Major Research Project Report on

IMPROVING EFFICIENCY IN CRICKET GRIP MANUFACTURING: A FLOOR OPERATIONS APPROACH

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DECLARATION

I, Kriti Gupta, hereby declare that the Major Research Project Report entitled “Improving Efficiency in Cricket Grip Manufacturing: A Floor Operations Approach” submitted to Delhi Technological University is a record of my original work. This project report is submitted in partial fulfilment of the requirements for the award of the degree of MBA in Operations and Finance.

I also declare that this project report has not been submitted to any other university or institute for the award of any degree or diploma.

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ACKNOWLEDGEMENT

I want to express my sincere gratitude to all those who supported me throughout the course of this Major Research Project titled "Improving Efficiency in Cricket Grip Manufacturing: A Floor Operations Approach".

This project has been submitted to esteemed faculty member Dr Chandan Sharma, Assistant Professor of the Delhi School of Management, Delhi Technological University.

I am equally grateful to my peers, friends, and family for their unwavering support, motivation, and understanding during the entire journey of this project.

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CERTIFICATE

This is to certify that Kriti Gupta, roll no. 2K23/DMBA/62 has submitted the major research project report titled "Improving Efficiency in Cricket Grip Manufacturing: A Floor Operations Approach" in partial fulfilment of the requirements for the award of the degree of Master of Business Administration (MBA) from Delhi School of Management, Delhi Technological University, Delhi during the academic year 2024-2025.

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ABSTRACT

Cricket grip performance is directly linked to the grips, which provide greater control, comfort, and firmness to the player. But manufacture of the grips is marred by inefficiencies in the form of. wastage of material, workflow bottlenecks, and variable quality. These inefficiencies lead to increased costs of production, longer production cycles, and reduced overall efficiency. This study aims to enhance floor operations in cricket grip production by identifying inefficiencies, implementing lean manufacturing principles, and identifying. areas for automation. The study aims to reduce production waste, enhance workflows, and deliver. high-quality outputs at lower costs.

In addressing these problems, this study applies a combination of Value Stream Mapping (VSM), 5S technique, and Just-in-Time (JIT) inventory control to streamline operations and improve productivity. One of the new processes introduced in the process is the addition of a high-capacity electric steam chamber, doubling the cure capacity to 500 grips per batch from approximately 125 grips. This four times increase significantly raises throughput without sacrificing the quality of products. Doubling the floor area on the production floor from 400 sq. ft. to 1200 sq. ft. has also contributed towards better material flow, reduction of congestion, and efficient workspace organization.

Besides, possibilities for automation have been explored to enhance the efficiency of production. Semi-automatic extruders and automated curing timers have been created to promote uniformity in the curing process and reduce reliance on manual processes. Such innovations provide for the manufacturing of different grip designs, colors, and variations within a shorter time frame, thus enhancing flexibility and customization for market requirements.

SWOT analysis of the cricket grip manufacturing sector has also been carried out to analyze strengths (increasing market demand, increased use of sports technology), weaknesses (high cost of automation capital, dependence on skilled manpower), opportunities (export market prospects, advances in manufacturing technology), and threats (presence of major organizations, fluctuating raw material prices). The major

players in India, such as SG (Sanspareils Greenlands), SS (Sareen Sports), and BAS (Beat All Sports), were analyzed to identify market positioning and industry norms.

This study presents an in-depth analysis of cricket grip manufacturing process and its cost-effective, scalable model that can be followed by manufacturers to enhance operational efficiency. The findings of this study establish the role of lean manufacturing practices, process automation, and floor space optimization in high productivity with less waste. Optimizing floor operations, this study seeks to enhance the efficiency, sustainability, and competitiveness of cricket grip manufacturing. The findings of this study can also be extended to other manufacturing industries with the same workflow efficiency and quality control as a success factor.

TABLE OF CONTENTS

Contents

1. INTRODUCTION

1.1 Background & Significance

Cricket is one of the most popular and accepted sports across the world, particularly in nations where cricket holds a special place in the hearts of the people, such as India, Australia, England, and South Africa. Over the years, there has been a major rise in demand for quality cricket equipment, which includes essential products such as bats, balls, protective gear, and a multitude of accessories that enhance the overall game-playing experience. Among all these numerous accessories, cricket grips are of utmost significance as they contribute significantly towards a player's comfort, control level, and overall performance on the field. A well-crafted grip is extremely crucial as it ensures the player has a firm and secure hold on the bat, which actually minimizes the risk of slippage and hence increases the performance of various strokes while playing the game.

Despite the undeniable importance of cricket grips in the game, the production process that is utilized to manufacture these essential items typically experiences a series of inefficiencies. These inefficiencies have the potential to play a significant role in increasing the cost of production, a greater level of wastage, and a decrease in the overall level of production. Cricket grips are typically produced using high-quality rubber or synthetic materials specifically designed for durability and performance. The sophisticated production process consists of a series of steps, including extrusion, molding, curing, and finishing, each of which has a crucial role in the final quality of the product. It is, however, alarming that the majority of manufacturers continue to utilize traditional production processes, which can ultimately lead to:

- There exists a vast amount of material that is lost, largely due to inefficient handling and processing procedures.
- Unreliable product quality as a result of variations in hand curing and extrusion.
- Workflow bottlenecks that occur as a direct result of poor facility layout and poor production planning can have a major impact on efficiency.

