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Improvement in Productivity by using Lean Manufacturing Techniques in Biscuit Industry

Aditya G. Satai , Shreyash R. Khare , Bhumi S. Mate , Priyanka P. Nimje , Minal A. Karhade
Dr. Imran A. Khan
[1]Mechanical Department & Priyadarshini College of Engineering
[2] Mechanical Department & Priyadarshini College of Engineering
[3] Mechanical Department & Priyadarshini College of Engineering
[4] Mechanical Department & Priyadarshini College of Engineering
[5]Mechanical Department & Priyadarshini College of Engineering
[6]Mechanical Department & Priyadarshini College of Engineering
[7]Mechanical Department & Priyadarshini College of Engineering

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Abstract - Lean manufacturing is an effective approach for improving productivity, reducing waste, and enhancing operational efficiency in manufacturing industries. The present study focuses on the performance analysis and productivity improvement of a manufacturing process using lean manufacturing techniques. The literature review indicates that various researchers have investigated lean manufacturing, bottleneck identification, process improvement, waste minimisation, and production-line efficiency. Studies involving DMAIC, Lean Six Sigma, and other lean tools highlight the importance of identifying the root causes of production problems and implementing suitable corrective measures. The reviewed literature also emphasises the importance of systematic data collection, process monitoring, and employee participation in achieving effective improvements. Based on these findings, the present study aims to analyse existing production activities, identify major sources of waste and inefficiency, and suggest appropriate lean manufacturing techniques to improve process performance. Production-related parameters such as cycle time, material waste, waiting time, and productivity can be evaluated to understand the scope for improvement. The study provides a systematic framework for improving resource utilisation, reducing non-value-added activities, and supporting continuous improvement in manufacturing operations.

Key Words: Lean Manufacturing, Productivity Improvement, Biscuit Industry, Kaizen, Waste Reduction, Process Standardization, Rejection Rate, Poka-Yoke.

1.INTRODUCTION

The manufacturing industry plays an important role in meeting customer demand while maintaining product quality and controlling production costs. In the biscuit industry, productivity depends on the effective coordination of several operations, including mixing, dough preparation, sheet formation, baking, cooling, and packaging. Problems in any of these operations can lead to product defects, material wastage, and interruptions in production.

Lean Manufacturing is a systematic approach that focuses on identifying and reducing activities that do not add value to the product. Techniques such as Kaizen, Five Whys analysis, and Poka-Yoke can help industries identify the causes of production problems and develop practical solutions.

This project focuses on Industries, where the existing production process is studied to identify opportunities for productivity improvement. Particular attention is given to burnt biscuits, product wastage, conveyor blockages, and packaging-material waste. Based on the available production data and process observations, suitable Lean Manufacturing measures are proposed to improve process consistency, reduce avoidable losses, and support continuous improvement.

2. LITRATURE REVIEW

Buer et al. investigated the relationship between lean manufacturing and digitalisation and their combined influence on operational performance. Lean manufacturing focuses on eliminating non-value-added activities, improving process flow, and reducing production waste, while digitalisation supports data collection, process monitoring, and information sharing. Their research provides a basis for understanding how these two approaches can complement one another in modern manufacturing environments. For productivity improvement projects, this relationship highlights the importance of combining conventional lean tools with accurate production data to identify inefficiencies and monitor improvements.[1]

Nandakumar et al. examined bottleneck identification and process improvement through the Lean Six Sigma DMAIC methodology. DMAIC consists of five stages: Define, Measure, Analyse, Improve, and Control. The method provides a structured approach to understanding production problems, collecting relevant measurements, identifying root causes, implementing corrective actions, and maintaining the results. Bottleneck identification is particularly important because a single constrained operation can reduce the throughput of an entire production line. This study is relevant to the present project because it supports the use of measured process data to identify production constraints and evaluate improvement opportunities. [2]

Shihab et al. investigated process improvement in a biscuit manufacturing industry using the DMAIC approach. The study's industrial context is useful for understanding how a structured problem-solving methodology can be applied to production processes. By examining the existing process, measuring performance, analysing the causes of inefficiency,

and developing improvement measures, manufacturers can work towards reducing delays and improving consistency. The reference is relevant to lean manufacturing research because it connects systematic process analysis with practical productivity improvement in a production environment.[3]

The authors presented a systematic review of lean manufacturing and productivity in the food industry. A systematic review helps consolidate findings from previous studies and identify recurring approaches, benefits, and research gaps. In production, productivity improvement may involve better resource utilisation, waste reduction, improved workflow, and more effective process management. This reference provides a broader perspective on the application of lean manufacturing and helps establish the importance of reviewing existing evidence before selecting improvement techniques for a particular industrial problem.[4]

Le investigated productivity improvement on a production line through lean manufacturing. Production-line performance depends on factors such as operation sequence, work distribution, material availability, and the time required to complete individual activities. Lean analysis can help identify unnecessary steps and improve the coordination of work between operations. This research is relevant to the present project because production-line productivity can be assessed by measuring the existing cycle time, identifying process delays, and comparing performance after improvement measures have been introduced.[5]

Djekic et al. examined lean manufacturing in a Serbian confectionery company through a case study. The research provides an example of how lean manufacturing can be considered in a food-processing environment, where production efficiency must be managed alongside product quality and process consistency. The case-study approach is relevant because it connects lean concepts with the operating conditions of an actual company. For manufacturing productivity research, this reference supports analysing workplace organisation, production flow, and operational activities to identify opportunities for improvement.[6]

Gavriluță et al. proposed an algorithm for applying selected lean manufacturing methods within an industrial production process. A structured algorithm can help organisations choose and implement improvement techniques in a consistent manner. This is important because the effectiveness of a lean tool depends on the type of problem, the production environment, and the information available. The research is relevant to the present project because it supports a planned approach in which the current process is examined, suitable tools are selected, and their effects are evaluated using defined performance measures.[7]

Ferrer-Blas et al. presented a systematic review and bibliometric analysis of lean manufacturing in food production, along with a proposed application. Systematic reviews help organise existing research, while bibliometric analysis examines patterns in publications and research activity. Together, these approaches provide insight into the development and application of lean manufacturing in food production. The reference is useful for understanding the broader research landscape and identifying opportunities to apply lean techniques more systematically. It also reinforces the value of linking improvement methods to the specific characteristics of a production process.[8]

Dora et al. studied operational performance and critical success factors associated with lean manufacturing in European food-processing small and medium-sized enterprises. The focus on critical success factors highlights that lean implementation involves more than introducing individual tools. Organisational support, employee participation, management commitment, and the suitability of implementation practices can influence the outcome of improvement initiatives. This research is relevant to productivity improvement because effective implementation requires both technical changes to production activities and appropriate support from the organisation.[9]

Punna Rao et al. investigated productivity improvement in a medium-scale manufacturing industry through the implementation of lean tools. Medium-scale manufacturers often need practical improvement methods that make better use of existing resources and production facilities. Lean tools can support the identification of waste, better workplace organisation, improved material flow, and more consistent working practices. The study is relevant to the present project because it focuses on implementing lean techniques in an industrial setting and assessing their contribution to productivity improvement.[10]

3.PROBLEM IDENTIFICATION

In Industries, the following areas were identified for three problems :

1.Burnt or over-baked biscuits: Variations in oven operating conditions may affect product quality.

2.Product wastage: Material handling, forming operations, and interruptions may contribute to product losses.

3.Packaging-material waste: Incorrect film alignment or machine settings may contribute to unnecessary plastic-film consumption.

The recorded baseline production is approximately 70 tonnes per day, with a 5% rejection rate. This corresponds to an estimated 3.5 tonnes of rejected product per day and 66.5 tonnes of good output, assuming the rejection rate is calculated against the total production.

4.IMPLIMENTATION OF LEAN MANUFACTURING

1.Reduction of Burnt Biscuits: The implementation of Lean Manufacturing for reducing burnt biscuits at Industries focuses on improving oven control and maintaining consistent baking conditions. The Kaizen technique can be used to encourage continuous improvement by identifying and correcting the causes of burnt biscuit. oven temperature, baking time, conveyor speed, and heating conditions should be monitored

regularly according to the approved product specifications. Standard Operating Procedures (SOPs) should be established for each biscuit variety to ensure consistent baking conditions. Visual inspection should be carried out at regular intervals to identify changes in biscuit colour and quality. The Five Whys technique can be applied to investigate recurring defects and identify their root causes. These measures are intended to reduce baking defects, improve product quality, and minimize rejection. The effectiveness of the proposed improvements should be confirmed by comparing rejection records before and after implementation. 2.Reduction of Product Waste: The implementation of Lean Manufacturing for reducing product waste focuses on minimizing biscuit losses during dough preparation, forming, cutting, baking, cooling, conveying, and handling. The Kaizen technique can be used to identify areas where material is unnecessarily wasted and develop practical solutions. Regular inspection of conveyors, proper alignment of production equipment, and careful handling of biscuits can help prevent damage and interruptions. The Five Whys method can be used to investigate the causes of recurring product losses, while standardized operating procedures can help workers follow consistent production methods. Production waste and rejected quantities should be recorded at each stage to identify operations with higher losses. These practices can help improve material utilization and production efficiency. Actual reductions in product waste should be determined through systematic measurement after the improvements are implemented.

3.Reduction of Packaging Waste: The implementation of Lean Manufacturing for reducing packaging waste focuses on minimizing unnecessary plastic film consumption and packaging defects. Packaging-machine settings, film alignment, sealing conditions, and cutting mechanisms should be checked regularly to ensure that packaging operations function correctly. Standard Operating Procedures should be established for machine setup and film replacement, while visual monitoring can help operators identify misalignment, defective seals, and excess film usage. The Poka-Yoke technique can be applied through suitable guides, alignment marks, sensors, or other error-prevention methods to reduce packaging mistakes. Packaging-material consumption and rejected packages should be recorded during production to identify the causes of waste. These measures are expected to improve packaging consistency and reduce unnecessary material consumption. Their actual impact should be evaluated by comparing packaging-film usage and packaging rejection data before and after implementation.

5.CONCLUSION

Based on the reviewed studies, the present project aims to analyse the existing production process, identify major sources of waste, and recommend suitable lean manufacturing techniques for improving productivity. By comparing relevant production parameters before and after implementation, the effectiveness of the selected techniques can be assessed. The study is expected to provide a practical approach to reducing material waste, minimising unnecessary delays, improving workflow, and utilising available resources more effectively. Overall, the literature provides a strong foundation for applying lean manufacturing principles to achieve continuous improvement and better operational performance.

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