(RESEARCH ARTICLE)

Implementation of 5S, Andon, and Kanban for waste reduction in creative industries (Case study: QRS Batik SME)

Ananda Rizki Ramadan Sinaga, Sista Anya Panjaitan, Dita Aditama Dewi, Faradhina Azzahra *, Sri Hartini and Diana Puspita Sari

Department of Industrial Engineering, Diponegoro University, Jl. Prof. Soedarto-SH, Tembalang, Semarang, 50275, Indonesia.

Abstract

Batik SMEs often face challenges in reducing waste, which impacts production efficiency and product quality. This study aims to evaluate the production process at QRS Batik Small Medium Enterprise (SME) using the 5S, Kanban, and Andon methods to minimize seven waste and improve productivity. The 5S method, which includes sort, set in order, shine, standardize, and sustain, was implemented to create a cleaner, more organized, and efficient work environment. Kanban served as a visual tool to optimize communication and manage production flow, especially among hearing and speech-impaired employees. Meanwhile, Andon was implemented to detect and address production issues in real-time, thereby minimizing downtime and maintaining product quality. The findings of this study indicated that the integrated implementation of 5S, Kanban, and Andon effectively reduces waste related to materials, transportation, and waiting time, while significantly improving product quality and production efficiency. This research hopes to serve as a guide for other Batik SMEs in adopting lean manufacturing approaches to enhance competitiveness and maximize effective and efficient resource utilization.

Keywords: Batik; SME; Seven waste; 5S; Kanban; Andon

1. Introduction

The creative industry, one of them is Batik Small and Medium Enterprise (SME) sector, plays an important role in the Indonesian economy. However, one of the challenges faced by Batik SME is waste in the production process which has an impact on product efficiency and quality. Waste in Batik SME can consist of inefficient waiting time, excessive use of materials, and lack of work management. It results in low productivity and product quality which can reduce the competitiveness of Batik SME.

One approach that has been proven effective in addressing waste and increasing efficiency is lean manufacturing. Lean manufacturing referred to a continuous improvement by maximizing resource utilization through the minimization of waste [1]. Lean manufacturing concept is necessary in a series of Batik production processes for eliminating waste so that it is expected to produce good quality products at low cost. Waste in lean manufacturing concept consist of 7 types of wastes, which are overproduction, time on hand (waiting), transportation, processing itself, stock on hand (inventory), movement, dan making defective products [2].

The problem of waste and the need to improve workflow are the main challenges faced by the QRS Batik SME in Semarang, Central Java. This QRS Batik focuses on producing batik clothing for women and men. Most of the workforce

---

consists of individuals with hearing and speech disabilities, which presents a challenge in effectively communicating information at each stage of production.

In the concept of lean manufacturing, there are 5S, Andon, and Kanban methods that have been widely used in managing production flows and increasing work efficiency in various industries. This study focuses on the implementation of the 5S, Andon, and Kanban methods in QRS Batik. The 5S method is an abbreviation of five Japanese terms, namely *seiri* (sorting), *seiton* (set), *seiso* (shine), *seiketsu* (standardize), and *shitsuke* (sustain). This method aims to prevent accidents, reduce machine downtime, improve operational process control, and create a healthier work environment [3]. Meanwhile, Andon serves as a tool to promptly address issues that emerge during the manufacturing process [4]. Kanban, as a visual aid, is implemented to optimize communication flow and production management and developed to materialized just-in-time production [5]. The implementation of this method is expected to reduce waste that occurs in the production process.

This study provides practical recommendations that are expected to improve production efficiency and quality of results at QRS Batik SME. The results of this study are also expected to be a reference for other Batik MSE in implementing a lean manufacturing approach to maximize resource use, increase productivity, and their competitiveness in the increasingly competitive batik industry.

2. Methods

This research was a descriptive study aiming to provide a detailed, realistic, and current portrayal of a phenomenon or research object. The data needed in this study were obtained by observing the production process of the QRS Batik SMEs directly. The results of observations were identification of seven wastes consisting of defect (D), transportation (T), unnecessary motion (M), unnecessary inventory (I), overproduction (OV), waiting (W), and overprocessing (P). These seven waste data was then used to be processed by implementing a lean manufacturing concept in the form of the 5S, Andon, and Kanban.

