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# *Cycle Time Study in Improving Production Output in the Garment Industry Sewing Line*

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**Abstract.** The garment industry is one of the fastest-paced production environments, where speed and accuracy are crucial for meeting global customer demand. Cycle time plays an important role in satisfying the speed factor as it represents the overall time needed to produce a single piece of a product. Maintaining an appropriate cycle time is key to achieving production line balance. This study aims to analyze the cycle time of men's jacket production on a sewing line in an Indonesian garment industry by comparing the actual cycle time with the standard cycle time based on the operation breakdown for each production process step. Four significant discrepancies in actual cycle time are identified, ranging from 16% to 95%, indicating that the actual cycle time was significantly longer than the standard cycle time. The root cause of the highest cycle time is analyzed using Fishbone and 5 Whys analysis to understand the problem from each factor and sub-factor. Six improvement action plans are proposed and implemented, resulting in a 57.81% reduction in actual cycle time, from 127.66 seconds to 53.85 seconds, making it 17.66% faster than the standard cycle time. Furthermore, the total output per hour increased by approximately 216.67%, from 12 pieces to 38 pieces. This result implies that the study successfully identified the root of the problem on the sewing line and managed to increase production output.

**Keywords:** Cycle time; Fishbone diagram; Five whys analysis; Garment industry; Production output

## 1. Introduction

The garment industry in Indonesia is one of the sectors that absorb a significant amount of labor. According to data from the Central Bureau of Statistics in 2022, the garment industry employs 2% of the workforce in the manufacturing sector. This industry plays an important role in national revenue and global competition. As of early 2024, the textile and garment industry

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contributes 5.8% to the non-oil and gas GDP. Additionally, the growth rate of the textile and garment industry in the first quarter of 2024 is 5.92% compared to the fourth quarter of 2023. The rapid development of the garment industry in Indonesia requires companies to compete in both product quality and production efficiency. The challenge of production efficiency is constantly faced by the garment industry, especially in the sewing line, which is the main area in garment manufacturing. Therefore, studies to improve efficiency and productivity in the sewing line, such as focusing on cycle time, are still needed.

PT Garmen is one of the garment industries producing ready-to-wear clothing such as men's shirts, pants, kids' wear, dresses, jackets, and more. These products are marketed both domestically and internationally. For international markets, PT Garmen must compete in terms of quality, production speed, and timely delivery according to buyer demands and standards. One of the products marketed internationally is the men's jacket with the Kurabo San style.

To meet the demands for production speed and timely delivery, PT Garmen establishes a standard production cycle time outlined in the operation breakdown. The operation breakdown is a method of preparing a sequential list of operations on a single page. This operation breakdown includes information such as sewing and non-sewing operations, the name of the machines used, and estimated time for each operation (Puranik & Patel, 2021). Cycle time is the interval required to produce one unit of product from start to finish. The condition for this cycle time is that it must not be shorter than the slowest workstation's production time (Alam et al., 2022). If this condition is not met, the production line balance will not be achieved. Variations in cycle time calculation can be influenced by the differing skills of operators in performing the production process (Larasati & Laksono, 2022).

Based on observations in line B1, there is a discrepancy between the cycle time in the operation breakdown and the actual cycle time in the field. The highest discrepancy occurs in the "Attaching sleeve lining" process, with the operation breakdown stating 65.40 seconds while the actual field value is 127.95 seconds. The actual output is 12 pieces per hour, whereas according to the operation breakdown, the output should be 31 pieces per hour with a production period of 5 days for a total production of 1000 pieces.

Several studies on cycle time and standard time in the garment industry have been conducted. The standard time as an analysis of actual processes in garment preparation was conducted using the stopwatch method by the Industrial Engineering Department (Yudhistira et al., 2022). Cycle time can also be predicted using neural networks, as applied by Cao and Ji (2022). Cycle time is used by Oktyajati et al. (2023) as a reference in calculating throughput time to analyze productivity in garment production using a one-piece flow system. One-piece flow is a lean manufacturing method focusing on completing one item before starting another. Kurnianingtias et al. (2021) also analyzed bottlenecks in waistband production in the textile industry. The study found that bottlenecks occur because one production process has a cycle time longer than the takt time. Takt time is the time needed to produce one unit of product based on customer demand speed (Sugiyarto et al., 2021). Improvements were made using Kaizen, reducing the cycle time by 30%, thus achieving production line balance. Jadav et al. (2017) used time study as a basis for productivity improvement in making leggings and shirts.

