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Applying VALSAT Analysis and Fishbone Diagram in Lean Manufacturing for Gold Jewelry Production

Penerapan Analisis VALSAT dan Fishbone Diagram *Dalam* Lean Manufacturing *untuk Produksi Perhiasan Emas*

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Abstract - This study investigates opportunities to reduce waste in the gold jewelry production process through a qualitative case study approach. Guided by lean manufacturing principles, value stream mapping was used to visualize the production flow and identify various forms of waste based on the seven wastes framework. Input from production personnel was collected via a closed-ended questionnaire to classify key waste types, while root causes were further explored using value stream analysis tools (VALSAT) and fishbone diagrams. The findings reveal critical inefficiencies in the current process, highlighting areas for targeted improvement. These insights form the basis for proposing actionable strategies to enhance operational efficiency and value creation within the gold jewelry manufacturing industry. While lean principles are well-established in conventional manufacturing settings, their application to the gold jewelry production process a sector characterized by artisanal craftsmanship and variable workflows remains relatively limited. This study addresses that gap by adapting and applying lean tools to a traditionally craft-based industry. The integrated methodological approach, which combines value stream mapping, VALSAT, and fishbone diagrams, strengthens the analysis and supports the development of targeted process improvement proposals. These proposals translate lean diagnostics into practical, context-specific recommendations for enhancing efficiency in jewelry manufacturing.

Keywords: Fishbone Diagram, Jewelry Industry, Lean Manufacturing, Value Stream Analysis Tools, Value Stream Mapping.

Abstrak *- Studi ini bertujuan untuk mengidentifikasi dan mengusulkan perbaikan untuk mengurangi* waste *dalam proses produksi perhiasan emas melalui pendekatan studi kasus kualitatif. Dipandu oleh prinsip-prinsip* lean manufacturing*, pemetaan aliran nilai digunakan untuk memvisualisasikan aliran produksi dan mengidentifikasi berbagai bentuk pemborosan berdasarkan kerangka kerja tujuh pemborosan. Masukan dari personel produksi dikumpulkan melalui kuesioner tertutup untuk mengklasifikasikan jenis-jenis pemborosan utama, sementara akar penyebabnya dieksplorasi lebih lanjut menggunakan* value stream analysis tools *(VALSAT) dan* fishbone diagrams*. Penelitian ini mengungkapkan inefisiensi kritis dalam proses saat ini, menyoroti area untuk perbaikan yang ditargetkan. Wawasan ini membentuk dasar untuk mengusulkan strategi yang dapat ditindaklanjuti untuk meningkatkan efisiensi operasional dan penciptaan nilai dalam industri manufaktur perhiasan emas. Meskipun prinsip-prinsip* lean *dalam pengaturan manufaktur konvensional, penerapannya pada proses produksi perhiasan emas, sektor yang dicirikan oleh kerajinan tangan dan alur kerja yang bervariasi, masih relatif terbatas. Studi ini mengatasi kesenjangan tersebut dengan mengadaptasi dan menerapkan alat-alat* lean *pada industri yang berbasis kerajinan tradisional. Pendekatan metodologis terpadu, yang menggabungkan* value stream mapping*, VALSAT, dan* fishbone diagrams*, memperkuat analisis dan mendukung pengembangan proposal perbaikan proses yang terarah. Penelitian ini menerjemahkan* diagnostic lean *menjadi rekomendasi praktis dan spesifik konteks untuk meningkatkan efisiensi dalam manufaktur perhiasan.*

Kata Kunci*:* Fishbone Diagram*, Industri Perhiasan,* Lean Manufacturing, Value Stream Mapping, Value Stream Analysis Tools*.*

INTRODUCTION

Fine jewelry is often regarded as a symbol of luxury, not only in terms of its material composition but also in its multifaceted purposes. Beyond their aesthetic appeal, fine jewelry pieces serve as reflections of the social, religious, cultural, and financial standing of their owners (Jain, 2021). The demand for gold jewelry plays a significant role in the global gold market, accounting for approximately 40-44% of annual consumption. In particular, the Asia-Pacific region stands out as the leading market, with countries such as Indonesia contributing significantly to this demand. In 2023 alone, this region generated 59.9% of global revenue for gold jewelry, a remarkable figure largely attributed to the prevalent wedding culture within these nations, where gold jewelry is a traditional essential (Fortune Business Insights, 2025; Zion Market Research, 2025).

