

A Conceptual Framework for the Implementation of Lean Manufacturing in the RMG Sector of Bangladesh

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Abstract

Over the past few decades, the lean manufacturing (LM) approach has gained strong recognition as one of the foremost strategies for enhancing organizational performance. The ready-made garments (RMG) sector of Bangladesh is the most vital economic sector, which is under the threat of acute competition. This sector has been claiming to have practicing lean manufacturing to some extent about two decades to overcome its low productivity issues, but the resulting success of its implementation is far cry. In this context of reality, the sector needs proper attention and effective guidelines to implement lean manufacturing successfully to enhance not only productivity but the overall performance in all pertinent dimensions to remain competitive. The main purpose of this research is to construct a conceptual framework by consolidating all the major characteristics applicable therein with its clear dimensions for successful LM implementation in the RMG sector of Bangladesh. This study is based on an extensive and comprehensive literature review of the various aspects of LM implementation, especially focused on the critical success factors (CSFs), lean implementation activities, organizational performance and the linkages between them. The conceptual framework presented here illustrates how the CSFs positively influence lean manufacturing implementation activities, which ultimately contribute to achieving excellence in organizational performance. This is an attempt to guide RMG factories on what CSFs are to be considered and what tools are to be used to sustain the rigors real LM implementation for wider and improved organizational performance. This paper, therefore, identified the genuine need for a conceptual framework for the successful lean manufacturing implementation in the aforesaid sector.

Keywords

lean manufacturing (LM) implementation, RMG sector, critical success factors (CSFs), organizational performance, conceptual framework.

1. Introduction

In the current evolving global business landscape, competition has intensified due to free market policies and industrial liberalization (Panwar et al., 2015). Manufacturers are very much focused on continuous improvement of their performance to survive in the global market competition. A primary challenge facing producers today is the timely,

cost-effective, and quality delivery of products (Holweg, 2007). Bangladesh is the second-largest ready-made garments (RMG) exporting country in the world. RMG is thus a very vital sector, contributing more than 13% to its national GDP. It employs 4.22 million workers, who directly support the livelihood of 40 million people in the country (Haque and Bari, 2021). The Bangladesh RMG industry is currently experiencing intense competition from other exporting nations, including Vietnam, India, Cambodia, and Indonesia. A major obstacle to the growth of the RMG sector is the persistent issue of low labor productivity. According to Asian Productivity Organization (APO)-2020 data (2020), the labor productivity of Bangladesh is lower than almost all the competing countries. In realization of these criteria, Bangladesh's National Industrial Policy-2022 states upgrading of technology at the firm level as one of its key targets and emphasizes the significance of increasing the productivity of firms (Bangladesh Economic Review 2024). According to the World Bank Report-2023 (2023), manufacturing industries of Bangladesh are required to be technologically more advanced to achieve Sustainable Development Goal (SDG)-9 and to better prepare for future challenges.

Lean manufacturing (LM), widely known as a soft technology is one of the most agile and effective methodologies to manage the progressions and necessities of the present business challenges, such as rapid technological changes, discerning customers, advances in production, and data innovation. In fact, most organizations around the world have started adopting lean manufacturing to sustain and achieve excellence in performance (Sakthi et al., 2020). Many firms have benefitted from effective lean manufacturing (LM) implementation by increasing the extent of their productivity and fine-tuning quality, lowering manufacturing costs extensively, and cutting manufacturing lead time significantly (Panwar et al., 2017; Jasti and Kodali, 2019; Touriki et al., 2021; Mathiyazhagan et al., 2022). Furthermore, research studies have confirmed positive changes in productivity in many RMG industries where lean has been adopted (Vijayakumar and Robinson, 2016).

In realization of the necessity, the lean manufacturing system had been implemented firstly in the RMG sector of Bangladesh at the very beginning of the 21st century. But it could not spread despite its inevitable necessity to compete in the international market due to various social and organizational barriers and limitations. So far, only 32% of garment factories have partially implemented lean practices here in the Bangladesh (Hasan et al., 2020). Application frameworks or models of some of the lean tools are projected by some experts for lean implementation to solve productivity problems. In reality, these frameworks could not satisfy the actual needs and work as a standard solution to productivity problems in the RMG sector of Bangladesh as a whole. In the true sense, people lack a proper guideline for the effective implementation of lean manufacturing in RMG factories, and an aggregate solution to the problem is the crying need of the present time. However, a suitable conceptual framework that covers the full spectrum of what is needed to be effective and successful at implementing lean manufacturing in the RMG sector might be a sustainable solution.

