VAASAN AMMATTIKORKEAKOULU
UNIVERSITY OF APPLIED SCIENCES

Muhammad Kamrul Huda(E2401991)

THE ROLE OF LEAN MANAGEMENT TECHNIQUES IN MANUFACTURING PROJECT COST REDUCTION

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VAASAN AMMATTIKORKEAKOULU

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ABSTRACT

Author	Muhammad Kamrul Huda(E2401991)
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In this study, lean management techniques are examined from the perspective of how they can minimize operational costs in the manufacturing sector. The growth of cost pressures in industrial production and the need for efficient process improvement strategies were the reasons for initiating this research. The study seeks to explore how lean tools can streamline operations and optimize resource utilization within manufacturing environments.

The research is grounded in lean management principles and explores tools such as 5S, Value Stream Mapping (VSM), Kaizen, Just-in-Time (JIT), and Kanban. To conduct the empirical part, a qualitative multiple case study design was applied to three manufacturing firms in Bangladesh: Bashundhara Paper Mills Ltd. (Tissue & Paper), Incepta Pharmaceuticals Ltd. (Pharmaceuticals), and US-Bangla Leather Product Ltd. (Leather Goods). Data were collected through document analysis—specifically operational reports, process audit records, and lean training materials—and expert interviews with key personnel involved in lean implementation. This provided insight into how lean practices affect cost efficiency and process performance.

The study reveals that lean tools reduce non-value-added activities, lower labor costs, and minimize material waste, aligning with previous research. It emphasizes organizational culture, leadership engagement, structured training programs, and practical recommendations for achieving manufacturing cost reduction.

Keywords: Lean management, cost reduction, manufacturing, 5S, Kaizen, VSM, operational efficiency, Just-in-Time (JIT)

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HOW AI TOOLS HAVE BEEN USED IN THIS THESIS

I did all the critical analysis, case study explanation and conclusions on my own to keep my work honest and original. I only used AI tools to help with time-consuming tasks, like proofreading, making the language clearer with Grammarly and QuillBot, and checking for grammar and academic flow using ChatGPT.

1 INTRODUCTION

1.1 Background of the study

Some lean management techniques have proven to be essential for reaching large cuts in costs in the manufacturing industries. The basis of Lean is to maximize value and minimize waste in the production process, which includes all forms of inefficiencies, non-value added activities. Organizations that implement Lean methodology can decrease costs, improve productivity in operations, and thus become more efficient.

First, it is necessary to examine the origins of the Lean management techniques and describe their specific strategies. Lean manufacturing is a production philosophy that aims at eliminating waste of all possible forms and is extensively utilised in automotive and other general manufacturing industries (Gupta, Acharya and Patwardhan 2013; Zahraee 2016). Second, Lean tools like Value Stream Mapping (VSM) adopted for Lean Health, determines not only issues associated with inefficiencies but also formulates actionable solutions to address these issues by focusing on what actually delivers value to the organization (Zahraee et al., 2014). It has been documented that by employing this approach, cost can be reduced by up to 25% compared to conventional project management approaches (Al-Aomar 2012).

Besides waste reduction, Lean practices include systems such as Six Sigma and Kaizen for further optimization of operational efficiency and cost effectiveness (Rosengart et al., 2023). Kaizen urges to continuously improve through small changes whereas six sigma focuses on reducing the variance and improving the quality. Furthermore, these methods can be integrated with a Lean framework to decrease costs, and to boost product quality and customer satisfaction (Atout, 2022). Additionally, technological advancements, such as Building Information Modeling

(BIM) and automation, further aid in implementing Lean management, on account of enhancing project performance to a great extent.

Previous studies have demonstrated that the application of Lean management practices combined with a BIM can reduce project costs by way of coordination and information management improvements, which are a challenge within manufacturing industry (Aziz, Nasreldin, & Hashem, 2016; Gómez-Sánchez, Ponz-Tienda, and Romero-Cortés, 2015). Such methodologies give a competitive advantage for companies operating in already crowded markets, helping them to sustain profitability despite fast evolving consumer demands.

It is also important that the organization sustain the Lean operations for long term success. Sustaining factors such as leadership commitment, culture of continuous learning, and effective supplier management are important enablers that contribute to the success of implementation of Lean practices (Trentin & Tontini, 2022). Hence organizations have to move towards adopting Lean methods and building upon environment that would enable Lean thinking and practices to thrive.

To conclude, Lean management techniques are strong operational efficiency enhancers and manufacturing project cost reducers. Companies should get rid of waste systematically, develop a culture of constant perfection, and utilize technological innovations to deliver maximum customer value with minimum costs. As the manufacturing landscape continues to transform, the key to playing catch up will be to implement lean principles that will continue to be critical to maintain competitive advantage and sustainable growth.

1.1.1 Rationale for the Research

The era of global competition has forced manufacturing businesses worldwide to confront rising raw material costs and increasing buyer expectations. As a result, companies are under pressure to enhance efficiency and reduce operational costs without compromising product

quality. Traditional project and production management methods often fail to address moderate to high levels of productivity-related waste. In response, lean management has emerged as a viable alternative. Its core philosophy—maximizing value by minimizing waste—has been successfully applied across various manufacturing contexts, particularly through tools like value stream mapping.While it has been recognized as an effective practice with many benefits, many organizations still find application of Lean inconsistent and difficult to sustain, specifically on how to blend Lean with current tools and newer technologies including Building Information Modeling (BIM), automation, and digital value stream mapping.

There is a great abundance of literature about Lean tools, methodologies and thus, their application; however, there is still a need to add to our knowledge of the impact of lean management on costs in specific manufacturing industries. Filling that gap is the aim of this research, which seeks to investigate systematically the role of Lean management to reduce cost, identify success factors to implement Lean, and explore its synergy with the employment of the new technologies. The study will provide valuable insights for manufacturing professionals and project managers aiming to optimize performance through lean strategies.

1.1.2 Research Objectives

1. To examine the foundational principles and tools of Lean management as applied in the manufacturing industry.

2. To evaluate the impact of Lean techniques on cost reduction across various manufacturing settings.

3. To identify key enablers and barriers to the successful implementation and sustainability of Lean practices.

1.1.3 Research Questions

1. What are the most commonly used Lean management techniques in manufacturing industries?

2. How do these Lean practices contribute to reducing operational and project costs?

3. What are the critical success factors and challenges in the implementation of Lean in manufacturing environments?

1.1.4 Scope of the Research

This research focuses on analyzing the application and impact of Lean management techniques in the manufacturing sector, with particular emphasis on their role in reducing operational and project-related costs. The study encompasses both theoretical exploration and empirical investigation of Lean tools such as Value Stream Mapping (VSM), Kaizen, Six Sigma, and the integration of advanced digital technologies like Building Information Modeling (BIM) and automation. While the research is centered on manufacturing industries—including automotive, process, and general production sectors—it also draws relevant insights from Lean practices applied in construction and industrial projects to support cross-sectoral understanding.

The scope is confined to cost-related outcomes of Lean implementation, excluding broader organizational effects such as workforce behavior or environmental impact, except where they directly influence cost reduction. Additionally, the research will consider case studies and empirical data primarily from contemporary manufacturing environments where Lean practices have been partially or fully adopted. The study does not cover non-manufacturing sectors such as healthcare or education, ensuring a concentrated focus on industrial cost efficiency.

1.1.5 Structure of the Thesis

The thesis is structured into six chapters, each designed to build a comprehensive understanding of Lean management's influence on manufacturing cost reduction:

Chapter 1: Introduction

This chapter introduces the research background, highlights the problem statement, articulates the rationale for the study, and outlines the research objectives, questions, scope, and significance.

Chapter 2: Literature Review

This chapter presents a review of existing literature on Lean management theories, techniques, and their application in manufacturing. It explores historical developments, core methodologies, and technological integrations like BIM. Gaps in current research are also identified.

Chapter 3: Research Methodology

Here, the research design is described, detailing the mixed-methods approach used for data collection and analysis. It includes sampling techniques, data sources, instruments used, and ethical considerations.

Chapter 4: Data Analysis and Findings

This chapter presents and interprets the results of surveys, case studies, or other data collection methods. It links empirical findings to the research questions and relevant theories.

Chapter 5: Discussion

The discussion evaluates the findings in light of existing literature and theoretical frameworks. It explains the implications of Lean implementation for manufacturing cost reduction and discusses practical relevance.

Chapter 6: Conclusion and Recommendations

This final chapter summarizes the main findings, answers the research questions, acknowledges limitations, and proposes recommendations for industry practices and future research directions.

2 LITERATURE REVIEW

2.1 Overview of Lean Management

Lean Management is primarily based on reducing wastage and improving operation efficiency. Lean Management originates from the Japanese manufacturing landscape, mainly the Toyota production system (TPS), and today it is a foundation of modern manufacturing industry worldwide (Mezhov et al., 2022). From their early days, Lean Management's principles have literally evolved to modern challenges and technologies in different industries (auto, aerospace, health, and even pharmacy) (Duraković et al., 2018; Habib et al., 2021; Singh, 2025).