The focus of this research is a white gold accessories company, established in 2000, which operates primarily in Greater Jakarta (Jabodetabek) and Bandung. This company offers a diverse array of products, including both ready-made and custom accessories, as well as maintenance services for jewelry. Currently, it boasts a stock of over 400 finished jewelry items that encompass white gold, yellow gold, diamonds, precious stones, and semi-precious stones. Despite its extensive product offerings, the company faces significant operational challenges, particularly in terms of waste management. Issues such as excessive material shrinkage throughout the production process, prolonged product processing times, and disrupted scheduling have been identified. For instance, production shrinkage has at times reached 15% of raw gold materials, contributing to inefficiencies. Given these challenges, there is a pressing need for innovation aimed at waste reduction and the streamlining of production processes (Mueanglue & Chompu-inwai, 2021). Conducting a comprehensive waste evaluation is essential to prioritize areas requiring improvement and to implement significant changes that will benefit the company in both the short and long term.

To effectively analyze and address waste within the production process, implementing lean manufacturing principles appears to be a highly relevant strategy for the company. The lean manufacturing approach focuses on classifying each stage of the production process according to the value it adds to the final product and the customer (Deshmukh et al., 2022). One effective tool for facilitating waste detection is the value stream map (VSM), which allows companies to visualize their entire production workflow. Through a value stream analysis tool (VALSAT), organizations can systematically analyze the waste identified within the VSM. Additionally, a fishbone diagram can be employed to investigate the root causes of the waste, providing insight into the underlying issues and paving the way for targeted interventions.

LITERATURE REVIEW

Lean Manufacturing

Lean manufacturing is conceptualized as a dynamic process driven by a systematic framework of principles and best practices aimed at fostering continuous improvement (Womack et al., 1990). This methodology fundamentally seeks to optimize resource utilization; it operates with significantly reduced needs compared to mass manufacturing requiring only half of the human resources, production space, equipment investment, and production time (Krafcik, 1988). In the context of today's highly competitive manufacturing landscape, lean manufacturing has emerged as a critical strategy, facilitating reductions in lead times and inventory while simultaneously enhancing quality and overall production productivity (Hines & Rich, 1997).

According to Hines and Rich (1997), Lean manufacturing encompasses three categories of operational activities: value-adding (VA) activities that directly enhance the product's value, non-value-adding (NVA) activities that are deemed wasteful and must be eradicated, and necessary but non-value-adding (NNVA) activities which, while not contributing value, are essential for operational compliance and thus often resistant to elimination.

Waste

Elimination of waste, or "muda," stands as the primary objective of lean strategies (Fabrizio & Tapping, 2006). Waste is defined as any activity that fails to impart value from the customer’s perspective (Jacobs & Chase, 2018). Hines and Rich (1997) categorize waste into seven distinct elements, each of which poses significant challenges in the production process. Overproduction, identified as the most severe form of waste, occurs when output exceeds consumer demand, resulting in excessive inventory and increased costs related to storage and potential product obsolescence. Inventory waste manifests from overaccumulation of materials, constraining capital and necessitating substantial storage facilities.

Defects represent products or services that do not satisfy preset quality standards, while excessive transportation relates to inefficient movement of materials that wastes time and resources. Motion waste pertains to unnecessary physical movement of labor or machinery. Overprocessing arises when non-value-adding steps are incorporated into the workflow, frequently through the excessive use of equipment for simple tasks. Lastly, waiting time is characterized by delays that obstruct workflow, thereby diminishing productivity and leading to wasted resources.

Value Stream Mapping

Value stream mapping (VSM) is a method used to visually represent the entire value stream involved in production processes (Goriwondo et al., 2011). It employs various methodologies to identify and eliminate non-value-adding activities associated with specific product families. The construction of a VSM involves several pivotal steps, including selecting a product family, mapping the current state, conducting an analysis, and mapping the future state (Pathania et al., 2021).