1.1 Aim and Objectives

The main aim of this research paper is to present a conceptual framework that is able to sustain the rigors of actual LM implementation with its clear dimensions defined and measurable performance improvements in place for the RMG sector in Bangladesh. To achieve this aim, the specific objectives of this research study are as follows:

- To find the critical success factors (CSFs) to be considered for the successful implementation of lean manufacturing in the RMG sector of Bangladesh.
- To cater to the suitable lean tools and techniques influencing the organizational performance of the RMG factories.
- To construct a conceptual framework for effective implementation of lean manufacturing in the RMG sector of Bangladesh.

2. Literature Review

Lean Manufacturing (LM), a fast-growing and one of the most well-known advanced manufacturing strategies, has been implemented by numerous businesses to enhance operational and business performance (Panwar et al., 2015; Amjad et al., 2021; Mathiyazhagan et al., 2022). LM, initially proposed by Toyota in the 1950s as the Toyota Production System (TPS), aimed to enhance production efficiency and reduce costs by minimizing waste and non-value-added operations (Womack et al., 2007; Buer et al., 2018). However, Krafcik (1988) first used the term "lean production", and lean gained worldwide attention when Womack et al. (1990) published the book "The Machine That Changed the World". Based on the applicable area and objectives, lean has different viewpoints, such as an approach, a concept, a practice, a system, a way of thinking, a programme, a tool or technique, a model, a means, etc. (Islam et

al., 2018). In the manufacturing world, it is a philosophy to eliminate waste. The core concept of lean manufacturing revolves around the continuous pursuit of eliminating non-value-adding activities (waste) and optimizing resource utilization. In lean manufacturing, waste is defined broadly to include any activity that consumes resources without creating value for the end customer. This encompasses overproduction, waiting times, unnecessary transportation, excess inventory, unnecessary motion, defects, and the underutilization of employee skills (Abbes et al., 2022). According to Womack and Jones (1996), five critical elements of lean implementation are value, value stream, flow, pull, and the pursuit of perfection. Lean manufacturing perceives any operation consuming resources but failing to deliver value to the end consumer as wasteful and in need of elimination (Womack et al., 2007; Buer et al., 2018; Sahoo, 2020).

Lean had its rolling and dynamic expansion over the times. Originating from the Toyota Production System and that of an automotive factory, lean principles have been widely adopted across various industries to enhance operational efficiency and competitiveness (Tapia-Cayetano et al., 2020). LM methodology, utilized under various names and forms, has proven to be a successful management strategy, focusing on waste reduction and revenue generation (Almasarweh, 2020). By eliminating waste in the processes, companies can achieve a shorter lead time, lower cost, and highest quality and can achieve a competitive advantage over the others (Mathiyazhagan et al., 2022). However, LM has established itself as a successful alternative in manufacturing, increasing the efficiency and performance of processes and improving operational management activities in the pursuit of industrial excellence (Shrafat and Ismail, 2019). Theoretically, LM can be successfully applied to all industries; many articles and books describe successful lean transformation, but the majority of articles focus on large organizations with enormous resources and skills (Pedersen-Rise and Haddud, 2016).

Lean manufacturing (LM) implementation refers to the active process of applying lean manufacturing principles in a company, utilizing lean tools and techniques, as well as making organizational cultural reforms. An effective transition to lean manufacturing (LM) can be facilitated through the gradual incorporation of lean concepts and practices (James, 2006). However, transitioning to LM faces significant hurdles, particularly in grasping its core concept and philosophy (Suleman, 2016); Furthermore, although lean methodologies are increasingly embraced in internal domains such as operations and management, the process of shifting from conventional production systems to lean manufacturing is intricate (Wyrwicka and Mrugalska, 2017; Bashar et al., 2024).

