Indonesian Journal of Engineering and Technological Innovation
DOI: https://doi.org/10.63142/ijeti.v1i2.381
Volume 1 Issue 2, 2025
e-ISSN: 3090-9244 | p-ISSN - | Hal. 69-81
Available Online Since: June, 30 2025

Analysis of Production Process Improvement on Automatic Bolt Forming Machine Using Value Stream Mapping and FMEA Approach

***Fiky Two Nando[a], Davin Danny Ivander[a], Desti Sagita Sharren[a], Christoforus Yudhistira[a], Hilbram Remadaniel[a] , Mashudan As Shidiq[a], A.Anditha Sari[b]**
[a] Universitas 17 Agustus 1945 Surabaya
[b] Politeknik Indonusa Surakarta
*Email Correspondence: fikynando@untag-sby.ac.id

Abstract

This study aims to analyze the production efficiency of an automatic bolt forming machine at PT XYZ using the Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA) approaches. The Lean Manufacturing concept was applied to identify non-value-added activities and potential failures affecting production quality. Data were collected through direct observation, cycle time measurement, and interviews with operators and supervisors over a three-month period. The VSM results indicate that the total process time of 20,304 seconds consists of 75.64% value-added activities, 11.97% non-value-added activities, and 12.40% necessary but non-value-added activities. These findings show that efficiency improvements are still possible by minimizing non-value-adding processes. The FMEA analysis revealed the highest Risk Priority Number (RPN) of 147, occurring in the forming stage with failures such as improper heading, inaccurate trimming, and die damage. The study concludes that combining VSM and FMEA provides an effective framework for assessing process performance and determining improvement priorities to enhance efficiency and reduce product defects.

***Keywords**: Value Stream Mapping, FMEA, Lean Manufacturing, Production Efficiency.*

Abstrak

Penelitian ini bertujuan untuk menganalisis efisiensi proses produksi pada mesin pembentuk baut otomatis di PT XYZ dengan menggunakan pendekatan Value Stream Mapping (VSM) dan Failure Mode and Effect Analysis (FMEA). Pendekatan Lean Manufacturing diterapkan untuk mengidentifikasi aktivitas yang tidak bernilai tambah dan potensi kegagalan yang memengaruhi kualitas produksi. Data dikumpulkan melalui observasi langsung, pengukuran waktu siklus, serta wawancara dengan operator dan supervisor selama tiga bulan. Hasil pemetaan VSM menunjukkan bahwa total waktu proses sebesar 20.304 detik terdiri dari aktivitas bernilai tambah sebesar 75,64%, aktivitas tidak bernilai tambah sebesar 11,97%, dan aktivitas pendukung sebesar 12,40%. Nilai tersebut menunjukkan bahwa masih terdapat peluang peningkatan efisiensi dengan mengurangi aktivitas yang tidak memberikan nilai pada produk. Berdasarkan hasil analisis FMEA, nilai Risk Priority Number (RPN) tertinggi sebesar 147 ditemukan pada proses forming dengan jenis kegagalan seperti heading tidak sesuai, trimming tidak tepat, dan kerusakan dies. Hasil penelitian menegaskan bahwa kombinasi VSM dan FMEA efektif digunakan untuk menilai kondisi aktual proses serta menentukan prioritas perbaikan guna meningkatkan efisiensi dan menurunkan potensi cacat produk..

Kata Kunci: Lean Manufacturing, Value Stream Mapping, FMEA, Efisiensi Produksi, Mesin Pembentuk Baut.

INTRODUCTION

This study employed a quantitative descriptive–applicative approach based on the principles of Lean Manufacturing to identify and minimize production waste in PT XYZ's automatic bolt forming machine line. The research was carried out over a three-month observation period, focusing on data stability and process accuracy. The main objective was to map process inefficiencies and evaluate potential failures that affect production performance.

Data for this study were obtained from both primary and secondary sources. Primary data were collected through direct observation on the production floor, cycle time measurement using a stopwatch, and interviews with operators and supervisors to gain a practical understanding of workflow patterns, bottlenecks, and daily operational challenges. Meanwhile, secondary data were derived from monthly production reports, product defect logs, machine maintenance records, and material flow layout documents provided by the company. These combined data served as the empirical basis for conducting Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA) (Horsthofer-Rauch et al., 2022; Salwin et al., 2023a).