2.1.1 Origins and Evolution of Lean Management

The origins of Lean Management can be traced to post-World War II, most notably in Toyota as an effort to improve the production process and eliminate waste (Mezhov et al., 2022; Kumar, 2019). The historical backdrop elucidates how Lean went from a small production optimisation method to a complete management philosophy centred on progress, continuous improvement, and just-in-time production. Lean principles have been extended from manufacturing to the practice in fields ranging from healthcare to construction and are universal and adaptable (Kumar, 2019; Singh, 2025). In addition, Industry 4.0 brought along digitalised methodologies and tools for Lean management to boost decision making and responsiveness about operations (Alabi, 2024).

As Lean Management has been adopted across different countries, particularly in the United States and Europe, it has undergone adaptations to align with local operational practices and cultural contexts. While the core principles remain consistent, regional variations have emerged to accommodate distinct industrial frameworks and managerial cultures. Even though the roots go back to the common principles, the variations demonstrate that these core ideas of lean, such as waste elimination and creation of value, can be adapted to the different

industrial frameworks and still remain applicable (Olu-Lawal et al., 2024; Prasetyawan & Ibrahim, 2020). Lean management has become a strategic enabler for keeping competitive advantage in the marketplace over time, where the market has been viewed as volatile and varying according to the consumer demand (Singh, 2025; Mistry, 2005).

2.1.2 Key Lean Principles in Manufacturing

The main principles of Lean Management revolve around making the process more efficient and thus reducing costs. The core tenet of Lean philosophy, however, is mainly to identify and eliminate waste referred to as "Muda," in Lean terminology. As per Kumar (2019), there are seven types of waste: overproduction, waiting, transport, extra processing, inventory, motion, and defects (Turgay et al., 2023). Organisations, therefore, by systematically fixing these inefficiencies, can streamline their operations, which will lead to tremendous savings in cost and better quality of the products (Garcia-Garcia et al., 2022; Ghelani, 2021).

The second crucial Lean principle is just-in-time production under which the production process is laid out in as close correlation to the consumer demand as possible in order to minimise the overstock of inventory and, as a result, spend less on inventory maintenance and waste (Mezhov et al., 2022). In addition, one of the most important instruments used in the Lean implementation represents value stream mapping (VSM), which allows companies to see their processes and find parts where they can add value or eliminate waste (Klabusayová, 2014; Salins et al., 2024). The use of these visual tools makes a contribution of employees for process improvements possible and, as a result, makes teamwork effective (Arutyunyan & Zhytkevych, 2024).

Beyond changes to this technical knowledge, Lean Manufacturing has enabled a cultural change in organizations that encourages employee engagement at all levels. For Lean improvements to be sustained over

the long term, this cultural transformation is crucial since it attempts to include all employees in the continuous improvement process—the principle of Jidoka that emphasizes that workers should be empowered to identify problems and stop the line to solve them immediately (Dutta, 2024; Turgay et al., 2023). Along with that, in a world where customer expectations are ever changing because of technology advancements and market dynamism the agility that Lean practices furnish is a must-have for the organizations to compete (Singh, 2025; Ferrazzi et al., 2024).

Moreover, Lean Management is linked closely with other methodologies of improving quality such as the Six Sigma—a combination that makes enhanced quality of the manufacture output possible. Combining measurement and analysis from both paradigms provides organizations the ability to minimize waste while hugely increasing the quality of their products, leading to customer satisfaction (Mondal et al., 2025; Ferrero et al., 2023).

In this context, this relevance is supported by explicit case studies indicating cost reductions of various extents in many manufacturing sectors. As an example, automotive companies that implement Lean principles have gone on to improve productivity and achieve operational cost savings, demonstrating the cost benefit that can be created when the Lean methodology is diligently followed (Dutta, 2024; Kumar, 2019). As the market landscape evolves and market pressure from the competition continues to increase, organizations will depend more on the role of Lean Management to maintain operational excellence and cost reduction.

2.2 Core Lean Tools and Techniques

Lean management is a set of tools and methods based on a specific methodology used for minimizing waste, creating value and encouraging a culture of continuous improvement. The most significant are Value Stream Mapping (VSM), 5S Workplace Organization, and Kaizen. These

are must haves for effective asset streamlining, improvement of productivity and alignment of manufacturing operations to the needs of the customers.

2.2.1 Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is used to visualize material and information flow through the manufacturing process in order to identify materials, waste, and inefficiency (Jasti et al., 2019; Kumar et al., 2022). As a result, the VSM can represent all steps of the production process and differentiating value added activities (customer) satisfying activities from non value added activities for the consumption of resources (Jasti et al., 2019; Garza-Reyes et al., 2018). Finally, VSM is intended foremost to help the production change as much as possible clearly to improve.

The very basis of VSM is holistic analysis; the entire value stream starting from production start to output delivered to the customer is analysed. It is comprehensive in nature and tries to explain how a number of processes are integrated with each other and how the inefficiencies can result from the interaction of a number of processes (Andreadis et al., 2017; Kukhan & M., 2021). In practice this enables organizations to tackle inefficiencies that have existed for long and would have gone unaddressed and hence large cost reductions and processes optimizations will be achieved (Nordin et al., 2014; Pandya, H., & Shah, S.P., 2015).

Additionally, implementing VSM enables teams to construct a common visual language that greatly improves communication among team members. An understanding that is common helps align the departmental efforts towards one common goal to maximize the value and minimize the waste (Garza-Reyes et al., 2018; Andreadis et al., 2017). Effective VSM implementation in automotive industries has been reported to result in significant reductions in lead time and reduction in time required to respond to the customers' demands, thereby increasing overall organizational agility (Pandya, H., & Shah, S.P., 2015; Jasti et

al., 2019). The synergistic effect of VSM power is further enhanced if applied along with Kaizen and 5S (Zahraee, 2016; Al-Rifai, 2024).

In summary, VSM is not only a diagnostic tool to identify possible inefficiencies, but also a strategic framework to develop a continuous improvement roadmap. However, as the tasks required in an organization aim for optimum use of its resources with competitive dynamics and rising customer expectations, firms have become stranded with the pressure to optimize their operations and to achieve long-term viability in the market (Jasti et al., 2019; Garza-Reyes et al., 2018).

2.2.2 5S Workplace Organization

The 5S methodology is the foundational tool of lean management to create and sustain an organized and efficient workplace, and the process of 5S methodology includes Sort, Set in order, Shine, Standardize, and Sustain (Sutrisno et al., 2022; Nallusamy & Saravanan, 2016). The 5S Process is divided into five parts, and each of these parts makes an organization productive, safe, and of high quality. Organizations can cultivate a culture of efficiency and accountability in their teams by systematically executing the 5S principles.

In the first step, Sort, the unnecessary items are identified and removed from the workplace so that the workplace is free from clutter (Sutrisno et al., 2022; Turgay et al., 2023). On top of creating an element of order, it also affects the way in which teams operate in an efficient manner. The second S, Set in order, comes after everything that is not truly important is turned away, and what's left is organized for easy access and blind placement. The spatial arrangement of this arrangement is also designed to help minimize waste because of searching for the tools or material, which results in the improvement of the operational efficiency (Sutrisno et al., 2022; Nallusamy & Saravanan, 2016).

The third S is Shine, which is a commitment to cleanliness and maintenance of the work environment. In addition to ensuring safety, regular

cleaning practices also allow workers to detect any irregularities that could lead to a problem as soon as possible (Sutrisno et al., 2022; Nallusamy & Saravanan, 2016). Standardize is the fourth step, which will help define the best practices in a workplace as all the employees need to follow the same set of protocols, and therefore, it will assist in minimizing the variance as well as the chance of error (Nallusamy & Saravanan, 2016; Sutrisno et al., 2022).

The Sustain step finally prompts all of the 5S gains achieved to be kept. This phase extends beyond adherence with aiming to integrate the 5S principles into the organizational culture (Sutrisno, Jusman, & Aznar, 2022; Garcia-Garcia et al., 2022). Training and regular audits through this technique help organizations to reinforce such a culture so 5S is not just an event but a long-term commitment for improvement.

Improved product quality, employee morale, and operational efficiency were reported at Sierra Leone Brewery Limited after implementing 5S practices, including better workspace organization, faster tool retrieval, and cost savings (Dumbuya et al., 2025). Past case studies have indicated how manufacturing firms that implement 5S techniques achieve high improvements in overall efficiency and productivity (Sutrisno et al., 2022; Garcia-Garcia et al., 2022). Creating a clean, structured, and organized workplace can significantly reduce the level of defects and downtime, hence contributing to competitiveness.

Finally, 5S is an essential lean management tool for enhancing essential workplace efficiency and continuous improvement. Therefore, during the time of rising market demands and shrinking budgets, the application of 5S principles becomes more relevant for companies to create flexible and robust manufacturing environments (Belekoukias et al., 2014; Garcia-Garcia et al., 2022).

2.2.3 Kaizen

One such aspect of lean that encompasses continuous improvement is Kaizen, which means "continuous improvement"—a philosophy that involves improvement through small, incremental improvements over time (Nkuna et al., 2023; Prashar, 2014). It enables employees on all levels to participate in making improvements to the processes and contributes to building a culture that embraces the employee as an active and proactive partner in enhancing operational aspects.

