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Implementation of Kanban and Poka-Yoke to Improve Production Efficiency at CV. XYZ

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Abstract

CV. XYZ is a household plastic components manufacturer facing elevated defect rates (4–5% daily), accumulation of work-in-process (WIP) in the cooling area, and recurring labeling errors during packaging. This study evaluates the combined application of Kanban as a pull-based material flow control and Poka-Yoke as simple error-proofing devices to improve production efficiency and product quality. A quantitative descriptive approach was employed, using direct observation, time-and-motion measurements, interviews with operators and supervisors, and before–after comparisons of key performance indicators. Kanban sizing was calculated using D = 125 units/hour, L = 4 hours, S = 0.1, and container capacity C = 50 units, yielding an optimal 11 Kanban cards. Poka-Yoke implementations included automatic temperature alarms on molding machines, fixture sensors at finishing stations, and barcode-based label verification at packaging. After implementation, WIP decreased from 280 to 150 units (−46%); inter-process waiting time reduced from 45 to 20 minutes (−56%); daily output increased from 800 to 950 units (+18.7%); defect rate declined from approximately 5% to 1.8%; and labeling errors were eliminated. The results indicate that integrating Kanban and Poka-Yoke can effectively streamline production flow, reduce waste, and enhance productivity in small-to-medium plastic manufacturing operations. Implications, limitations, and recommendations for broader application are discussed.

***Keywords**: Kanban, Poka-Yoke, Lean Manufacturing, Production Efficiency, Plastics Industry.*

Abstrak

CV. XYZ adalah produsen komponen plastik rumah tangga yang menghadapi tingkat cacat yang tinggi (4–5% per hari), penumpukan barang dalam proses (WIP) di area pendinginan, dan kesalahan penandaan berulang selama pengemasan. Studi ini mengevaluasi penerapan gabungan Kanban sebagai sistem pengendalian aliran material berbasis permintaan dan Poka-Yoke sebagai perangkat pencegahan kesalahan sederhana untuk meningkatkan efisiensi produksi dan kualitas produk. Pendekatan deskriptif kuantitatif digunakan, meliputi pengamatan langsung, pengukuran waktu siklus, wawancara, serta perbandingan kondisi sebelum dan sesudah intervensi. Perhitungan kartu Kanban menggunakan D = 125 unit/jam, L = 4 jam, S = 0,1, dan kapasitas kontainer C = 50 unit, menghasilkan 11 kartu Kanban. Implementasi Poka-Yoke meliputi alarm suhu otomatis pada mesin molding, sensor fixture pada proses finishing, dan verifikasi barcode pada pengemasan. Setelah penerapan, WIP berkurang dari 280 menjadi 150 unit (−46%); waktu tunggu antar proses menurun dari 45 menjadi 20 menit (−56%); output harian meningkat dari 800 menjadi 950 unit (+18,7%); tingkat cacat turun dari sekitar 5% menjadi 1,8%; dan kesalahan label berhasil dihilangkan. Hasil menunjukkan bahwa integrasi Kanban dan Poka-Yoke efektif untuk memperlancar aliran produksi, mengurangi pemborosan, dan meningkatkan produktivitas pada perusahaan manufaktur plastik skala kecil dan menengah. Implikasi praktis, keterbatasan, dan rekomendasi untuk penerapan lebih luas dibahas.

Kata Kunci: Kanban, Poka-Yoke, *Lean Manufacturing*, Efisiensi Produksi, Industri Plastik.

INTRODUCTION

The competitiveness of manufacturing firms increasingly depends on their ability to deliver products of consistent quality while minimizing waste and lead time. The household plastic components industry, which produces items such as cleaning-liquid bottles, gallon caps, and liquid soap containers, is no exception: manufacturers must balance high-volume production with stringent quality control to remain competitive. Small-to-medium enterprises (SMEs) in this sector often face operational challenges including imbalanced process times, high defect rates, and accumulation of work-in-process (WIP), which collectively reduce throughput and increase costs Mike Rother (1998).

CV. XYZ is a plastic injection manufacturer experiencing several of these common issues: an average production capacity reported at approximately 1,200 units per day, but with daily defect rates of 4–5%, WIP accumulation in the cooling area, and occasional labeling errors during packaging. Such operational inefficiencies point to the need for production control mechanisms that can stabilize flow and reduce human error Bintang Nusantara Adji (2020). Lean Manufacturing principles particularly pull systems such as Kanban and error-proofing techniques like Poka-Yoke offer practical, low-cost interventions that address both material flow and operator-induced defects.

