean operations observed is the elimination of waste throughout the production process. By identifying and removing non-value-added activities, lean practices aim to streamline operations and optimize resource utilization. This can result in cost savings by reducing inventory, minimizing defects, and improving overall efficiency. Similarly, agile operations focus on flexibility and responsiveness, enabling companies to quickly adapt to changes in demand and market conditions. This can lead to improved manufacturing reliability by reducing lead times, enhancing product quality, and increasing customer satisfaction (Qi et al., 2017).

However, it is important to acknowledge that the implementation of lean and agile operations is not a one-size-fits-all solution. Organizations must carefully assess their specific needs, capabilities, and industry dynamics before embarking on such initiatives. Lean methodologies, for example, require significant investments in training, process redesign, and cultural change. These investments may take time to yield measurable results and can be challenging to implement across complex supply chains or in organizations with deeply ingrained traditional practices.

Moreover, it has argued that the pursuit of lean operations can sometimes lead to unintended consequences. For instance, a relentless focus on cost reduction may compromise product quality or innovation. Overemphasis on efficiency and waste elimination may hinder the ability to experiment and take calculated risks, stifling creativity and inhibiting long-term growth. Additionally, lean practices can be susceptible to disruptions in the supply chain, as a just-in-time approach leaves little room for error or delays (Qrunfleh and Tarafdar, 2013).

Furthermore, agile operations, while effective in dynamic environments, may not be suitable for all industries or product types. Certain sectors, such as heavy machinery or aerospace, require longer lead times and complex planning due to the nature of their products. Trying to apply agile methodologies in these contexts may result in increased risks, higher costs, and compromised safety.

RQ2: *What are the specific strategies and tools employed in agile operations that lead to enhanced cost efficiency and manufacturing reliability?*

One of the key strategies in agile operations is the concept of cross-functional teams. By bringing together individuals from different functional areas, such as engineering, production, and quality assurance, agile teams aim to foster collaboration and knowledge sharing. This can lead to improved decision-making, faster problem-solving, and reduced lead times. However, it is important to note that forming and maintaining effective cross-functional teams can be challenging. Differences in expertise, priorities, and communication styles can hinder seamless collaboration, potentially leading to delays or misunderstandings.

Another strategy employed in agile operations is the use of iterative and incremental development. By breaking down projects into smaller, manageable increments, agile methodologies enable faster feedback loops and shorter development cycles. This iterative approach allows for continuous improvement and course correction, reducing the risk of costly mistakes and rework. However, this strategy may not be suitable for all types of manufacturing processes. Certain industries or products may require longer lead times, extensive planning, and precise coordination, making it difficult to implement an iterative approach without compromising quality or customer requirements (Towill and Christopher, 2002).

Furthermore, it has asserted by (Stratton and Warburton, 2003) agile operations often utilize tools such as Kanban boards, Scrum boards, and visual management systems. These tools aim to provide transparency, facilitate communication, and enable effective task management. Kanban boards, for instance, help visualize work progress, identify bottlenecks, and promote a balanced workflow. While these tools can enhance coordination and efficiency, their effectiveness relies heavily on team buy-in and discipline. If teams fail to consistently update and maintain these tools, their benefits may diminish, and the system could become a mere formality rather than a catalyst for improvement.

Additionally, agile operations emphasize the importance of customer collaboration and responsiveness. By involving customers early in

the development process and seeking their feedback, companies can reduce the risk of developing products that do not meet market needs. However, this strategy may present challenges in certain industries with complex regulatory requirements or long development cycles. Balancing customer involvement with the need for compliance and thorough testing can be a delicate and resource-intensive task.

RQ3: *What are the critical success factors for effectively integrating lean and agile operations to achieve improved cost efficiency and manufacturing reliability?*

Effectively integrating lean and agile operations to achieve improved cost efficiency and manufacturing reliability requires careful consideration of critical success factors. While combining these methodologies can offer benefits, it is essential to critically discuss the key factors that contribute to successful integration and highlight potential challenges.

1. **Alignment of Goals and Strategies:** To integrate lean and agile operations successfully, it is crucial to align organizational goals and strategies. Both lean and agile approaches have distinct principles and objectives. Lean focuses on waste reduction, continuous improvement, and efficiency, while agile emphasizes flexibility, responsiveness, and customer collaboration. Achieving a harmonious balance between these goals is essential to avoid conflicting priorities and ensure effective integration.
2. **Organizational Culture:** The existing organizational culture plays a significant role in the successful integration of lean and agile operations. Lean and agile methodologies require a supportive culture that embraces change, promotes cross-functional collaboration, and empowers employees. Organizations with hierarchical structures or resistance to change may struggle to create an environment conducive to the integration of these approaches.
3. **Leadership Commitment and Support:** Leadership commitment and support are critical for driving the integration process. Leaders must champion the adoption of

lean and agile principles, provide resources for training and development, and actively promote the benefits of the integrated approach. Without leadership support, employees may not fully embrace the changes required for successful integration.

4. **Employee Engagement and Empowerment:** Engaging and empowering employees is vital for effective integration. Employees at all levels should be involved in the integration process, providing their insights and expertise. This participatory approach fosters a sense of ownership and commitment to the integrated system. However, empowering employees requires clear communication, training, and the establishment of a supportive work environment.
5. **Training and Skill Development:** Adequate training and skill development are crucial for employees to understand and implement the principles of lean and agile operations. Training programs should cover not only the technical aspects but also the underlying principles and mindset required for successful integration. Insufficient training can hinder the adoption of new practices and limit the potential benefits.
6. **Integration of Processes and Systems:** Integrating lean and agile operations requires aligning processes, systems, and metrics. Lean principles, such as value stream mapping and standard work, can help identify waste and improve efficiency. Agile practices, such as Scrum or Kanban, can enhance responsiveness and adaptability. However, integrating these practices and ensuring seamless coordination across departments and functions can be complex and challenging.
7. **Continuous Improvement and Learning:** The integration of lean and agile operations is an ongoing process that requires a culture of continuous improvement and learning. Regular evaluation and feedback loops are essential to identify areas for refinement and optimization. Organizations must encourage experimentation, embrace failure as a

learning opportunity, and continuously adapt their practices to changing market dynamics.