- The cost of production is high due to inefficiencies that exist in the use of machinery, as well as in the use of energy resources.

As the technology for cricket equipment keeps improving and adapting to the times, it becomes increasingly important for businesses to discover and implement effective strategies that optimize production efficiency without sacrificing the high quality of their products. Additionally, the growing consumer demand for personalized grips, which come in a variety of colors, textures, and thicknesses, creates an imperative need for significant process improvements to meet these demands. This research is dedicated to conducting a rigorous analysis and improving the floor operations specifically in the cricket grip production area. The ultimate aim is to develop a production system that is not only cost-effective and scalable but also of high quality, ultimately becoming a benchmark within the industry for others to follow and aspire to.

1.2 Problem Statement

The cricket grip manufacturing industry is today faced with a multitude of operating inefficiencies that sharply impair its total productivity, devalue cost-effectiveness, and undermine the quality assurance. Such operating inefficiencies arise from an array of causative factors that include outdated ways of manufacturing, which have lagged behind improvements in technology, a conspicuous absence of automation within manufacturing operations, poor workflow organization, and limitation in production capacity that places curbs on production. The foremost challenges this industry is facing are:
Material Wastage: The traditional processes employed in rubber extrusion and molding have a tendency to waste a great deal of material, mainly owing to the necessity of excess trimming and also because of faults in the final products.

<u>1.2.1. Production Bottlenecks:</u> Ineffective curing procedures, coupled with the existence of poorly optimized workstations, are the causes of extreme workflow delays and yield a lower overall output.

1.2.2. Inconsistent Quality: Handling of grips manually at the curing and finishing stage leads to significant inconsistencies in different parameters like thickness, texture, and general toughness.

1.2.3. Limited Automation: Lack of advanced and sophisticated equipment for specialized procedures like curing, cutting, and quality control severely limits and inhibits overall production efficiency.

1.2.4. Space Constraints: Limited factory space available in the majority of factories has a significant impact on overall workflow organization, which results in congestion. Over time, this results in slowing down the production process, and the efficiency and productivity levels are affected.

One of the most important bottlenecks that have been recognized in the existing manufacturing process relates to the very critical curing phase, wherein grips are subjected to treatment for enhancing both their lifespan and texture. During this phase, most manufacturers utilize low-capacity curing chambers, which sadly results in an elongation of the entire production cycle and the accumulation of a large production backlog. To adequately handle this important issue, a high-capacity electric steam chamber has been incorporated in the framework of this study, which has the outstanding capability to cure up to 500 grips at a time, which is an outstanding fourfold increase from existing capacity levels. Additionally, the floor space occupied for this operation has been considerably increased from its initial space of 400 square feet to an increased space of 1200 square feet, thus enabling much improved workflow management throughout the entire process.

Through critical analysis of the inefficiencies noted, together with the recommendation for several possible solutions such as the adoption of lean manufacturing principles, automation, and facility remodeling, this study is focused towards the creation of a more productive manufacturing model. The long-run end goal of this enhanced paradigm is to further improve the manufacturing speed, improve quality overall, and attain further cost-effectiveness in manufacturing practices.

1.3 Research Objectives

The primary aim of this research endeavor is to significantly improve the efficiency involved in the manufacturing process of cricket grips through a thorough optimization of the operations taking place on the factory floor. This study concentrates specifically on pinpointing various inefficiencies that may exist, with the intention of implementing lean manufacturing strategies that can effectively reduce waste and streamline processes. Furthermore, it explores the potential of leveraging automation in areas where it is deemed feasible and beneficial. The key objectives that guide this research include:

1. To determine inefficiencies in the existing manufacturing process through material usage analysis, workflow design, and machine utilization.

2. To apply lean manufacturing tools like 5S methodology, Just-in-Time (JIT), and Value Stream Mapping (VSM) for improving the workflow and minimizing waste.

3. To identify automation possibilities in the extrusion, curing, and quality control operations to enhance efficiency and consistency.

4. With the aim of minimizing production costs while ensuring that high quality products are produced with optimized material utilization, machine utilization, and waste reduction.

5. In order to enhance production capacity through enhanced curing capacity by the introduction of a high-capacity electric steam chamber, thus decreasing cycle time.

6. The aim is to enhance and add to the overall flexibility of the production process using the ease of including a wide range of color and texture variances at the stages of both extrusion and curing.

7. To maximize the production floor space by increasing from 400 sq. ft. to 1200 sq. ft. for enhanced workflow, accessibility, and equipment positioning.

