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# Optimization of Production Process Activities in an Effort to Increase the Production Capacity of BZ 020 Cover Housing

Muhammad Syahrul Akmal[1], Orlanda Arya Hidayat[1], Moch Solikin[1*]

[1]Department of Mechanical and Automotive Engineering, Faculty of Vocational, Universitas Negeri Yogyakarta, Kulon Progo, Yogyakarta 55652, Indonesia

*Corresponding author: moch_solikin@uny.ac.id

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**ABSTRACT**

The objectives of this study are: (1) To optimize the production process activities of Cover Housing BZ 020 production by implementing an 8-step improvement to increase production capacity. (2) To determine the comparison of the production capacity value of Cover Housing BZ 020 before and after the improvement. (3) To determine the activities that can be optimized to increase the production capacity of Cover Housing BZ 020 production. The method used in this research is the 8-step improvement research method approach. The data collection techniques used are (1) Observation and (2) Documentation. Meanwhile, the research instruments used are (1) Logbook, (2) Observation Sheet, and (3) Cellphone. The data analysis used is descriptive, comparing production capacity and operator activities. The results of this study indicate that: (1) Implementation of the 8-step improvement can be done at PT. Gemala Kempa Daya and is in accordance with the applicable standard SOP. (2) The results obtained after the improvement of production capacity are from 360 units/hour to 468 units/hour, or an increase of 30%. As a result of this improvement, the company also recorded a profit of IDR 55,800,000.00 per year. (3) By adding an extension conveyor, it can shorten the duration of two of the four operator work activities. The decrease in cycle time from 10 seconds to 8 seconds is due to optimizing work activities.

## 1. Introduction

Indonesia is a country with rapid digital technology development in Southeast Asia. This rapid development has greatly influenced the economy in various fields. One sector that has benefited from advances in digital technology is the automotive industry. Digitalization has had a significant impact on several industries, including the automotive sector [1]. Advances in digital technology in the era of globalization have been very beneficial across various fields. With the conveniences provided by digital technology, many new companies have emerged. According to data from the Central Statistics Agency in 2022, the number of micro and small companies in the Motor Vehicles, Trailers, and Semi-Trailers field increased by 846 companies from the previous year. The impact of globalization is that many companies are working together, thereby increasing business competition [2].

Despite the development of the automotive industry in the era of globalization, the need for transportation, driven by people's increasing mobility in daily life, has become an important factor in competition among automotive companies. People's mobility between locations is increasing, resulting in a greater need for transportation [3]. This is because companies will face an increase in demand each year. This is reinforced by data from the Indonesian Motor Vehicle Industry Association (Gaikindo), which reports that domestic car sales increased by 11.8% in 2023. The increase in car sales is an opportunity for automotive companies, especially car manufacturers, to market their vehicles. Therefore, every company needs the right business strategy to compete and excel against competitors [4]. The increase in vehicle

demand at each sole brand agent company (ATPM) also affects demand at vendor companies. In this case, companies must continue to meet consumer demand to maintain consumer satisfaction and loyalty [5]. To meet consumer demand, companies, both regionally and globally, must produce superior products or services [6].

PT. Gemala Kempa Daya is a company engaged in the manufacture of frame chassis and press products for the underbody of four-wheeled vehicles. Several customers with well-known vehicle brands, such as HINO, Toyota, Mitsubishi, and many others, place their complete trust in PT. Gemala Kempa Daya to supply the components needed for vehicle production. Based on 2023 customer demand data, there has been an increase from 7,880,048 units in 2022 to 8,069,429 units. This increase in demand will impact existing production capacity.

