



## Production Afalan Analysis Using Value Stream Mapping (VSM) and Root Cause Analysis (RCA) Methods at PT. XYZ

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### Abstract

*The competitiveness of the manufacturing industry demands companies to enhance production efficiency and reduce product defects. PT. Kerta Rajasa Raya, a woven bag manufacturing company, faces a high level of production scrap (defects), which decreases productivity and increases production costs. This study aims to analyze the defect rate, identify process waste using the Value Stream Mapping (VSM) approach, and determine the root causes of major defects through Root Cause Analysis (RCA). The research employs a descriptive case study method using secondary data from production and defect reports from January to June 2025. The results show that the total defect rate reached 3.44%, with the dominant defect being setting at 0.56% of total production. Based on the VSM mapping, the main wastes occur in the printing and cutting processes due to the absence of a standard operating procedure (SOP) for machine setting, long waiting times, and repeated rework. RCA analysis revealed that the root causes stem from insufficient operator training, machine wear, and variations in raw material quality. Improvement through the future state map, including the implementation of SOPs, kanban system, and operator training, led to a 52% improvement in process efficiency and a 50% reduction in defect rate. This study demonstrates that the integrated application of VSM and RCA is effective in identifying waste and improving production performance in manufacturing industries.*

**Keywords:** Value Stream Mapping; Root Cause Analysis; Lean Manufacturing; Defect; Production Efficiency.

### Abstrak

Persaingan industri manufaktur menuntut perusahaan untuk meningkatkan efisiensi proses produksi dan menekan tingkat cacat produk. PT. Kerta Rajasa Raya sebagai industri karung menghadapi permasalahan tingginya tingkat afalan (defect) yang berdampak pada penurunan produktivitas dan peningkatan biaya produksi. Penelitian ini bertujuan untuk menganalisis tingkat afalan, mengidentifikasi pemborosan proses melalui pendekatan Value Stream Mapping (VSM), serta menentukan akar penyebab utama defect menggunakan Root Cause Analysis (RCA). Metode penelitian yang digunakan bersifat deskriptif dengan pendekatan studi kasus. Data diperoleh dari laporan produksi dan afalan periode Januari–Juni 2025. Hasil penelitian menunjukkan bahwa tingkat afalan total mencapai 3,44%, dengan defect dominan berupa setting sebesar 0,56% dari total produksi. Berdasarkan pemetaan VSM, ditemukan bahwa pemborosan utama terjadi pada proses printing dan cutting akibat tidak adanya SOP setting mesin, tingginya waktu tunggu, serta rework berulang. Analisis RCA menunjukkan akar penyebab utama terletak pada kurangnya pelatihan operator, keausan mesin, dan variasi kualitas bahan baku. Implementasi perbaikan melalui future state map dengan penerapan SOP, dan pelatihan operator menghasilkan peningkatan efisiensi hingga 52% dan penurunan defect sebesar 50%. Penelitian ini menegaskan bahwa penerapan terpadu VSM dan RCA efektif dalam mengidentifikasi pemborosan serta meningkatkan performa produksi di industri manufaktur.

**Kata Kunci:** Value Stream Mapping; Root Cause Analysis; Lean Manufacturing; Defect, Efisiensi Produksi.



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## **INTRODUCTION**

Competitive manufacturing requires companies to produce high-quality products at low cost and with short production times. PT. XYZ, a paper packaging company, faces the challenge of high levels of scrap in its production process. High scrap can reduce efficiency, increase costs, and reduce profitability. Therefore, an analytical approach is needed to identify and minimize this waste.

The Lean Manufacturing method, using the *Value Stream Mapping* (VSM) approach, can be used to map the entire process and detect non-value-added activities. Additionally, *Root Cause Analysis* (RCA) is important for unearthing the root causes of waste, so that corrective solutions can be implemented effectively.

1. What is the state of waste in PT. XYZ's production process?
2. How can *value stream mapping* (VSM) illustrate waste points in the production process?
3. What are the main root causes of waste based on the RCA method?
4. What improvement strategies can the company implement to reduce the number of waste?