This study analyzes the cycle time differences in producing the men's jacket Kurabo San style between the operation breakdown and actual cycle time. The factors causing cycle time differences in the sleeve lining attachment process are analyzed, and recommendations are made to reduce the actual cycle time, bringing it closer to the operation breakdown time. The objective of this study is to analyze cycle time differences and propose problem-solving recommendations to improve efficiency and strengthen the garment industry's competitiveness in the global market.

## 2. Methods

This study observes and analyzes the cycle time in the production process of Men's Jackets at PT Garmen. The cycle time in this production process is divided into two categories: the cycle time established in the Operation Breakdown (OB) and the actual cycle time occurring on the production line. The OB cycle time is determined by the Engineering Prepare Department during the creation of the men's jacket product sample before mass production is undertaken by the Sewing Department. This OB cycle time value serves as the standard cycle time that must be met for each stage of the production process. Observations are then made on the actual cycle time during the mass production of men's jackets. The cycle time for each production stage is calculated and then compared with the OB cycle time to determine the percentage difference. The four highest cycle time discrepancies in the men's jacket production process are identified. The percentage differences in cycle time are calculated using the method described in Formula 1.

$$Percentage\ difference = \frac{actual\ cycle\ time\ value}{operation\ breakdown\ cycle\ time\ value} \times 100\% \qquad (1)$$

The process with the highest cycle time discrepancy between the operation breakdown (OB) and the actual time will be further analyzed using one of the seven tools methods, the Fishbone Diagram. The Fishbone Diagram is used to identify the causes of a problem based on man, machine, method, material, and environment (Neyestani, 2017). The Fishbone Diagram is also frequently used to solve production process issues, particularly in the textile and garment industry, such as in yarn production (Afifuddin, 2020) and women's sportswear production (Kurnianingtias et al., 2022). To deepen the analysis, the 5 Whys analysis will be employed, continually asking "why"—typically five times—to determine the cause of nonconformity (Kasanah & Suryadini, 2021). This 5 Whys analysis will reveal the root cause of each failure or contributing factor (Khairunnisa et al., 2022). The 5 Whys analysis will be conducted for each factor: man, machine, method, material, and environment, analyzing each sub-factor until the root cause is identified. Improvement actions will be proposed for each identified root cause. These corrective actions will be implemented in the production line, followed by a recalculation of the cycle time after the improvements. The production output and process cycle time post-improvement will be compared to the cycle time before the improvements to measure the effectiveness of the proposed solutions.

## 3. Result and Discussion

The issue addressed in this study occurs in the production process of men's jackets. Observations over a period of 7 days reveal a significant discrepancy between the predetermined cycle time (cycle time from the operation breakdown) and the actual cycle time in the production line. The four most significant time discrepancies in the men's jacket production process are presented in Table 1.

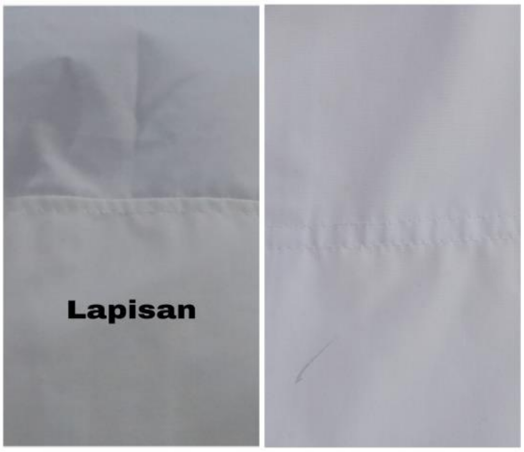
**Table 1** Cycle time

| No | Process | Operation Breakdown (second) | Actual condition (second) | Difference (%) |
|---|---|---|---|---|
| 1 | Stik Pasang Lapisan Lengan *k/k* | 65,40 | 127,66 | 95% |
| 2 | Stik Krah | 22,31 | 39,12 | 75% |
| 3 | Blabar Lapisan Zipper + Jepit Zipper | 39,60 | 62,07 | 56% |
| 4 | Blabar Pasang Zipper Pada Lapisan | 74,94 | 87,58 | 16% |