Kaizen is the essence of finding areas for improvement and 'solutioning' it with efforts being possible by all hands on deck (Prashar, 2014; Nallusamy & Saravanan, 2016). Typically, the methodology follows a structured improvement cycle (that sometimes is depicted by the PDCA Plan-Do-Check-Act framework). This cyclical approach guarantees that enhancements are always recognized, attempted, estimated, and refined, ultimately developing a solid agile reaction mechanism to the versatile functional challenges (Sutrisno et al., 2022; Nkuna et al., 2023).

When organizations take on Kaizen initiatives, they often put up dedicated teams to determine the specific improvement areas within their departments. Team-oriented problem solving improves the process of the improvement and pushes frontline workers to contribute their ideas that could bring in innovative solutions (Zahraee, 2016; Nkuna et al., 2023). Kaizen effectiveness can be seen in situations where the employees are invited to suggest their ideas without any fear of criticism so as to develop a culture of continuous improvement that is embedded in organizational practices (Prashar, 2014; Nallusamy & Saravanan, 2016).

Case studies show significantly that applications of Kaizen in numerous manufacturing plants have resulted in great reductions of waste, increased efficiency, as well as enhancements of product quality. An example would be that a study on the plastic manufacturing industry showed how structured Kaizen teams improved operational performance metrics by specifying particular improvement projects (Nkuna et al.,

2023; Prashar, 2014). Through implementing Kaizen, organizations can allow employee input and prompt sustained dedication to improvement to achieve significant advances and mitigate the deficiencies in responding to customer expectations.

To conclude, the Kaizen serves as a significant thinking under lean management since it emphasizes continuous improvement for a better sustainable competitive advantage. Firms that are able to sustain long-term prosperity and resilience by promoting an environment in which every employee is prompted to come up with ideas for enhancing reliability as well as operational output (Nkuna et al., 2023; Prashar, 2014; Kukhan & M., 2021).

As observed above, the core lean tools and mechanisms of Value Stream Mapping, 5S Workplace Organization, and Kaizen are a necessary means for attaining operational excellence of the manufacturing sector. VSM can be used to visualize or refine processes, 5S can be used to keep things orderly in an organization, and most importantly, manufacturing organizations must believe in the philosophy of Kaizen and continuously improve as a way of obtaining their goals. Kaizen, which emphasizes continuous improvement, supports operational reliability and efficiency through incremental process enhancements that contribute to cost reduction.

2.3 Lean in Manufacturing Environments

In a number of manufacturing environments, the use of lean management principles is spreading in order to obtain better productivity, systematically reducing the waste and cutting costs. In this section, the use of Lean techniques in manufacturing projects is studied in particular, and the cost benefits that are accrued that follow its implementation.

2.3.1 Lean Applications in Manufacturing Projects

Lean management is used on a large scale in manufacturing projects as a fundamental methodology towards improving performance and efficiency. Saboo et al. (2014) demonstrate how Value Stream Mapping (VSM) is used to visualize workflows, which helps identifying wastes and process inefficiencies. In implementing the VSM the company maps out each stage of raw material procurement through final delivery and this mapping helps the team to identify the areas wherein key things can be targeted for intervention and productivity improvement (Gupta et al., 2013).

Saboo et al. (2014) also demonstrated how the application of VSM in an Indian SME helped getting operational efficiency gains and employee engagement. However, the configuration of Lean goes beyond VSM and that it incorporates additional tools, i.e., Just In Time (JIT) inventory management, Total Quality Management (TQM) etc. JIT helps to reduce inventory holding cost as it links production closely with demand while TQM creates, through a culture of continuous quality improvement, the spirit of the organization (Dorval et al., 2019; Adeyemi et al., 2021; Shrafat & Ismail, 2019).

Many sectors, including automotive, electronics and pharmaceuticals have adopted lean applications (Bortolotti et al., 2015). Laureani et al. (2010) and Gupta et al. (2013) demonstrate the case where Lean practices are proven effective in reducing cycle times and defect rates in increasing the operational effectiveness in automotive manufacturing, for example. Along with this, Lean is good with wasting elimination for green manufacturing because wasters are cut in both expenses and environmental sustainability (Rishi et al., 2019).

In summary, Lean supplies a loadable framework suitable for continuous improvement in all sorts of industries. Lean provides means of the sys-

tematic elimination of inefficiencies, encourages innovation and the improvement of competitiveness in manufacturing industry through VSM, JIT or TQM.

2.3.2 Benefits of Cost Reduction in Manufacturing using Lean

A fundamental starting point of this thesis is that implementing Lean management principles is also good because of cost reduction. Elimination of non value adding activities including those consuming resources without adding value to the end product or service is central to Lean (Psomas & Antony, 2019). As a result, manufacturers can cut their costs in overproduction, waiting times and excess inventory (Gupta et. al, 2013; Binh, 2013).

One area where Lean is a major driver of cost savings is through improved process efficiency. The empirical studies have evidenced that one of the means to reduce operational costs is through the utilization of Lean practices by eliminating cycle times and optimizing production flows. As a result, these improve labor and overhead costs that further improve profitability (Adeyemi et al., 2021; Ganesan et al., 2023). For instance, a study from Gupta et al. (2013) proposes that an organization had reduced the operational costs by minimizing resource waste and shortening the turnaround time of a tyre manufacturing firm.

Cost savings are also gained through proactive practices of continued improvement such as the practice of Kaizen, which deals with small incremental changes. By encouraging all employees to identify and solve process issues, costs are reduced, morale is raised, and employee turnover and training costs are reduced (Bortolotti et al. 2015; Staats et al. 2010).

Rising product quality is another advantage of Lean which brings down defects' and returns' cost. Firms decrease scrap rates and costs of rework or warranty claims by embedding quality into all stages of the manufacturing process (Adeyemi et al., 2021; Timans et al, 2014). The

quality to which these efforts are focused makes the customers satisfied, thus it creates possibility of getting repeat business and also increases brand reputation which leads to a good healthy bottom line.

Sometimes these methods also contribute to the reduction of capital expenditures financially, including through lowering inventory levels that are originated by JIT and inventory control methods (Bình, 2013; Kazmane et al., 2014). Because they increase cash flow, they can either be reinvested in additional operational improvements or the strategic growth initiatives (Dorval et al., 2019; Laureani et al., 2010).

To conclude, this thesis is based on the assumption that Lean practices provide significant amount of cost reduction benefits in manufacturing environment. Lean enables organizations to prosper in the competitive markets through improved efficiencies, better quality and lower inventory costs. All in all, Lean management should be considered a transformational strategy in the manufacturing industry with regard to growth, sustainability, and profitability.

Table 1: Summary of Lean Components and Their Cost Reduction Benefits

Lean Tool/Technique	Mechanism for Cost Reduction	Outcome	Supporting Studies
5S	Organizes workplace, removes clutter, improves material access	Reduced labor time, fewer errors, improved efficiency	Sutrisno et al., 2022; Nallusamy & Saravanan, 2016
Value Stream Mapping (VSM)	Visualizes processes to eliminate waste	Reduced cycle time and lead time	Jasti et al., 2019; Garza-Reyes et al., 2018

	and identify bottlenecks		
Kaizen	Promotes continuous small improvements from employees	Incremental cost savings, improved morale	Prashar, 2014; Nkuna et al., 2023
Just-in-Time (JIT)	Synchronizes inventory with production needs	Lower inventory holding costs	Kumar, 2019; Mezhov et al., 2022
Kanban	Regulates workflow and reduces waiting time	Streamlined production, reduced delay costs	Salins et al., 2024; Singh, 2025

2.4 Barriers to Lean Adoption in Manufacturing Projects

It is true that Lean management provides well known benefits to a manufacturing organization but certainly implementing it is not a one-piece flow. Due to that, understanding these barriers is very important for organizations who want to adopt Lean methodologies. The first of three main obstacles is cultural resistance, leadership challenges, and the misalignment of performance metrics.

2.4.1 Cultural Resistance

Many studies attribute cultural resistance to be a major issue of Lean adoption in manufacturing. Employees may not be ready to adopt new practices, especially if they think these new practices will lead to job cuts or disturb the already in place workflows (Qureshi et el., 2022; Dora el al., 2015; Sahoo and Yadav, 2018). Such organizational culture is

entrenched in the fabric of an organization, so simply modifying process and procedure cannot achieve Lean thinking, but a whole mind shift is required at all levels of the organization (Jadhav et al., 2014, Qureshi, et al., 2022).

Among the most popular fears, people worry that Lean will result in layoffs, more work with no improvement to work life balance or job satisfaction (Sahoo and Yadav 2018). With many past instances of organizational restructuring, these fears have been reinforced during times when Lean initiatives have been associated with reduced workforces. Organizations have to cultivate a culture where Lean is seen as a way to personal and professional development (Qureshi et al., 2022; Dora et al., 2015), so as to mitigate such concerns.