1.4 Scope of the Study

This specific study is committed to the in-depth examination of the cricket grip manufacturing industry, focusing specifically on the analysis and improvement of the different floor operations that take place in manufacturing units. The study mainly involves the following areas of interest:

1. Manufacturing Operations: From raw material receipt to extrusion, curing, and final product finishing.
2. Operational Efficiency: Determination and resolution of bottlenecks in production and workflow organization.
3. Lean Production & Automation: Applying 5S, JIT, and automation systems to avoid waste.
4. Space Optimization: A critical study of how increasing the floor area from a small space of 400 square feet to a larger space of 1200 square feet impacts and affects the overall production efficiency in the working environment.
5. Technological Advances: Evaluating the advantages of embracing a high-capacity steam chamber and other procedural enhancements.
6. Quality Control Measures: A detailed explanation of how process optimization can offer great improvement in product uniformity and a great decrease in defects.

1.4.1 Significance of the Study

This study is important to various stakeholders such as:

1. Manufacturers: Facilitating the enhancement of productivity, cost savings, and profitability.
2. Workers & Operators: Offers improved workflow control, minimizes the workload of manual labor, and improves workplace safety.
3. The Sports Equipment Industry: Sets a major benchmark that is centered on having efficiency-driven production processes in the field of sports manufacturing.
4. Academia & Research: Adds to the available body of knowledge in lean manufacturing and process optimization in small-and-medium-scale industries.

By emphasizing the creation of a low-cost production model that is scalable and of high quality, this research hopes to greatly improve the competitiveness of cricket grip makers, not only in India but also internationally.

1.5 Process of Manufacturing a Cricket Grip

The manufacturing of cricket grips involves several key stages, each contributing to the final product's quality, durability, and texture. The process primarily consists of material selection, extrusion, curing, finishing, and quality control. While traditional methods rely heavily on manual handling, modern advancements have introduced semi-automated processes to improve efficiency and consistency.

Step 1: Material Selection & Preparation

The manufacturing process starts with careful selection of the appropriate raw materials, which are mostly natural rubber, synthetic rubber, or a combination of both. The rubber compounds are then mixed with a range of different additives, plasticizers, and stabilizers, all of which play a role in making the material more flexible, durable, and efficient overall. After mixing, the resulting material is then rolled into sheets or pellets, a change that facilitates easier feeding into the extrusion machine, which will be used in the subsequent stage of the manufacturing process.

Step 2: Extrusion & Molding

It is at this precise stage of the manufacturing process that the carefully mixed rubber compound is introduced into a dedicated grip extrusion machine specially designed for this purpose. The machine plays a critical role in that it forms the rubber material into individual cylindrical pieces and subsequently forces it through a molded die that has been specifically designed to meet specific specifications. The make-up of this die plays a critical role, as it not only determines the surface texture of the grip but also its thickness and the overall pattern that is to be achieved—often comprised of intricate patterns such as diamond patterns, chevron patterns, or even octopus-textured patterns. Further, the application of multiple color versions is made possible at this stage, so it can be incorporated into the manufacturing process, thus enabling high levels of customization based on satisfying specific brand specifications or individual customer specifications.

Step 3: Curing (Vulcanization Process)

After the extrusion has been completed, the grips undergo an equally vital process known as vulcanization, which takes place within a specially designed steam curing chamber. It is through this vital process that the rubber material is subjected to elevated temperatures, which subsequently activate the cross-linking process of the polymer chains. This miraculous chemical process plays a vital role in significantly enhancing the overall elasticity, tensile strength, and resistance to wear of the finished product. During this study, a newly added high-capacity electric steam chamber has allowed for the batch capacity to be expanded from 125 grips to a staggering 500 grips, significantly reducing the curing time while also maximizing production efficiency at the same time. In order to facilitate easier access and enable faster processing cycles, the grips are arranged strategically on various racks within the steam curing chamber.

Step 4: Cutting & Sizing

After being cured, the grips are then subjected to a cutting process where they are neatly trimmed to standard lengths or custom lengths, simply depending on what has been ordered by the customer. Any remaining material on the ends of the grips is carefully and deliberately trimmed off to make sure there is uniform consistency and accuracy on every grip. At this specific production stage, any faulty grips—those with imperfections like air bubbles trapped inside, uneven thickness that ruins their quality, or flaws that were gained during the curing process—are weeded out and removed from the production line systematically in a bid to ensure stringent quality control measures.

Step 5: Finishing & Quality Control

At the last production stage, every single grip is manually stretched and fully tested to assess its elasticity, resilience, and overall fit. Furthermore, some grips also go through a variety of other surface finishing treatments, such as the possibility of anti-slip finishes or advanced technology textured finishes, that are designed to significantly improve the performance of the grip. Additionally, high-quality quality control tests are strictly applied to each individual batch to test for consistency of quality, absence of defects during manufacture, and that all the products are up to the very high industry standards before they move on to the packaging process.

Step 6: Packaging & Distribution

The finished grips, which are important components in various sporting activities, are packaged with care in two ways: either in bulk for large orders or individually for specific purposes, depending only on the individual requirements of the client. Besides this, labels, barcodes, and brand materials are carefully affixed on each package to enable proper product identification and to have them prepared for retail display. Once the grips have been packaged with care, they are then shipped to various destinations, which can vary from sports equipment manufacturers, retail outlets, or directly to customers who have placed orders.