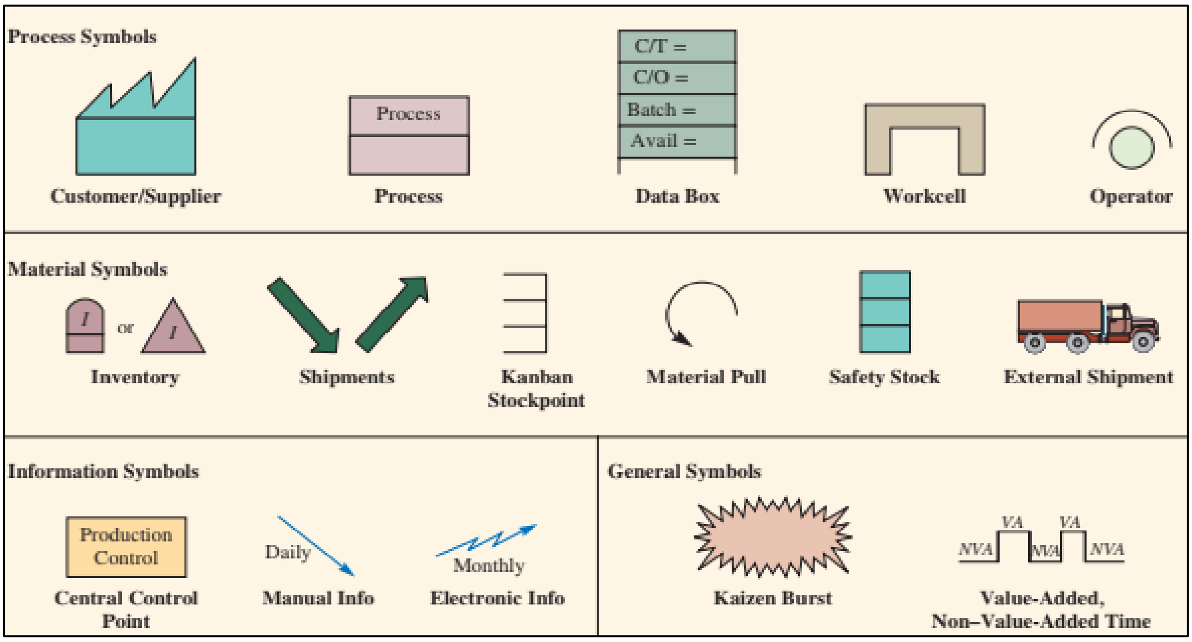

Figure 1. Value Stream Mapping Symbols

Source: Jacobs and Chase (2018).

In the creation of VSM, distinct symbols are employed to enhance clarity (as shown in figure 1). Process symbols convey information about processes, such as production stages or supplier interactions, while material symbols depict product movement and inventory levels. Information symbols illustrate the flow of information through the process, and general symbols represent the time allocations within various stages of production.

The Seven Value Stream Mapping Tools

Hines & Rich, (2005) identify seven fundamental VSM tools that are instrumental in meticulously charting the value stream, with a particular emphasis on value-added processes. The first tool, process activity mapping (PAM), is designed to identify and mitigate waste and inconsistencies within operations, thereby enhancing overall process efficiency. The supply chain response matrix (SCRM) serves a critical role in evaluating timelines and logistics, fostering better alignment of supply chain activities. The production variety funnel (PVF) focuses on minimizing excess inventory while effectively identifying production bottlenecks, facilitating a smoother workflow. Quality filler mapping (QFM) introduces a framework for assessing quality within the supply chain, targeting both product and service defects to improve output consistency. Demand amplification mapping (DAM) is notable for its focus on detecting delays that arise from inaccurate information flow, which can significantly impair operational efficiency. Additionally, decision point analysis (DPA) identifies crucial decision-making junctures within processes, promoting timely and informed decision-making. Lastly, the physical structure tool provides a visual representation of the supply chain's status on an industrial scale, serving as a vital resource for strategic planning and operational oversight.