Source: *Engineering Preparation Department*, 2022

The cycle time in the operation breakdown is predetermined by the Engineering Preparation Department. The percentage differences shown in Table 1 were calculated using the formula mentioned in the methods section. The output recorded during data collection was 12 pieces per hour, whereas the operation breakdown data indicates that the output should be 31 pieces per hour over a five-day production period. Table 1 reveals that the highest discrepancy occurs in the "Stitch Sleeve Lining" process, with a calculated cycle time of 127.66 seconds. This results in a time difference of 95% from the predetermined cycle time of 65.40 seconds. This significant discrepancy must be addressed promptly to ensure smooth production line output.

The "Stitch Sleeve Lining" process involves sewing the lining fabric to the sleeve fabric. In this case, the men's shirt is made from 65% polyester and 35% cotton for the main fabric and 100% cotton for the lining. The stitching process for the sleeve lining is depicted in Figure 1. The actual cycle time observed by Engineering Preparation for the "Stitch Sleeve Lining" process was 127.66 seconds, as detailed in Table 2.




Source: Data *Sewing Line* B1, 2022

**Figure 1** Stitching on Sleeve Lining

**Table 2** Cycle time calculation for sleeve lining stitch installation

| ***Time Observation* (second)** | | | | | | ***Rate* (*x*) second** | **Performance (*P*)+1point** | ***Normal Time* (*x.P*) second** |
|---|---|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | | | |
| 169,6 | 169,88 | 164,84 | 168,40 | 167,2 | 167,92 | 167,97 | 0,76 | 127,66 |

Source: *Engineering Preparation Department*, 2022

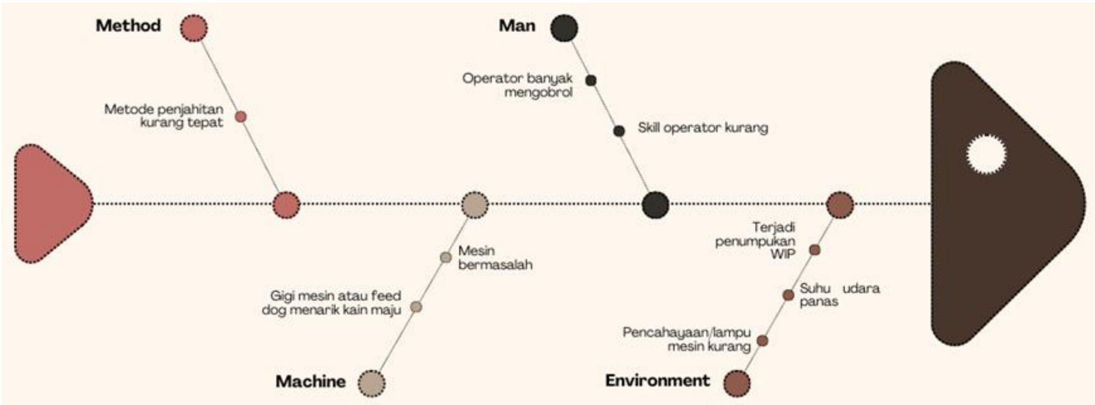
To obtain the time observation, Engineering Preparation conducted six cycle observations. The cycle time calculation starts when the operator picks up the component and ends when they pick up the next one. The average rate of the "Stitch Sleeve Lining" process is derived from these six cycles. This rate is then multiplied by the performance value. At PT Garmen, the Engineering Preparation Department uses the Westinghouse method with an additional 1-point rating to determine the performance value. Multiplying the average rate by the performance value yields the normal time for the process in seconds. The calculation method used at PT Garmen to determine normal time is shown in Table 3.

