iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 Issue: X Month of publication: October 2024

DOI: https://doi.org/10.22214/ijraset.2024.64431

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

An Analysis of Critical Processes and Employee Challenges at Velmurugan Heavy Engineering Industries (VHEI) Private Limited, Thanjavur

S. Saravanan[1], Dr. P. Aranganathan[2], Dr. S. Christina Sheela[3], M. Martin[4]

Abstract: This study investigates the critical processes and challenges faced by employees at Velmurugan Heavy Engineering Pvt. Ltd., located in Sengipatti, Thanjavur. The aim is to identify areas for improvement and provide recommendations to enhance employee performance and organizational effectiveness. Employing a mixed-method approach combining qualitative and quantitative methods, data were collected extensively through surveys, interviews, and observations from a representative sample across departments and hierarchical levels. The findings highlight critical areas such as project management, quality control, communication channels, and performance evaluation. While the organization demonstrates competence in these areas, gaps exist, particularly in streamlined communication and efficient project management. The study also uncovers challenges including unclear role expectations, limited professional development opportunities, inadequate work-life balance, and insufficient recognition and rewards. Recommendations are offered to strengthen communication channels, enhance project management practices, implement employee development programs, promote work-life balance initiatives, and establish a robust recognition and rewards system. Addressing these challenges and implementing recommended strategies has led to improved employee satisfaction, productivity, and overall organizational performance. This study provides valuable insights for Velmurugan Heavy Engineering Pvt. Ltd. to cultivate a positive work environment and foster a highly engaged workforce, contributing to sustainable growth and success.
Keywords: Lean Management, Critical Process Analysis (CPA), Effectiveness, Supply Chain, Iteration Process.

I. INTRODUCTION

In today's fast-paced and highly competitive business environment, organizations must continuously seek ways to enhance their efficiency and productivity while optimizing costs. Critical Process Analysis (CPA) has gained significant traction as a powerful tool for identifying and optimizing essential business processes, enabling organizations to remain competitive and agile in an ever-evolving market. The need for this study arises from the increasing importance of process enhancement for organizations striving to maintain their competitive edge.

For Velmurugan Heavy Engineering Industries Private Limited (VHEI), located in Thanjavur district, Tamil Nadu, optimizing critical processes is essential for sustaining growth and operational excellence. This research aims to provide valuable insights for project managers and organizational leaders by conducting a detailed study on the critical processes and challenges faced by employees during the implementation of process improvements. The study focuses on identifying common challenges such as resistance to change, lack of training, increased workload, communication breakdowns, and resistance from management.

The primary objectives of this research include observing the difficulties faced by employees during the fabrication of Wind Mill Tower sections, identifying significant challenges in the manufacturing process, exploring sustainability initiatives, analyzing production processes, and studying time consumption throughout the manufacturing process. VHEI plays a critical role in the production of windmills, involving stages like design, manufacturing, testing, and installation, each posing challenges that can impact performance, job satisfaction, and productivity. By investigating these challenges and providing practical recommendations, this study aims to enhance job satisfaction, well-being, and productivity, leading to improved operational effectiveness, increased quality, and reduced costs.

[1] Assistant Professor, Gnanam School of Business, Sengipatti - 613 402, Thanjavur
[2] Professor, Gnanam School of Business, Sengipatti – 613 402, Thanjavur
[3] Associate Professor, Gnanam School of Business, Sengipatti - 613 402, Thanjavur
[4] Research Scholar (Part Time), Department of Management Studies, SASTRA Deemed-to-be University, Thanjavur.

The wind turbine tower market, projected to reach USD 14.32 billion by 2027, is experiencing notable growth driven by increased investments and reduced costs.

Major players in this market include Valmont Industries Inc., Trinity Industries Inc., KGW Schweriner Maschinen-Undanlagenbau GMBH, and Broadwind Energy. The market is influenced by trends such as the growth of concrete towers due to their lower transportation costs and high strength. The Asia-Pacific region, particularly China and India, is a promising market due to government policies and renewable energy efforts.

Established in 1979, Velmurugan Industries (VMI) and VHEI have achieved technical competence and global competitiveness, offering a diverse product portfolio including thermal power generation equipment, windmill towers, and more. Committed to quality with ISO 9001:2008 and LRQA certifications, VHEI invests in precision-oriented technology guided by experienced engineers.

Their manufacturing processes, including the Black Side and White Side Processes, involve multiple stages like CNC operation, edge preparation, rolling, welding, testing, blasting, and painting. Premier clients include Bharat Heavy Electrical Limited, Caterpillar India Private Limited, Vestas Wind Technology India Ltd., SMS Group, and Gamesha.