Value Stream Analysis

Value stream analysis represents a systematic methodology for evaluating the value stream to uncover avenues for improvement through waste reduction and efficiency enhancement. This analytical process enables organizations to pinpoint specific areas ripe for value addition and waste minimization, thereby aligning their operational practices with the core principles of lean manufacturing. The insights derived from value stream analysis empower organizations to optimize their processes effectively, which is crucial for enhancing competitive advantage in dynamic market environments. By integrating value stream mapping and analysis, firms can cultivate a culture of continuous improvement, reinforcing the importance of aligning operational efficiencies with strategic business objectives.

Cause-Effect Diagram (Fishbone Diagram)

Islam et al., (2017) articulate the utility of the fishbone diagram, a visual tool that aids in the identification of root causes for problems, process bottlenecks, and the sources of process failures. This diagram represents problems in a fishbone configuration, with the primary issue illustrated at the 'head' and the contributing factors delineated along the 'bones' (Gartlehner et al., 2017). Central to the fishbone diagram framework are five critical problem factors: man (human resources), machine (equipment), method (work methodologies), material (inputs), and environment (surroundings) (Gaspersz, 2007). While these factors form the foundational structure, practitioners of the fishbone diagram are encouraged to incorporate additional elements such as measurement and management to tailor the analysis to specific contexts, thereby enriching the depth and applicability of their investigations.

RESEARCH METHOD

The methodology employed in this research is characterized as a descriptive qualitative approach, utilizing a case study strategy. Qualitative research is grounded in the researcher’s ability to comprehend and interpret social issues and specific cases, emphasizing the intricacies and nuances of the studied phenomenon. According to Bougie & Sekaran, (2016), descriptive qualitative research is specifically designed to collect data that elucidates the distinctive characteristics of the subject matter. The case study method is particularly advantageous as it facilitates the acquisition of in-depth information about an object, activity, or phenomenon through the application of various data collection techniques, allowing for a comprehensive understanding of the research context (Bougie & Sekaran, 2016).

In this study, primary data were gathered through direct observations of the business processes within the selected company, as well as in-depth interviews involving key stakeholders who possess intimate knowledge of the jewelry production process. Specifically, interviews were conducted with the company’s two owners and a senior employee, selected based on their extensive experience within the organization. This targeted approach ensures that the insights derived are not only relevant but also rich in context. Additionally, secondary data sources were leveraged to complement the primary findings, which included customer demand data, supplier information, details regarding outsourced work, and relevant academic literature. This combination of primary and secondary data serves to enrich the analysis and foster a robust understanding of the operational dynamics within the company under investigation.

FINDINGS AND DISCUSSION

Findings

The subject of this research is a home-based company operating in the jewelry industry, specifically focusing on gold and diamond jewelry, established in 2000 in South Bekasi, West Java, Indonesia. The company not only sells finished jewelry but also offers a range of services, including custom jewelry design, accessory production, and jewelry melting and reshaping services. The production timeline varies significantly depending on the size of the jewelry; small pieces generally require approximately five days, while larger pieces necessitate a timeframe of seven to ten days (Kaspin et al., 2021). This variation in production time is largely attributed to the nature of custom jewelry, which is tailored to meet specific customer requests, including unique designs, size specifications, and types of stones. Consequently, custom orders require a pre-order period of around one to two weeks, depending on the complexity of the design request (Floricel et al., 2016). The company has developed a robust market presence, covering various cities across Indonesia, including Medan, Batam, Pekanbaru, and Papua, with primary operations centered in Greater Jakarta and Bandung.

The production process is systematic and comprises several key stages. The first stage involves jewelry designing, where the company's designers either develop original designs or refine customer-submitted concepts, complete with material usage estimates (Fatma et al., 2021). Following this, material requirements planning takes place, whereby the owner assesses the necessary gold inventory and identifies diamonds to be acquired from suppliers. The subsequent stage involves the actual purchasing of gold, diamonds, and gold alloys needed for production (Ivanov et al., 2021). Once materials have been procured, a design briefing session is conducted, wherein the owner communicates the design specifications to the craftsman. This session entails providing detailed drawings and guidance on the quantity of diamonds and the appropriate amount of gold to be utilized. The initial hands-on production activities commence at the frame processing station, where gold and gold alloys are melted and formed into the basic jewelry frames. This stage includes melting, grinding, bending, and assembling the material into a structured frame. Following frame construction, the next step is the Tumbling and Polishing Station, where the frame undergoes polishing and boiling processes to eliminate dust and create a smooth surface finish. Subsequently, the Stone Filling Station is where the crafted frames are hollowed out to accommodate diamonds. Finally, the production concludes at the finishing post, where a chrome cleaning process is performed to remove any residual production dust, and a comprehensive quality check is conducted on the finished jewelry.