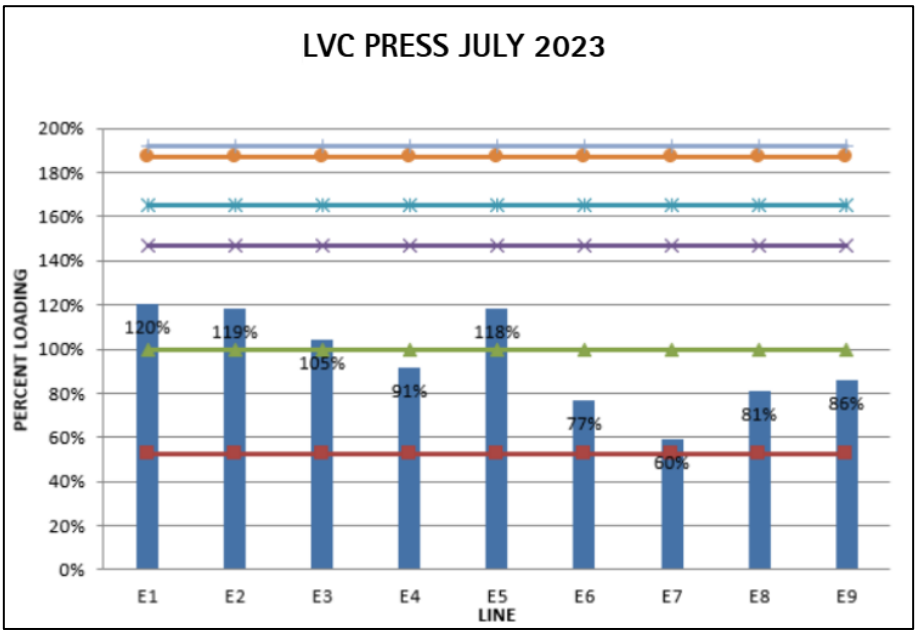


**Figure 1.** Loading vs. Capacity (LVC) line Stamping graph for July.

Based on the loading vs. capacity on Fig. 1, in July 2023, four machines on the stamping line had loading times exceeding the prepared time capacity. The two machines with the highest production hours were E1 and E2. As a result, the company needed to spend more money to provide additional wages to employees for performance outside working hours. Not only that, but the company also needs to spend more money to support production during overtime hours. Adding overtime hours can lead to a decline in productivity due to several factors, including disruptions to operator health, reduced workforce capabilities, and disruptions to project resources [7]. Machines E1 and E2 are designed with a tandem line layout. Therefore, the products manufactured on both machines are not significantly different. With the highest production time, the following is the total production time per product on machines E1 and E2 in July 2023.

**Table 1.** Total Production Time for Products on Machines E1 and E2

| No | Product Name | Quantity Requested (pcs) | Cycle Time (s) | Total Production Time (h) |
|---|---|---|---|---|
| 1 | BRKT, ENGINE FR MTG, 2 RH/LH | 3,366 | 18 | 17 |
| 2 | Gusset C/MBR No. 6 (51361-EW011) | 3,000 | 11 | 9 |
| 3 | GUSSET 43 | - | 12 | 0 |
| 4 | Reinforced Rear Axle Housing (BZ050) | 13,508 | 9 | 34 |
| 5 | BRKT, ENGINE FR MTG, 1 | 2,200 | 12 | 7 |
| 6 | Cover Housing 640 SUV | 5,601 | 19 | 14 |
| 7 | C/M 101 | 274 | 12 | 1 |
| 8 | Cover Housing D16D/BZ020 | 18,037 | 10 | 50 |
| 9 | Bumper Stopper | - | 12 | 0 |
| 10 | Gusset C/MBR Frame No. 3 | 2,796 | 12 | 9 |
| 11 | Housing RR Axle Upper/Lower MPV | 7,873 | 15 | 33 |
| 12 | C/MBR FRONT (51211-0W020) HMMI | 754 | 14 | 3 |
| 13 | Gusset C/M No. 3 FE 73/74/75 | 5,050 | 14 | 20 |
| 14 | C/MBR, AUXILIARY (MK305222FM) | 200 | 14 | 1 |
| 15 | Reinforced Rear Axle Housing (BZ070) | 8,369 | 10 | 23 |

Table 1 shows the results of calculating the total production time for several products manufactured by machines E1 and E2 in July 2023. Based on the above data, an analysis was conducted to identify the factors most influencing production time. The tool used is the Pareto Diagram. This diagram helps management to immediately determine which areas require extra care and attention at this time [8]. The following is a data analysis using the Pareto Diagram on Fig. 2.