This study is crucial for understanding the critical processes and challenges faced by employees at VHEI during the implementation of process improvements. By investigating these challenges and providing practical recommendations, the study aims to enhance employee satisfaction, well-being, and productivity. This, in turn, will help VHEI and similar organizations optimize their business processes, leading to improved operational effectiveness, increased quality, and reduced costs. Maintaining their competitive edge in the highly dynamic and competitive heavy engineering industry is imperative for sustained growth and success. Ultimately, this research underscores the importance of process optimization in achieving operational excellence. By addressing the specific challenges faced by employees during process improvements and leveraging advanced analytical tools, VHEI can significantly enhance its productivity and efficiency.

The insights gained from this study will not only benefit VHEI but also contribute to the broader field of process optimization in the heavy engineering sector, providing a valuable framework for other organizations aiming to enhance their operational effectiveness in a rapidly changing market.

II. LITERATURE REVIEW

A. Efficient Aggregation and Assimilation in Manufacturing

The aggregation process in manufacturing must be completed quickly and cost-effectively, which can be achieved through efficient measures and procedures. Blaga, Pop, Hule, Karczis, and Buzdugan (2021) propose a robust procedure for managing the assimilation process of new products using the Critical Path Method (CPM).

Their study focuses on creating plastic products, starting with a critical analysis of existing procedures and organizing activities into a project implemented with Microsoft Project software. This helps identify critical activities within the project, allowing for reduced execution time and optimized resource allocation. Introducing new industrial products is increasingly risky, requiring corporate marketing to navigate economic uncertainties. Reassessing the new product development process is crucial to facilitate successful introductions. Proven processes that outline necessary activities can significantly reduce risks for marketing managers (Dundas & Krentler, 1982). Similarly, Nacional (2022) developed a system using PERT and CPM network analysis to optimize time and increase productivity, identifying critical and non-critical activities to enhance operational efficiency.

B. Quality Control and Manufacturing Efficiency

Accuracy in fulfilling company promises and maintaining product quality is vital for consumer satisfaction. The Least Oriented Manufacturing Control (LOMC) method helps determine lead time delivery, processing times, and production flow to identify critical paths in manufacturing (Syahrully, Julyanto, Maryani, & Sanjaya, 2020). Recent studies emphasize the need for operations research techniques to manage complex industrial projects, such as yacht construction, where CPM and PERT techniques have demonstrated efficiency in reducing completion time and costs (Elaiwi, 2018).

In the apparel industry, techniques like CPM are employed to meet competitive demands. For instance, Takebira and Mohibullah (2017) applied CPM to minimize lead time and optimize the manufacturing system in men's T-shirt production. In construction, the Last Planner System (LPS) has gained popularity for enhancing project outcomes by improving collaboration among subcontractors (Brittle, Gaedicke, & Akhavian, 2018).

C. Challenges in MSMEs and Industry 4.0

Micro, Small, and Medium Enterprises (MSMEs) face significant challenges in adopting Industry 4.0 technologies due to operational and financial constraints. Kumar, Rajesh, and Yogesh (2020) identified fifteen challenges impacting the implementation of Industry 4.0 in MSMEs, particularly in India. Their study highlighted the lack of motivation from partners and customers as a leading challenge, and their findings are crucial for enabling MSMEs to enact effective strategies for adopting Industry 4.0 technologies. Linder (2019) examined how MSMEs benefit from external knowledge to enhance operational flexibility and reduce production costs. The study collected data from 1,663 MSMEs, demonstrating that information inflow can optimize productivity by minimizing liabilities and enhancing flexibility.

D. Cost Reduction in Manufacturing

Indian automobile manufacturers are under pressure to reduce overall manufacturing costs to remain competitive. Shivajee, Rajesh, and Sanjay (2019) applied the DMAIC approach, incorporating Quality Control (QC) tools such as Pareto Charts and Cause & Effect diagrams, to analyze and reduce conversion costs. Their study identified eighteen aspects of conversion costs and demonstrated significant cost savings through cleaner production practices and sustainable manufacturing processes.

E. Smart Manufacturing and Automation

The concept of smart manufacturing is rapidly emerging, aiming to achieve excellence in mass production while personalizing products through highly responsive automated operations at competitive costs. Lu, Xu, and Wang (2020) presented a comprehensive review of manufacturing automation standards, emphasizing the need for end-to-end integration of intra-business and inter-business processes to facilitate mass personalization.

F. Market Orientation and Business Performance

Market orientation has a favourable effect on business performance in both the short and long run. Kumar, Jones, Venkatesan, and Leone (2011) constructed a panel data set from managerial positions in 261 firms over a nine-year period. Their analyses indicated that firms embracing market orientation saw enhanced sales and profit, emphasizing the importance of customer acquisition and retention.