The research process began with identifying and classifying all activities within the bolt forming process using Process Activity Mapping (PAM). Each recorded activity was categorized into three main types: value-added, non-value-added, and necessary but non-value-added. The total process time was then measured, and the percentage contribution of each activity type was calculated. The description of activities and their classifications were summarized in Table 1, which provides a clear representation of the Process Activity Mapping results.

In addition to waste identification, the assessment of process reliability is also essential. Therefore, Failure Mode and Effect Analysis (FMEA) is utilized to evaluate and prioritize potential failures that could affect production performance. This method determines risk priority through the Risk Priority Number (RPN), which combines the severity, occurrence, and detection ratings of each potential failure. The integration of VSM and FMEA allows not only for waste identification but also for preventive control of process risks that may disrupt production stability (García Aguirre et al., 2022; Oliveira et al., 2019; Varghese, 2025).

Several recent studies have demonstrated the success of combining these methods. For example, (García Aguirre et al., 2022) reported that integrating VSM and FMEA in the automotive industry reduced lead time by 30% and product defects by 20%. Similarly, (Varghese, 2025) found that this approach improves machine reliability and overall production efficiency. These studies highlight the effectiveness of combining lean and risk analysis tools in achieving continuous improvement.

Based on this background, the objective of this research is to analyze and improve the production efficiency of an automatic bolt forming machine at PT XYZ by applying the Value Stream Mapping and Failure Mode and Effect Analysis approaches. The expected outcome is the reduction of non-value-added activities, an increase in the value-added ratio, and effective control of potential failures within the production process (Aleksić et al., 2025; Alruqi et al., 2021; El-Awady, 2023).

RESEARCH METHODS

This study employed a quantitative descriptive–applicative approach based on the principles of Lean Manufacturing to identify and minimize production waste in PT XYZ's automatic bolt forming machine line. The research was carried out over a three-month observation period, focusing on data stability and process accuracy. The main objective was to map process inefficiencies and evaluate potential failures that affect production performance.

Data for this study were obtained from both primary and secondary sources. Primary data were collected through direct observation on the production floor, cycle time measurement using a stopwatch, and interviews with operators and supervisors to gain a practical understanding of workflow patterns, bottlenecks, and daily operational challenges (Iskandar & Singgih, 2023; Suhardi et al., 2020; Wang et al., 2024). Meanwhile, secondary data were derived from monthly production reports, product defect logs, machine maintenance records, and material flow layout documents provided by the company. These combined data served as the empirical basis for conducting Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA)

The research process began with identifying and classifying all activities within the bolt forming process using Process Activity Mapping (PAM). Each recorded activity was categorized into three main types: value-added, non-value-added, and necessary but non-value-added(Salwin et al., 2023b; Singh et al., n.d.; Zuraidah Rasi et al., n.d.). The total process time was then measured, and the percentage contribution of each activity type was calculated. The description of activities and their classifications were summarized in Table 1, which provides a clear representation of the Process Activity Mapping results (Gomaa, 2025).

Tabel 1. Process Activity Mapping (PAM) Classification

Activity	Description
O	Operation
T	Transportstion
I	Inspection
S	Storage
D	Delay
VA	Value Added
NVA	Non Value Added
NNVA	Necessary Non Value Added

After obtaining the PAM data, the total cycle time and the proportion of each activity type were analyzed using the following relationships:

$$Percentage\ of\ Activity = \frac{Activity\ Time}{Total\ Process\ Time} \times 100\% \quad \text{………………(1)}$$

Activity Time = *"Total duration of a specific activity (in seconds or minutes)"*
Total Process Time = *"Total duration of all activities in the process cycle"*

The value-added efficiency was then determined using the following formula:

$$VA\ Efficiency = \frac{Total\ VA\ Time}{Total\ Process\ Time} \times 100\% \quad \text{………………(2)}$$

Total VA Time = *"Sum of all time spent on value-added activities"*
Total Process Time = *"Sum of all process cycle times recorded during production"*

After mapping process activities and identifying efficiency levels, the study proceeded with Failure Mode and Effect Analysis (FMEA) to assess potential failures in the production line. Each potential failure mode was evaluated based on three parameters: Severity (S), Occurrence (O), and Detection (D). Each parameter was rated on a scale of 1 to 10 according to its level of seriousness, likelihood, and detectability. The rating standards are presented in Tables 2, 3, and 4 respectively.