However, most of the organizations, including SMEs, faced difficulties with LM implementation and misapplication of lean practices due to (Herron and Braiden, 2007)

- Use the wrong tool to solve a problem.
- Use one tool to solve a problem; use the same set of tools to solve problems.
- Lack of understanding about the real concept and purpose of lean manufacturing by managers and employees.

Although there is a tendency towards oversimplification, indicating that lean is a set of tools to be used for improving productivity, the situation is not that simple. A lean project should focus on the overall concept rather than on lean tools and techniques (Grove et al., 2010). Lean methodology indeed encompasses two fundamental aspects: hard aspects (lean tools and techniques) and soft aspects (human factors, also known as critical success factors). The combination of both soft and hard aspects of lean philosophy, as well as the alignment between them, is needed (Solaimani et al., 2019).

Implementing LM requires systematic thinking and methodical approaches, necessitating changes in measurement, control, and accounting systems (Alves et al., 2022). The piecemeal deployment of LM systems may hinder its full potential and organizational performance (Mumani et al., 2022). Implementing LM holistically throughout an enterprise's lifespan aids in the development of lean thinking and practices, enhancing essential business processes to address challenges such as market volatility and increasing client demand (Demirkesen, 2021). The successful application of lean principles also necessitates a cultural shift within the organization, where continuous improvement and respect for people are prioritized. This cultural shift is supported by various lean tools and techniques, such as Just-In-Time (JIT) production, Kanban systems, value stream mapping (VSM), and 5S workplace organization. Collectively, these elements form a cohesive system aimed at achieving operational excellence (Orji and U-Dominic, 2022). Various studies have indicated that two out of three attempts at lean application in companies result in failure (Hopp, 2018). Compared with in developed countries, these challenges are much more amplified in developing countries. This is because of factors such as the learning paradox, high worker turnover rate, lack of worker involvement and participation, and lack of implementation processes (Maalouf et al., 2019). However, as we

mentioned earlier, lean manufacturing could not gain desirable success even after two decades of its journey in the RMG sector of Bangladesh, and only 32% of garment factories are practicing lean at different in levels as shown Figure 1.

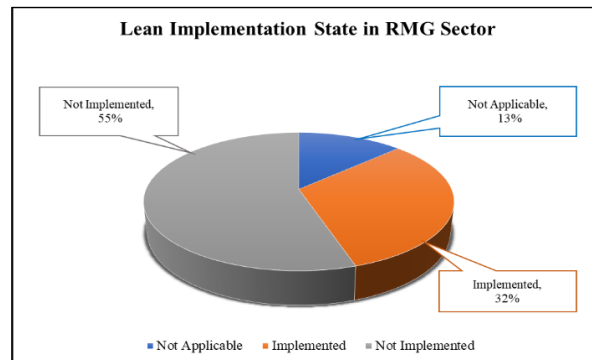


Figure 1. Rate of implementation of lean practices in Bangladeshi RMG sector
(Source: Hasan et al., 2020)

3. Methodology

This research is based on an intensive literature review, that is, the collection and evaluation of data from the relevant books, reports, journal articles and publications. The prime objective is to develop a conceptual framework that encompasses various lean activities (lean tools and techniques) as well as critical success factors, to facilitate the effective implementation of lean manufacturing within the RMG sector. In order to achieve objectives, we will follow the methodology illustrated in Figure 2 below in this paper. We concentrate on several key phases: conducting a literature review, examining various lean implementation frameworks or models, identifying critical success factors for lean manufacturing (LM) implementation, and exploring the tools and techniques utilized in lean practices. The "Literature Review" phase involves selecting and examining articles that concentrate on lean concepts and lean implementation aspects within the manufacturing sector. The "different frameworks/models" phase explores various types of lean implementation approaches and identifies those that should be retained for the effective capture of these concepts.