G. Continuous Improvement and Quality Management

Continuous quality improvement is essential for maintaining competitive advantage. Sokovic, Pavletic, and Pipan (2020) highlighted the use of PDCA, Six Sigma (DMAIC & DFSS), and the EFQM Model for improving organizational performance. These methodologies, though varied in complexity, offer systematic approaches to enhance value propositions, processes, and services.

H. Impact of Economic Environment on MSMEs

The macroeconomic environment significantly impacts MSMEs, which play a crucial role in employment generation and socio-economic stability. Maheshkar and Soni (2022) identified key problems faced by MSMEs, such as financing issues, social infrastructure deficiencies, and managerial skill gaps. Their study provided insights into the impact of demonetization, GST, and skill development programs on MSMEs, offering recommendations for improving their performance.

This literature review underscores the importance of efficient procedures, quality control, and strategic management in manufacturing and MSMEs. It highlights the challenges and opportunities in adopting new technologies and processes, emphasizing the need for continuous improvement and market orientation to achieve sustainable growth and competitive advantage.

II. METHODOLOGY

The research methodology employed in this study is a comprehensive approach designed to transition from general assumptions to specific data gathering and reasoning techniques, utilizing systematic models, procedures, and techniques to rigorously address the research problem. This methodology incorporates a descriptive research design, which aims to accurately and systematically detail the characteristics of the population and sample without influencing variables. Additionally, an observational study will be conducted, entailing 30 days of observation and interviews at Velmurugan Company's manufacturing plant to document operational challenges. The focus of the study is on the company's employees, with the objective of gaining insights into the difficulties they face during process improvements.

Data will be collected through direct observation and structured interviews, and then analyzed descriptively. The data will be categorized into key areas such as supply chain management issues, quality control, production efficiency, employee training, and customer satisfaction.

For the operational and statistical analysis, software tools like QM for Windows and SPSS are utilized. QM for Windows will assist in operational analysis, particularly in scheduling and identifying critical activities through the Critical Path Method (CPM), while SPSS was used for more general statistical analysis. Data analysis tools include CPM for scheduling and pinpointing essential tasks, Gantt charts for visual project scheduling, and percentage analysis for summarizing categorical variables. By employing these methodologies, the study aims to provide a detailed and systematic examination of the critical processes and challenges faced by employees at Velmurugan Company. The insights gained from this research are expected to highlight key areas for improvement, ultimately enhancing productivity, efficiency, and overall operational effectiveness. The combination of descriptive research and observational study, supported by advanced analytical tools, ensures a thorough and rigorous investigation into the operational challenges at Velmurugan Company, paving the way for targeted process improvements and enhanced employee performance.

III. ANALYSIS AND DISCUSSION

A. Critical Path Analysis

Table 2: Critical Path Analysis Output

Critical Path Method								
Activity	Activity Time	Predecessor 1	Predecessor 2	Predecessor 3	Predecessor 4	Predecessor 5	Predecessor 6	Predecessor 7
1	6							
2	4	1						
3	6	2						
4	6	3						
5	3	4						
6	6	5						
7	14	6						
8	20	7						
9	2	8						
10	64	6						
11	60	10						
12	6	11						
13	22	6						
14	20	13						
15	2	14						
16	2	15						
17	1	16						
18	2	17						
19	20	9	12	18				
20	18	19						
21	4	20						
22	2	21						
23	1	22						
24	10	23						
25	7	24						
26	45	25						
27	3	26						