Tabel 2. Severity Rating Scale

Rating	Scale	Description
10	Hazardous Without Warning:	Extremely dangerous failure; occurs without prior warning and may cause severe damage or injury.
9	Hazardous With Warning	Very dangerous failure; warning signs appear before the failure occurs.
8	Very High	Failure causes total loss of product function; requires complete replacement or rework.
7	High	Significant malfunction; product needs major repair or partial disassembly.
6	Moderate	Partial loss of function; requires moderate rework to restore quality.
5	Low	Slight performance reduction but product remains functional.
4	Very Low	Defects are noticeable but do not affect product function significantly.
3	Minor	Minor defects visible only under close inspection.
2	Very Minor	Very slight defect; barely noticeable and has negligible effect.
1	None	No effect on product performance or quality.

Tabel 3. Occurrence Rating Scale

Rating	Scale	Description
10	Extremely High	Failure is almost unavoidable; occurs frequently.
9	Almost Certain	Failure occurs very often under current conditions.
8	Very High	Failure occurs frequently in similar processes.
7	High	Failure happens regularly, though not constantly.

6	Moderately High	Failure occurs occasionally but remains significant.
5	Moderate	Failure occurs occasionally under normal conditions.
4	Moderately Low	Failure is uncommon but still possible.
3	Low	Failure is rare; occurs in isolated cases.
2	Very Low	Failure is very unlikely to occur.
1	Remote / Almost Never	Failure is nearly impossible under current control measures.

Tabel 4. Detection Rating Scale

Rating	Scale	Description
10	No Detection / Impossible to Detect	Failure cannot be detected by any control or inspection system.
9	Almost Impossible Detection	Extremely low chance of detection before failure occurs.
8	Very Low Detection	Very difficult to detect failure before it reaches the next process.
7	Low Detection	Detection methods exist but are not consistently effective.
6	Moderately Low Detection	Detection possible but requires significant effort or chance.
5	Moderate Detection	Moderate ability to detect; depends on operator awareness.
4	Moderately High Detection	Detection likely with standard inspection or visual check.
3	High Detection	Failure can be detected easily with existing inspection methods.
2	Very High Detection	High probability of detection before reaching the customer.
1	Almost Certain Detection	Failure will almost always be detected by process control systems.

After assigning scores for each failure mode, the Risk Priority Number (RPN) was calculated using the following formula:

$$RPN = S \times O \times D \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

S (Severity) = *"The seriousness of the effect of failure"*
O (Occurrence) = *"The probability or frequency of failure occurrence"*

D (Detection) = *"he likelihood that the failure will be detected before it reaches the customer"*

The higher the RPN value, the greater the priority for corrective actions. Based on the results, the analysis focused on identifying the failure modes with the highest RPN to develop improvement strategies.

This methodological framework integrates Lean Manufacturing tools through VSM to identify waste and FMEA to evaluate risks. Together, these tools provide a comprehensive and systematic approach to improving process performance, enhancing value-added ratios, and reducing potential failures in the automatic bolt forming production system.

RESULTS AND DISCUSSION

Research Data

The data used in this study were obtained from both primary and secondary sources collected over a three-month observation period at PT XYZ. The object of research was the automatic bolt forming machine, which is a critical part of the company's mechanical production department. This process was selected because it contributes the most to total company output and shows the highest defect and waiting time among other production lines.

Primary data were gathered through direct observation of the production floor, real-time measurement of cycle times using a stopwatch, and interviews with operators and supervisors to understand workflow patterns, delays, and process variations. Secondary data were obtained from monthly production reports, machine maintenance records, product defect logs, and material flow layouts provided by the company.

All collected data were used to build a comprehensive overview of the existing production system and served as the foundation for the Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA). These tools were applied sequentially to evaluate the current production performance, identify process waste, and determine the most critical failure points affecting production reliability.