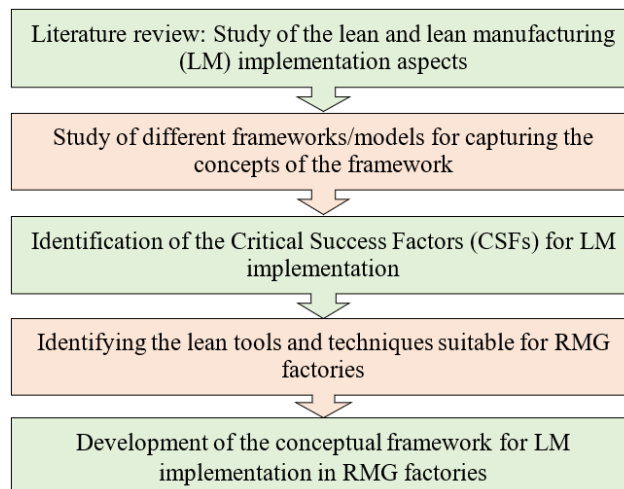


Figure 2. Research Methodology

4. Different Frameworks/Models Used for Lean Manufacturing Implementation

Literature offers many frameworks and models of the lean approach. We are especially focused on frameworks or models designed to support the implementation of the lean approach within manufacturing sectors. Our primary objective in examining the various LM implementation frameworks and models is to establish a clear understanding

and capturing the concepts of a conceptual framework that facilitates effective and sustainable lean manufacturing implementation in the ready-made garment (RMG) sector of Bangladesh. Accordingly, various lean manufacturing implementation frameworks and models across different manufacturing sectors, including the RMG factories, have been reviewed. The analysis of these frameworks and models for lean implementation, as presented by various scholars, is summarized in Table 1.

Table 1. A review of the main existing frameworks of lean implementation by different scholars

No	Authors	Key findings
1	Marchwinski et al. (2003)	This model, referred to as 'TPS House', lacks flexibility in adapting to environmental changes, as it offers a range of tools without taking the human factor into account. Furthermore, this model features a limited selection of tools, which can be attributed to its age.
2	Hines and Lethbridge (2008)	The model, known as Hines' Iceberg Model (2008), illustrates the visible aspects above the waterline and the invisible, enabling aspects below the waterline of a lean implementation. The elements situated below the waterline (namely, strategy and its alignment, leadership, and employee behavior and engagement) are often overlooked, yet they are essential for the successful and sustained implementation of Lean methodologies.
3	Wong and Wong (2011)	This paper presents a framework consisting of 3 parts that serves as a guideline to implement lean manufacturing, which was developed through case studies conducted in four electrical and electronics companies in Malaysia.
4	Pearce (2014)	The research developed a lenses approach to review. Each lens was a looking glass, giving a different perspective and understanding of lean implementation success. The primary lens was lean itself, including the principles, method, and tools. To this, two additional angles or lenses were organizational development for transformational change and risk management for decision analysis.
5	Abdulmalek et al. (2015)	The model indicates that lean can be better explained by examining its objectives, principles and associated tools. Also classified Lean's tools into two broad categories. Tools whose effectiveness depends strongly on the sector where they are applied, like TPM and JIT and others, are effective in all cases, like VSM and 5S.
6	AlManei et al. (2018)	A conceptual lean implementation framework based on change management theory using eight steps of Kotter's model as a basis and highlighting the lean tools roadmap use in sequence based on lean maturity.
7	Bajjou and Chafi (2018)	The findings from this model indicate that there are nine principal lean construction principles: customer focus, supply, continuous improvement, waste elimination, people involvement, planning and scheduling, quality, standardization, and transparency. Furthermore, the most frequently utilized lean construction sub-principles have been identified through an extensive review of the literature.
8	Pulikkottil and Kishore (2019)	A lean manufacturing implementation framework is proposed by leveraging these strengths and mitigating the weaknesses. The novelty of the proposed framework is that it provides easy-to-understand steps to be followed during pre-implementation and post-implementation phases for easy understanding and self-assessment at critical milestones.
9	Begum et al. (2024)	This study has demonstrated that lean tools such as 5S workplace organization, value stream mapping, Just-In-Time (JIT) production, Kanban systems, and continuous improvement (Kaizen) can yield substantial benefits for textile manufacturers.

We have identified 9 (nine) models, all aimed at facilitating the implementation of the lean approach within organizations. Each of them has its vision and presents different solutions to succeed in this implementation. In addition, it was noticed that there is a considerable change between the model of 'TPS House', which is considered the first model that models the lean approach, and the following models that introduced new concepts to this approach.