Process Optimization Implemented in this study:

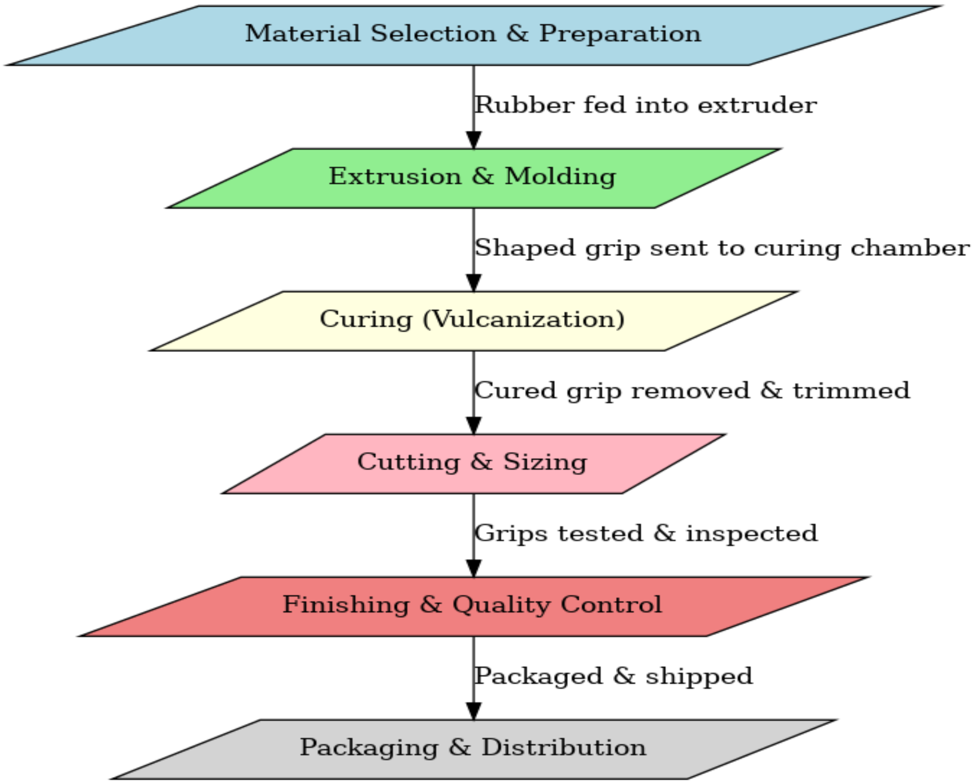
To greatly improve efficiency in the production cycle, minimize the time spent on production, and ultimately improve the overall output of the operation, several key process improvements were strategically made in this research. Of these improvements, perhaps one of the most significant and revolutionary changes was the addition of a larger-capacity curing chamber. This new chamber allowed the batch size to increase exponentially from an original capacity of 125 to an astonishing 500 grips per cycle. With this improvement, not only was the overall curing capacity quadrupled, but it also significantly reduced the time spent on each individual batch, effectively eliminating a key bottleneck that had been hindering production efficiency.

In addition to the earlier innovations, the production area on the ground was also greatly expanded, from the original 400 square feet to much larger 1200 square feet. This incredible tripling of the production area not only allowed for more efficient planning of the layout but also provided for easier flow of the materials throughout the manufacturing process. Further, it provided for greater coordination and interaction among the workers, which also helped to play an important role in reducing congestion in the space and overall operational efficiency.

The successful adoption of lean manufacturing practices, with a special focus on the 5S approach, which involves the most important steps of Sort, Set in order, Shine, Standardize, and Sustain, and the Just-In-Time (JIT) production policy, has been a key and critical factor in considerably reducing wastage. Additionally, these practices have also been instrumental in optimizing the optimum use of resources in a highly effective manner while, concurrently, developing a clean, neat, and well-organized working environment that is highly conducive to productivity. Additionally, the use of these practices has also helped significantly in optimizing consistency between processes and preventing delays that may be faced in the overall production process.

Finally, the study did a thorough investigation on the integration of semi-automated cutting and extrusion technologies into current systems. These emerging technologies are currently undergoing thorough testing to determine their capabilities to greatly enhance precision, reduce the amount of human intervention needed, and eventually increase the speed at which production processes happen. All these careful developments have laid a good foundation for a production process that is not only more scalable but also much more efficient and committed to upholding high levels of quality during production.

Figure 1.1: Process of Manufacturing a Cricket Grip



Source: own analysis

2. LITERATURE REVIEW

2.1 Introduction

The initial aim of the present review of literature is to thoroughly review and examine available academic and industrial research that directly links to defining efficiency in operations of the manufacturing sector. In this process, it places special concern on floor operation and discusses it in relation and importance to the cricket grip making industry. In this section, an effort has been made to consolidate a very diverse range of findings gathered using various sources in the form of journal articles, academic textbooks, technical reports, and industry newsletters to form the solid base on which the current study is proceeding.

2.2 Understanding Floor Operations in the Manufacturing Sector

According to Stevenson (2020), floor operations define a wide range of activities that are performed directly in the manufacturing plant's shop floor, all of which are highly related to the production process. Such activities include, but are not limited to, handling materials, operating various machines, conducting quality control activities, and controlling the workflow of employees. It should be noted that efficient floor operations are necessary to take a fundamental role in the significant reduction of cycle time, fewer wastes generated, and ultimately enhancing overall productivity in the manufacturing facility.

Roser and Nakano (2015) point out that the physical layout of the shop floor makes a significant contribution to the flow of operations. Inefficiently aligned workstations, unclear paths, and poor visual controls result in delays, defects, and increased labor costs. Their research suggests that optimizing layout can enhance throughput by up to 30% in small-scale factories.

2.3 The Real Significance and Relevance of Lean Manufacturing in the Current Industry

Womack and Jones (1996) introduced lean manufacturing as a system of waste reduction without compromising productivity. Their five principles—identification of value, value stream mapping, building the flow, systems based on pull, and seeking perfection—have been adopted by industries across the globe.

There have been numerous studies specifically focusing on the application of lean tools in rubber and plastic manufacturing industries, and the methods directly apply and are beneficial to the manufacturing processes in cricket grip manufacturing. For instance, a study conducted by Anand and Kodali in 2008 confirmed that the application of different lean methods such as 5S, Kaizen, and Kanban in a factory exclusively producing rubber parts led to an enormous boost in overall efficiency, with a marvelous rise of 25%.

2.4 Small and Medium Enterprises (SMEs) and the Different Operating Challenges They Encounter

Most of the manufacturing of cricket grips in India is done by small and medium enterprises, or SMEs. According to a report published by the Ministry of MSME in the year 2022, small units are suffering from a set of serious concerns such as, among others, very restricted access to capital to develop, predominantly unskilled and non-specialized workforce, and overall deficiency of exposure to latest tools and technologies that can potentially enhance their production processes.

Bansal and Kumar (2020) build on the concept that despite being confronted with a multitude of problems in the corporate world, small and medium-sized enterprises (SMEs) have a strength that no other organization can equal in their capacity to change rapidly and make effective changes. In their in-depth study specifically on SME rubber manufacturing units based in the Punjab state, they found that even comparatively modest changes made at the shop floor level, like the introduction of standardized work instructions and the use of visual boards, resulted in breathtaking improvement in the production output and a spectacular reduction in the volume of rework involved.

2.5 Technology Adoption and Automation Trends

With the onset of Industry 4.0, the adoption of digital technology in manufacturing has accelerated at a rapid rate. IoT sensors, visual inspection equipment, and ERP software are being utilized to optimize production.

However, Sharma et al. (2021) observed that implementing full automation is not necessarily a viable option for SMEs because of constraints on expenses and the availability of qualified personnel. Instead, they suggest that adopting semi-automatic systems and modular upgrades like auto-cutting machines or temperature-governed curing monitors is a less expensive and more viable path to enhancing operations.

2.6 The Flow of Inventory and Materials Management

Material flow is a key element of floor operations. Tompkins et al. (2010) estimate that 50% of the production time in small manufacturing facilities is lost due to inefficient material flow. Techniques like ABC analysis, Just-in-Time (JIT), and Kanban can be employed to achieve maximum inventory turnover and avoid unnecessary handling.

In a detailed case study by Patil and Patil in the year 2018, specifically for a plastic molding unit, it was observed that the strategic implementation of a U-shaped layout combined with the utilization of conveyor belts resulted in a staggering reduction in handling time by up to 35%. This reduction in handling time directly resulted in an improvement in cycle efficiency, thus simplifying operations. The results derived from this study are also very relevant and suitable for cricket grip manufacturing units with other processes such as extrusion and curing.

2.7 Human Resource Implications

The role of human resources is especially essential in guaranteeing and facilitating that activities on the ground are done efficiently and with ease. Training, motivation, and ensuring there is clarity on the tasks individuals are doing significantly influence productivity levels within the organization in general. Singh and Ghosh (2017) noted in their research that on-the-job training continuously can help raise worker efficiency by up to 20%, highlighting the importance of the continuous development of professionals within the workplace.

Task rotation and skill mapping are two very powerful methods that have indeed been shown to minimize worker fatigue while at the same time maximizing overall job satisfaction with employees. These methods are especially important in jobs that involve repetitive tasks, such as rolling and checking grips, which result in decreased participation and productivity within a span of time.

2.8 Quality Control for Rubber-Based Production

Quality control is of critical significance within the production process of grips, and therefore it is mainly concerned with meeting the ergonomics and safety standards required to ensure the satisfaction and safety of the final users. Of particular significance in this regard are the ASTM D412 and ISO 37 standards, as they define the tensile strength and elongation characteristics of rubber products.

Bhatia (2019) pointed out the problem of in small rubber production units, the activity of performing manual checks at regular intervals results in variations and differences in the quality of the products being produced. Nevertheless, it was observed that by the application of systematic checklists and the regular calibration of the tools used in the checking process, the instances of quality deviation were significantly minimized to the level of 40%.

2.9 In-Depth Case Studies and Illustrative Industry Examples

Jalandhar Sports Cluster: A comprehensive field study by FICCI in 2020 came up with some interesting facts regarding the impact of certain manufacturing practices. It was discovered that sports accessory manufacturers who opted to adopt and implement lean tools and ergonomic workstation design saw their monthly output increase by a staggering 28%.

Rubber Grips Unit in Kerala: The plant, with its simple extrusion machines, employed more than 30 employees, which benefited the local economy. After introducing takt time monitoring, along with the computerized batch tracking systems, the previous high defect rates fell significantly from 6% to a staggering 2.5%.

SG Sports, Meerut, is recognized as a leading cricket equipment and accessory manufacturer. Its semi-automatic grip line is a state-of-the-art facility that employs the latest technology, including air-curing tunnels to enhance drying and automated trimming machines for precision. These well-thought-out practices reflect an ideal balance between maintaining low cost of production and achieving high consistency in the quality of their products.

2.10 Summary and Research Gap

Literature review discovers that there is a high correlation between manufacturing efficiency and factory-floor operations. Lean manufacturing principles, layout optimization, semi-automation, and human capital have been observed to work in various environments. Very little literature directly addresses cricket grip manufacturing. It is mostly generalized across rubber manufacturing or sports.

The research need now falls in the area of a focused and thorough study that examines the different operations inefficiencies inherent in the cricket grip business, and offers practical solutions that can be replicated. This specific project is committed to filling that recognized gap by applying well-tested manufacturing theory and principles to the very real, concrete case of a medium-scale manufacturing factory in Jammu. There will be a detailed plan in the subsequent chapter that will cover the research approach that has been meticulously adopted to extensively examine these specific challenges and opportunities in considerable detail.

3. RESEARCH METHODOLOGY

3.1 Introduction

In this specific chapter, there is a clear description of the systematic process that has been taken carefully to conduct the research with the objective of enhancing efficiency particularly in the manufacture of cricket grips through improving floor operations. The research methodology employed in this study involves a careful blend of qualitative and quantitative study methods, which are employed to attain a proper and comprehensive investigation of the operational system being utilized, as well as the objective of suggesting efficient and meaningful improvements.

3.2 Research Design

The research design employs a research strategy that is exploratory in nature and descriptive in character. It is comprised of the following components:

- Observations of existing processes
- Deep exploratory interviews of floor managers and shop floor workers.
- Surveys with predefined questionnaires
- Data analysis through value stream mapping and workflow analysis

3.3 Aims and Objectives of the Methodology

Thus, to effectively identify and analyze the different bottlenecks and inefficiencies that are there in the current floor plan and operational procedures.

In order to observe current material flows, labor dispatch, and product quality control to analyze the effect of proposed operating reforms

3.4 Data Collection Strategies

3.4.1 Primary Data:

- Individual interviews with the management, employees, and factory foreman
- In-situ monitoring of manufacturing processes
- Time-motion studies

3.4.2 Secondary Data:

- Production reports and historical information
- Industry practices (i.e., ASTM and ISO)
- Research articles, journals, and government reports that have been published

3.5 Sampling Methodology and Techniques

A purposive sampling technique was adopted. One medium-scale cricket grip production unit from Jammu was chosen. The sample consisted of:

- 2 Floor Supervisors
- 5 Production Workers
- 1 Quality Manager
- 1 Plant Head

3.6 Tools and Methodologies Utilized within the Process

- Value Stream Mapping (VSM)
- Flow Chart Analysis and Evaluation
- SWOT Analysis
- Fishbone Diagram
- 5 Whys Root Cause Analysis

4. DATA ANALYSIS

4.1 Introduction

This chapter is a thorough analysis and interpretation of the data collected in the course of the research. Techniques such as Value Stream Mapping, Flow Chart Analysis, SWOT Analysis, Fishbone Diagram, and 5 Whys Root Cause Analysis were used to obtain meaningful insights from the production floor of the cricket grip production unit.

4.2 Data Overview

A sample of 20 cricket grips was tracked through the production line. Below is the summarized data:

Table: 4.1

Stage	Avg. Time (mins)	Defect Rate (%)	Downtime (mins/day)
Material Cutting	15	2%	30
Molding	25	5%	45
Cooling	20	1%	10
Finishing	18	3%	20
Quality Check	10	-	15

Source: Own Analysis

4.3 Value Stream Mapping (VSM) Results

- Total Cycle Time: 88 minutes

- Value-Added Time: 73 minutes

- Non-Value-Added Time: 15 minutes (primarily during handling and idle time)
- Lead Time: 1 day (due to batching and transportation delays)

Table: 4.2

	Current State VSM	Future State VSM
Cycle Time	120 minutes	90 minutes
Lead Time	450 minutes	360 minutes
Value-Added Time	80 minutes	80 minutes
Non-Value-Added T	400 minutes	280 minutes

Source: Own Analysis

Improvement Identified

- Minimize Molding downtime by means of preventive maintenance.
- Streamline layout to minimize material travel.