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

B. CPM Solution

Table 3 - Solution

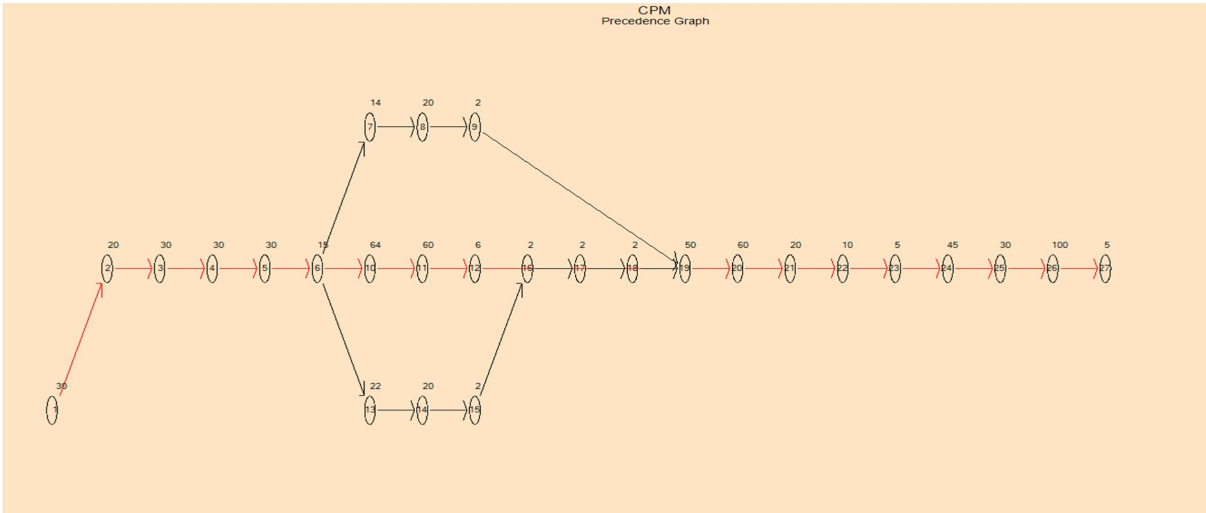
Activity	Activity Time	Early Start	Early Finish	Late Start	Late Finish	Slack
Project	610					
1	30	0	30	0	30	0
2	20	30	50	30	50	0
3	30	50	80	50	80	0
4	30	80	110	80	110	0
5	30	110	140	110	140	0
6	15	140	155	140	155	0
7	14	155	169	249	263	94
8	20	169	189	263	283	94
9	2	189	191	283	285	94
10	64	155	219	155	219	0
11	60	219	279	219	279	0
12	6	279	285	279	285	0
13	22	155	177	235	257	80
14	20	177	197	257	277	80
15	2	197	199	277	279	80
16	2	199	201	279	281	80
17	2	201	203	281	283	80
18	2	203	205	283	285	80
19	50	285	335	285	335	0
20	60	335	395	335	395	0
21	20	395	415	395	415	0
22	10	415	425	415	425	0
23	5	425	430	425	430	0
24	45	430	475	430	475	0
25	30	475	505	475	505	0
26	100	505	605	505	605	0
27	5	605	610	605	610	0

The tables 2 and 3 illustrate a project analyzed using the Critical Path Method (CPM), detailing activity times, early and late start/finish times, and slack times for 27 activities. The total project duration is 610 units of time. Early Start (ES) and Early Finish (EF) columns show the earliest possible times for each activity, while Late Start (LS) and Late Finish (LF) columns represent the latest possible times without project delays. Activities with zero slack time, indicating no delay tolerance, are on the critical path: 1, 2, 3, 4, 5, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27. Delays in these activities directly affect project completion. Efficient resource allocation and risk management for critical activities are essential to prevent delays. Non-critical activities, with significant slack time, provide flexibility for optimization and resource reallocation. By leveraging CPM, project managers can effectively schedule, allocate resources, and manage risks, ensuring timely and within-budget project completion.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