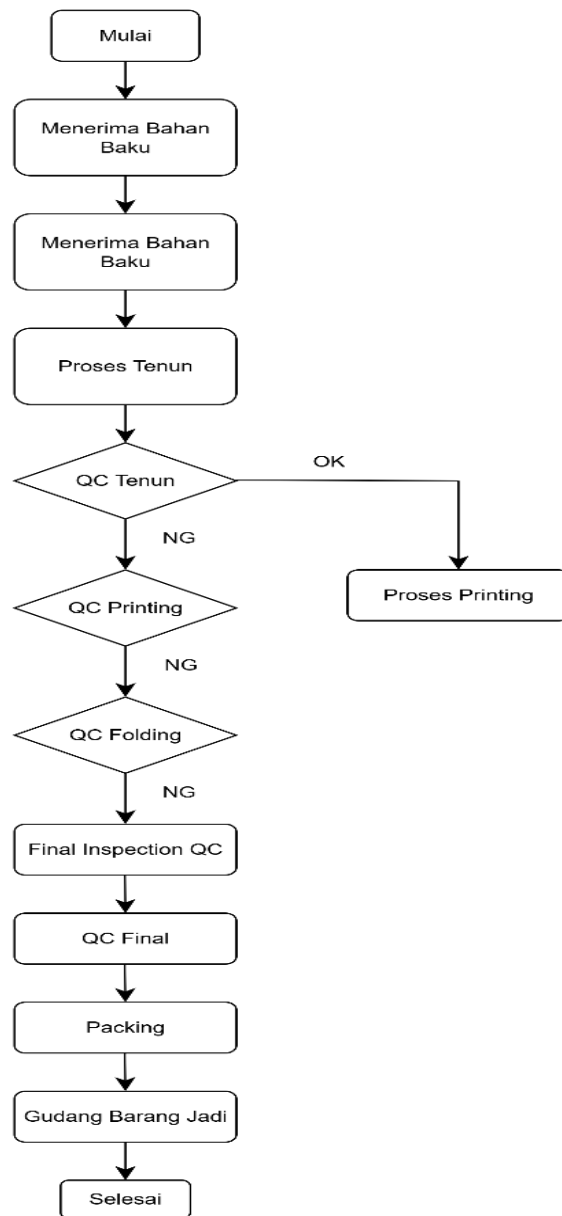
The purpose of this study is to analyze the level of production defects based on the 2025 report data, identify the dominant types of defects that affect production efficiency, and conduct value stream mapping using the Value Stream Mapping (VSM) method to find waste points in the production process. In addition, this study also aims to apply Root Cause Analysis (RCA) in exploring the main root causes of defects and provide recommendations for targeted process improvements. Academically, this study is expected to contribute to the development of the application of VSM and RCA methods in the sack industry, while practically, the results of this study are expected to help PT. XYZ in reducing the level of defects, increasing production process efficiency, and supporting the implementation of Lean Manufacturing principles in a sustainable manner (GS Citation, n.d.).

## **RESEARCH METHODS**

This research is a descriptive case study at PT. XYZ, a sack manufacturing company. Descriptive research was chosen because it aims to describe in detail the actual conditions in the field related to production defects, while also providing improvement analysis using the Value Stream Mapping (VSM) and Root Cause Analysis (RCA) methods (Sebelas Maret University Journal, n.d.). This type of research can also be categorized as applied research, as the results are expected to be directly used by the company to improve production process efficiency and reduce defect rates.

## **RESULTS AND DISCUSSION**

### **Defect Data Analysis**



**Figure 1 :** flowchart alur proses di PT. XYZ

Based on the production report from January to June 2025, the total scrap rate at PT. XYZ reached 3.44 % of total production. The dominant defect category was setting, with 58,163 pcs (0.56 %), followed by *triangle misalignment* (0.16 %) and *body not opening* (0.14 %). These three categories collectively contributed to more than one-third of the total defective output. The high frequency of setting-related defects indicates instability in the printing process and inadequate standardization of machine adjustments.

The presence of rework and repeated scrap events suggests that waste occurs not only in defective output but also in extended cycle time and increased production cost. Such a condition decreases productivity and disrupts the smooth flow of the value stream.