Process Efficiency Analysis

The analysis of process efficiency using the Value Stream Mapping (VSM) approach revealed the detailed time structure and process distribution in the automatic bolt forming production line. The total process time (cycle time) was measured at 20,304 seconds, with activities classified into five main categories: operation, transportation, inspection, storage, and delay. The detailed mapping of these activities is summarized in Table 5.

Table 5. Takt Time Calculation

Activity	Total	Second (s)	Precentage
O	51	17422	86.32
T	2	450	2.23
I	6	1997	9.89
S	0	0	0

D	2	315	1.56

Activity	Total	Second (s)	Precentage
VA	41	15357	75.64
NVA	8	2430	11.97
NNVA	12	2517	12.4
Total	**61**	**20304**	**100,00%**
Cycle Time		**20304**	

The data indicate that operation activities dominated the production process with a total of 17,422 seconds (86.32%), followed by inspection (9.89%), transportation (2.23%), and delay (1.56%). No significant storage activity was identified. When categorized by value contribution, value-added (VA) activities accounted for 75.64% of the total time, while non-value-added (NVA) and necessary but non-value-added (NNVA) activities represented 11.97% and 12.40%, respectively. These proportions demonstrate that nearly one-fourth of the total process time is still consumed by activities that do not directly contribute to product value, suggesting opportunities for improvement on Figure 1.

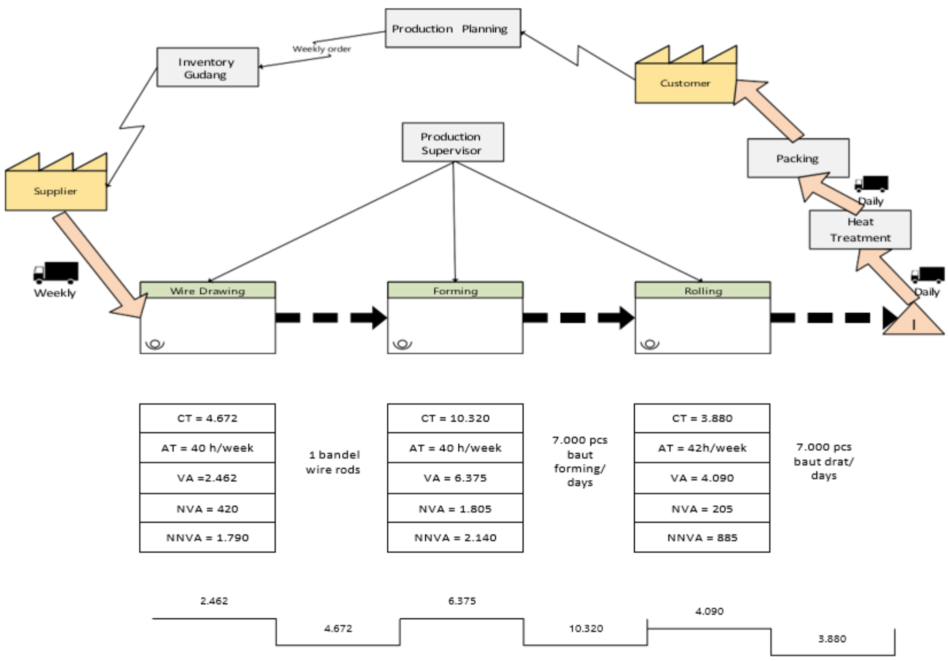

Figure 1. Current State Map

The results of the current state map indicated that the production flow consists of three main stages wire cutting, bolt forming, and thread rolling with a total lead time of 18,872 seconds and a Value-Added Ratio (VAR) of 68.5%. This means that about two-thirds of total production time is dedicated to value creation, while the remaining time reflects inefficiencies such as waiting, motion, and transportation waste.

The analysis identified that the highest waste contributions came from waiting and motion categories. Waiting time was primarily caused by capacity imbalance among workstations, particularly in material feeding and cooling stages, while motion waste resulted from long distances between workstations that required additional handling time. Repeated inspection steps also contributed to overprocessing, as visual and dimensional checks were performed multiple times due to the lack of standardized inspection procedures.

Production Capacity Analysis

To evaluate process risks, a Failure Mode and Effect Analysis (FMEA) was conducted after completing the VSM. Ten potential failure modes were identified across the production stages. Each failure was assessed based on three parameters severity (S), occurrence (O), and detection (D and assigned an RPN (Risk Priority Number) to determine the priority for corrective action. The FMEA results are presented in Table 6.