Value stream mapping (VSM) is an essential tool that offers a holistic perspective of an organization's processes, tracing the journey from customer order receipt to the delivery of finished products (see figure 2). This method allows businesses to visualize areas where waste occurs across the full spectrum of operations while concurrently illustrating the interdependencies among various stages within the process (Rother & Shook, 2003). Recent literature emphasizes the significance of VSM in identifying inefficiencies and enhancing operational performance, particularly in manufacturing contexts (Baydoğan et al., 2025). To concretely exemplify such applicability in practice, researchers engaged in comprehensive interviews with the company owner to delineate the production workflow. Complementary direct observations further enriched the understanding of the production dynamics, allowing for the systematic collection of data such as production times and material consumption at each phase (Womack & Jones, 2013).

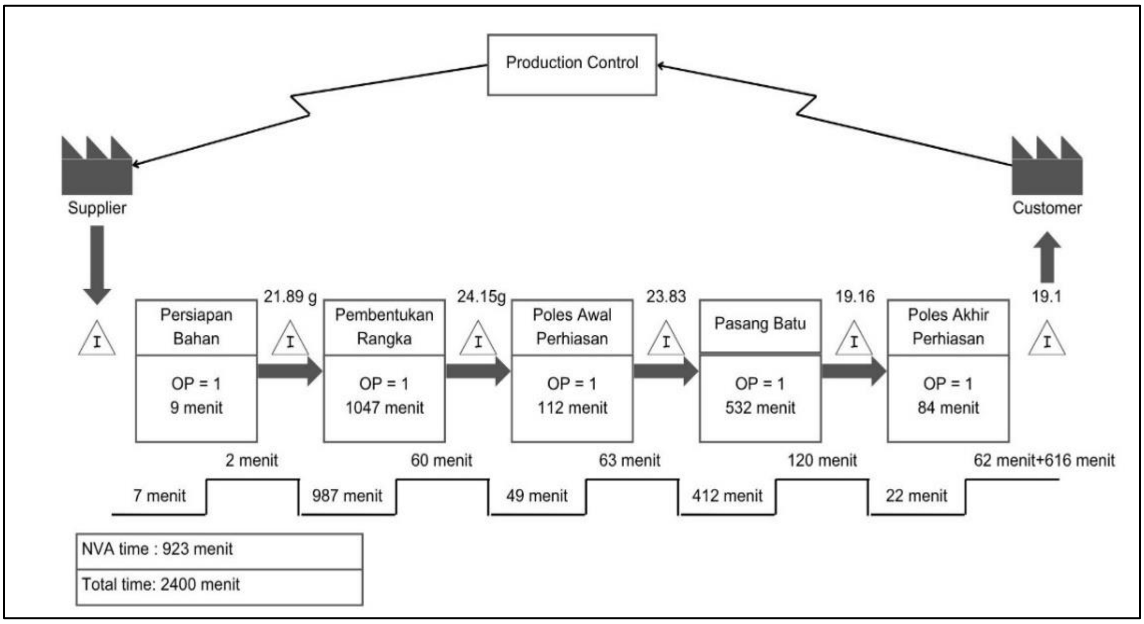

Figure 2. Current Value Stream Mapping of Jewelry Production

Source: Developed by authors (2025).