However, some of these frameworks tend to a tools focus, e.g., what tools to implement first, without a strong emphasis on sustainability. These frameworks tend toward lean as a project rather than developing organizational culture for excellence. It is worthy to note that the Lean Iceberg model (Hines and Lethbridge, 2008) and the three lenses approach (Pearce, 2014) are very significant among all those studied.

The Lean Iceberg Model (Hines and Lethbridge, 2008) is an analogy for the two aspects of a lean organization, the visible and the invisible, as shown in Figure 3. The visible aspects are those above the waterline, and the invisible aspects are those below the waterline. This is similar to a tree analogy; the roots, which are crucial to the health of a tree, are hidden below the surface. The visible aspects are readily understood and are noticed when touring a lean business. The danger is to over focus on the tools and methods of lean and have only a limited appreciation and application of the less visible aspects below, which are crucial for sustainability. The lean iceberg model (Figure 3) alerts us that underwater-enabling factors like strategy and alignment, leadership, employee behavior and engagement are more important than those of above-water-visible things like technology, tools, techniques and processes.



Figure 3. Lean Iceberg Model. (Source: Hines and Lethbridge, 2008)

Regarding the three-lenses approach, the three lenses for the study of lean implementation success are lean, organizational development, and risk management. Three lenses are represented by three overlapping triangles, as shown in Figure 4, for better understanding of its significance.



Figure 4. The three lenses for this study of lean implementation success (Source: Pearce, 2014)

However, before planning for the successful implementation of lean manufacturing, it is wise to specially consider the two models mentioned above.

Based on the literature review, we observed a continued absence of a suitable framework that could be deemed universal or adequately tailored for implementation in RMG factories in Bangladesh. Therefore, the purpose of the proposed new effective conceptual framework is designed to serve as a guideline for lean manufacturing implementation in RMG factories in an attempt to fill up this gap.

5. Critical Success Factors (CSFs) and Relevant Hypotheses

The term “critical success factors (CSFs)” refers to organizational characteristics that must be prevalent to ensure

operational success (Chrusciel and Field, 2003). CSFs incorporate issues vital to a firm's current operating activity and to its prospects (Toyota, 2017). Therefore, companies must identify and comprehend the Critical Success Factors (CSFs) in order to implement lean methodology effectively (Alhuraish et al., 2017). To assist companies in implementing lean and avoiding costly failures, researchers and consultants have suggested a range of critical success factors (CSFs). However, the literature review finds the following reference sources of the suitable CSFs that affect LM implementation, referred to as hypotheses (H1 to H10), as shown in Table 2.

Table 2. Reference sources of the suitable CSFs that positively affect LM implementation