Although numerous studies investigate Kanban or Poka-Yoke individually, fewer empirical studies document their combined application in SME plastic injection settings with quantified before–after performance metrics. This study fills that gap by designing, implementing, and evaluating a combined Kanban Poka-Yoke intervention at CV. XYZ. The primary objectives are to size and implement a Kanban system to balance inter-process material flow P, Kurniawan Prasetyo & D, Nardiansyah A (2025). Design and deploy Poka-Yoke solutions at critical process points to reduce defects and labeling errors Ir. Endrik Purbo Yunastyo (2024); and measure the impact on WIP, inter-process waiting time, daily output, and defect rate Womack & Jones, (1997). The remainder of the paper is organized as follows: Research Methods presents the study design and data collection procedures; Results and Discussion report the measured impacts and practical observations; and Conclusion summarizes findings and provides recommendations for practice and future researchGallang Pamungkas (2023).

RESEARCH METHODS

This research uses a quantitative descriptive approach aimed at analyzing the implementation of Kanban and Poka-Yoke systems in the production process of CV. XYZ. The study focuses on measuring the effectiveness of these systems in reducing waste and improving production flow. Data was collected through direct observation of production activities, interviews with operators and supervisors, and review of daily production reports to obtain quantitative information related to cycle times, WIP levels, and product defects. The use of quantitative analysis allows for objective comparison between pre-implementation and post-implementation performance.

The Kanban system was designed using the pull production concept to control material flow between processes Liker (2013). Based on production data, the number of Kanban cards was determined using the formula. The Kanban system was designed using the pull production approach with the following basic formula:

$$N = \frac{D \times L \times (1 + S)}{C}$$

D = *Demand per hour (units / hour)*
L = *Lead time (hours)*
S = *Safety stock percentage*
C = *Container capacity (units)*

Based on the production data, the values were determined as D = 125, L = 4, S = 0.1, and C = 50, resulting in 11 Kanban cards. Each card represents 50 semi-finished units transferred between processes, maintaining balance in the material flow and preventing overproduction.

To assess the baseline condition, Table 1 presents production data and defect types before Kanban and Poka-Yoke implementation.

Table 1. Production and Product Defect Data Before System Implementation

Month	Target Production (units)	Actual Production (units)	Dent Defects (units)	Scratch Defects (units)	Labeling Errors (units)
Jan	20,000	18,950	210	315	420
Feb	20,000	18,990	190	285	380
Mar	20,000	18,830	205	298	390
Apr	20,000	19,205	160	250	340
May	20,000	19,210	180	260	330
Jun	20,000	18,679	195	270	375
Total	120,000	113,864	1,140	1,678	2,235

The average product defect rate reached approximately 4–5% of total monthly production, contributing to reduced efficiency and higher material costs. After identifying this condition, a Poka-Yoke system was designed and applied to critical points in the process molding, finishing, and packaging(Nasional & Ums, 2012). The Poka-Yoke devices included automatic temperature alarms on molding machines, fixture sensors in finishing stations to prevent incomplete trimming, and barcode scanners in packaging for label validation. The overall objective of these implementations was to eliminate recurring human errors and stabilize the production flow for sustained improvement.

RESULTS AND DISCUSSION

The production process at CV. XYZ involves six major stages: raw material melting, molding, cooling, finishing, quality inspection, and packaging. Observations revealed that prior to the implementation of Kanban and Poka-Yoke, there was a process imbalance particularly at the finishing stage which acted as a bottleneck. This imbalance caused the accumulation of WIP in the cooling area, extended waiting times between operations, and an elevated defect rate.

After applying the Kanban and Poka-Yoke systems, production data were collected again to measure the improvement. Table 2 compares the key performance indicators before and after implementation.

Table 2. Comparison of Production Indicators Before and After Implementation

Indicator	Before Implementation	After Implementation	Change (%)
Daily Output (units)	800	950	+18.7%
Product Defect Rate	5%	1.8%	−64%
Inter-Process Waiting Time	45 minutes	20 minutes	−56%
Work in Process (units)	280	150	−46%
Labeling Errors	2 cases/week	0 cases	Eliminated

The data show that the integration of Kanban and Poka-Yoke significantly improved production efficiency

The calculation of performance improvements was based on the Kanban formula and actual production observations. Using the equation $N = (D \times L \times (1 + S)) / C$, with $D = 125$ units/hour, $L = 4$ hours, $S = 0.1$, and $C = 50$ units, the optimal number of Kanban cards required to maintain process equilibrium was 11 cards. This setup ensured that each production loop handled 50 semi-finished products per batch, allowing a controlled flow of materials. Before implementation, unregulated flow caused WIP accumulation of around 280 units per day Andrew P Dillon (2021). After Kanban implementation, the flow limitation reduced this accumulation to 150 units, indicating a 46% reduction in WIP.