**Table 1 :** Table Data Afalan/Defect PT.XYZ

NO	LAPORAN AFALAN STARPAK TROPODO		TOTAL KESELURUHAN 2025			
	KELOMPOK AFALAN	NAMA AFALAN	BRUTO:		10340905	
			SUB TOTAL		JUMLAH	PROSEN
			1 Ply	2 Ply		
1	ADS	Setting	51939	6224	58163	0,56%
2		Body miring	2435	28	2463	0,02%
3		Body tidak membuka	14386	378	14764	0,14%
4		Segitiga miring	16559	429	16988	0,16%
5		Overlap lubang	5079	175	5254	0,05%
6		Stop bottom opener	22131	600	22731	0,22%
7		Tes sobek	10014	412	10426	0,10%
8		Valve melipat	14795	654	15449	0,15%
9		Patch melipat	15162	220	15382	0,15%
10	CL	Keperet	58193	0	58193	0,56%
11		Rajutan renggang	16902	885	17787	0,17%
12		Rajutan lubang	26915	210	27125	0,26%
13		Sambungan isolasi	61	0	61	0,00%
14	PRINT	Printing geser	3994	0	3994	0,04%
15		Printing buram	47595	1123	48718	0,47%
16	LAMI	Lami mengelupas	20158	0	20158	0,19%

### Value Stream Mapping (VSM)

The VSM analysis was carried out in two stages, namely the current state map to identify existing waste, and the future state map to propose improvements for process efficiency. The current state map represents the existing production condition before improvement. It shows the sequence of processes, lead time, and defect concentration points that hinder efficiency.

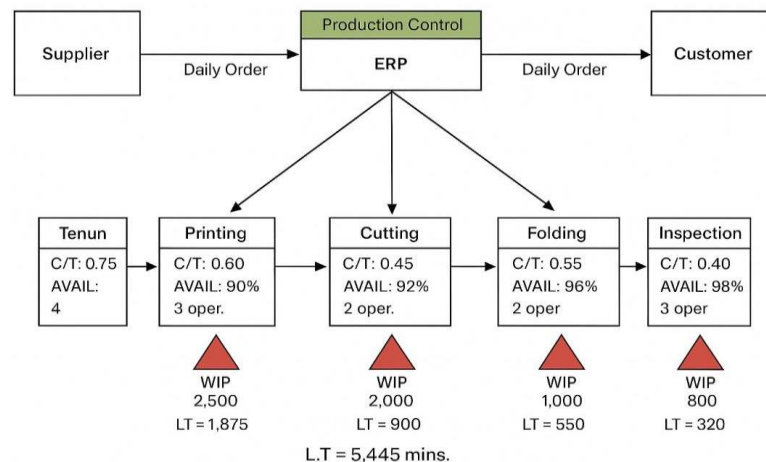
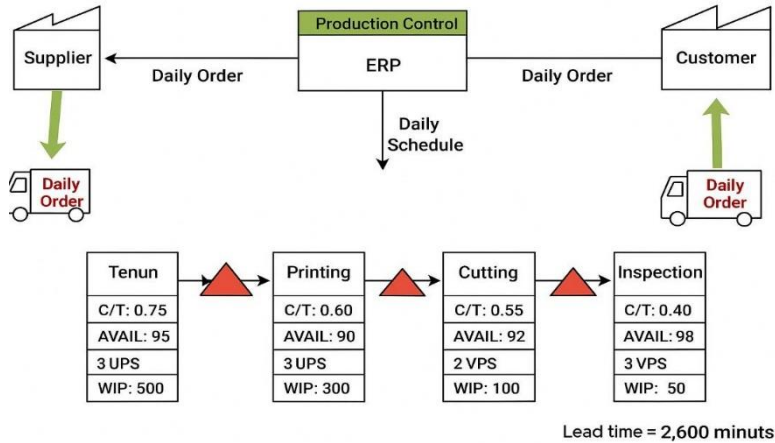


Figure 2 : Gambar Alur Proses Produksi PT.XYZ

As illustrated, the process flow consists of Supplier → Weaving → Printing → Cutting → Folding → Inspection → Finished Goods → Customer. Several critical findings were identified the total lead time reached approximately 5,445 minutes, with

high WIP between stages (2,000–3,000 pcs). Major bottlenecks were found in the printing and cutting stages due to the absence of machine-setting SOPs and limited operator training. These issues result in excessive waiting, rework, and material movement, all of which represent *non-value-added* activities in lean terminology.