Table 6. FMEA Calculation Result

No.	Process / Failure Mode	Potential Effect of Failure	Severity (S)	Occurrence (O)	Detection (D)	RPN = S × O × D	Recommended Corrective Action
1	Improper heading during forming	Defective product dimensions, poor thread alignment	7	7	3	147	Improve die alignment and calibration procedure
2	Inaccurate trimming	Irregular product length, poor fit tolerance	6	6	3	108	Regular tool regrinding and operator training
3	Thread rolling defect	Incomplete or damaged thread, product rejection	6	5	3	90	Maintain roller die clearance and adjust speed ratio
4	Die damage or wear	Unstable forming process, frequent downtime	6	4	3	72	Implement scheduled die inspection and preventive replacement
5	Machine instability / vibration	Inconsistent forming results, rework,	6	3	6	108	Improve machine maintenance and balance components

		reduced precision					
6	Improper tooling setup	Extended setup time, inconsistent product output	5	4	3	60	Provide setup standardization checklist
7	Overstored finished goods	Risk of corrosion, space inefficiency	6	3	4	72	Apply FIFO system and optimize storage layout
8	Rework repetition	Additional labor and production delay	5	4	3	60	Strengthen quality control at early process stage
9	Lack of written SOP	Inconsistent work methods, operator confusion	4	3	3	36	Develop and document standard operating procedures
10	Moisture exposure on product	Product corrosion and surface defect	6	3	4	72	Improve packaging and humidity control in storage

The analysis revealed that the highest RPN value (147) occurred in the forming process, with failures such as improper heading, inaccurate trimming, thread rolling defects, and die damage. These failures significantly affected product quality and production continuity. The second-highest RPN (108) was found in the category of machine instability, which caused unplanned downtime and reduced overall equipment availability.

Other notable failures included improper tooling setup (RPN = 72), overstored output (RPN = 72), and repeated rework (RPN = 60). Although their risk levels were moderate, these issues contributed to additional process time and cost inefficiencies. Failures with lower RPN values, such as lack of written SOP (RPN = 28), still require corrective attention to ensure long-term stability of production processes.

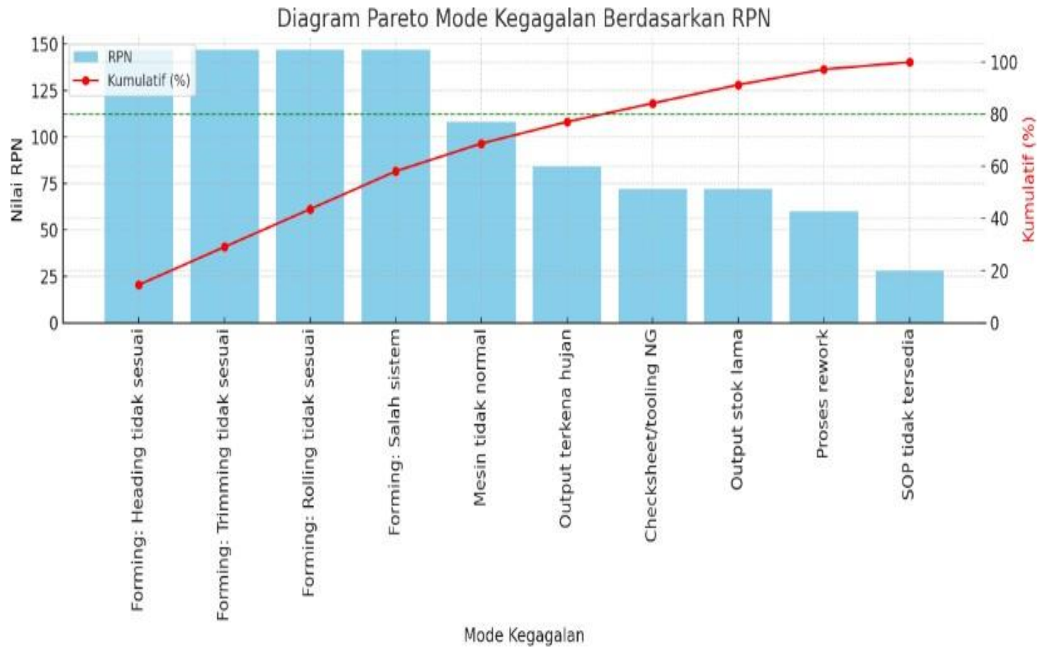

Figure 2. FMEA Pareto Analysis

Based on the Pareto analysis, approximately 80% of total production risk originated from the top four failure modes in the forming process. Therefore, corrective measures should prioritize improving die maintenance and inspection frequency, implementing standardized visual inspection, and balancing process loads between stages.