While the integration of lean and agile operations offers potential benefits, it is important to recognize that it may not be suitable for all organizations or industries. Factors such as product complexity, market demands, and regulatory requirements should be considered when evaluating the feasibility and potential impact of integrating lean and agile approaches.

4. CRITICAL DISCUSSION

The overall study findings suggest a significance level of study variables. The practices and solutions have been presented. Lean operations has an impact on the cost efficiency which further helps organizations to achieve organization goals and achievements by performing the business operations at low cost. There are various types of dependent variables of lean operations which determines the cost efficiency of an organization. Since in this research paper we have discussed the impact of lean operations on improving the cost efficiency in the manufacturing industry. Below mentioned are the variables that have an impact on the cost efficiency of an organization.

- **TPM:** TPM is abbreviated as total productivity maintenance which is a technique that helps organizations to fare well by reducing costs and setting up time. TPM also allows all the machines of an organization to be maintained well so that future mishaps and failures can be avoided. This will help the organization to carry out operations effectively and not cause any delay in the process of manufacturing.
- **Standard work:** This can ensure that the processes in the manufacturing industry are well performed and also enhances the effectiveness of human work in the production process. Standard work allows to develop work instructions so that there is a guideline of the operation processes to ensure consistent and timely work to be done. This also helps to decrease the errors that may be caused by humans at work.
- **RCA:** It is abbreviated as Root cause analysis which gives the businesses a problem solving method which is used by

the businesses to identify where the mishap or issue has raised from. In simpler words, it helps in identifying the root of cause and acts as a proactive tool which helps in improving the business processes and operations. This means that any issue raised in the processes and operations in manufacturing firms can be benefited by RCA as it detects and identifies the root cause and its proactive attribute allows to improve the business operations.

- Five S Housekeeping (5S): This variable helps in discarding any tools that are unnecessary and also helps in developing or adopting tools that are easily accessed and helps in the enhancement of the productivity of a business. It also helps in utilizing the resources efficiently and also helps in improving the productivity of an organization. Moreover, this also allows businesses to decrease the size of inventory or in simple words to discourage excessive inventory as it is an expense of an organization which helps in cutting down the cost.
- One piece flow: According to (Towill and Christopher, 2002) low progress in work, high reliability on schedule, short throughput times and high utilization can happen to be really significant for manufacturing firms and to manage that one piece flow is a tool which helps in the reducing the inventory. It helps in achieving the most of the above mentioned four objectives and helps to achieve a positive impact on the organization's cost efficiency.
- Visual management: This is the type of lean operation tool which helps in increasing the availability of information as well as transparency in the workplace. It is also a relatively economical tool which is not highly expensive and works well for an organization's cost efficiency. This lean operation tool also helps manufacturing industries to manage motion wastes, delay in delivery and process reduction effectively. It helps the manufacturing industry to utilize its resources better and efficiently.

The above information regarding the variables of

lean operations and their impact on the cost efficiency talks about to what extent are these lean operation tools/variables can impact an organization's cost efficiency in the manufacturing industry.

The findings show that there is a significant and direct impact of lean operations on the cost efficiency of an organization. TPM, Standard work, RCA, 5S Housekeeping and one piece flow are the lean operation tools which allows the businesses to operate efficiently and reduce its costs while maintaining its efficiency. All the variables and tools of lean operations has a different way to impact the cost efficiency. However, all the impacts from the lean operational tools are positive.

Although lean operations have a positive impact on the cost efficiency of an organization, it is important for organizations to use the lean operation tools effectively because if they aren't used efficiently, it may pose low efficiency or no efficiency. This means although the lean operations have a positive impact on cost efficiency, it is relatively important for organizations to use these operational tools to in the best way to reap out greater efficiency and profits. When lean operation tools are implemented into organizations effectively, there is higher possibility of enhancing the performance and cost efficiency of those organizations.

This study depicts that there is a positive impact of lean operation on the cost efficiency of an organization in the manufacturing industry when the lean operation tools are used wisely and effectively in order to maintain the manufacturing reliability. The better implementation of lean operations in an organization would allow the company to have a direct influence of success on the organization and will consequently show a positive impact on the cost efficiency of the organization. Along with the all of the above, all previous research proves as an evidence that lean operations help the cost efficiency of an organization to be better and improve with time.

4. CONCLUSION

In this study, a detailed study on the notion of agile supply chain operation and reliability has been presented. In the modern age, a greater reliance on the suppliers and partners has been observed. Therefore, it is necessary to maintain quality relationships at each ends to ensure a reliable

connection between the involved parties for an effective agile supply chain. Improvement of delivery reliability has become the aim of every manufacturing industry as it will enable the industries to reap several market benefits. The manufacturing industry is drastically evolving. It is indeed necessary that open options are kept in place to respond to the challenges of the market. This will help the manufacturing industry to be able to deliver superior results, managing risks of disruption, and improving their overall business output. It has been discussed that various manufacturing companies face volatile and unpredictable demands from the customer base and in this regard agility and reliable delivery can be a real aid. The current study opens areas for future research and the research will provide assistance to the pioneers of the field.

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