**Table 3** Determining normal time

| | **Formula** |
|---|---|
| Nilai *Rate* | $\frac{Sum\ of\ 6\ Cycle\ Observations}{Number\ of\ Cycles}$ |
| *Normal Time* | $Rating\ value \times Rating\ performance$ |

Source: *Engineering Preparation Department,* 2022

The observations indicate that the issue arises from the operator taking too long to handle the fabric. The handling involves adjusting the lining fabric while sewing to ensure neat stitching and prevent twisting. Several other factors influencing this issue include method, man, machine, and environment. A fishbone diagram in Figure 2 illustrates the root causes of this problem.




Source: Personal data, 2022

**Figure 2** Fishbone diagram

The factors causing the cycle time calculation difference in the "Sleeve Lining Stitch" process are shown in Table 4. Root cause analysis using the 5 Whys tool for each contributing factor is detailed in Table 5.

**Table 4** Factors contributing to issues

| Factors | Factors Contributing to Issues |
|---|---|
| Method | **Improper Stitching Method:** During the initial production of sleeve lining stick installation, the guide was placed on the left side of the machine foot, 10mm away from the machine needle. This caused the final stitch size to differ from the sample. The sample stitch size was 10mm, but due to the incorrect method used by the operator, the stitch size became 12mm-15mm. Before correction, the operator took a long time to adjust the stitch size to match the sample. |
| Man | **Lack of Operator Skill:** The operator is new and not accustomed to sewing jacket styles, as the B1 line is specialized in Blazer production. This caused the operator to take longer to complete the Kurabo-San style. Additionally, the operator was slow and cautious during the sewing process due to inexperience.<br><br>**Excessive Talking:** Operators often engaged in conversations during the sewing process, leading to inefficient time usage and impacting the line's target output. |
| Machine | **Incorrect Machine Setting:** During the first sewing attempt, the machine feed dogs pulled the fabric, resulting in twisted stitches. Before the machine was adjusted, the operator had to handle the fabric carefully to avoid twisting, which took additional time. |
| Environment | **Work In Process (WIP) Accumulation:** The accumulation of WIP restricted the operator's movement, requiring careful handling of the lining and sleeve fabric. The raglan sleeve type used in this style added complexity as the sleeve was already attached to the jacket.<br><br>**Insufficient Machine Lighting:** The production of this men's jacket involved white fabric, necessitating higher light levels to see the stitches clearly. Poor lighting made the operator spend more time ensuring accurate stitching to avoid mistakes.<br>**Hot Room Temperature:** The B1 line at PT Garmen is adjacent to the finishing area with pressing machines, causing the air to be warm due to steam from the boiler. This discomfort caused operators to frequently stop to wipe sweat, leading to motion waste that affected the cycle time. |

**Table 5** *Whys analysis*

| Factors | Sub factors | Why 1 | Why 2 | Why 3 | Why 4 | Why 5 |
|---|---|---|---|---|---|---|
| Method | Improper stitching method | Stitch size does not match the sample | Incorrect guide placement distance | No tool to determine guide placement | No specific SOP for guide placement | Lack of awareness of stitching method details |

| Factors | Sub factors | Why 1 | Why 2 | Why 3 | Why 4 | Why 5 |
|---|---|---|---|---|---|---|
| | | | Incorrect sewing foot type | No SOP for sewing foot type for different fabrics | Lack of awareness of stitching method details | |
| Man | Insufficient operator skill | Operator's sewing speed is slower | Operator is not used to sewing jacket styles | Operator previously worked more on Blazer styles | Operator is new | |
| | Exccesive talking | Lack of operator discipline | Incomplete implementation of sewing SOPs by operators | Insufficient SOP supervision and evaluation by team leader | Inadequate SOP dissemination and guidance on proper sewing processes | |
| Machine | Machine problems | Feed dogs pulling the fabric, causing twisted stitches | Improper feed dog setting | Insufficient routine machine maintenance | Mechanics are not thorough in ensuring all feed dogs function properly | |
| Environment | Insufficient machine lighting | The fabric being sewn is white, requiring higher light levels to see the stitches | Operator did not promptly request a mechanic to replace the light | Uniform machine lighting for all fabric colors | No standards and specifications for lighting levels for different fabric colors | |
| | Hot room temperature | Air mixed with steam from the boiler in the finishing area next to the sewing line | No specific temperature control for the area around the finishing section | No additional cooling devices like AC or fans | Room temperature is not well-standardized | |
| | WIP accumulation | Many components are not yet sewn | Components require extra handling, taking longer to process | Components being sewn are raglan sleeves (extending fully to the collar) | | |

After identifying and analyzing the root causes of the cycle time discrepancy in the sleeve lining stitch process, improvement suggestions are provided in Table 6. Implementing these suggestions led to a reduction in cycle time for the sleeve lining stitch process, as shown in Table 7.

**Table 6** Corrective actions analysis

| Factor | Sub factor | Cause | Resolution |
|---|---|---|---|
| Method | Improper Stitching Method | Lack of method detail awareness | Change the guide placement from the left to the right side of the presser foot, 10mm from the needle, using the CR 3/8 sewing foot for this style and material. |
| Man | Insufficient Operator Skill | New operator | New operators should undergo training and receive guidance from sewing staff, leaders, engineering prepare, and sample team on efficient stitching methods. |
| | Excessive Talking | Lack of SOP awareness and guidance | Issue warnings and emphasize the importance of following sewing SOPs and staying focused to meet output targets. |
| Environment | Insufficient Machine Lighting | No specific lighting standards | Develop standards for lighting levels for different fabric colors and ensure operators promptly request lighting adjustments. |
| | Hot Room Temperature | Unregulated room temperature | Monitor and adjust room temperature according to set standards, adding fans to cool the B1 line area if necessary. |
| Machine | Machine issues | Inadequate mechanical adjustments | Mechanics should adjust the feed dogs to prevent fabric pulling and twisting. |

Source: Personal data, 2022

Table 7 presents the cycle time data for the sleeve lining stitch process after implementing the improvement suggestions in Table 6. The cycle time decreased from 127.66 seconds to 53.85 seconds, a reduction of 57.85%. This improved cycle time is also 17.66% faster than the standard cycle time from the operation breakdown. Implementing the solutions in Table 6 took three days and resulted in a significant increase in hourly output on line B1, from 12 pieces per hour to 38 pieces per hour, a 216.67% increase.

**Table 7** Final cycle time calculation data

| Time Observation (second) | | | | | | Rate (*x*) second | Rating Perform (p) +1 | Normal time (*x.p*) second |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | | | |
| 57,91 | 59,21 | 58,80 | 58,22 | 58,81 | 58,29 | 58,54 | 0,92 | 53,85 |

Source: Personal data, 2022

## 4. Conclusions

This study observes and analyzes the production cycle time of men's jackets on the sewing line of a garment industry. Four stages of the production process were examined, with the most significant discrepancies between the standard cycle time and the actual cycle time ranging from 16% to 95%. The actual cycle time was substantially longer than the standard cycle time, indicating issues within the production line. Fishbone and 5 Whys analyses were utilized to identify the causes and root problems of the high actual cycle time, particularly in the sleeve attachment process. Six corrective actions were proposed and implemented, resulting in a 17.66% reduction in cycle time for the sleeve attachment process, achieving faster than the standard cycle time. Additionally, the hourly output of the production line increased by 216.67%. This demonstrates that addressing production line issues by identifying root causes can not only reduce cycle time but also enhance productivity. The findings of this study are expected to serve as a reference for reducing production cycle time and resolving issues in garment production lines specifically, and in other industrial sectors generally. However, the corrective actions in this study focused solely on one production stage with the most significant cycle time discrepancy, without considering the entire production process. Therefore, further studies are recommended to conduct a comprehensive assessment of all stages of the process, considering value-added and non-value-added activities, as well as waste found in the production process. Implementing lean manufacturing techniques throughout all production stages could be done to identify and reduce waste.

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