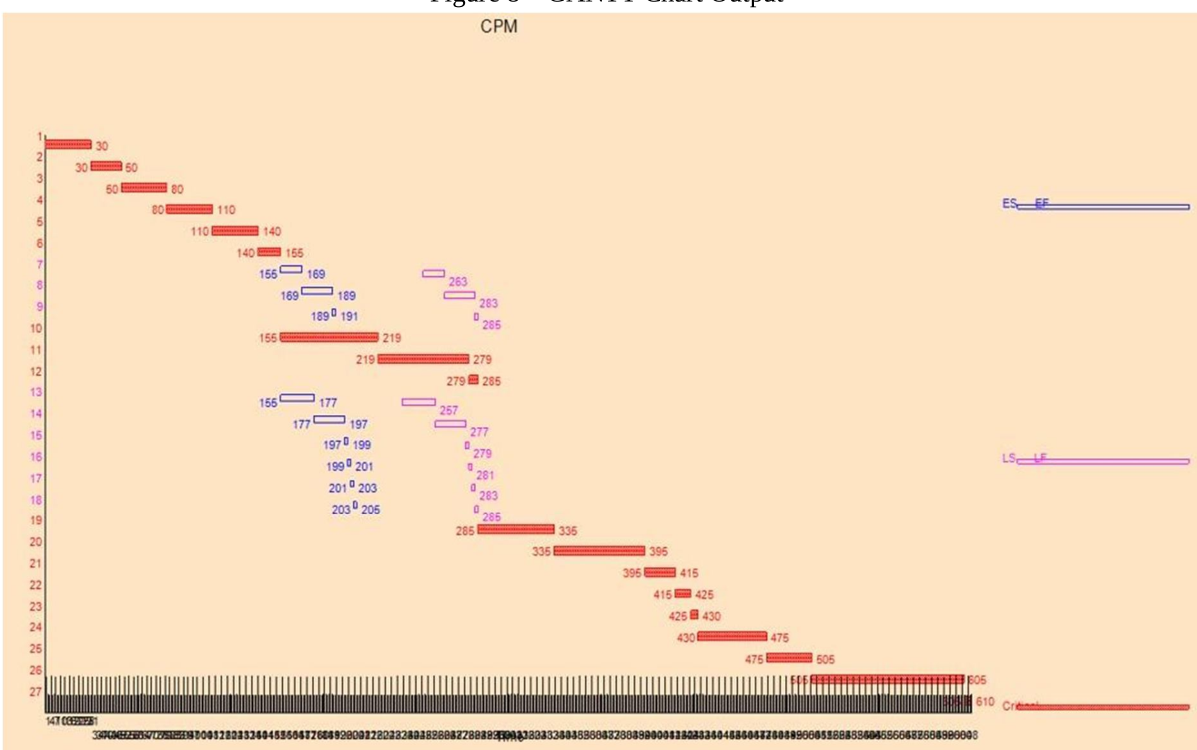
C. Critical Path Method

Figure 7 - CPM Output



D. GANTT Chart

Figure 8 – GANTT Chart Output



The Critical Path Analysis (CPA) output and the Gantt chart provide a detailed overview of the project scheduling, task prioritization, and resource allocation at Velmurugan Heavy Engineering Industries Private Limited. The Critical Path Analysis output (Table Figure 2) highlights the sequence of critical activities that directly affect the project's completion time. These activities must be completed on schedule to avoid delays in the overall project timeline. The CPM solution (Table 3) elaborates on this by providing the earliest and latest start and finish times for each activity, along with the total float, which indicates the amount of permissible delay without affecting the subsequent tasks or the project's finish date. Key elements such as Early Start (ES), Early Finish (EF), Late Start (LS), and Late Finish (LF) are instrumental in identifying the critical path and ensuring that project managers can effectively manage the schedule.

The CPM output (Figure 7) visually represents the critical and non-critical activities within the project, making it easier to identify the activities that require close monitoring. Activities on the critical path are highlighted, indicating that any delay in these activities will directly impact the project completion date. This visualization aids in better planning and proactive management to mitigate potential delays.

The Gantt chart (Figure 8) further complements the CPA by providing a graphical timeline of the project's tasks, showing their durations, dependencies, and starts and end dates. This chart is a practical tool for project managers to track progress, manage resources, and adjust schedules as necessary. It facilitates clear communication among stakeholders by presenting a straightforward visual representation of the project plan and current status.

The combination of the CPA output and the Gantt chart equips project managers at Velmurugan Heavy Engineering Industries with robust tools for effective project planning, scheduling, and control. These tools ensure that critical activities are prioritized, resources are optimally allocated, and potential delays are identified and addressed promptly, thereby enhancing the overall efficiency and success of the project.

The study's major findings indicate that the critical path primarily involves operations in the Middle Tower section at Velmurugan Industries, where three sections exhibit significant process delays. The GANTT charts reveal early start and finish processes, as well as late start and finish processes, which allow for better planning and expected deadlines. The completion of a single tower section takes approximately 25 days, equivalent to 610 hours. The data represents a project with 27 tasks, identified by numbers, with columns denoting parameters such as duration, Earliest Start Time (EST), Earliest Finish Time (EFT), Latest Start Time (LST), Latest Finish Time (LFT), and Float (or slack) time. The Critical Path is determined by identifying tasks with zero float time, indicating no flexibility and necessitating on-schedule completion. This path includes tasks 1, 2, 3, 4, 5, 6, 10, 11, 12, 19, 20, 21, 22, 23, 24, 25, 26, and 27, which have the longest durations and are interdependent; meaning any delay in one task will delay the entire project. Therefore, special attention is required to ensure these tasks are completed on time. Tasks 7, 8, 9, 13, 14, and 15 have some float time, indicating they can be delayed without affecting the overall project duration. Focusing on the critical path allows project managers to allocate resources and monitor the progress of these essential tasks, ensuring the project is completed within the timeline.