After implementing lean improvement, the future state map was designed by simplifying the process flow and introducing a pull-based kanban system between workstations. Standard Operating Procedures (SOP) for machine setting are also applied to minimize setup time



**Figure 3 :** Gambar sesudah di lakukannya metode VSM

Figure 3 shows that the process became more balanced with significantly reduced WIP and lead time. Total lead time decreased from 5,445 minutes to 2,600 minutes (52% improvement), and defect rates reduced by approximately 50%.

Root Cause Analysis (RCA).

The Root Cause Analysis (RCA) was carried out to identify the main causes of the dominant defect, namely *Setting*. This stage used two tools: the 5 Whys analysis to trace the cause-and-effect sequence, and the Fishbone Diagram to categorize contributing factors.

The 5 Whys analysis was conducted to determine the underlying reasons for the occurrence of *Setting* defects. The results are summarized in Table 2.

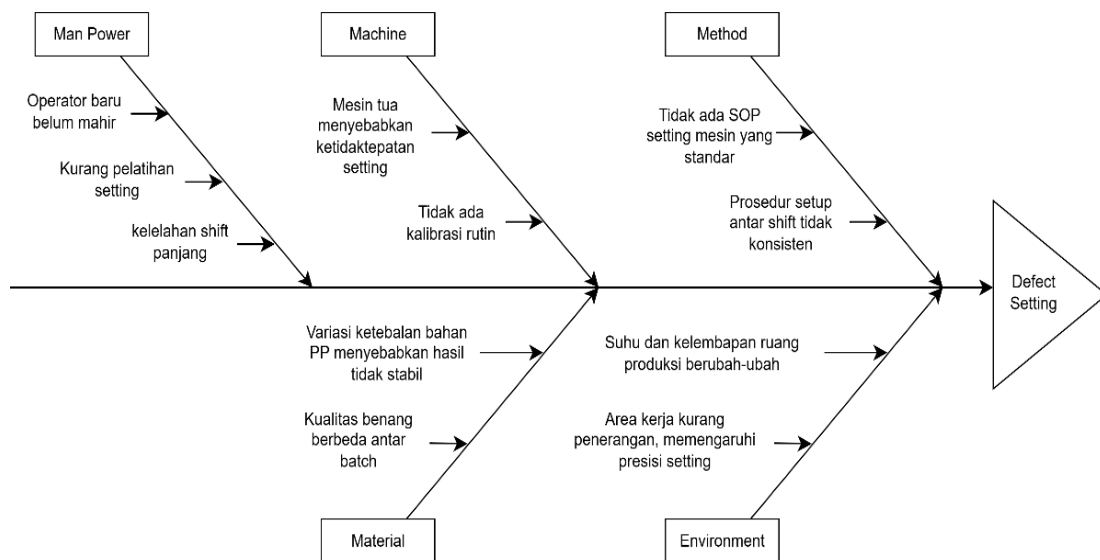
**Table 2 :** Table 5 whys

Mengapa terjadi defect setting?	Karena hasil cetakan atau posisi karung tidak sesuai spesifikasi setelah proses mesin
Mengapa hasil tidak sesuai spesifikasi?	Karena penyetelan (setting) mesin tidak akurat saat pergantian jenis karung atau bahan.

Mengapa penyetelan mesin tidak akurat?	Operator tidak memiliki panduan standar setting yang jelas untuk setiap varian produk.
Mengapa tidak ada panduan standar setting?	SOP belum terdokumentasi secara lengkap dan belum dilakukan pelatihan rutin bagi operator baru.
Mengapa pelatihan belum dilakukan secara rutin?	Karena fokus manajemen masih pada target output produksi, bukan peningkatan kompetensi teknis.

From the 5 Whys results, it can be concluded that the main cause of the *Setting* defect lies in the absence of a standardized SOP and inadequate operator training, leading to inconsistency between product batches.

To further visualize the relationships among factors causing *Setting* defects, a Fishbone Diagram (Ishikawa) was constructed, as presented in Figure 4.