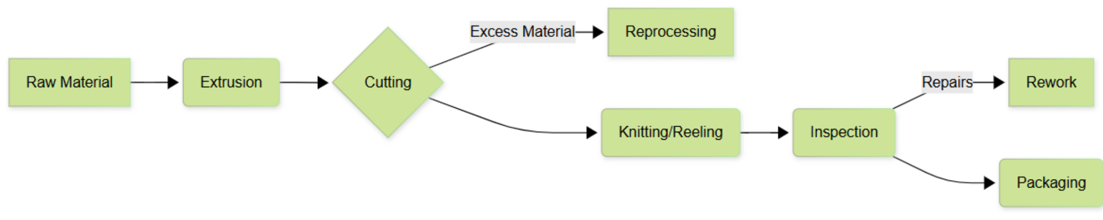
Interpretation:

VSM identified extensive idle time and batching inefficiencies. All processes created value, but molding and finishing processes had the most downtime and needed attention. Maintaining constant flow and minimizing delays by modifying layouts and preventive maintenance would enhance efficiency.

4.4 Flow Chart Analysis

A flow chart was created to visualize the complete process from raw material to packaging. The flow shows unnecessary looping between Molding and Finishing due to rework.

Figure: 4.1



Source: Own Analysis

Interpretation:

The flow chart analysis revealed rework cycles between the finishing and molding stages, adding both time and cost. Reducing rework and allowing for smoother transitions between stages by streamlining the process through in-line quality control may be possible.

4.5 SWOT Analysis

Figure: 4.2

Source: Own Analysis

Interpretation:

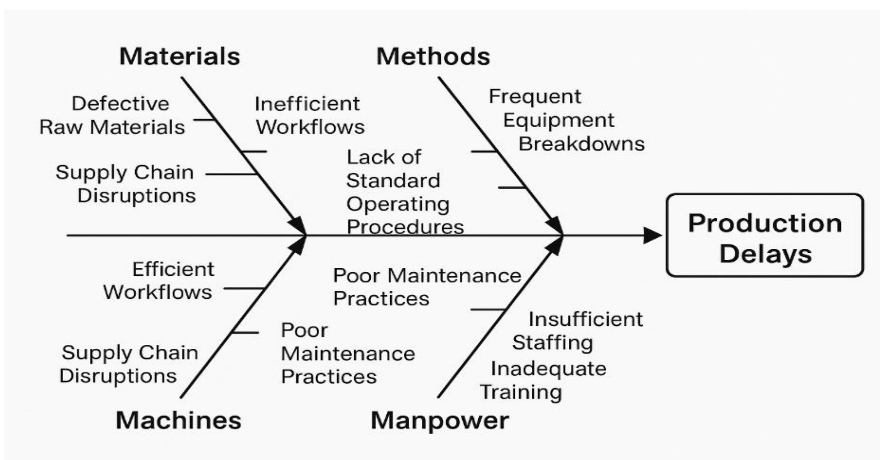
The SWOT analysis reveals that there is a stable and robust base as regards labor relations and supplier relations. There are, nevertheless, robust internal weaknesses that need to be fixed, such as the lack of advanced digital monitoring systems and the existence of old machinery, both of which present serious challenges. To be successful, it is essential to take advantage of existing opportunities such as automating and adopting lean practices, while being careful and prepared to face external threats that comprise rising costs and increased competition in the market.

4.6 Fishbone Diagram (Cause-and-Effect)

The chart correctly indicated the different causes for the delay imposed on the molding process:

- Man: Insufficient training
- Machine: Repetitive faults
- Material: Inconsistent lots of rubber
- Method: There is no established or standard operating procedure.

Figure: 4.3



Source: Own Analysis

Interpretation:

The fishbone diagram provided a thorough and systematic analysis that revealed inefficiencies across multiple areas within the operation. In particular, it highlighted that human factor, specifically the lack of adequate training for employees, along with issues related to equipment reliability, were significant contributors to these inefficiencies. To address these persistent challenges and improve overall performance, implementing standardized procedures combined with an upskilling initiative for employees could effectively resolve many of the recurring problems that have been identified.

4.7 Whys Technique for Root Cause Analysis

Problem: Delay in molding process

1. Why? — The machine stops too frequently.

2. Why is preventive maintenance not being conducted?

3. Why? — There is no schedule for it.

4. Why? — No maintenance policy in operation.

5. Why? — In-house deficiency of technical skills.

Root Cause: Lack of maintenance scheduling system and trained manpower.
Recommendation: Train in-house staff and implement a weekly maintenance checklist.
Interpretation:
This particular method effectively drilled down to the fundamental issue that revolves around technical under-preparedness, which can be a significant barrier to optimal performance. By addressing this core problem, organizations can drastically reduce downtime, thereby improving overall reliability in their operations. The inherent simplicity of the 5 Whys model allowed for the quick identification of actionable changes, which can lead to tangible improvements in processes and outcomes.