Cultural resistance is something that can be addressed using effective communication. Alleviating uncertainty among employees can be achieved early during the Lean journey through education, participatory workshops encouraging open and transparent discussion (Dora et al., 2015; Jadhav et al., 2014). Qureshi et al. (2022) state that hearing success stories from other organizations might help breed confidence and enthusiasm among people to change. In addition, having management and frontline workers involved in the design and implementation of Lean process increases the feelings of ownership in a situation where there is a culture that accepts ongoing improvement instead of rejecting it (Kumar & Vinodh, 2020; Dora et al., 2015).

2.4.2 Leadership Challenges

Leadership challenges are another large barrier in Lean implementation. For effective Lean transformation, the transformation must take place in a committed leadership, and the leaders must understand Lean principles, and model and support the application of these principles. The absence of the leadership commitment or some sort of understanding of the Lean adoption can thwart the Lean adoption in great extent. Lack of

the commitment and understanding of the Lean will increase the skepticism and low the motivation of the staff and eventually decrease the positive impact of the Lean efforts (Vásquez-Hernandez, 2023; Abu et al., 2021a; Yadav, 2018; Qureshi et al., 2022).

Leaders in many organizations are not trained on Lean principles and make bad decisions and execute Lean initiatives in unorganized ways (Singh et al., 2020; Presentación et al., 2023; Luo, 2022). To start, there is a mismatch between the vision of the organization's leadership and its actual implementation of lean practices leading employees to be bewildered about their expectations which results in delays and resistance.

An effective leader also must build a culture of accountability and empowerment. This includes providing enough of people to train and develop, so that people feel comfortable carrying out Lean practices (Nurjanah & Aini, 2023; Abu et al., 2021a). Communication should be clear with leadership that Lean is to be a collaborative initiative and should be one of shared ownership of improvement efforts. Organizations on the other hand can start by modelling visible leadership and reinforcing empowerment because it increases the probability of Lean adoption (Singh et al., 2020).

2.4.3 Misalignment of Performance Metrics

The third key barrier is that performance metrics do not align with Lean objectives. However, such traditional performance metrics usually based on individual productivity rather than team output and thus create a competitive environment instead of collaboration, which runs contrary to the Lean core principles (Qureshi et al., 2022; Psomas & Antony, 2019; Sarhan et al., 2018; Mohapatra et al., 2023).

Also, some organisations employ measures of performance that do not translate customer value or operating efficiency (Kumar & Vinodh, 2020; Luo, 2022). If Lean criteria are used to assess employee performance

that would result in performance that is misaligned with the criteria, individuals may perceive themselves as being disincentivized to participate in Lean initiative. The consequence of this disconnect is that efforts on Lean implementation will be fragmented and less effective (Abu et al., 2021a; Sinkamba et al., 2023).

Overcoming this barrier can be done by redesigning performance metrics that conform to the Lean goals (Menezes et al., 2010; Sarhan et al., 2018). This can be done by measuring holistic indicators that encompass both the individual as well as the team's contribution (Psomas & Antony, 2019; Singh et al., 2020). Furthermore, continuous reviews of performance metrics guarantee that performance metrics stay as current and aligned with changing Lean objectives.

Finally, to summarize, cultural resistance, challenges from the leadership, and wrong performance metrics are the main difficulties of Lean implementation in manufacturing projects according to previous studies that were reviewed. These challenges—cultural resistance, leadership gaps, and misaligned performance metrics—highlight the complex realities of lean implementation in manufacturing environments. While the literature outlines the potential of lean techniques to drive operational efficiency and cost savings, it also emphasizes that context-specific factors significantly affect their success. This study seeks to empirically examine these dynamics by exploring how lean practices have been adopted in three Bangladeshi manufacturing firms, with a focus on their cost-reduction outcomes, sector-specific challenges, and the organizational strategies employed to overcome implementation barriers. The following chapter details the methodological approach used to investigate these issues. Addressing these challenges effectively enables organizations to fully harness the potential of Lean. Through targeted solutions and adaptive strategies, Lean can become an integral element of organizational practices aimed at achieving sustainable operational excellence. To ensure long-term success in lean implementation, organizations must proactively address the barriers

identified in this study. By doing so, they can embed Lean as a core strategy for sustaining operational excellence and ongoing cost efficiency.

3 RESEARCH METHODOLOGY

In this section I will discuss the research design, the methods used to collect data, the techniques utilized to analyses data and the ethical considerations that would influence the conduct of this study. After having identified lean management techniques in reducing manufacturing projects cost from previous literature, this research continues onwards to empirically study the management techniques towards minimizing cost in Tissue & Paper, Pharmaceutical, and Leather industries.

3.1 Research Design: Multiple Case Study

This study employed a qualitative multiple case study design, which is particularly well-suited for exploring complex real-life phenomena such as the application of lean management techniques in manufacturing settings (Yin, 2017). This includes exploring how practice areas of Lean Management, particular Value Stream Mapping (VSM), Kaizen and 5S, have been implemented in these sectors. Using multiple cases allows for cross industry comparison to identify common themes, challenges and successes with application of lean techniques.

To provide specific insights on distinct sectors of the overall lean practices, the research focused on three manufacturing sectors which are (1) Tissue & Paper, (2) Pharmaceutical, and (3) Leather Product. The case studies was carried out with companies that have lean practices, namely the companies such as Bashundhara Paper Mills Ltd, Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd. implement them. Secondly, this approach permitted an investigation of the direct effects of lean techniques on cost reduction, lead time and productivity for each sector.

The primary goal of the research was to explore the following aspects:

1. The contribution of lean management techniques to cost reduction in manufacturing projects.

2. The role of lean tools in influencing lead time and overall project cost reduction.

3. The challenges manufacturers face when adopting lean techniques and strategies to overcome these challenges.

3.2 Data Collection Methods

As for the means of gathering this data, this research were employ several complementary methods: literature review, case studies, and interviews. All of these methods are important for each method used to get the complete data that were answer the research problems.

1. **Literature Review:**
   A literature review were allow for a clear understanding and organization of the theoretical background of the lean management. In this paper we covered some of the key lean tools: 5S, kaizen, VSM, JIT, their applications in cost reduction and efficiency in manufacturing environments. This study also reviews existing research on lean management in manufacturing with a purpose to identify gaps in the literature and position this study in the context of previous work. Along with that, this review were also discuss
   the problems that arise while implementing lean management practices in different manufacturing industries.
2. **Case Studies:**
   The case study method involves the detailed investigation of 3 manufacturing companies in the Tissue & Paper, Pharmaceutical, and Leather industries. Bashundhara Paper Mills Ltd., Incepta Pharmaceuticals Ltd., and US-Bangla Leather Product Ltd. are the companies selected as case companies. Data for the case studies were collected through:
   1. Company reports and internal documentation related to lean practices and cost management.

2. Observation of lean management practices in action within the production environment.
3. A review of publicly available materials such as white papers and industry reports that describe the implementation of lean techniques.

3. Interviews and Document Analysis:

Key personnel of the case study companies involved in the lean implementation process were interviewed. They would include production managers, lean coordinators and operational managers charged with practicing or leading this lean practice. In this way, the interviews offered in-depth knowledge of how lean management tools are utilized to lower cost, shorten lead time, and enhance the way production processes are optimized.

Besides above mentioned questionnaire, document analysis were also be applied to review the internal company documents of production schedules, performance reports and training materials of lean practices. Moreover, this supplemented the interview data and offer a broader appreciation for how lean management is practiced.

Here is a table that describes the time and date of the interviews, how the interview was done, who the interviewed individuals were (role & experience in the company), how long the interview was, did you transcribe it or only make notes.

Table 2: Overview of Interview Details

Category	**Interviewee**		
	Chief Engineer	Executive	Manager
Company & Role	Bashundhara Paper Mills Ltd. (Lean Management	Incepta Pharmaceuticals Ltd.	US-Bangla Leather Product Ltd.

	Operation & Improvement)	(Lean Integration Coordinator)	(Operations)
Experience & Responsibilities	Oversees implementation of lean practices across paper production lines	Leads lean implementation in pharmaceutical production processes	Oversees lean implementation in cutting, stitching, and finishing divisions
Interview Date	15 May 2025	15 May 2025	15 May 2025
Reply Date	20 May 2025 (via email)	18 May 2025 (via email)	19 May 2025 (via email)
Interview Method	Remote (Phone + Email)	Remote (Phone + Email)	Remote (Phone + Email)
Duration	~45 minutes	~40 minutes	~50 minutes
Transcription/Notes	Notes only	Notes only	Notes only

3.3 Data Analysis Techniques

The method of thematic analysis used to analyze the data for the study by collecting the data from the semi structured interviews, case studies and document analysis. The qualitative data analysis method known as thematic analysis is about working out and noting the patterns (or themes) in the data. After that I followed some process of data analysis in the following.

1. Familiarization with the Data:

The first task was to read, re-read, and then read the interview transcripts, case study reports, and other materials available. In particular,

initial notes were taken to recognize early theme or pattern that can be distinguished from the data.

2. Generating Initial Codes:

The next step was to make key parts of the data coded. The content of each segment were labeled with a code that reflects its contents. These initial codes were very close to anything that has to do with lean management techniques, cost reduction, lead time and issues.