No.	Hypotheses of the relevant CSFs	Sources
H1	Top-management leadership and commitment has a positive effect on the level of lean implementation.	Pearce, 2014; Singh and Thakar, 2014; Yunus et al., 2017; Gandhi et al., 2017; Belhadi, et al., 2018; Roslin et al., 2018; Jain and Ajmera, 2019; Elkhairi et al., 2019; Blijleven et al., 2019; Chiarini and Brunetti, 2019; De la Vega et al., 2020; Sancha et al., 2020; Sunder and Prashar, 2020; De la Vega et al., 2023, and Bashar et al., 2024. (15 sources)
H2	Employee involvement has a positive effect on the level of lean implementation.	Singh and Thakar, 2014; Netland, 2015; Yunus et al., 2017; Roslin et al., 2018; Hopp, 2018; Blijleven et al., 2019; De la Vega et al., 2020, and van Assen, 2021. (8 sources)
H3	Empowerment of employees has a positive effect on the level of lean implementation.	Netland, 2015; Hopp, 2018; Roslin, et al., 2018; Buer et al., 2018; Blijleven et al., 2019; Jain and Ajmera, 2019; De la Vega et al., 2020, and van Assen, 2021. (8 sources)
H4	Training and education has a positive effect on the level of lean implementation.	Pearce, 2014; Singh and Thakar, 2014; Netland, 2015; Yunus et al., 2017; Gandhi et al., 2017; Belhadi et al., 2018; Roslin et al., 2018; Jain and Ajmera, 2019; Sunder and Prashar, 2020; De la Vega et al., 2020; van Assen, 2021, and De la Vega et al., 2023. (12 sources)
H5	Teamwork (communication and cooperation) has a positive effect on the level of lean implementation.	Netland, 2015; Yunus et al., 2017; Gandhi et al., 2017; Belhadi, et al., 2018; Al-Manei et al., 2018; Roslin et al., 2018; Elkhairi et al., 2019; Jain and Ajmera, 2019; Blijleven et al., 2019, and Sancha et al., 2020. (10 sources)
H6	Human resource management has a positive effect on the level of lean implementation.	Netland, 2015; Tortorella et al., 2016; Belhadi et al., 2018; Roslin et al., 2018; Blijleven et al., 2019; Chiarini and Brunetti, 2019; Sunder and Prashar, 2020, and Bouranta et al., 2021. (8 sources)
H7	Customer relationship management	Jasti and Kodali, 2014; Yunus et al., 2017; Roslin et al., 2018; Kafuku, 2019; Blijleven et al., 2019; De la Vega et al., 2020, and De la Vega et al., 2023. (7 sources)
H8	Supplier relationship management has a positive effect on the level of lean implementation.	Jasti and Kodali, 2014; Bortolotti et al., 2015; Tortorella et al., 2016; Roslin et al., 2018; Kafuku, 2019; De la Vega et al., 2020, and De la Vega et al., 2023. (7 sources)
H9	Organizational culture/change has a positive effect on the level of lean implementation.	Pearce, 2014; Singh and Thakar, 2014; Bortolotti et al., 2015; Belhadi et al., 2016; Alhuraish et al., 2017; Yunus et al., 2017; Gandhi et al., 2017; AlManei et al., 2018; Belhadi, et al., 2018; Roslin et al., 2018; Elkhairi et al., 2019; Blijleven et al., 2019; Jain and Ajmera, 2019; Sancha et al., 2020; Sunder and Prashar, 2020, and Bashar et al., 2024. (16 sources)
H10	Application of information technology has a positive effect on the level of lean implementation.	Gandhi et al., 2017; Roslin et al., 2018; Filho et al., 2019; Belkadi et al., 2019; Nhat, 2020; Barud et al., 2020; Oliveira-Dias et al., 2022, and Buhaya and Metwally, 2024. (8 sources)

6. Lean Tools and Techniques for RMG Factories

There is a versatile set of lean tools and techniques that many firms choose to apply and sustain as a means of

increasing the effectiveness of manufacturing and the overall consumer value while concurrently eliminating waste (Duttai and Banerjee, 2014). Most practitioners and researchers had highlighted the lean tools, which could reduce inventories, lead times, and rapid product development processes. Those are workforce management, setup time reduction (SMED), pull system (Kanban), TPM, mistake proofing (Poka-yoke), 5S, value stream mapping, JIT, visual management, one-piece flow (takt time), standardized procedures/work, and Kaizen (Shah and Ward, 2003; Womack and Jones, 1996). These tools are sometimes used independently or as a bundle, where a set of them is selected based on the context and nature of the intervention (Mostafa et al., 2013). Scholars found that the effect of practicing lean tool bundling is greater than that of individual tools (Shah and Ward, 2003). In selecting both individual and bundled lean tools, it is crucial to identify which tools are most appropriate for specific conditions. To date, no well-known explanation of lean adoption exists. Its implementation varies in process as well as context (Hakansson, 2019). Additionally, the application of lean tools depends on techniques, skills, experience, and lean guides or consultants (Kaur et al., 2016). Other studies have suggested that the adoption of lean tools also depends on the product variety and product volume (Fawaz et al., 2006), as shown in Figure 5 below.