2.1. Lean manufacturing

Lean manufacturing is a systematic approach that eliminates waste in the production process whose main goal is to increase customer value by increasing the ratio between added value and waste so that the company is more efficient and competitive [6]. Some principles that can be used as the main basis for implementing a lean system [7] are

- Determine the value of products in the form of goods or services based on customer views, where most customers want high-quality products at competitive prices and on-time delivery.
- Map the value stream for each product or service, because many industrial companies in Indonesia only map the work process, not the production process.
- Eliminate non-value-added activities from the entire value stream to eliminate waste.
- Implement arrangements that allow all materials, information, and products to flow effectively and efficiently through the value process using a pull system.
- Explore technology and continuous improvement tools to continuously increase value for customers and achieve competitive advantage.

2.2. Seven waste

Seven waste refers to activities that do not add value to the production process. The purpose of the seven waste analysis is to identify and reduce waste that occurs in a system [8]. The following is an explanation of each of the seven wastes:

- A defect is an error in the product or material that causes repairs, repetition of the process, or even disposal of the product.
- Overproduction (Excessive Production) is the production of goods exceeding demand or needs at a certain time.
- Inventory is excessive storage of goods, both raw materials and finished products, without immediate use.
- Motion (Movement) is inefficient operator or machine movements, such as repetitive movements that can actually be minimized.
- Transportation is the transportation or transfer of unnecessary goods.
- Waiting is the occurrence of waiting time in the production process, such as waiting for materials or machines.
- Overprocessing (Excessive Process) refers to performing unnecessary or overly complex processes that exceed what is required.

2.3. The 5S Methods

The 5S is a method used to create and maintain an organized, clean, and efficient work environment. It is part of the lean manufacturing approach and consists of five interrelated steps [9]. Here is an explanation of each of the 5S:

- *Seiri* (sort) is sorting out necessary and unnecessary items in the work area. Unnecessary items should be removed to keep only the items that are really needed in the workplace. This helps reduce clutter and increase work efficiency.
- *Seiton* (set) is placing each item in its proper place so that it is easy to find and use when needed. The goal is to create order in the workplace, allowing workers to find and return items to their original places more quickly.
- *Seiso* (shine) refers to cleaning the workplace regularly. This is not only about maintaining cleanliness, but also checking equipment to ensure everything is working properly. A clean workplace helps reduce the risk of accidents and maintains optimal equipment performance.
- *Seiketsu* (standardize) involves standardizing the first three steps (*Seiri, Seiton, and Seiso*). The objective is to maintain cleanliness and order consistently, ensuring that the 5S practices become a daily habit followed by everyone.
- *Shitsuke* (sustain) refers to the discipline and habit of consistently adhering to established standards. It requires everyone to comply with the 5S rules, fostering self-awareness and responsibility for maintaining the work area.

Based on several studies, the implementation of 5S in batik industry can improve the performance and working conditions [10]. Although the concept of 5S is not directly related to the cause of waste, it is believed can prevent defect or waste and improve the product quality [11]. It also can improve health and safety of the industry [10].

2.4. Kanban

Kanban is a visual workflow management system used to optimize and improve efficiency in various processes, both in manufacturing and software development. Originally developed by Toyota in the 1940s, the main purpose of kanban is to support just-in-time production and reduce waste by visualizing work in progress. In the Kanban system, work is organized using a Kanban board, which typically consists of three main columns: 'To Do' (tasks to be completed), 'In Progress' (tasks currently being worked on), and 'Done' (tasks that have been completed). Cards or tasks are moved from one column to the next according to the progress of the work [12]. There are several types of kanban, which are:

- Production kanban is used to instruct the production line to start or continue production of a particular unit. This card indicates that a specific part of the product needs to be produced, facilitating the organization of the production flow based on demand.
- Material kanban is used to move goods or materials from storage to the production line. This type of Kanban instructs the warehouse team to retrieve the required items and deliver them to the designated area.
- Supplier kanban is a kanban that connects the company with external suppliers. This card is used to notify suppliers that a specific material or component needs to be sent to the company, ensuring stock availability without overstocking.