Additionally, the study's findings on employee feedback reveal that 65% report pre-maintenance is conducted, 85% indicate scheduled machine checks, and 60% state plans are not postponed due to maintenance. Internal staff handles repairs according to 80% of employees, while 60% believe specialized maintenance staff from outside the VM group are needed. Furthermore, 65% suggest an exclusive team for maintenance and training, and 55% express the need for a troubleshooting team. Opinions on delays in maintenance by internal staff are split, with 50% accepting and 50% rejecting it. Additionally, 60% report no set deadlines for maintenance, troubleshooting, or time period maintenance. Awareness of the 5'S process is reported by 70% of employees, with 55% confirming staff are trained in 5'S philosophy and 55% reporting the availability of pictorial elements of 5'S in every department. Supervisors' verification of 5'S adherence is confirmed by 90% of employees. Accident records are available according to 75%, and connectivity between production and stores is affirmed by 65%. Differences in material ordering are acknowledged by 70%, and 65% are aware of a policy regarding order placement by the stores. Finally, 70% report unplanned operations causing work schedule delays and 65% indicate independent transactions in stores while ordering materials.

E. Implications of the Study

The findings and analysis of the study at Velmurugan Industries highlight several key implications for improving project management and operational efficiency. Firstly, it is imperative to estimate the required time for each activity accurately, taking into account resource availability and expertise, to capture precise data for making reliable estimates. Utilizing these estimated durations and activity sequencing to identify the critical path is crucial, as this path represents the longest sequence of dependent activities, determining the project's total duration. Identifying and managing dependencies between activities, such as start-to-start, finish-to-finish, and start-to-finish relationships, is essential for establishing a logical sequence of tasks.

Developing a comprehensive project schedule that incorporates estimated durations, dependencies, and resource allocations will provide a clear outline of start and end dates for each activity, ensuring the overall project timeline is maintained. This schedule will help project managers allocate resources effectively and monitor the progress of critical tasks, ensuring timely project completion.

Additionally, enhancing the 5'S process across all departments is crucial for achieving better outcomes and operational efficiency. The study's observation of lagging in pre-maintenance activities suggests that periodic maintenance by external staff is necessary to avoid equipment failures and operational disruptions.

Addressing issues in material ordering within the stores department by improving communication with the production team will ensure timely procurement of goods, thereby avoiding delays in the production process. Furthermore, the current layout of the working space at Velmurugan Industries appears insufficient for continuous processes, indicating a need for reorganization to optimize workflow and improve operational efficiency. By implementing these suggestions, Velmurugan Industries can improve project management, operational efficiency, and overall productivity, ultimately leading to better project outcomes and enhanced company performance.

IV. CONCLUSIONS AND FUTURE RESEARCH

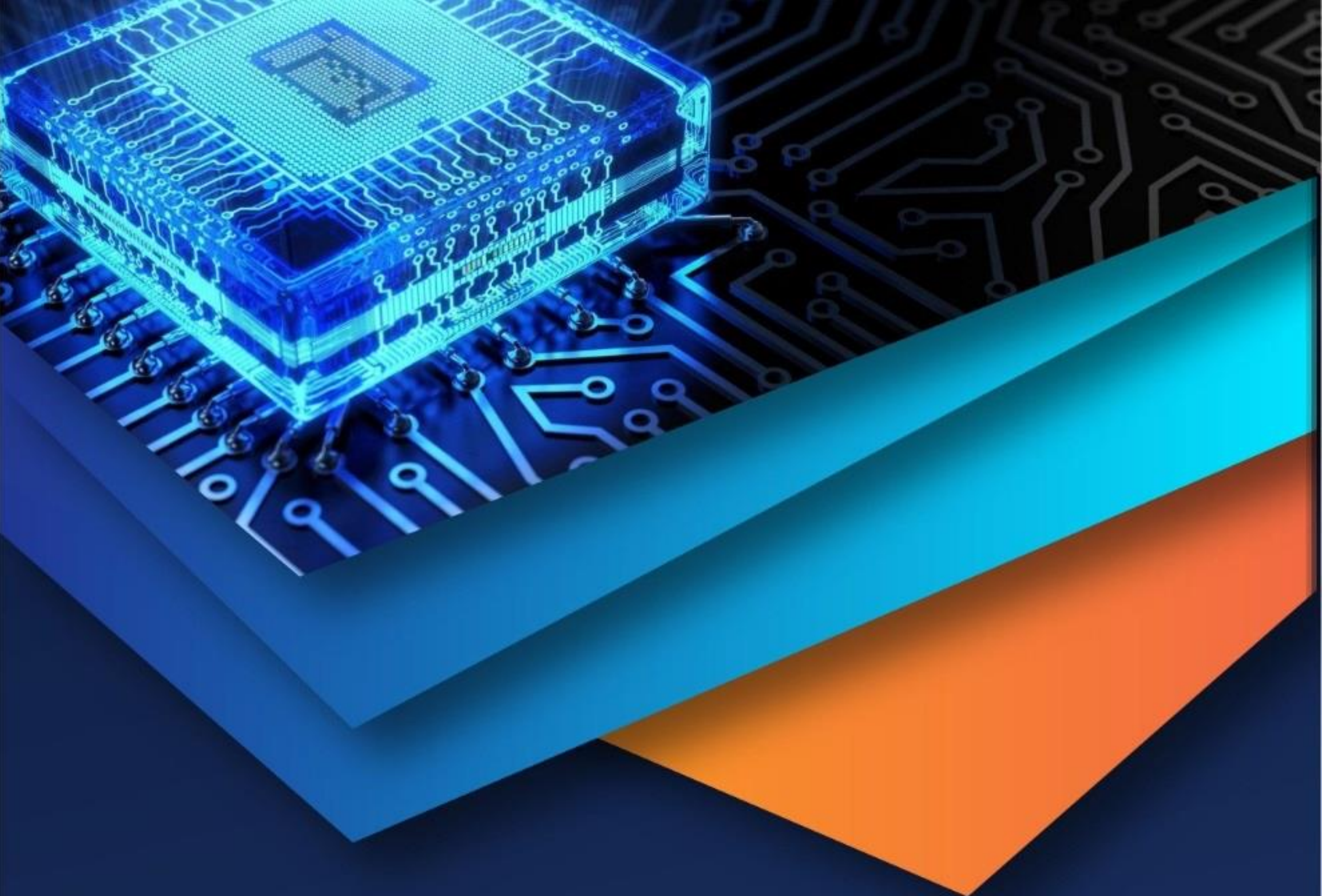
In conclusion, the critical path analysis identified operational processes within Velmurugan Industries' windmill production that require optimization to minimize time delays. Allocating resources efficiently and implementing structured workflows in these critical areas are essential steps towards overcoming challenges faced by employees during windmill tower production. By addressing these issues proactively, the organization can enhance operational efficiency and foster a more supportive work environment conducive to sustainable growth and innovation.