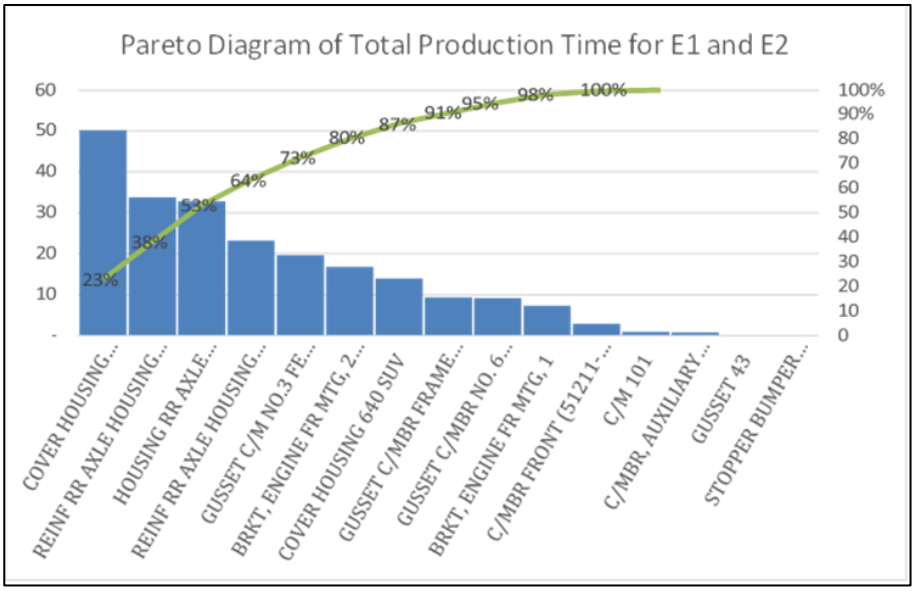


**Figure 2.** Pareto Diagram of Total Production Time for Machines E1 and E2

In the diagram above, Cover Housing BZ 020 has a total production time of up to 50 hours in one month. Therefore, improvement will be achieved by reducing the cycle time for Cover Housing BZ 020. This has a significant impact because demand for Cover Housing BZ 020 products is highest each month.

## 2. Methodology

### 2.1 Type of Research

The research method used is action research. Adopting the seven types of action research described by [9], Development Action Inquiry is the use of scientific methods in everyday life, emphasizing individual development to collaboratively solve problems. In this case, the research method will also use the 8-step improvement tool. This method consists of steps found in Quality Control Circle (QCC) activities, which are often used to empower all company assets to improve quality and productivity, add value, and increase company profits. The 8-step improvement method is the standard SOP used at PT. Gemala Kempa Daya.

### 2.2 Research Procedure

The 8-step process is grouped into Plan, Do, Check, Action (PDCA), with steps one to five in the plan, step six in the do stage, step seven in the check stage, and step eight in the action stage [9]. Table 2 show the following are the steps in the 8-step improvement.

**Table 2.** 8-step improvement steps

| Group | Steps |
|---|---|
| Plan | Determine the Theme |
| | Determine the Target |
| | Analyzing Existing Conditions |
| | Cause and Effect Analysis |
| | Mitigation Plan |
| Do | Mitigation |
| Check | Evaluation of Results |
| Action | Standardization and Follow-up |

### 2.3 Research Location and Time

The research was conducted at PT. Gemala Kempa Daya Plant Karawang, located at Kawasan Indotaisei Blok P4, Dawuan, Kalihurip, Cikampek, Karawang, West Java 41373. This research was conducted from September to December 2023.

### 2.4 Data Collection Methods and Instruments

The data collection methods used in this study were observation and documentation. The observation method was used to collect data on the production process cycle time and to document field conditions. Meanwhile, the documentation method focused on collecting data in the form of company documents and images. The observation and recording data collection methods were used to assess the quality of the collected data [10].

The data collection instruments used in this study were logbooks, observation sheets, and mobile phones. Logbooks were used to record progress at each step of the 8-step improvement process. Observation sheets were used to record the results of cycle time data collection. Mobile phones were used to record the production process of Cover Housing BZ 020.

## 2.5 Data Analysis Techniques

The analysis used for the implementation of the 8 steps of improvement focuses on monitoring the progress of the steps taken. Monitoring is carried out by providing an assessment of compliance with the standard SOPs applicable at PT. Gemala Kempa Daya regarding their implementation. The results of the improvement are analyzed by comparing the production capacity values before and after the improvement. The technique for analyzing the results of work activity optimization is to compare work activities before and after the improvement.

## 3. Result and Discussion

### 3.1 Result

#### 3.1.1 Implementation of the 8 Steps Improvement

The analysis used for the implementation of the 8 steps of improvement focuses on monitoring the progress of the steps taken. Monitoring is carried out by providing an assessment of compliance with the standard SOPs applicable at PT. Gemala Kempa Daya regarding their implementation. The results of the improvement are analyzed by comparing the production capacity values before and after the improvement. The technique for analyzing the results of work activity optimization is to compare work activities before and after the improvement. The target is determined based on the SMART method (Table 3).