Research on the implementation of Kanban is widely conducted. Kanban digital was implemented in service industry, like laundry business, that enable to track the overall process from transactional process until return to the customer [13]. Digitalization of Kanban by integrating Radio Frequency Identification (RFID), QR codes and readers, microcontrollers, electronic displays, and server was developed to increase the functionality of real-time information [14]. Kanban is also used in welding companies to improve internal logistics flow, both in materials and information, thereby facilitating the management system and reducing stockouts [15]. However, research on the implementation of Kanban in the batik industry remains limited.

2.5. Andon

Andon is a visual management system used to provide real-time information to operators, managers, and maintenance teams about the production status on a production line. This system usually consists of light or sound signals that indicate whether the process is running normally, requires attention, or there is a problem that requires immediate intervention. The goal is to enhance efficiency, quickly detect problems, and address production disruptions as swiftly as possible to minimize downtime and maintain product quality [16].

3. Results and discussion

3.1. Seven Waste Identification

Based on the conditions at the production site of the QRS Batik, several conditions that indicate the existence of waste are as follows.

- Defect. Incorrect information provided to workers by supervisors or previous workers leads to product defects, such as cutting not according to the pattern or size, untidy sewing, and incorrect fabric material selection. This results in the need to repeat the process or even dispose of the product.
- Overproduction. Misinformation about the quantity of products received compared to the amount being worked on leads to workers producing more than demand.
- Inventory. Finished and semi-finished products are stacked around the work area.
- Motion. A narrow workspace full of stacks of finished or semi-finished products causes inefficient movement in taking, moving or reaching materials or tools.
- Transportation. The transportation flow is poorly organized, requiring workers to move materials or products through a narrow area congested with materials and tools.
- Waiting. All workers proceed without waiting for the previous station, as the work in progress is already available from the earlier workstation.
- Overprocessing. Workers often carry out excessive processes, such as adding pockets to products that were designed without pockets, and excessive sewing on certain parts of the clothes.

3.2. The Application of Kanban

The employees of QRS Batik are predominantly deaf and mute. To facilitate communication and support production efficiency, we have designed a production Kanban system to streamline communication. The production kanban contains several elements needed to make communication between employees more efficient. Table 1 shows the elements needed and their description that is required in Kanban card. The proposed design of Kanban production card is shown in Figure 1.

Table 1 List of Elements in Kanban Card

Element	Description
Orderer	This section contains information about the name of the customer who placed an order for batik from QRS Batik.
Order date	This section contains information about the date, month, and year when the orderer placed an order in the format dd/mm/yyyy.
Due date	This section contains information about the date, month, and year when the orderer wants the order to be completed in the format dd/mm/yyyy.
Item type	This section contains information about the type of item ordered by the customer, such as clothes, outerwear, dresses, and so on.
Product name	This section contains the name of the product ordered by the customer, such as Outer Lowo Batik, Women's Top Outer Lowo Batik, and so on.
Product quality	This section contains the quantity of products ordered by the customer.
From	This section is filled with the name of the worker or employee from whom the kanban is sent.
To	This section is filled with the name of the worker or employee to whom the kanban is sent.
Product picture	This section is filled with a catalog photo of the product to be made in colour to make it easier for workers to recognize product details.
Company identity	This section contains the logo accompanied by the SME's name which is used as the kanban identity.
Colour and process name	This section contains the name of the process along with its identity colour.