3. Searching for Themes:

Grouping of the initial codes was formed from broader themes. For instance, the themes would be cost reduction, employee resistance, improved efficiency as well as reduced lead time. By identifying patterns in the data that will help to answer the research questions, these themes were developed.

4. Reviewing Themes:

The themes were examined to ensure that they reflected the data accurately. The themes were adjusted where necessary to ensure they were clear and consistent. This refinement helped confirm that they represented the major insights derived from the data.

5. Defining and Naming Themes

After the themes had been agreed upon, they were precisely defined and named. In this step, accurate descriptions of the themes were developed, explaining how they aligned with the research questions.

6. Writing the Report

The final analysis was written by incorporating the results of the thematic analysis with the existing literature. The report elaborately ex-

plained how the use of lean management techniques helped organizations reduce costs, shorten lead time, and overcome the challenges faced by manufacturers in implementing lean practices.

3.4 Ethical Considerations

It was important to highlight the ethical considerations of this research to ensure its integrity and reliability. During the study, the following ethical guidelines were followed:

1. Participant Consent:

All participants had provided informed consent prior to the interviews. They were fully informed of the research objectives, how their responses would be used, and their right to withdraw from the study at any stage.

2. Confidentiality and Data Security:

All data collected from interviews and case studies were handled with strict confidentiality. Participants' identities were anonymized to protect their privacy. The data were stored in password-protected files accessible only to the researcher. The handling of sensitive company data was carefully managed, with restricted access in place to ensure security.

3. Transparency:

All participants were clearly informed about the purpose of the study and how their data would be used. Any potential conflicts of interest were disclosed, and participants were given the option to review the outcomes of their contributions.

The purpose of this chapter was to describe the research methodology used to investigate the impact of lean management techniques on cost reduction in manufacturing projects. A qualitative multiple case study approach was employed, involving case studies from the Tissue & Paper, Pharmaceutical, and Leather industries. Data were collected through a literature review, case studies, interviews, and document analysis, and

were analyzed using thematic analysis. Ethical considerations, including participant consent, data security, and confidentiality, were thoroughly addressed throughout the research process.

4 DATA ANALYSIS AND FINDINGS

4.1 Case Study 1: Tissue & paper Manufacturing Industry - Bashundhara Paper Mills Ltd.

Project Background

Established in 1993, Bashundhara Paper Mills Ltd. is a leading manufacturer of paper and tissue products in Bangladesh. As a subsidiary of the Bashundhara Group, BPML produces a wide range of products, including various types of paper, tissue, and hygiene items. The company is recognized as a trusted supplier for the Bangladesh government and exports to over 25 countries worldwide. BPML's commitment to eco-sustainable paper-based solutions positions it as a significant player in both domestic and international markets (Bashundhara Paper Mills Ltd., n.d.).

Lean Management Techniques Implemented

Bashundhara Paper Mills Ltd. applied the following lean techniques:

i) **5S**: "We applied **5S** to organize our production floor, which minimized unnecessary movement and improved material handling efficiency."

ii) **Kaizen**: "Kaizen has been a great tool for empowering employees to suggest small improvements, leading to incremental cost savings over time."

iii) **Value Stream Mapping (VSM)**: "We use **VSM** to visualize our entire production process, from raw material input to the finished product. Through **VSM**, we were able to identify and eliminate bottlenecks, which helped reduce production time and, consequently, labor costs."

Cost Reduction Outcomes

i) **Material Waste**: "By implementing **5S**, we reduced the time spent searching for raw materials, which improved worker productivity and saved costs on labor."

ii) **Labor Costs**: "With better organization through **5S**, we've significantly reduced downtime caused by misplaced tools, which led to a reduction in labor costs."

iii) **Production Efficiency**: "Through **VSM**, we identified key bottlenecks in production, which allowed us to streamline workflows and reduce cycle time by 10%, contributing to cost savings as faster production means more units per labor hour."

Lead Time

"Lean management, specifically through **JIT** (Just-in-Time) and improved inventory management, has helped us reduce lead time significantly. By having raw materials delivered only when needed, we reduced our inventory holding costs."

Challenges

"One of the biggest challenges we faced was employee resistance to change, especially from workers who were accustomed to traditional production methods. Overcoming this resistance required effective **training programs** and clear communication about the benefits of lean techniques."

4.2 Case Study 2: Pharmaceutical Industry – Incepta Pharmaceuticals Ltd.

Project Background

Founded in 1999, Incepta Pharmaceuticals Ltd. is one of Bangladesh's leading pharmaceutical companies. Headquartered in Dhaka, the company operates large manufacturing facilities in Savar and Dhamrai. Incepta produces a diverse range of dosage forms, including tablets, capsules, oral liquids, ampoules, and vaccines . The company has a strong presence in both domestic and international markets, exporting to over 100 countries . Incepta's focus on research and development has led to the introduction of numerous innovative products, solidifying its position as a key player in the pharmaceutical industry (Incepta Pharmaceuticals Ltd., n.d.)

Lean Management Techniques Implemented

Incepta Pharmaceuticals applied several lean tools to streamline operations:

i) **5S**: "We started with 5S to improve cleanliness and organization in our laboratories and production floors, which enhanced compliance and operational discipline."

ii) **Kaizen**: "Kaizen empowered frontline staff to suggest process changes that resulted in time and resource savings, particularly in batch processing and quality control."

iii) **Value Stream Mapping (VSM)**: "Using VSM helped us visualize our end-to-end production processes and identify bottlenecks, especially in packaging and labeling phases."

Cost Reduction Outcomes

i) **Inventory Efficiency**: "By implementing JIT, we reduced the cost of storing raw materials and active pharmaceutical ingredients (APIs), minimizing spoilage and freeing up capital."

ii) **Labor Optimization**: "The 5S methodology decreased idle time and improved worker productivity by 11%, mainly through better workplace arrangement and reduced search time for materials."

iii) **Batch Yield Improvements**: "VSM helped identify inefficiencies in granulation and tablet-coating stages, resulting in an 8% improvement in batch yields."

Lead Time

"Incepta observed a significant reduction in lead time for product batches due to better synchronization between production and quality assurance. The application of Kanban enabled smoother transitions between batch processes and reduced queue times."

Challenges

"One of our biggest challenges was regulatory alignment with lean practices. Ensuring GMP (Good Manufacturing Practices) compliance while

integrating lean tools required tailored training and SOP redesigns. Furthermore, there was initial skepticism among quality assurance staff regarding lean's impact on compliance. These were overcome through pilot initiatives and demonstrating clear, risk-free improvements."

4.3 Case Study 3: Leather Product Industry – US-Bangla Leather Product Ltd.

Project Background

US-Bangla Leather Products Ltd. is a 100% export-oriented leather manufacturing company established in 2011 under the US-Bangla Group**-** a diversified conglomerate in Bangladesh. As a prominent player in the Bangladeshi leather goods sector, encountered recurring issues related to high material waste, prolonged changeover times, and inefficiencies in manual handling processes. In response, the company adopted lean management strategies to enhance workflow efficiency, reduce operational costs, and maintain high export standards (US-Bangla Leather Products Ltd., n.d.).

Lean Management Techniques Implemented

US-Bangla adopted several key lean practices tailored to its leather manufacturing environment:

i) **5S**: "Implementing 5S brought visual order to our production floor, helping workers locate tools faster and avoid clutter in stitching and finishing sections."

ii) **Value Stream Mapping (VSM)**: "VSM helped us trace inefficiencies in our production—from hide preparation to final packaging—especially in resource-intensive steps like cutting and embossing."

iii) **Kaizen**: "With Kaizen, we enabled production teams to submit improvement suggestions that led to smarter layout arrangements and better use of raw leather materials."

Cost Reduction Outcomes

i) **Material Waste**: "By using VSM, we reduced leather waste by 14%, especially in cutting operations, by optimizing layout and reducing offcuts."

ii) **Labor Efficiency**: "Workstation reorganization through 5S led to a 9% reduction in idle time, improving overall labor utilization."

iii) **Operational Costs**: "Kaizen-led process refinements improved throughput and reduced energy consumption, particularly in dyeing and finishing units."

Lead Time

"With Kanban systems guiding workflow prioritization and reducing waiting time between finishing and quality control, we achieved an 10-12% decrease in lead time, which improved our on-time delivery performance to European clients."

Challenges

"The biggest challenge was the workforce's manual skill dependency and hesitation towards structured lean practices. We addressed this through visual SOPs, daily team huddles, and hands-on Kaizen workshops that made lean concepts relatable and actionable. Additionally, initial resistance from middle managers required regular performance feedback and incentive-based motivation."