The integration of Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA) provided a comprehensive view of production efficiency and process risks. VSM enabled the visualization of material flow and the identification of non-value-added activities, while FMEA quantified and prioritized potential failures that may disrupt operations. The combination of both tools allowed PT XYZ to identify not only where inefficiencies occurred but also why they happened, making improvement actions more targeted and measurable.

The findings indicate that most production waste and risk sources are concentrated in the forming stage of the process. Reducing waiting time, improving workstation balance, and strengthening preventive maintenance will directly improve efficiency. In addition, implementing standardized inspection methods and written operating procedures can minimize human error and ensure consistent product quality. These improvements align with Lean Manufacturing principles, emphasizing waste reduction and continuous process improvement to achieve higher productivity and reliability.

CONCLUSION

This research aimed to analyze and enhance the production efficiency of the automatic bolt forming machine at PT XYZ through the combined application of Value Stream Mapping (VSM) and Failure Mode and Effect Analysis (FMEA). The study was designed to identify sources of waste and potential risks that reduce production performance. The analysis revealed that the current process still contained a substantial proportion of non-value-added activities, primarily associated with waiting time, excessive motion, and repetitive inspection. These inefficiencies indicated that the production flow had not yet reached an optimal continuous state, and process synchronization between workstations was still imbalanced.

The VSM analysis provided a clear visualization of material and information flow, quantifying both value-added and non-value-added activities within the process. It was found that value-added activities accounted for approximately three-quarters of the total process time, while the remaining quarter represented wasteful or supporting activities. These findings emphasize that significant improvement potential exists by minimizing idle time, unnecessary movement, and redundant inspection procedures. A balanced layout and improved material handling system are necessary to enhance production flow efficiency and reduce total cycle time. Through the FMEA evaluation, ten potential failure modes were identified, with the highest Risk Priority Number (RPN) observed in the forming process. Failures such as improper heading, inaccurate trimming, and die damage were categorized as high-priority risks that directly impact product quality and production stability. Machine irregularities and poor tooling setups were also found to contribute to downtime and rework, affecting overall equipment effectiveness. Addressing these high-risk failure modes through preventive maintenance, standard operating procedures, and improved inspection standards will reduce process variability and increase product reliability.

Integrating VSM and FMEA provides a comprehensive framework for achieving sustainable production improvement. The combination of process mapping and risk analysis allows the company to visualize inefficiencies, quantify their impacts, and prioritize corrective actions effectively. Implementing continuous improvement programs, such as lean-based workflow balancing, standardization of inspection criteria, and proactive equipment maintenance, is recommended to ensure long-term efficiency and quality stability. These efforts will strengthen PT XYZ’s competitiveness by promoting leaner, more reliable, and more efficient manufacturing operations.

BIBLIOGRAPHY

Aleksić, A., Tadić, D., Komatina, N., & Nestić, S. (2025). Failure Mode and Effects Analysis Integrated with Multi-Attribute Decision-Making Methods Under Uncertainty: A Systematic Literature Review. In *Mathematics* (Vol. 13, Issue 13). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/math13132216

Alruqi, M., Baumers, M., Branson, D., & Farndon, R. (2021). A Structured Approach for Synchronising the Applications of Failure Mode and Effects Analysis. *Management Systems in Production Engineering*, *29*(3), 165–177. https://doi.org/10.2478/mspe-2021-0021

El-Awady, S. M. M. (2023). Overview of Failure Mode and Effects Analysis (FMEA): A Patient Safety Tool. *Global Journal on Quality and Safety in Healthcare*, *6*(1), 24–26. https://doi.org/10.36401/JQSH-23-X2