In the specific case of jewelry production analyzed, the value stream comprises five critical production stations, including: (1) the weighing and material preparation station (station 0), (2) the frame forming station (station 1), (3) the initial jewelry polishing station (station 2), (4) the stone installation station (station 3), and (5) the final polishing and finishing station (station 4). Each production stage encompasses various tasks such as pattern design, material cutting, and finishing processes. This multifaceted workflow is represented in the value stream mapping through distinct box symbols, which convey crucial information including process name, duration, and employee involvement (Hines & Rich, 2005). Additionally, inventory points are indicated using triangular symbols, illustrating, for example, the weight of gold utilized at any stage of the process.

The total lead time for the production cycle is calculated to be 5 working days, equivalent to 2400 minutes. Notably, the standard time required to produce a single product averages 1784 minutes; thereby, there remains a surplus of 616 minutes. This idle time typically accommodates necessary activities such as product repairs in response to quality issues, adjustments arising from design inaccuracies, or the placement of products in finished goods inventory during periods of low demand (Shah & Ward, 2007). A breakdown reveals that, out of the total lead time, 1443 minutes are classified as value-added time, while 34 minutes are considered necessary but non-value-added time. The remaining 923 minutes correspond to non-value-added time, highlighting a substantial opportunity for operational improvement (Mann, 2014). These insights substantiate the argument that systematic application of VSM and lean principles can significantly reduce waste and promote greater efficiency in production processes.

The identification of waste within the gold and diamond jewelry production process was systematically conducted through a structured questionnaire distributed to two company owners. This approach aligns with best practices in waste analysis, leveraging both qualitative and quantitative methods to gain comprehensive insights into production inefficiencies (Womack & Jones, 2013). The results indicated that the most prevalent types of waste identified were waiting activities (19%), overproduction (16%), and defects (16%), followed by other categories such as unnecessary inventory, inappropriate processing, transportation, and unnecessary motion. These findings resonate with the lean manufacturing principles, which posit that the reduction of these specific waste types is crucial for enhancing process efficiency and overall operational performance (Ohno & Bodek, 1988).

Following the identification of these wastes, the study utilized value stream analysis tools (VALSAT) to develop an analytical framework for evaluating the effectiveness of various value stream mapping (VSM) tools. The highest weighted tool identified was process activity mapping (PAM), scoring 5.59. PAM is recognized in the literature as an effective analytical tool that elucidates the cycle time and productivity of information and material flows in production processes (Rother & Shook, 2003). This methodology allows organizations to distinguish between value-added and non-value-added activities, thus facilitating targeted improvements in operational workflows.

Table 1. Process Activity Mapping of Jewelry Production

Stream	Total		
Operation	54	85,38%	
Transportation	8	5,29%	
Inspection	8	0,83%	
Storage	0	0%	
Delay	3	7,50%	
Activties	Total		Time
VA	41	60,13%	1443
NVA	12	38,46%	923
NNVA	20	1,42%	34
Total production time	2400 minutes		
Total materials	Gold 21,89 g and Diamond 0,89 g		
Total shrinkage	Gold 2,79 g or 12,75% of gold		

Source: developed by authors (2025).

The analysis employing PAM revealed that within the small jewelry production activities, 2,400 minutes of total production time were recorded, with only 1,443 minutes (approximately 60.13%) classified as value-added activities. In contrast, the study found that non-value-added activities constituted a significant portion of the time spent, amounting to 923 minutes or 38.46%. This aligns with the findings previous research Dara et al., (2024); Khawka et al., (2024), who emphasized that non-value-added activities can substantially hinder production efficiency and increase costs. Furthermore, the analysis of material waste illustrated a shrinkage of 2.79g of gold, equating to a material waste level of 12.75% of the total gold utilized, which underlines the importance of implementing robust waste management strategies.

Discussion

The results of this study highlight significant opportunities for improvement in the production process of gold and diamond jewelry. By adopting tools within a structured framework, organizations can systematically identify and mitigate waste, ultimately enhancing their operational effectiveness in accordance with lean principles (Shah & Ward, 2007). The integration of theoretical frameworks into practical applications can foster a culture of continuous improvement and operational excellence within the jewelry manufacturing landscape.

In addressing the multifaceted nature of waste in the jewelry production process, the utilization of a fishbone diagram serves as a powerful tool for root cause analysis. This method allows for a comprehensive examination of waste categorized into six distinct factors: man (labor), machine (machinery), measurement (measurement and standards), method (work method), material (raw materials), and environment (work environment) (Gartlehner et al., 2017). Recent literature emphasizes the importance of such analytical frameworks in not only diagnosing inefficiencies but also in formulating targeted intervention strategies that enhance operational performance (Kumar & Singh, 2019; Safrizal et al., 2023; Santosa, 2017; Wurjaningrum & Lenga, 2025).

An essential observation in the production workflow is the occurrence of delayed activities, characterized by prolonged and uncertain durations. The analysis reveals that lead times can be significantly curtailed during the owner's presence in the workshop, however, when the owner is engaged in off-site sales, these lead times tend to exceed estimated timelines. This situation highlights the interplay between manpower and method, particularly where a shortage of labor at critical posts contributes to waiting times. Furthermore, the stringent approval processes while ostensibly designed to maintain quality appear to inadvertently exacerbate delays by limiting the owner's availability. Environmental factors, particularly the physical distance between workshops 1 and 2, further complicate timely production outcomes. This aligns with the theories presented by Womack and Jones (2013), who argue that value stream mapping is vital in identifying and eliminating non-value-adding activities.

Inventory management remains a critical concern for the studied jewelry company, characterized by an excess of over 400 finished goods across varied models. This overproduction issue can be attributed to several factors, including material management strategies aimed at minimizing the risk of loss during rework, a lack of sufficient labor for these rework processes, and an absence of a comprehensive catalog for marketing new designs without necessitating additional production. The relevance of inventory turnover ratios is underscored in contemporary research, as highlighted by Frazelle, (2016), which posits that excessive inventory not only ties up capital but also increases the risk of obsolescence and requires additional storage costs.

In handmade jewelry production, product defects are notably rare due to a rigorous quality control system implemented across each production stage. However, several underlying factors contribute to the occurrence of defects. The traditional briefing system employed by the company often leads to miscommunication, which can adversely affect product quality. Additionally, inadequate maintenance of machinery exacerbates the likelihood of defects arising in the production process. Human errors, often linked to workload saturation, further contribute to this issue. Research by Bouzdine-Chameeva & Krzywoszynska, (2011) indicates that human error can significantly affect production quality, suggesting that optimized workload distribution and enhanced communication strategies are vital in mitigating defects.

The waste analysis conducted within the production process adhered to the principles of lean manufacturing, classifying waste into three primary categories: waiting, overproduction, and defects. Each category was scrutinized through the lens of its causal factors, which include environment, man, method, material, and machine. The findings indicate that addressing these factors significantly enhances operational efficiency by reducing waste.

In the waiting category, major causes of delays were identified that impede workflow. Notably, the environment factor revealed that the considerable distance between workshops 1 and 2 presented a logistical challenge. To enhance efficiency, a reorganization of the workspace specifically dedicated to the stone installation process is recommended. Additionally, issues stemming from the man factor were observed, particularly a shortage of frame-forming workers, which led to bottlenecks in the workflow. Increasing workforce levels in this section can mitigate delays and promote a more seamless operation. From the method perspective, an inefficient approval process emerged as a barrier to workflow continuity. The recommendation to assign a full-time worker to the workshop is aimed at streamlining information flow and expediting the approval process, effectively aligning with the continuous flow principle outlined in lean literature (Womack & Jones, 2013). The proposed workspace reorganization and redistribution of labor not only exemplify efforts to eliminate non-value-adding activities but also embody the Value Stream principle critical to lean manufacturing practices (Henao et al., 2019; Jasti & Kodali, 2015; Sinha & Matharu, 2019).

The overproduction category highlighted waste generated by both overproduction and ineffective recycling processes. Analyzing the materials factor revealed significant potential losses associated with the recycling of old products. Recommendations for improvement include the creation of a comprehensive product catalog, the implementation of scheduled recycling processes, and the restructuring of work processes during gold drilling activities. Furthermore, from a management perspective, labor shortages within the recycling arms of production constitute a significant constraint that could be rectified by augmenting the workforce. Method-related issues were characterized by a mismatch between production volume and market demand, underscoring the necessity for enhanced market research and production control. This strategic orientation aligns with the just-in-time (JIT) and pull concepts, which advocate for production driven strictly by actual demand, thereby preventing overproduction (Lara et al., 2022; Liker, 2004; Pepper & Spedding, 2010). This balanced approach ensures optimal production practices that are both efficient and environmentally sustainable, minimizing excess inventory while reinforcing rapid response and inventory control (Papavassilopoulos et al., 2020).