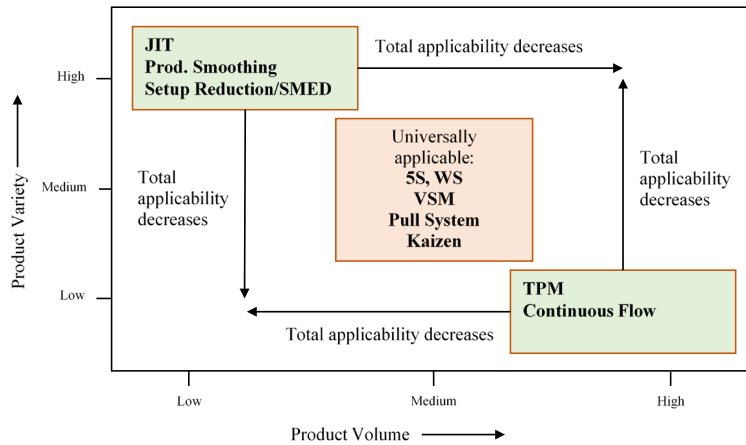


Figure 5. General guidelines for applying lean tools in process industry (Fawaz et al., 2006)

Many researchers have identified various tools in their lean implementation frameworks and models; however, not all of these tools and techniques are applicable to RMG factories. The production system, production volume and product variety may be the basic considerations for the selection of the tools for RMGs. Hamja (2019) suggests that the lean tools as listed in Table 3 below should receive priority for being applied in the RMG sector.

Table 3. Suitable lean tools in the RMG industry (Hamja, 2019)

Lean tools	Effects
5S	Cleanliness, workstation redesign, improved worker movement
WS	Operation with the right method, efficiency
VSM	Less inventory and work in process (WIP), reduced worker fatigue
Line balancing	Justified workload in each station of the line, reduced waiting time, increased output
QCO/SMED	Decreased setup time
Kaizen	Improved efficiency, teamwork, and commitment of workers, and increased participation
DHU	Reduced defects, improved product quality
TPM	Cost-effectiveness, increased product quality, timely delivery, and increased flexibility volume
Pull system (Kanban)	Less inventory and WIP, improved worker movement

Several factory owners have taken the initiative to implement the above lean tools on a pilot basis, and most of these independent cases have obtained positive results on productivity (Hamja, 2019).

7. LM Implementation, Organizational Performance and Relevant Hypothesis

The clarity in the definition and classification of the organizational performance is necessary to assess the performance. Chavez et al. (2015) highlighted operational and financial performances as the two major performance indicators. Nawanir et al. (2013) have studied organizational performance by measuring OP and BP. According to Rasi et al. (2015), the four dimensions of operational performance, i.e., quality, delivery, cost, and flexibility, are positively related to the lean production practice in the manufacturing industry. According to Roslin et al. (2018), a full-blown implementation of the LM system has successfully gained performance improvements in all five dimensions studied, namely waste reduction, marketing performance, financial performance, operational performance, and non-financial performance.

However, the literature review reveals the following reference sources that lean manufacturing implementation has a positive effect on organizational performance, referred to as hypothesis (H11), as shown in Table 4.

Table 4. Reference sources of positive effects of LM implication on organizational performance

No.	Hypothesis	Sources
H11	Lean manufacturing (LM) implementation has a positive effect on organizational performance.	Panwar et al., 2015; Panwar et al., 2017; Roslin et al., 2018; Jasti and Kodali, 2019; Touriki et al., 2021; Amjad et al., 2021; Mathiyazhagan et al., 2022, and Bashar et al., 2024. (8 sources)

8. Proposed Conceptual framework for RMG Factories

A conceptual framework is a set of simplified guidance for an organization to follow systematically, which is easy to understand and could assist the organization to follow efficiently in an implementable way (Rose et al., 2010). The conceptual framework proposed here is a specific one for the lean manufacturing implementation in the RMG sector of Bangladesh. The design idea concerned here is a holistic approach that pays due attention to CSFs along with the use of necessary lean tools and techniques. This conceptual framework will guide us to the critical success factors to be considered and lean tools and techniques to be used for RMG factories for effective implementation of lean manufacturing to achieve targeted organizational performance. Importance is given to organizational aspects as well as the main stakeholders while choosing the CSFs. The production systems generally followed in RMG factories are also considered for the right selection of the lean tools and techniques.

From the literature review, we identified 10 Critical Success Factors (CSFs) that positively influence the implementation of lean manufacturing. Additionally, we examined 10 relevant lean tools and techniques that serve as indicators of lean manufacturing implementation in RMG factories. Furthermore, this lean manufacturing implementation links with and directly affects organizational performance. Finally, we identify a fair relationship among the critical success factors (CSFs), the utilization of lean tools and techniques, and organizational performance, which are conceptually illustrated and framed in Figure 6 below.

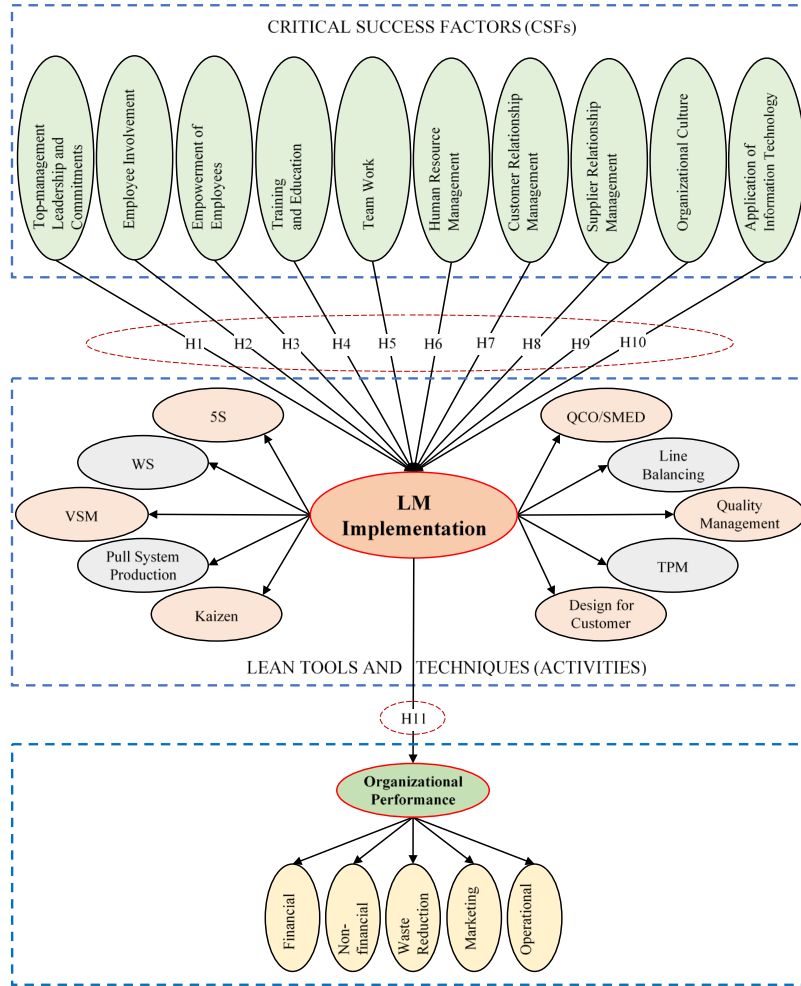


Figure 6. A conceptual framework for the implementation of LM in RMG factory

9. Conclusion

The RMG sector in Bangladesh needs to act proactively to survive and excel in the globally competitive business environment. This conceptual framework will guide us to the critical success factors to be considered and lean tools and techniques to be used for RMG factories. In overall consideration, this conceptual framework will be a very useful guideline for the RMG factories for effective and successful implementation of lean manufacturing to increase their productivity at a significant level and, at the same time, hopefully minimize the risk of lean implementation. Although the research was carried out for the RMG sector, it can also be followed by any other relevant manufacturing companies, such as the textile industry, through customizing the necessary tools and techniques.

10. Future Work

The developed conceptual framework expected to be a suitable one for the RMG factories here in Bangladesh. To enhance the framework some future improvements can be made.

- I) Efforts may be undertaken to enhance the framework by selecting more appropriate dimensions, or it may be tailored to meet the specific requirements of individual factories.
- II) Alternatively, it can be generalized for all RMG factories worldwide.
- III) The relevant data is in process of collecting to test the aforesaid hypotheses and to come up with a model for holistic LM implementation in RMG sector in Bangladesh.

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