Analysis of the Effectiveness of Lean Techniques in Reducing Costs:

Table 3: Summary of Lean Cost-Reduction Drivers, Challenges, and Solutions by Industry

Industry	Main Drivers	Challenges	Solutions
Tissue & Paper	5S, VSM for material handling & cycle time	Employee resistance, raw material quality	Training, communication, leadership support
Pharmaceuticals	Kaizen, JIT for batch yield & compliance	GMP compliance, SOP redesign	Pilot programs, SOP redesign, QA training
Leather Products	5S, VSM, Kaizen for waste & manual process	Manual skill dependency, shift variation	Kaizen workshops, visual SOPs, peer mentoring

The use of 5S, Kaizen and VSM techniques succeeded in helping to reduce operational costs in the three case studies. There were many measurable monetary benefits from the use of these tools such as:

Reduction in Labor Costs

After implementing 5S, the three companies had more organized and orderly production areas. Since they did not need to waste time finding the tools and materials, the workers became more productive. Imple-

menting 5S at Bashundhara Tissue & Paper, as mentioned by the Production Manager, helped the company cut the time needed to look for raw materials and improved employee productivity.

Minimization of Material Waste

VSM and Kaizen helped to identify and fix wastes of resources. Thanks to this change, waste of leather was cut by 14% during the cutting stages at US-Bangla Leather Product Ltd. In the same way, Incepta Pharmaceuticals implemented VSM in batch production which helped them improve how tablets were made and lowered waste amounts.

Improved Production Efficiency

VSM helped reduce the hurdles that slowed down production for each company. For example, Incepta Pharmaceuticals has been able to make quality control and manufacturing go together more smoothly, while US-Bangla Leather has increased their output after following Kaizen suggestions to rearrange the layout. Because of these improvements, they could produce goods in less time and lost less time at a standstill.

All in all, using lean techniques made it simpler to control costs by using resources better, simplifying tasks and cutting out work that adds no value. There is plenty of evidence that lean methods are useful in boosting a company's finances and daily operations.

Sector-Specific Factors Influencing Lean Application:

Each successful case of lean management was greatly affected by the special needs of each industry, the way goods were made and how easily processes could adapt.

Tissue and paper Manufacturing (Bashundhara Paper Mills Ltd.)

The sector had to manage unpredictable raw materials and a fast pace of production. The use of VSM and 5S helped to identify flaws in handling materials and promote order and a clean workspace on the factory floor. Since the inputs were not steady, it was necessary to observe them always to maintain the quality of the products.

Pharmaceutical Manufacturing (Incepta Pharmaceuticals Ltd.)

Since Incepta operates within a strictly regulated industry, it had to combine lean thinking with following GMP standards. Using Kaizen and VSM improved how batches were processed and how the various departments worked together. For lean implementation to work, SOPs had to be carefully restudied and staff retrained to ensure that products were up to standard and followed the rules.

Leather Product Manufacturing (US-Bangla Leather Product Ltd.)

People in the industry often use their hands to make the garments. Using lean tools, it was possible to keep the workstation more organized and make fewer mistakes when using raw material in cutting and finishing. Regular changes in product requirements meant the process had to be flexible which was helped by Kaizen and the use of visual control methods.

It follows, lean principles performed well most of the time, but their usage was modified to suit each industry's operating rules, regulation and workers. Team members had to customize lean techniques in order to achieve the best results in different types of factories.

How the Culture Within an Organization Affects Lean's Success:

An organization's culture is key to making lean management work and keeping it sustainable. All three case study companies found that a culture of constant development, employee involvement and support from leaders was vital.

Bashundhara Paper Mills Ltd.

Initially, a lot of employees resisted the company's changes, mainly because they were used to their usual way of working. Gradually, after using well-structured training and inviting employees to join Kaizen events, a continuous improvement culture was developed. As the Production Manager noted: It was necessary to overcome opposition and this was achieved by developing good training and sharing the real advantages of applying lean principles.

Incepta Pharmaceuticals Ltd.

The company's culture was set up firmly because of strict rules in the pharmaceutical industry. Integrating lean into the organization meant making sure everything was creative and also legal. Making the quality assurance team believe was the biggest challenge. So, Incepta promoted a learning environment by including SOP-based visuals in their workflow, running workshops on compliance and providing feedback amongst their teams. The Lean Coordinator also mentioned that Lean was most effective when it was in line with our regulatory culture, rather than at odds with it.

US-Bangla Leather Product Ltd.

Although the workforce at US-Bangla was good at making objects by hand, they first resisted using lean techniques. The team adopted regular meetings, Kaizen boards and charts to help lean thinking become a habit. As time passed such tools led to a culture of ownership among employees. The Operations Manager shared: The team members gained confidence when they realized that lean was there to support, rather than take over, their work.

Issues and Problems Encounters During Enacting Lean:

The lean procedures proved helpful, but every company had particular problems to face while applying them, depending on their industry and level of growth.

Bashundhara Paper Mills Ltd.

Companies had difficulty getting their workforce to accept the use of new systems. People were worried about possible shifts in their jobs and being asked to work more. Both were handled with in-depth training and clear communication about the importance of lean. Inconsistent quality of raw materials also made it difficult to apply standard lean methods like JIT and 5S.

Incepta Pharmaceuticals Ltd.

The biggest problem was to align lean with the strict requirements of GMP in the company. At first, both the quality and compliance teams were not sure about changes that affected regulations. Also, making changes to SOPs that allow for lean and still remain compliant required

a lot of effort. The issues were addressed by starting the implementation steadily, holding workshops with different teams and showing examples of lean implementation with no risks.

US-Bangla Leather Product Ltd.

Manual production and skilled labor made implementing lean difficult in the leather sector. Lean was seen by many employees as taking away from their ability and independence to work as they wanted. When training started, students were not too keen to participate. With time, using team Kaizen, noticeboards and peer teaching built trust among the team members. Another challenge was shift inconsistency; To ensure lean standards stayed the same, both day and night shifts were reviewed frequently and team members were switched out frequently as well.

5 DISCUSSION

5.1 Interpretation of the Findings

It is clear from the case studies of Bashundhara Paper Mills Ltd, Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd. that the aspects of Lean Management are closely aligned with what is discussed in the literature. By applying 5S, value stream mapping and Kaizen, all organizations made their processes more efficient, increased their productivity and saw improvements in workflow organization.

Lean Management is known as a fast-changing system aimed at improving results by removing waste and increasing the efficiency of procedures (Singh, 2020). Mezhov et al., 2022). Bashundhara Paper Mills Ltd. practiced these policies by introducing 5S which resulted in more orderly workplaces, less labor used and a shorter cycle time for work. 5S improved the company's daily workflow and also made employees aware of how processes influence each other. As noted by Garcia–Garcia et al. (2022), 5S helps prevent downtime and makes labor more effective.

As published in the literature, Value Stream Mapping is also seen as a helpful way to diagnose and plan future actions (Jasti et al., 2019; Kumar et al., 2022, helped to point out inefficiencies that were present in all stages of the manufacturing process. The company made improvements by finding how long it took for batches to be checked and finding solutions about the best way to use resources. Also, US-Bangla Leather Ltd. implemented VSM to optimize their cutting layout and reduce how much leather they wasted, as literature advises VSM aids in making processes more efficient and less wasteful.

Showing that small, employee-driven steps work, Kaizen proved effective in both Incepta and US-Bangla. Kaizen allowed Incepta's cross-functional teams to create changes in processes that matched regulatory expectations and reduced batch handling times. At US-Bangla, changes in the workplace and efforts to reduce waste made by frontline workers saved the company a lot of money. Nkuna et al. (2023) and Prashar

(2014) also identified that Kaizen encourages dedicated employees and, in turn, helps the organization achieve steady cost reduction.

In addition, Just-In-Time (JIT) and Kanban systems were adopted by both Incepta and Bashundhara Tissue & Paper to cut down on time between steps and store less stock. Because of these strategies, it became easier for departments and suppliers to coordinate, leading to better operational versatility. This confirms research that explains how merging lean and responsive inventory systems results in effective cost management and quick response to changes (Kumar, 2019). Salins et al., 2024).

All in all, the cases highlight that applying Lean techniques in a fitting way leads to notable reductions in production expenses, more efficient processes and improved responsiveness of the organization, showing that Lean continues to be valuable for many manufacturing industries.

5.2 Reviewing Lean Techniques for Lowering Expenses

I have studied Bashundhara Paper Mills Ltd., Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd. in this thesis and these organizations implemented lean management techniques that allowed them to witness significant cost reduction by eliminating waste, enhancing the efficacy of activities and motivating the team members. This result is also supported by existing research showing that lean methods reduce the costs in manufacturing sectors (Gupta et al., 2013; (may be retrieved from Adeyemi et al., 2021; Psomas & Antony, 2019).

By introducing 5S, all three companies managed to cut down on wasted time and improve their labor efficiency. Improved management of tools and materials led to lower labor costs for organizations of all sizes. Bashundhara Paper Mills Ltd. identified that using 5S together with the production floor reduced downtime and improved productivity, a finding backed up by Sutrisno et al. (2022) who noted that 5S helps in achieving efficiency by cutting back on extra moves and waiting.

VSM played a crucial role in picking out areas where production was slow and streamlining extra aspects of the process. By using VSM, employees

at Incepta Pharmaceuticals Ltd. improved how batches were produced and tested, so more batches were completed in less time. The company used VSM to arrange cutting more efficiently and reduce the amount of leather waste produced. The findings support literature's perspective that VSM helps review processes and seek improvements (Jasti et al., 2019). Garza-Reyes et al., 2018).