Moving forward, future research should focus on a comprehensive exploration of various organizational facets to further enhance effectiveness and employee satisfaction at Velmurugan Industries. Key areas include assessing and improving employee satisfaction, enhancing organizational communication, analyzing leadership styles and management practices, exploring training and development opportunities, managing work-life balance and stress levels, addressing employee turnover and retention factors, promoting employee well-being, evaluating diversity and inclusion practices, analyzing feedback mechanisms, and studying the impact of technology and automation. Additionally, integrating principles such as Kaizen and Kanban in operational management will be crucial for achieving sustained quality control and improving mass production efficiency. This strategic approach aims to provide valuable insights for organizational improvement and sustainable development.

REFERENCES

[1] Blaga, F. S., Pop, A., Hule, V., Karczis, A., & Buzdugan, D. (2021). “Using Critical Path Method for a New Project Scheduling the Case of a New Product Launch in Production”, In IOP Conference Series: Materials Science and Engineering (Vol. 1009, No. 1, p. 012005). IOP Publishing.
[2] Brian S. Klaas, John McClendon & Thomas W. Gainey (2000). Managing HR in the Small and Medium Enterprise: The Impact of Professional Employer Organizations. Entrepreneurship Theory and Practice, Pp.107 - 124.
[3] Brittle, P., Gaedicke, C., & Akhavian, R. J. J. S. C. O. M. (2018). “Perspective of the Last Planner: Effectiveness of the Traditional Critical Path Method in Comparison with the Last Planner System”, Journal of Supply Chain and Operations Management, Vol. No. 16(1), Pp. 59-81.
[4] Chandan Maheshkar and Neha Soni (2022) Problems Faced by Indian Micro, Small and Medium Enterprises (MSMEs) SEDME (Small Enterprises Development, Management & Extension Journal, Pp. 1–18.
[5] Dundas, G. R., & Krentler, K. A. (1982). “Critical Path Method for Introducing an Industrial Product”, Industrial Marketing Management, Vol. No. 11(2), Pp.125-131.
[6] Elaiwi, A. H. (2018). “Efficiency of Critical Path Method (CPM) and PERT Technique for Yacht Construction”, International Journal of Mechanical Engineering Technol (IJMET), Vol. No. 9, Pp.11-48.
[7] Farid Hirji Badruzzaman, M Yusuf Fajar, Onoy Rohaeni, Gani Gunawan, Erwin Harahap (2020) “CPM And PERT Technique Efficiency Model for Child Veil Production”. International Journal of Scientific & Technology, Research Vol. No.9, Issue No. 04, April.
[8] George S. Day (1994) The Capabilities of Market-Driven Organizations. Journal of Marketing, Vol. 58, No. 4 (Oct., 1994), Pp.37-52.
[9] Gestao-da-Producao, Operacoes-e-Sistemas, Webb, R. A., Purves, J. V., White, B. A., & Ellis, R. (1974). “A Critical Path Analysis of Fruit Production in Strawberry”, Scientia Horticulturae, Vol. 2(2), Pp.175-184.
[10] Gupta Tarun (1991) Applying the Critical Path Method to Manufacturing Routing, Computers and Industrial Engineering - 13th Annual Conference Proceedings, Volume 21, No.1-4, Pp.519-523.
[11] Jeffrey Pfeffer and lohn F. Veiga (1999) Putting people first for organizational success, Academy of Management Executive, Vol 13, No. 2, Pp.37-48.