**Figure 4 : Fishbone Diagram**

As shown in Figure 4, the causes of *Setting* defects originate from five main factors

:

1. Man Power

A significant root cause is attributed to the Man Power or human element, specifically that operators do not possess a complete and correct understanding of the machine setup procedures. This knowledge gap is exacerbated by a demonstrable lack of formalized training and inadequate routine supervision. Consequently, operators resort to performing setups based on individual habits, undocumented "tribal knowledge," or personal preferences rather than adhering to the established technical standards. This reliance on subjective methods

introduces high variability between operators and shifts, leading to inconsistent setup parameters, which in turn directly contribute to the "Defect Setting" and make process troubleshooting exceptionally difficult due to the absence of a standardized operational baseline.

2. Machine

Under the Machine category, the primary issue stems from the physical condition of the equipment. The machinery in use exhibits significant wear and tear on critical components and, crucially, has not been subjected to a routine or preventative calibration schedule. This neglect in maintenance means that even if correct parameters are entered by an operator, the machine's actual physical output (such as tool position, pressure, or feed rate) may drift from the setpoint, leading to a state of poor process capability. This mechanical inconsistency and lack of calibration directly result in unreliable and non-repeatable "Setting" outcomes, manifesting as critical product defects such as dimensional inaccuracies and incorrect component positioning.

3. Method

The Method category reveals dominant procedural failures that are a major source of defects. There is a complete absence of a standardized, documented Standard Operating Procedure (SOP) for the machine setup process, creating ambiguity and forcing operators to rely on memory or improvisation. This lack of standardization is compounded by non-uniform procedures for handovers between production shifts, leading to inconsistent communication and configuration changes. Furthermore, the process is not supported by a critical verification tool, such as a setup checklist. The absence of a formal checklist means there is no mechanism to ensure process uniformity or to verify that all critical parameters have been correctly configured before full-scale production commences, eliminating a key opportunity for error-proofing the setup phase.

4. Material

Significant variability in the Material category, specifically in the thickness and quality of raw materials between different supplied batches, is identified as a key destabilizing factor. These inconsistencies in material characteristics (such as density, viscosity, or tensile strength) mean that the pre-defined machine settings are no longer optimal for each new batch. This forces operators to engage in reactive, manual re-adjustments to the machine settings to compensate for the material differences. This frequent, non-standardized manual intervention significantly increases the risk of human error, making it difficult to achieve a stable and controlled process, thereby leading to unstable output and the observed defects.

5. Environment

Finally, the physical Environment of the production area introduces uncontrolled variables. Fluctuations in ambient temperature and humidity are not adequately controlled, directly impacting the stability of the machine settings; for instance, thermal expansion can alter the precise alignment of mechanical components, while humidity can affect the properties of the raw materials. Compounding this, the work area suffers from suboptimal lighting conditions. This poor illumination is an ergonomic hazard that reduces operator precision and visual acuity during the critical machine setup phase, increasing eye strain and

heightening the likelihood of errors when reading gauges, aligning parts, or verifying settings.

These interrelated causes confirm that improving standard procedures and operator capability are key to reducing *Setting* defects in the future. The combination of VSM and RCA provided a comprehensive understanding of production inefficiencies. VSM visualized the waste and quantified the process impact, while RCA identified the underlying behavioral and technical causes. The improvements implemented namely SOP establishment, kanban system adoption, and structured operator training proved to be effective, reducing both defect rates and cycle time.

The results corroborate previous studies (Fadilah & Wibero, 2024; Misda, 2022) which found that integrating lean tools such as VSM and RCA significantly enhances production performance in manufacturing industries. PT. XYZ's case demonstrates that systematic waste identification and root-cause-based corrective actions can yield tangible operational gains and lay a foundation for continuous improvement (Kaizen).