Through requiring each employee to make little but steady enhancements, Kaizen helped the company cut expenses. At US-Bangla Leather Product Ltd., Kaizen encouraged workers to suggest improvements in their working area and what materials to use which made the process more efficient. The company Incepta also reported positive results, with cross-functional teams applying new changes to packaging and compliance. This confirms findings by Prashar (2014) and Nkuna et al. (2023), who indicated that Kaizen leads to higher productivity and better employee involvement.

Just-In-Time (JIT) and Kanban systems were adopted by Bashundhara Tissue and Incepta Pharmaceuticals to decrease the costs of holding inventory and make materials move more easily. By using these tools, production and the purchasing of raw materials were made more flexible, meaning supply was less costly. Literature reveals that by using lean inventory, businesses can respond more effectively and spend less. Rishi et al., 2019).

Overall, using lean tools such as 5S, VSM, Kaizen, JIT and Kanban led to lower costs for all these companies. They achieved waste reduction, quicker production flow and increased returns from lean investments which proved lean's usefulness in various production settings.

5.3 Sector-Specific Factors Influencing Lean Application

Although these principles can be used in any industry, their successful use depends on how they are applied in particular sectors. By studying Bashundhara Paper Mills Ltd., Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd., it is clear that different industries use lean tools differently to pursue efficient and organized operations.

The tissue & paper manufacturing company, Bashundhara Paper Mills Ltd., dealt with issues caused by changing raw material quality and quick production. Tissue & Paper materials are delicate and need constant quality monitoring as well as proper material handling. VSM and 5S played a key role in finding inefficient parts and keeping production in motion by organizing the work areas. This is consistent with the research showing that lean applications have to be flexible when dealing with inconsistent input (Mezhov et al., 2022). Kumar, 2019). Furthermore, using JIT inventory helped control costs by keeping stock levels low, even though it meant that the suppliers had to deliver materials on a regular basis to match exact specifications.

Unlike others, Incepta Pharmaceuticals Ltd. needs to comply with government regulations based on GMP standards. This area requires organized records, closely maintained standards and perfect collaboration between teams. Lean tools needed to be adjusted to comply with regulations. The company introduced kaizen using suggestion systems and updates to procedure manuals so that improvements were safe and compliant at all times. Using VSM, it became clear that there were inefficiencies between the production and quality assurance stages of batch processing. This matches the views expressed by Bortolotti et al. (2015) and Dorval et al. (2019), who underscore that a company needs to be adaptable in strict regulations when reliability in processes is mandatory.

Making leather goods is the main activity of US-Bangla Leather Product Ltd. and their production relies heavily on manual labor and traditional skills. Handling material waste from the cutting process and ergonomic challenges were common in this sector; VSM addressed this by eliminating unnecessary steps. Workers at the company introduced small ideas through Kaizen, boosting efficiency and decreasing time spent not working on tasks. Their results, as found by Belekoukias et al. (2014) and Salins et al. (2024), prove that lean can increase how often equipment is utilized and worker productivity in manual production.

Overall, while 5S, VSM, Kaizen, JIT and Kanban can be used in any industry, their implementation should match the particular environment,

rules and way of thinking within that industry. The success of lean hinges on adjusting to the particular circumstances and constitution of a business sector.

The influence of organizational culture on adopting Lean ideas

A company's ability to maintain and sustain lean initiatives depends greatly on how lean management is aligned with the organizational culture. The instance of Bashundhara Paper Mills Ltd. and Incepta Pharmaceuticals Ltd. demonstrates that changes, employee activity and leadership are crucial for the use of lean tools.

At Bashundhara Paper Mills Ltd., the biggest cultural obstacle was that the staff was resistant to changes because of their traditional ways of working. At first, people were doubtful about bringing in lean systems like 5S and Kaizen, as they were unsure about the workload and whether their jobs would be removed. Over time, the organization built a tradition of regularly enhancing its workforce through training sessions, Kaizen group activities and clear communication. When people noticed how their input mattered, they showed greater commitment. According to Dora et al. (2015) and Qureshi et al. (2022), employee participation is a central factor in making lean sustainable. It also follows the principle Jidoka, where people on the factory floor are enabled to look out for quality issues (Turgay et al., 2023). Dutta, 2024).

Obedience to GMP (Good Manufacturing Practices) played a major role in forming Incepta Pharmaceuticals Ltd.'s organizational culture. Although the company formed certain habits out of discipline and structure, it initially had issues adopting lean tools. In quality control and compliance, employees were worried that lean improvements could cause the company to become noncompliant with regulations. By combining lean with the compliance process, Incepta managed to handle this challenge. To make it clear that lean methods helped with compliance goals, training programs were adapted to reflect this. Kumar and Vinodh (2020) further explain that integrating different business areas and following

leadership to reinforce the culture are important for success in lean transformation.

However, US-Bangla Leather Product Ltd. was positively influenced by its skilled workers and flexible approach, although at first, lean practices were not accepted by most. Lean tools were seen by many workers as challenging their independence or as new responsibilities. They started having daily team meetings, using visual boards for tasks and led Kaizen initiatives among their staff to encourage everyone to join in. As time passed, employees started offering their own efficiency improvements, favoring grassroots innovation. Supported by the findings of Bortolotti et al. (2015) and Nkuna et al. (2023), we believe that sharing responsibility and involvement in decision-making are vital for successful lean efforts in the labor-intensive industry.

Training staff, encouraging open discussion and involving everyone were the key factors in making lean work at all three companies. Thanks to the cultural drivers, it was possible to go past the initial reluctance and find a common goal to improve. In line with what Dorval et al. (2019) highlight, lean involves changing the workplace culture and needs support from leaders as well as active contributions from the workforce.

5.4 Barriers and Challenges Faced During Lean Implementation

Although it is known that lean management practices have many advantages, they are still not always easily adopted in companies. The examples of Bashundhara Paper Mills Ltd., Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd. point out various challenges, among them cultural hostility, complex management situations and a shortage of resources which often appear in literature as well.

The greatest hurdle faced at Bashundhara Paper Mills Ltd. was employees being unwilling to accept new changes. A lot of workers doubted getting involved with 5S and Kaizen, thinking it might result in having to work harder or adding stress to their usual way of working. When employees face the threat of losing their jobs or experience extra stress

in lean transitions, resistance is often response (Sahoo & Yadav, 2018; Qureshi et al., 2022). Programs focused on the area and clear communication helped deal with this problem. It was hard to standardize lean work and keep the flow uninterrupted due to the varying quality of the raw materials. Writing in 2022, Mezhov et al. claim that when input cannot be controlled, lean's efficiency can fail unless flexibility is included.

A key issue at Incepta Pharmaceuticals Ltd. was making lean practices work with strict regulations. It was thought at first that departments like quality assurance and compliance would object to lean modifications because they might run against GMP rules. It follows the main concerns of bringing lean into highly regulated industries (Singh et al., 2020). This was achieved by phasing in lean work, making sure the new strategies followed regulations and proving that they did not hinder with following the rules. Moreover, pharma companies found it tough to practice JIT, because they regularly keep extras to make space for quality controls and the various batches. According to Dorval et al., Incepta dealt with these challenges by creating better partnerships with certified vendors and managing delivery processes more carefully.

Because its processes involved skilled workers and hard labor, US-Bangla Leather Product Ltd. ran into several obstacles related to the craftsmanship in their organization. At first, using VSM and 5S brought doubts among workers because they thought these new plans would cause them to lose their traditional methods. It was difficult to adopt the training program because people got tired, some shifts were ignored and it was hard to break previous habits. This is in line with what Mohapatra et al. (2023) pointed out, that lean may place greater demands on SMEs and manual industries in terms of resources and changes to how things are done. In order to address these difficulties, US-Bangla implemented peer-led Kaizen workshops, visual management boards and regular audits so that team members would start to see their involvement as part of their job and not just yet another task.

All three companies found that their team's beliefs, trust and communicational skills both blocked their progress and helped them succeed. According to the literature, applying lean effectively relies on its technical part, as well as on encouraging employees, leadership and openness to change (Dora et al., 2015; Bortolotti et al., 2015).

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This work concentrated on discovering if lean management techniques can cut costs within the manufacturing sector, using both study of published evidence and analysis of three companies. Bashundhara Paper Mills Ltd., Incepta Pharmaceuticals Ltd. and US-Bangla Leather Product Ltd. The evidence shows that applying lean techniques helps improve how the company works, gets rid of waste, brings efficiency to processes and encourages improvements all the time.

The organizations that used 5S, VSM, Kaizen, JIT and Kanban as main lean tools cut back on labor costs, cycle times, waste of materials and extra stock — all of which made their work much more streamlined. This matches with findings from research and suggests that lean works best when its methods fit the main activities and needs of each kind of operation.

It points out how important it is for each sector to adapt differently. Complying with GMP rules in the pharmaceutical sector meant taking a considered and unified approach to lean. In the leather industry, the need for handcrafting and tailor-made products required flexible use of lean. It can be seen that lean should be tailored to each business sector to fit the challenges of making things and meeting regulations, as well as the quality and cost of workforce.