García Aguirre, P. A., Perez-Dominugez, L., Luviano-Cruz, D., Romero-López, R., & Leon-Castro, E. (2022). *PFDA-FMEA-VSM Application for Outsourcing Risk Analysis*. https://doi.org/10.20944/preprints202201.0002.v1

Gomaa, A. H. (2025). Enhancing Lean Performance through TPM–VSM Integration: A Case Study in Spare Parts Production. *International Journal of Darshan Institute on Engineering Research and Emerging Technologies*, *14*(1), 1–14. https://doi.org/10.32692/ijdi-eret/14.1.2025.2501

Horsthofer-Rauch, J., Schumann, M., Milde, M., Vernim, S., & Reinhart, G. (2022). Digitalized value stream mapping: Review and outlook. *Procedia CIRP*, *112*, 244–249. https://doi.org/10.1016/j.procir.2022.09.079

Iskandar, R., & Singgih, M. L. (2023). *Lean and Green Value Stream Mapping: Case Study of an East Java Furniture Factory* (pp. 114–131). https://doi.org/10.2991/978-94-6463-288-0_12

Oliveira, M., Batista, S., Reis, D., Veroneze, G., & Maciel, R. (2019). Application of fmea for improvement in the manufacturing process of mobile phones in a factory of the industrial pole of Manaus. *International Journal for Quality Research*, *13*(4), 1021–1036. https://doi.org/10.24874/IJQR13.04-18

Salwin, M., Pszczółkowska, K., Pałęga, M., & Kraslawski, A. (2023a). Value-Stream Mapping as a Tool to Improve Production and Energy Consumption: A Case Study of a Manufacturer of Industrial Hand Tools. *Energies*, *16*(21). https://doi.org/10.3390/en16217292

Salwin, M., Pszczółkowska, K., Pałęga, M., & Kraslawski, A. (2023b). Value-Stream Mapping as a Tool to Improve Production and Energy Consumption: A Case Study of a Manufacturer of Industrial Hand Tools. *Energies*, *16*(21). https://doi.org/10.3390/en16217292

Singh, M., Singh, E. G., & Garg, E. J. (n.d.). Value Stream Mapping: A Case Study of Fastener Industry. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN*, *12*(5), 7–10. https://doi.org/10.9790/1684-12530710

Suhardi, B., Hermas Putri K.S, M., & Jauhari, W. A. (2020). Implementation of value stream mapping to reduce waste in a textile products industry. *Cogent Engineering*, *7*(1). https://doi.org/10.1080/23311916.2020.1842148

Varghese, N. (2025). Enhance Productivity in Garment Industry Through VSM and FMEA Approaches. In *IJISET-International Journal of Innovative Science, Engineering & Technology* (Vol. 12). www.ijiset.com

Wang, C. N., Vo, T. T. B. C., Chung, Y. C., Amer, Y., & Truc Doan, L. T. (2024). Improvement of Manufacturing Process Based on Value Stream Mapping: A Case Study. *EMJ - Engineering Management Journal*, *36*(3), 300–318. https://doi.org/10.1080/10429247.2023.2265793

Zuraidah Rasi, R. R., Tun Hussein Onn Malaysia, U., Pahat, B., Rohana Abdullah, M., Omar, N., Tuah Jaya, H., Suhana Mohamed, M., Teknologi MARA, U., Johor Bahru, K., Heman, J., Aman, K., & Bahru, J. (n.d.). *Value Stream Mapping using Simulation at Metal Manufacturing Industry*.

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to all those who have provided support in the preparation of this research. Special thanks are extended to the supervising lecturer and all the teaching staff of the Industrial Engineering Study Program who have provided guidance, direction, and valuable input throughout the research process. The author also thanks the management and employees of the bag-producing SME who were willing to provide data, information, and access to the production process. Without the help and support of various parties, this research entitled "Optimization of Bag SME Production Using the Heijunka and SMED Methods" would not have been completed successfully.

FUNDING INFORMATION

This Research used the author's personal funds.

CONFLICTING INTEREST STATEMENT

The authors state that there is no conflict of interest in the publication of this article.

HISTORY OF ARTICLE

Submitted : March 29, 2025
Revised : May 30, 2025
Accepted : June 29, 2025
Published : June 30, 2025