## **CONCLUSION**

Based on research conducted at PT. XYZ regarding the analysis of production defects using the Value Stream Mapping (VSM) and Root Cause Analysis (RCA) methods, it was concluded that the level of production defects in the January-June 2025 period reached 3.44%, with the highest type of defect, namely setting defects of 0.56% of total production (58,163 pcs). The results of the VSM analysis show that the main source of waste occurs in the printing and cutting process due to long waiting times for materials, rework activities, and the absence of a standard Standard Operating Procedure (SOP). Through the analysis of 5 Why's, it is known that the root cause of setting defects is the absence of standardized SOPs for adjusting machines, inadequate training and supervision of operators, and the absence of structured adjustment procedures when changing products or materials. The Fishbone Diagram analysis reinforces these findings by identifying five main causative factors, namely: (1) Manpower – lack of operator training and understanding of standard machine settings; (2) Machine – machine wear and absence of routine calibration; (3) Method – SOP has not been well documented and there is no adjustment checklist available; (4) Material – variation in the quality of raw materials between batches; and (5) Environment – unstable temperatures and inadequate lighting. The implementation of the Future State Map showed significant improvements, in the form of a 52% reduction in lead time and a 50% reduction in the defect rate after the implementation of SOPs for engine tuning, pull production system (kanban), and operator training on an ongoing basis.

## **BIBLIOGRAPHY**

- Alexander, K., & Handayani, N. U. (2022). Perancangan Lean Manufacturing dalam Proses Packing TV LED 32” (Studi Kasus: PT. XYZ).
- Ansyah, E., Kustiwan, S., & Supriyati, S. (2025). Analisis Lean Manufacturing untuk Mengurangi Cycle Time dengan Menggunakan Metode Value Stream Mapping. *Jurnal Penelitian Inovatif*, 5(3), 2153–2162. <https://doi.org/10.54082/jupin.1693>
- Chopra, S., & Meindl, P. (2019). *Supply Chain Management: Strategy, Planning, and Operation* (7th ed.). Pearson Education.
- Fadilah, M. F., & Wibero, R. (2024). Rancangan Lean Manufacturing untuk Mengurangi Pemborosan pada Proses Pembuatan Sepatu dengan Pendekatan Metode Value Stream Mapping (VSM) dan Root Cause Analysis (RCA) di Home Industry Sepatu. *Jurnal Greenation Ilmu Teknik*, 2(1), 16–25. <https://doi.org/10.38035/jgit.v2i1.230>
- Hasibuan, A., Hasibuan, A. A., Hasim, F., & Ramadhana, F. (2023). Penerapan Lean Manufacturing dalam Meningkatkan Efisiensi Proses Produksi di Industri Manufaktur.
- Khalidzky, M. K., Winarno, & Maulidin, W. F. (2022). Lean Manufacturing dalam Reduksi Waste untuk Peningkatan Efisiensi Produksi Konektor Tipe X di PT. XYZ.
- Misda, Y. (2022). Production Line Improvement Analysis with Lean Manufacturing Approach to Reduce Waste at CV. TMJ Uses Value Stream Mapping (VSM) and Root Cause Analysis (RCA) Methods.
- Pujawan, I. N., & Mahendrawathi, E. R. (2017). *Supply Chain Management* (Edisi ke-3). Guna Widya.
- Setiawan, I., & Rahman, A. (2021). Penerapan Lean Manufacturing untuk Meminimalkan Waste dengan Menggunakan Metode VSM dan WAM pada PT. XYZ.
- Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2008). *Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies* (3rd ed.). McGraw-Hill.
- Susanti, D. A., Yulianto, L., Kurniawan, V. R. B., Nurhayati, E., & Rezalti, D. T. (2022). Analisis Lean Manufacturing Pendekatan VSM dan FMEA untuk Meminimasi Pemborosan pada Salah Satu Perusahaan Logam di Jawa Tengah.
- Tekmapro. (n.d.). Analisis Penerapan Lean Manufacturing dengan Metode VSM (Value Stream Mapping) Guna Mengurangi Waste dan Cycle Time pada Proses Produksi Keramik di PT XYZ. Retrieved October 9, 2025, from <https://tekmapro.upnjatim.ac.id/index.php/tekmapro/article/view/419>
- Jurnal Universitas Sebelas Maret. (n.d.). Retrieved October 9, 2025, from <https://jurnal.uns.ac.id/lean-vsm-fmea-logam>
- GS Citation. (n.d.). Google Docs. Retrieved October 9, 2025, from <https://docs.google.com/spreadsheets/d/e/2PACX-1vQM9s58en1N5-LDLePLqUEvgKXi-GnQRd6k6lkjmmMnH3bLxq1d3sNvyeDI3BORICBYNbDhWupmzD8/pubhtml>

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