The final category, defects, encompasses waste arising from defective products. Under the machine perspective, reliance on aging machinery was identified as a significant risk factor contributing to production failures. Regular maintenance scheduling is recommended to enhance machine reliability and performance. From the human perspective, excessive workloads were identified as a primary contributor to errors, indicating the necessity for workforce expansion to alleviate pressure on existing employees. This dual-focused approach addresses the principles of automation and standardized work, as articulated in the toyota production system (TPS), which includes automatic process halting upon defect occurrence and the establishment of work standards to optimize human and machine workloads (Arunagiri & Babu, 2013). Addressing method-related inefficiencies, particularly an ineffective briefing system, also emerged as crucial for mitigating miscommunication during task execution. Implementing effective briefings, supported by visual media, adheres to visual control practices in lean manufacturing (e.g., andon, visual boards) and enhances worker awareness, facilitating early problem identification and quality assurance. This is congruent with the application of Poka-Yoke methodologies to prevent errors in the early stages of production (Khadar, 2018; Palange & Dhatrak, 2021).

In addressing the identified inefficiencies through workforce augmentation in the waiting, recycling, and defect categories, the company aims to minimize overburden (muri) and unevenness (mura), key concepts in TPS that contribute to waste (Abu Bakar et al., 2022). The active involvement of employees in briefings and process improvement initiatives exemplifies the Kaizen philosophy of continuous improvement, emphasizing direct observation and team participation at the gemba level (Palange & Dhatrak, 2021; Shingo & Dillon, 1989).

In conclusion, the thorough identification of waste root causes, coupled with the implementation of targeted improvement proposals, shows promise for significantly enhancing production process efficiency. This analytical approach serves as a vital element of a continuous improvement strategy in manufacturing environments, establishing a foundation for sustainable operational excellence.

CONCLUSION

This study analyzes a home-based gold and diamond jewelry company located in South Bekasi, Indonesia, operating since 2000. The company produces both ready-made and custom jewelry, with production times ranging from five to ten days depending on the complexity of the order. Using value stream mapping (VSM), the study mapped five key production stages: material preparation, frame forming, initial polishing, stone installation, and final finishing. The analysis revealed that only 60.13% of the total 2,400-minute lead time was value-added, while 38.46% constituted non-value-added activities, indicating significant inefficiencies within the production process. To further assess these inefficiencies, value stream analysis tools (VALSAT) were employed, with process activity mapping (PAM) identified as the most effective tool. PAM revealed substantial time and material waste, including a gold loss of 2.79 grams or 12.75% of total usage. A root cause analysis using fishbone diagrams categorized the sources of waste into six factors: man, machine, method, material, measurement, and environment. Waiting times were linked to labor shortages, inefficient approval processes, and workshop distance; overproduction stemmed from weak market alignment and recycling inefficiencies; and defects were caused by miscommunication, equipment wear, and worker fatigue. The study concludes that significant operational improvements are possible through the implementation of lean manufacturing and Toyota production system (TPS) principles. Recommendations include reorganizing the workspace, expanding the workforce, improving maintenance and scheduling, and adopting visual communication tools. Integrating these approaches with continuous improvement strategies such as Kaizen, Poka-Yoke, and just-in-time (JIT) can enhance efficiency, reduce waste, and improve overall production performance in the handmade jewelry sector. The identification of waste within jewelry production through a structured root cause analysis reveals several interrelated factors influencing operational efficiency. It becomes evident that targeted interventions focusing on manpower management, inventory optimization, and enhanced communication can lead to substantial improvements in the production process. Future research should continue to explore the dynamic interplay between these factors to further refine the operational capabilities of handmade jewelry companies.

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