**Table 3.** Setting SMART Targets

| | | |
|---|---|---|
| 1 | Specific | Increasing capacity production Cover Housing BZ 020. |
| 2 | Measurable | Reducing cycle time from 10 seconds to 8 seconds. |
| 3 | Achievable | Previous improvements have been made, and the target has been achieved. |
| 4 | Reasonable | Improvements are needed, or overtime hours will continue to increase. |
| 5 | Time Base | The research period is 4 months, from September to December. |

In this step, Standard Worktable data and actual Cycle Time data were collected, and the root causes of the problems were identified (Fig. 3). The results showed that there were non-value-added work activities that could be improved. Among these were back-and-forth movements when picking up products from the process and placing them on the conveyor.

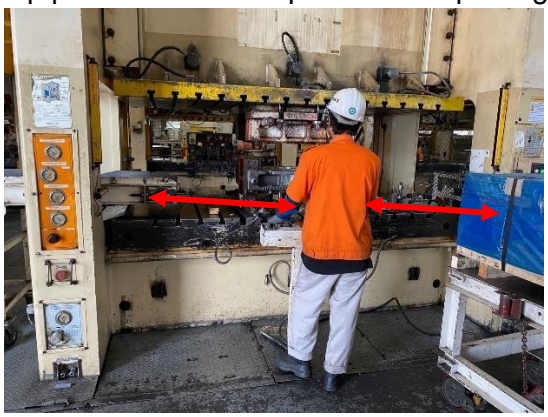

**Figure 3.** Actual Conditions of OP 10

Create a countermeasure plan using the 5W+2H method as shown in Table 4.

**Table 4**. 5W + 2H Countermeasure Plan

| | |
|---|---|
| **What** | Distance between dies and conveyor is 620 mm. |
| **Why** | A stepping motion is required when handling products onto the conveyor. |
| **How** | An extension conveyor is created. |
| **Who** | Syahrul. |
| **When** | October 5, 2023 |
| **Where** | E1 Press Machine |
| **How Much** | IDR 0-, |

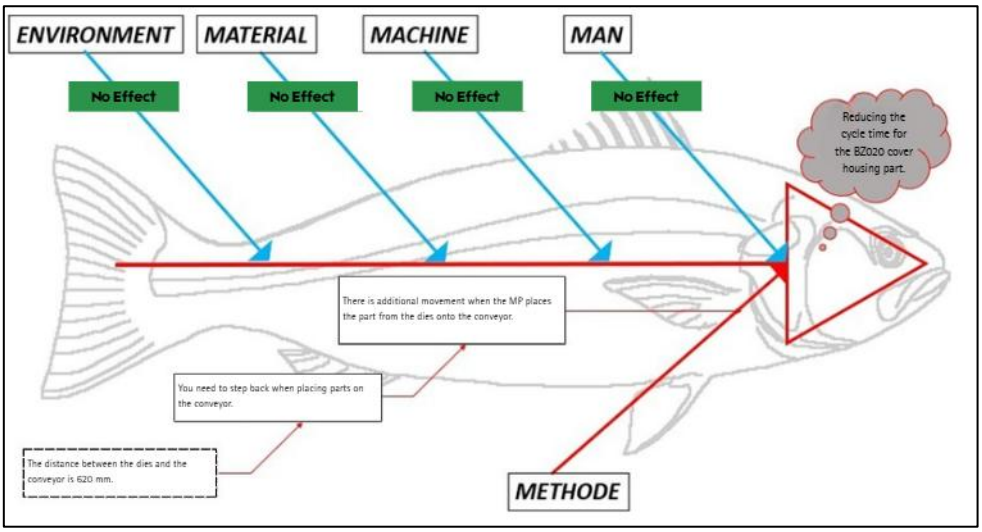


**Figure 4.** Fishbone Diagram

Analyzed possible causes that could be improved to reduce cycle time (Fig. 4). The results showed a considerable gap between the dies and the conveyor, measuring 620 mm. The first step in the solution is to create a 2D and 3D design for the extension conveyor (Fig. 5). The design was also consulted with the mentor, who is the section head of engineering.

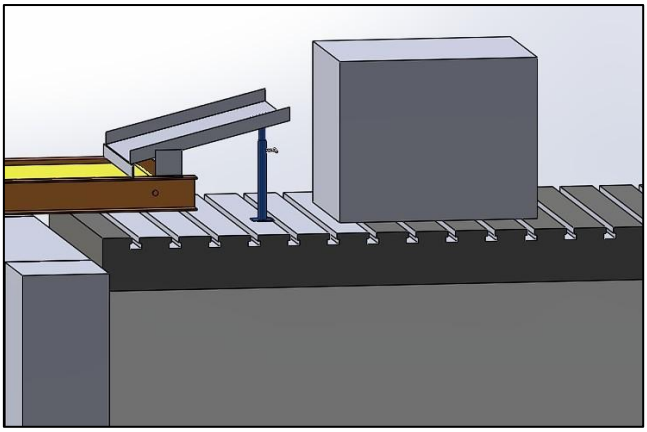

**Figure 5.** Extension Conveyor Simulation Design

After the 2D drawing is complete, the next step is to create the actual design (Fig. 6).

**Figure 6.** Extension Conveyor Painting Process

The maintenance department assists the manufacturing process itself to ensure its implementation. Of course, the manufacturing must comply with the drawings. The next step is to conduct a trial, the first of which is to fit the finished extension conveyor onto the conveyor. The results are in accordance with the layout of the dies and conveyor (Fig. 7).

**Figure 7.** Extension Conveyor Fitting Process

After the fitting process is complete, the next step is to conduct a trial process. The trial process involves taking 10 cycle-time samples (Fig. 8).

**Figure 8.** Trial Process

At this stage, data on cycle time is collected after the trial. The results of the cycle time data collection after the trial show that the cycle time for the production process of the Cover Housing BZ 020 product has decreased from 10 seconds to 8 seconds. At this stage, the Work Instruction (WI) for the Cover Housing BZ 020 product is standardized. The Work Instruction (WI) is revised and explained to the relevant operators. Meanwhile, the next improvement measure is to reduce the cycle time for products that exceed the takt time. These include Brkt, Engine Fr Mtg, 2 Rh/Lh, and Cover Housing 640 Suv products.

### 3.1.2 Production Capacity Value for Cover Housing BZ 020

After calculating the production capacity data before and after the improvement process, the next step is to calculate the difference between the two data sets. The calculation is as follows in Table 5.

**Table 5.** Production Capacity Data Results

| Test No. | Production Capacity | | Difference | Percentage Comparison |
|---|---|---|---|---|
| | Before | After | | |
| 1 | 340 | 439 | 99 | 29% |
| 2 | 360 | 474 | 114 | 32% |
| 3 | 360 | 461 | 101 | 28% |
| 4 | 360 | 473 | 113 | 31% |
| 5 | 336 | 444 | 108 | 32% |
| 6 | 333 | 474 | 141 | 42% |
| 7 | 346 | 461 | 115 | 33% |
| 8 | 371 | 444 | 73 | 20% |
| 9 | 360 | 456 | 96 | 27% |
| 10 | 356 | 480 | 124 | 35% |

After calculating the difference before and after the improvement, the next step is to calculate the 10 samples studied. The result of the calculation above is 108.4, or if rounded up, the difference in production per hour for the Cover Housing BZ 020 product is 108 units per hour.

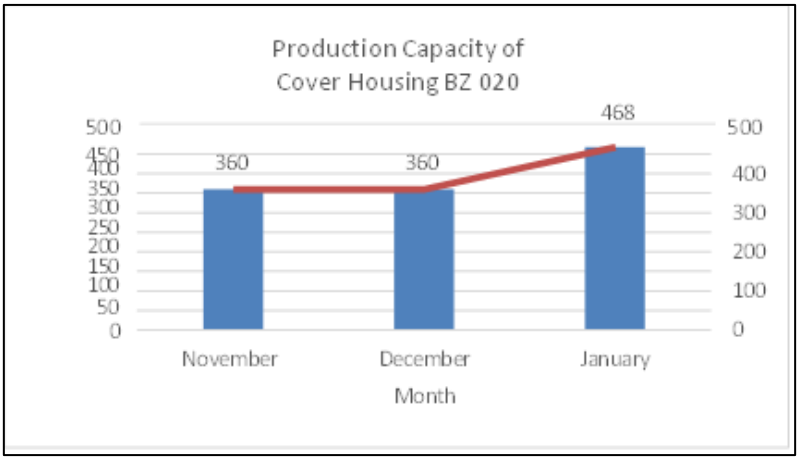


**Figure 9.** Production Capacity Chart for BZ 020 Housing Covers

As shown in the Fig. 9, the production capacity of Cover Housing BZ 020 increased in January, specifically after the improvement was implemented. Over the last two months, production capacity increased from 360 units/hour to 468 units/hour, a 30% increase. From this increase in production capacity, the company earned a profit of IDR 55,800,000.00 per year.

### 3.1.3 Optimization of Work Activities in the Cover Housing BZ 020 Production Process

The following is a comparison of work activities before and after the improvement was implemented. Since the improvement was carried out on OP 10, the comparison includes only work activities from that OP. The results are as follows:

The result of the improvement was a 2-second reduction in cycle time. The operator's work activity when handling the product involved only moving their hands while their body

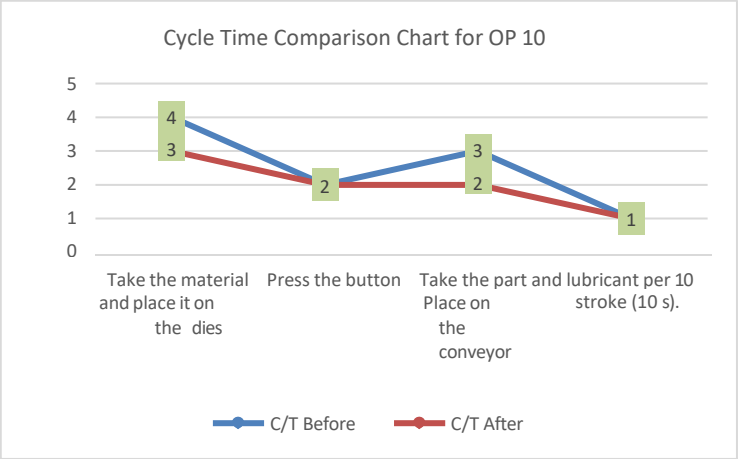


**Figure 10.** Cycle Time Comparison Chart for OP 10

remained in the original position. The impact was a reduction in cycle time for the BZ 020 Cover Housing product from 10 seconds to 8 seconds and an increase in production capacity.

## 3.2 Discussion

### 3.2.1 Implementation of the 8 Steps Improvement

The implementation of the 8-step improvement at PT. Gemala Kempa Daya Plant Karawang can be carried out within a period of 4 months. The implementation of the 8-step improvement process is in accordance with the standard operating procedures (SOP) of the Quality Control Circle (QCC) at PT. Gemala Kempa Daya. Additionally, the implementation of the 8-step improvement process aligns with the research titled "Implementation of the Quality Control Circle Method for Enhancing Propeller Shaft Production Capacity at PT XYZ" [11].

### 3.2.2 Improvement Results

After implementing the 8-step improvement, production capacity increased by 108 units/hour. The steps taken reduced the production process cycle time, thereby increasing production capacity. This aligns with the research, which found that the main cause of low production capacity was the relatively high cycle time in the production process. Therefore, improvements were made to the production process tools. The results obtained showed that the production process cycle time decreased from 5.5 seconds to 4.5 seconds. Production capacity increased from 506 units/hour to 557 units/hour.

### 3.2.3 Optimization of Work Activities

The improvement was to add a conveyor extension to OP 10, which affected the operator's handling of goods. Initially, the operator had to walk from the starting point to the conveyor. This increased the operator's activities and could increase the cycle time of non-value-added activities. This shows that there is a difference in work comfort when using the redesigned valve spring compressor compared to the conventional one. Thus, work productivity increases when using a redesigned alternative valve spring press tool. Additionally, according to [12], a company's optimization can be achieved by selecting, reducing, and eliminating activities that do not add value to the company.

## 4. Conclusion

The analysis confirms that the "8 Steps of Improvement" framework was successfully implemented at PT. Gemala Kempa Daya is in full compliance with existing Standard Operating Procedures (SOPs). This comprehensive process ranged from determining the

initial theme and setting targets to analyzing root causes, implementing countermeasures, and finally standardizing the results. The primary technical intervention involved the installation of an extension conveyor. This modification significantly streamlined the workflow by reducing the distance and time required for operators to pick up and place materials, specifically at the OP 10 station. Consequently, the cycle time at OP 10 was optimized, dropping from 10 seconds to 8 seconds. These operational improvements increased production capacity by 30%, raising output from 360 to 468 units per hour. Finally, this efficiency gain translated into an annual profit increase of IDR 55,800,000.00 for the company.

## Conflict of interest

The authors declare no conflict of interest.

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