The decrease in inter-process waiting time from 45 minutes to 20 minutes was calculated by comparing the average lead time between production stages before and after implementing the Kanban system. As each process received materials only when required, idle time and overproduction were minimized, resulting in a 56% reduction. The increase in daily output from 800 to 950 units (+18.7%) was derived from improved process synchronization and reduced stoppages, calculated using the formula: $(950 - 800) / 800 \times 100\%$.

Meanwhile, the defect rate dropped from 5% to 1.8%, showing a 64% reduction, which was the result of Poka-Yoke mechanisms that prevented operator errors. The percentage reduction was calculated as $(5 - 1.8) / 5 \times 100\%$. Automatic temperature control reduced molding defects, fixture sensors minimized incomplete finishing, and barcode verification eliminated label errors (Hernadewita, 2019). These results confirm that the application of 11 Kanban cards and integrated Poka-Yoke mechanisms effectively improved process stability, reduced waste, and enhanced production efficiency at CV. XYZ.

CONCLUSION

The implementation of Kanban and Poka-Yoke systems at CV. XYZ successfully improved production performance in measurable ways. The Kanban system balanced the material flow between production stages, reduced waiting time from 45 minutes to 20 minutes, and decreased WIP by 46%. The daily output increased from 800 to 950 units, demonstrating a productivity rise of 18.7%. Simultaneously, the Poka-Yoke system effectively prevented operator mistakes, reducing the defect rate from 5% to 1.8% and eliminating labeling errors. These improvements validated that the integration of Lean Manufacturing tools can significantly enhance efficiency, quality, and reliability in small-scale plastic manufacturing environments. However, this study was limited to one production line and a short observation period. Future research is recommended to apply Kanban and Poka-Yoke across multiple lines or combine them with other Lean tools, such as 5S or Value Stream Mapping, to further optimize performance and sustainability.

BIBLIOGRAPHY

Adji, B. N. (2020). *PENERAPAN KONSEP LEAN MANUFACTURING UNTUK RANCANGAN USULAN PERBAIKAN MINIMASI WASTE DEFECT DENGAN METODE POKA YOKE PADA PT. TETRA MITRA SINERGIS*.

Pamungkas, G. (2023). *IDENTIFIKASI DAN ELIMINASI WASTE UNTUK MENGURANGI LEAD TIME PADA PROSES PRODUKSI MENGGUNAKAN PENDEKATAN LEAN MANUFACTURING (STUDI KASUS: CILEGON INTERIOR FURNITURE)*.

Hernadewita, H. (2019). *Application Poka-Yoke to Capture Defect (A Case Study in Industry Component Otomotive)*.

Yunastyo, Ir. E. P. (2024). *KANBAN MASTERY Terobosan Revolusioner dalam Pengelolaan Persediaan untuk Meningkatkan Efisiensi Material Inventori*.

Liker, J. K. (2013). *Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw-Hill.

Rother, M. (1999). *Mike Rother - Learning to See Version 1.2 (kanban)_value stream lean*.

Nasional, S., & Ums, R. X. F. (2012). *IDENTIFIKASI WASTE DI PT. BRIDGESTONE TIRE INDONESIA MENGGUNAKAN PENDEKATAN LEAN MANUFACTURING*.

Prasetyo, K. (2025). THE IMPACT OF KANBAN IMPLEMENTATION IN OPTIMIZING MATERIAL PROCUREMENT ON CONSTRUCTION PROJECT TIMELINESS. *Journal of Scientech Research and Development*, *7*(1). https://idm.or.id/JSCR/in

Womack, J. P., & Jones, D. T. (2008). *Zero Quality Control: Source Inspection and the Poka-yoke System*.

Womack, J. P., & Jones, D. T. (1997). Lean Thinking Banish Waste and Create Wealth in your Corporation. *Journal of the Operational Research Society*, *48*(11), 1148–1148. https://doi.org/10.1038/sj.jors.2600967

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