[12] Kumar Ravinder, Singh Kr. Rajesh & Dwivedi Kumar Yogesh (2020). Application of industry 4.0 technologies in SMEs for ethical and sustainable operations: Analysis of challenges, Journal of Cleaner Production, 275 Pp.1-13.
[13] Linder Christian (2019) Customer orientation and operations: The role of manufacturing capabilities in small- and medium-sized enterprises, International Journal of Production Economics 216 (2019) 105–117.
[14] Lu, Y., Xu, X., & Wang, L. (2020). Smart manufacturing process and system automation – A critical review of the standards and envisioned scenarios. Journal of Manufacturing Systems, 56, 312 - 325.
[15] M. Sokovic, D. Pavletic, K. Kern Pipan (2020). Quality improvement methodologies - PDCA cycle, RADAR matrix, DMAIC and DFSS Journal of Achievements of Materials and Manufacturing Engineering, November, Volume 43, Issue 1, Pp.476 - 483.
[16] Melissa S. Cardona, Christopher E. Stevens (2004) Managing human resources in small organizations: What do we know? Human Resource Management Review, 14 (2004) 295–23.
[17] Prahalad C K and Hamel Gary (1990). The Core Competence of the Corporation, Harvard Business Review, May - June, Pp.79-91.
[18] Qingyu Zhang, M. A. Vonderembse & Jeen-Su Lim (2002) Value chain flexibility: A Dichotomy of competence and capability. International Journal of Production Research 2002, vol. 40, no. 3, 561 - 583.

[19] Rajinder Singh (2023) Problems and Prospects of Employees in the Manufacturing Sector in the Haridwar District of Uttarakhand, India Asian Journal of Managerial Science, Vol.12, No.2, Pp.41-47.
[20] Ritchell B. Nacional (2022) "Philippine Public Senior High School Time Optimization of School Forms Preparation", American Journal of Education and Technologies (AJET), Vol. No. 01, Issue No.2, ISSN: 2832-9481.
[21] S M Masum Alam (2022) Analysis of the Critical Path Methods Impacts on the Basic T-Shirt Manufacturing Process in the Apparel Industries International Journal of Innovative Science and Research Technology, Volume 7, Issue 9, September, Pp.413 - 418.
[22] Shivajee Veer, Singh Kr Rajesh and Rastogi Sanjay (2019) Manufacturing conversion cost reduction using quality control tools and digitization of real-time data. Journal of Cleaner Production, 237, Pp.1-13.
[23] Syahrully, R. M., Julyanto, O., Maryani, E., & Sanjaya, D. (2020). "Analysis of Machine Design Project Scheduling NCB 8 Critical Path Method (CPM) Load and Method of Manufacturing Oriented Control (LOMAC) in Pt. XXX." International Journal of Innovative Science and Research Technology, Vol. No.5(1), Pp.1048-55.
[24] Takebira, U. M., & Mohibullah, A. T. M. (2017). "Using Critical Path Method for Making Process Layout of a T-Shirt within Earliest Finish Time", Journal of Textile Science & Engineering, Vol. No. 7(5).
[25] Kumar, Eli Jones, Rajkumar Venkatesan, & Robert P. Leone (2011) Is Market Orientation a Source of Sustainable Competitive Advantage or Simply the Cost of Competing? Journal of Marketing, Vol. 75, January 2011, Pp. 16 –30.
[26] Wernerfelt Birger (1984). A Resource-based View of the Firm, Strategic Management Journal, Vol. 5, 171-180.
[27] Yuniar Farida, Lulitasari Putri Anenda (2022). "Network Planning Analysis on Road Construction Projects by CV. X Using Evaluation Review Technique (PERT) – Critical Path Method (CPM) and Crashing Method", International Journal of Integrated Engineering, Vol. 14, No.4, Pp.377-390.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY