RESEARCH ARTICLE OPEN ACCESS

Optimizing Productivity in Casting Industries: A Comprehensive Review of Process Mapping Techniques

Mohammad Kaif Hakim[1] , Nawab Juvale[2] , Wojdan Kadri[3] , Prof.Pratik Kamble[4]

Department of Mechanical Engineering,

Finolex Academy of Management and Technology, Ratnagiri

****

Abstract:

This review paper critically examines the application of Lean Manufacturing Techniques (LMT) in the casting industry, drawing insights from four key research papers. It analyzes methodologies, key findings, challenges, and success stories associated with the implementation of Lean approaches, with a primary focus on productivity improvement. The synthesis provides a comprehensive understanding of how Lean principles, particularly Value Stream Mapping (VSM) and related tools, contribute to operational efficiency and sustainable growth in casting processes.

Keywords — **P Value stream mapping , Lean manufacturing , Process improvement , Defect analysis Waste reduction**

****

I. INTRODUCTION

The casting industry plays a vital role in manufacturing, contributing significantly to diverse sectors such as automotive, aerospace, and construction. With a constant demand for higher efficiency and competitiveness, the industry has been exploring innovative approaches to enhance productivity. This review paper delves into the realm of process mapping as a strategic tool for productivity improvement in casting industries. Process mapping involves the visual representation and analysis of production processes, enabling organizations to identify bottlenecks, streamline operations, and optimize resource utilization. As the industry navigates challenges such as complex workflows and resource constraints, a comprehensive understanding of how process mapping methodologies contribute to productivity gains becomes crucial. This review aims to synthesize existing literature, examining the various process mapping techniques employed in casting manufacturing and highlighting their impact on operational efficiency. By unravelling the complexities and nuances of process mapping in the casting context, this paper seeks to provide valuable insights for practitioners, researchers, and decision-makers keen on driving productivity advancements within the casting sector.

II. METHODOLOGIES

A. TAKT Time Computation and Value Stream Mapping (VSM)

One of the reviewed papers explores the strategic use of TAKT time computation and VSM to enhance line efficiency and reduce lead time in foundry operations [1]. TAKT time computation serves as a foundational step in optimizing production rates, while VSM offers a visual representation of the entire production process, enabling the identification and elimination of non-value-added activities.

B. Application of VSM Tools in Foundries

Some articles provides a detailed case study on the application of VSM tools in a foundry setting [2]. The methodology involves identifying, quantifying, and minimizing major wastes through the mapping of current and future states. This approach facilitates a systematic reduction in unnecessary inventory,

transportation, and waiting times, leading to improved overall process efficiency.

C. Integration of Simulation and VSM in Die Casting

The third paper introduces the integration of simulation and VSM in the die casting industry [3]. This methodology involves data gathering related to foundry operations and the creation of a conceptual model using VSM. The use of simulation allows for the verification of the model's performance before implementing continuous improvement ideas. The paper also highlights the deep-rooted Kaizen philosophy in Japanese culture, emphasizing continuous improvement and employee involvement.

D. Lean Principles for Reducing Manufacturing Lead Time

One paper outlines a company's journey in implementing Lean principles to reduce manufacturing lead time [4]. The methodology involves the use of VSM to analyse and improve disconnected flow lines within manufacturing environments. The five phases of VSM—selection of a product family, current state mapping, future state mapping, definition of a work plan, and achievement of the work plan—are crucial steps in achieving significant improvements.

III. KEY HIGHLIGHTS

E. Waste Reduction and Line Efficiency

All reviewed papers highlight the significant impact of Lean methodologies in reducing waste and improving line efficiency. Through the systematic application of Lean principles, including VSM tools, the studies demonstrate tangible benefits such as lead time reduction, increased line efficiency, and substantial cost savings.

F. Case Studies and Success Stories

The inclusion of case studies and success stories in the reviewed papers provides concrete examples of how Lean Manufacturing Techniques have been successfully implemented in various casting environments [1][2][4]. These stories serve as inspiration and practical insights for industry practitioners seeking to replicate similar achievements.

IV. KEY HIGHLIGHTS

G. Cost of Implementation

While the benefits of Lean methodologies are evident, the papers acknowledge the significant costs associated with implementing changes [4]. However, the potential long-term gains, such as increased throughput and reduced lead times, are highlighted as justifications for the initial investment.

H. Opportunities for Further Improvement

The research papers suggests additional opportunities for improvement, including the implementation of 5S and visual management on the shop floor, as well as the introduction of Andon and Jidoka systems [4]. These strategies are identified as complementary approaches that can further enhance operational efficiency and streamline production processes.

V. CONCLUSIONS

In conclusion, this review synthesizes methodologies, key highlights, challenges, and opportunities associated with the application of Lean Manufacturing Techniques in the casting industry. The methodologies presented offer practical insights into the implementation of Lean principles, particularly the strategic use of TAKT time computation, VSM, and related tools [1][2][3][4]. The key highlights emphasize the transformative impact on waste reduction, line efficiency, and cost savings. Recognizing the challenges and opportunities outlined in the review, industry practitioners can strategically adopt Lean methodologies to drive continuous improvement, optimize operations, and achieve sustainable growth in the dynamic casting industry.

REFERENCES

[1] Das, [1] A.K. Das and M.C. Das, "Productivity Improvement Using Different Lean Approaches in Small and Medium Enterprises (SMEs)," Manag. Sci. Lett., vol. 13, pp. 51–64, 2023.

[2] G.C. Pude, G.R. Naik, and P.G. Naik, "Application of value stream mapping tools for

process improvement: a case study in foundry," IOSR J. Mech. Civ. Eng., vol. 3, pp. 7–12, 2012.

[3] P. Teli and S.N. Teli, "Productivity improvement by value stream mapping in die casting industry," JETIR, vol. 2, no. 6, pp. 2049-2064 , 2015.

[4] A.P. Chaple and B.E. Narkhede, "Value stream mapping in a discrete manufacturing: A case study," International Journal of Supply Chain Management, vol. 6, no. 1, pp. 55-67, 2017.