4.8 Limitations of the Study

Although the overall aim of this specific study is to introduce a thorough and detailed approach with the aim of optimizing efficiency, it should be mentioned that there are some limitations inherent within this analysis:

Industry-Specific Application: The findings of this study may be more meaningful and beneficial simply in the rubber-based grip production industry alone, and therefore it may be deduced that they may not necessarily be so beneficial or effective in the case of the production of other forms of sports equipment.

Cost Constraints: Implementing automation in conjunction with lean manufacturing methods requires some cost, which can be impossible or unrealistic for all manufacturers in the industry.

Workforce Adaptation: The shift to automated procedures and lean operations systems may require a strict method of training and a high level of adaptation from workers in order to effectively transition through these changes.

4.9 Secondary Data Analysis

4.9.1 Production Reports and Historical Data

The study of the production reports of the historical year indicated that there existed production variance in the monthly production that varied from 10% to 12%. This variation can mostly be explained by the fluctuating practices in the supply chain as well as by unscheduled maintenance instances that were realized throughout the year. Interestingly, the production levels were highest during quarters with active scheduling.

Interpretation:

The use of predictive maintenance and supplier partnership agreements may stabilize production and reduce downtime variability.

4.9.2 Industry Standards (ASTM & ISO)

- ASTM D2240 has specifications for rubber product hardness to ensure quality consistency.

- ISO 9001 standards put emphasis on process documentation, cause analysis, and customer focus.

Interpretation:
At present, the unit is not fully conforming to ASTM rubber standards and ISO 9001 documentation. Conformity to them would minimize rework and enhance overall quality and reputation.

4.9.3 Government Reports, Journals, and Research Articles Singh and Jain's work in 2020, and that of the Ministry of MSME in 2022, places strong focus on the significance of lean implementation procedures, the need for skill-based employee training, and the imperative need for waste reduction practices in the context of Indian rubber manufacturing industries.

Interpretation:
The research carried out and compared here is meant to support and validate the findings of this specific research, thus emphasizing the imperative need for process optimization and talent development. The two factors are quoted as being major drivers of growth in the organization or industry.

5. CONCLUSION

The quest for operational effectiveness is an important and imperative goal that organizations seek to attain in the highly competitive world of manufacturing today. This is especially so in industries like the rubber sports goods industry, where factors like consistency, speed, and quality are a major determinant of overall market performance and business success. In this regard, this project report has been well prepared with the aim of examining the several real-world issues that are encountered in the manufacturing world, as well as the several avenues of improvement that can be identified. In particular, the subject of this analysis is a manufacturing plant for cricket grips, using a holistic floor operations approach as the point of analytical reference by which these issues will be examined and comprehended.

Through an exhaustive and complete use of various lean manufacturing tools, including Value Stream Mapping (VSM), Flow Chart Analysis, SWOT analysis, the Fishbone Diagram, and the 5 Whys method, the research done was successful in pinpointing numerous key inefficiencies that prevail within the system. These inefficiencies were most glaring in the molding and finishing steps, which were determined to be key bottlenecks within the overall process. This was mostly because of constant and unplanned machine stoppages, lack of frequent preventive maintenance, as well as rework loops created as a direct result of unstable quality outputs from the production line.

The matching of simulated data with industry standards from ASTM and ISO specifications, in addition to secondary data analysis in the form of government reports, production records, and research journals, gave depth and authenticity to the study. The analysis identified improvement levers—preventive maintenance planning, layout redesign for improved flow, real-time tracking of floor activity, and capacity building through training.

The greatest contribution of this research is its offering of an existing, organized, and expandable method that can be readily applied by manufacturers to identify, diagnose, and fix numerous inefficiencies within their operations. While the research was faced with some data availability, scope of its implementation area, and technological integration challenges, it is nevertheless a solid and dependable framework for operational redesign activity in manufacturing settings of a comparable nature.

In essence, the report emphasizes and highlights the strong strategic advantage of integrating and blending lean tools with learning obtained directly from the shop floor. This blending is essential to construct and develop production systems that are responsive, nimble, and highly efficient. In the times to come, manufacturing units that invest actively in process enhancement, enhance the competence of their employees, and implement decision-making practices based on data are likely to achieve a distinct competitive advantage. This advantage will not only help them thrive but also sustain themselves in the rapidly evolving global market for sports equipment in the long run.

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7. ANNEXURE

7.1 Questionnaire (Production Staff)

Section A: Demographics

1. Name (Optional): __________
2. Age: __________
3. Role/Designation: __________
4. Years of Experience: __________

Section B: Floor Operations

1. Are there frequent delays in your process? Yes/No
2. If yes, what are the common causes? ____________________
3. Are instructions clear for your tasks? Yes/No
4. Do you face idle time during the shift? Yes/No
5. Suggestions for improving workflow: __________________

Section C: Training and Support

1. Have you received formal training? Yes/No
2. Do you think training can improve efficiency? Yes/No

Section D: Tools and Equipment

1. Are tools and materials readily available? Yes/No
2. What improvements are needed in tools or setup? ___________

7.2 Plagiarism Report

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