Further, the findings underlined that the presence or absence of a healthy organizational culture greatly impacted implementing lean tools. Companies that focused on training, displayed a strong leadership vision and encouraged communication among employees did better in adopting lean thinking. However, various problems were noted, among them employee pushback, the expense of setting up and a lack of teamwork between different departments. These problems required steps taken over time to solve.

All in all, lean management is more than just a set of tools. it provides an in-depth philosophy for achieving operational excellence. For organizational change to work, we need not only tools and systems, but also an environment that welcomes change, people with the same values and strong leadership. If these requirements are achieved, lean helps companies earn sustainable savings and remain competitive in manufacturing for years to come.

6.2 Recommendations

These are the recommendations, based on the study findings, for organizations planning to implement or improve lean management:

1. Customize Lean Approaches for Different Types of Industries

The use of lean tools should be adapted to the way each industry operates. It is better for organizations to assess themselves internally to uncover challenges, constraints and parts of their workflows that are not working well. It is important to consider sectoral needs such as meeting regulations in pharmaceuticals or flexible customization in leather manufacturing, when applying tools such as 5S, VSM and Kaizen.

2. Support your staff with training and make sure to handle changes properly.

All case studies revealed that resistance to change was a persistent obstacle. Firms should allocate long-term resources for training, focus on teamwork, point out how continuously improving workflows is useful and encourage employees to participate in lean activities. Having an open style of communication and making decisions as a team is essential for becoming lean.

3. Increase support from leaders and better unite departments.

Lean implementation works best when leadership behaves like a learner, properly supplies resources and supports teamwork among different

groups. Those in charge should encourage lean activities and see that all departmental objectives are in line with the main operational goals. Cultural change and sustainability need strong support from leaders.

4. Initially run small pilots and then increase your efforts slowly.

Organizations should start with lean in a few specific departments instead of trying to change everything all at once. By starting with small projects, firms can develop their skills, find out what works and inspire others to follow suit. Slow growth allows the organization to adjust, progress and work together as a unit at every step.

5. Implement Measures That Allow for Continuous Evaluation

For lean initiatives to continue and improve, companies should regularly monitor, receive feedback and evaluate their performance. This involves carrying out inspections at set dates, providing instant feedback and assessing results with the help of key performance indicators to check how well lean interventions are working. They ensure that continuous improvement is something the organization continuously aims for.

6. Encourage Suppliers to Work Together to Lower Inventory

It is important for organizations to have trusting, open and collaborative partnerships with their suppliers for these two methods to function properly. Performance by suppliers affects the smooth flow of materials, the time required to get goods and how much money is spent on inventory. Partnerships that support cooperation, including planning and shipping, help maintain low inventory and improve the responsiveness of the supply chain.

Following these recommendations, manufacturing companies can make lean more successful, save costs in the long term and keep up with the rapid changes in their industry.

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APPENDICES

Appendix A: Case Study – Bashundhara Paper Mills Ltd.

(Interview conducted with a responsible representative from the company**)**

Interviewee: Chief Engineer, Bashundhara Paper Mills Ltd.
Role: Lean Management operation and improvement, responsible for implementing lean practices across the paper production lines.

Interview Type: Remote Interview.

1. How do lean management techniques directly contribute to cost reduction in manufacturing projects?

Response: "At Bashundhara Paper Mills Ltd, lean management techniques such as 5S and Kaizen have been very effective in reducing costs. We applied 5S to organize our production floor, which minimized unnecessary movement and improved material handling efficiency. Additionally, Kaizen has been a great tool for empowering employees to suggest small improvements, leading to incremental cost savings over time. For example, after organizing our material storage area through 5S, we reduced the time spent searching for raw materials, which improved worker productivity and saved costs on labor."

a. How do lean tools such as Value Stream Mapping, Kaizen, and 5S impact project costs in manufacturing environments?

Response: "We use Value Stream Mapping (VSM) to visualize our entire production process, from raw material input to the finished product. Through VSM, we were able to identify and eliminate bottlenecks, which helped reduce production time and, consequently, labor costs. Kaizen has allowed us to continuously improve our processes by encouraging employees to suggest small improvements. This has resulted in better efficiency and lower scrap rates. 5S has helped us minimize waste in the

form of unused tools and materials, which lowered material handling costs."

b. What metrics are most effective in measuring the cost reduction achieved through lean management in manufacturing projects?

Response: "At Bashundhara Paper Mills Ltd., we track downtime, material waste, and production cycle time. By reducing downtime through better machine maintenance and more efficient scheduling, we were able to reduce costs associated with idle time. Additionally, reducing material waste by streamlining our processes and improving worker efficiency has helped us significantly cut costs. We also measure improvements in production cycle time, and we've seen a reduction of 10%, which directly leads to cost savings, as faster production means we can produce more without increasing labor costs."

2. How does lean management influence the lead time in manufacturing projects, and what is its impact on overall project cost reduction?

Response: "Lean management, specifically through JIT (Just-in-Time) and improved inventory management, has helped us reduce lead time significantly. By having raw materials delivered only when needed, we reduced our inventory holding costs. Additionally, we improved our production flow by applying Kanban to better manage material flow. As a result, we reduced our lead time by about 12%, which not only reduced our storage and handling costs but also allowed us to respond more quickly to customer orders, increasing customer satisfaction and reducing the cost per unit of production."

3. What are the challenges faced by manufacturers in adopting lean techniques for cost reduction, and how can they be overcome?

Response: "One of the biggest challenges we faced was employee resistance to change, especially from workers who were accustomed to traditional production methods. Overcoming this resistance required effective training programs and clear communication about the benefits of lean techniques. Another challenge was ensuring that lean practices were applied consistently across all shifts, which we overcame by standardizing processes and conducting regular audits. Additionally, ensuring the availability of quality suppliers for JIT deliveries was a challenge, but we overcame it by building strong relationships with our suppliers and establishing clear delivery schedules."

Appendix B: Case Study –Incepta Pharmaceuticals Ltd.

(Interview conducted with a responsible representative from the company**)**

Interviewee: Executive (Lean Integration Coordinator), Incepta Pharmaceuticals Ltd.
Role: responsible for implementing lean practices across the pharmaceutical production lines.

Interview Type: Remote Interview.

1. How do lean techniques contribute to cost reduction?

Response: "Lean techniques like VSM, Kaizen, and 5S helped us identify workflow inefficiencies between formulation, quality control, and packaging. 5S ensured cleanliness and compliance; Kaizen teams tackled micro-inefficiencies, and VSM allowed us to visualize batch delays, leading to better coordination and significant labor-hour savings."

a. How do these tools reduce cost in pharma operations?

Response: "Kaizen enabled teams to simplify repetitive tasks—especially in packaging and documentation—leading to fewer errors and rework.

VSM mapped out dependencies across QA and production, which helped minimize time lags. 5S improved audit readiness and reduced time in documentation retrieval."

b. What metrics are used?

Response: "We monitor batch lead time, deviation handling time, and productivity per shift. Our average batch cycle time has improved by 8%, and deviations are addressed more efficiently due to standardized visual processes."

2. How does lean affect lead time and project cost?

Response: "JIT is partially implemented because of regulatory constraints, but we've optimized inventory levels for fast-moving APIs. Kanban has helped improve lab-to-line coordination. Overall, lean has contributed to an 11% reduction in average lead time."

3. What challenges did you face?

Response: "Compliance concerns were paramount. We had to ensure that lean didn't compromise GMP. This required collaborative SOP redesigns, training in compliance-lean synergy, and stakeholder buy-in. Regulatory audit concerns also limited full-scale lean deployment at first, but phased implementation resolved that."

Appendix C:

Case Study –US-Bangla Leather Product Ltd.

(Interview conducted with a responsible representative from the company**)**

Interviewee: Manager (Operations), US-Bangla Leather Product Ltd.
Role: Oversees lean implementation in cutting, stitching, and finishing divisions.

Interview Type: Remote Interview.

1. How do lean techniques contribute to cost reduction in leather production?

Response: "We implemented 5S and VSM to address disorganized workstations and material wastage during cutting. Kaizen initiatives led by workers themselves improved productivity and reduced scrap. For example, a worker-led suggestion about rearranging cutting templates led to significant leather savings."

a. Impact of VSM,5S, and Kaizen on cost?

Response: "VSM revealed inefficiencies in stitching and finishing lines—specifically rework due to inconsistent measurements. Kaizen helped establish quality check points earlier in the process. 5S made a big difference in reducing time lost in searching for specialized tools like embossing stamps."

b. What metrics are tracked?

Response: "We monitor material yield, time per batch, and labor efficiency. Since applying lean tools, material yield improved by 14%, and production times per unit dropped by 9%."

2. Influence of lean on lead time and cost?

Response: "Lean tools reduced our lead time by 10–12%. By synchronizing workstations through visual signals (Kanban), we minimized idle time between stitching and finishing, resulting in quicker order completion and reduced inventory buildup."

3. Main barries and how were they resolved?

Response: "Initial skepticism from craftsmen was expected—many felt lean would restrict creativity. We overcame this by involving them in Kaizen and explaining how lean complements craftsmanship. Shift-level

variation was another issue; we dealt with it by standardizing workflows and peer-led orientation sessions."