Figure 1 Design of Kanban Production Card

Because there are 4 processes in production at QRS Batik SME, there are 4 colors that represent each process identity. Green represents completed tasks, red indicates the sewing process, yellow signifies the cutting and measuring process, and blue denotes the design process. In addition to the use of production kanban, a kanban board is also used which consists of 4 parts, namely, To Do, In Progress, Done, and Approved as illustrated in Figure 2.
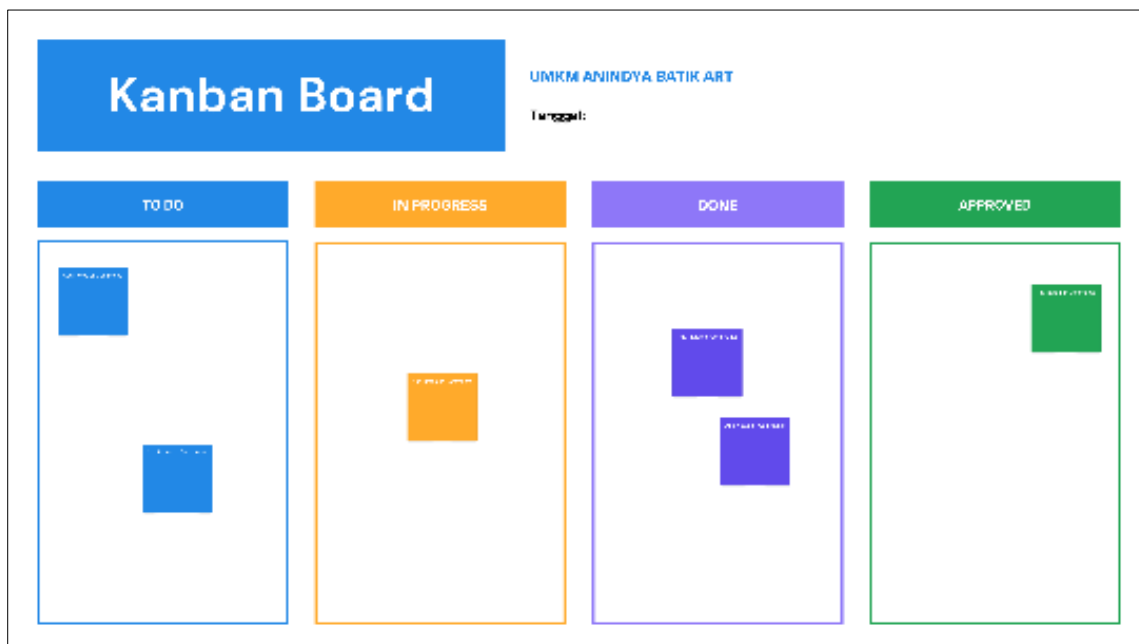

Figure 2 Design of Kanban Board

The use of Kanban boards is intended to help employees and owners track the progress of each batik product ordered by customers, thereby reducing unnecessary communication. The To Do section contains orders or activities that must be carried out by QRS Batik; the In Progress section contains orders or production activities that are currently running; the Done section contains orders that have been completed and are ready to be re-checked to ensure that the order has no defects; the Approved section contains orders that have been checked without any problems and can be continued to be given to the customer.

Kanban can help reduce four different types of waste in QRS Batik SME. First, it helps to prevent overproduction by adjusting the production flow to match actual demand, avoiding excess production that does not meet requirements. Second, it reduces inventory waste by improving stock management, ensuring that only the materials or products required are produced or moved, minimizing the accumulation of inventory or work in process, which can disrupt employee performance. Third, workflow visualization reduces wait times because Kanban allows for better

coordination between work stages or employees, removing the need for unnecessary communication. Finally, Kanban reduces transportation waste by coordinating the flow of materials, reducing unnecessary material movement or work in progress.

3.3. The Application of 5S Methods

The first step in implementing the 5S principle is to sort or *Seiri* or separate between necessary and unnecessary items. Based on direct observation results on the production floor of QRS Batik, there are several tools and materials used, such as cloth, thread, needles, sewing machines, and cutting tools. However, among these tools and materials, some are rarely used or no longer needed, such as dull scissors, empty glue bottles, pieces of used production cloth that cannot be reused, outdated production papers, and batik garments that have already been ironed but are still on the production floor. Items that are rarely used or no longer needed should be removed from the production area and stored in a warehouse or separate place. For example, blunt scissors should be discarded if they are no longer usable, along with waste glue bottles, used cloth pieces, paper, and other items that can no longer be used. Batik garments that have been ironed should be removed from the production floor and placed in a closet or stored in a warehouse. By minimizing unnecessary items, the workspace will be tidier and more efficient, so workers can move more freely and productivity increases.

After the sorting process, the next step is *Seiton* which is to arrange or organize frequently used items in a systematic and easily accessible manner. On the production floor of QRS Batik, good arrangement can save worker's time and energy. Each tool and material should have a designated place and be organized according to its function. For example, a sewing worktable should have a designated storage area for thread, scissors, needles, and other necessary accessories. However, an observation of the current arrangement shows that many tools are still mixed up and placed far from the production table. Sewing machines should also be spaced adequately to allow workers to move comfortably without disturbing each other. Additionally, storage racks for cut fabrics and unprocessed fabrics can be placed in the corner of the room to avoid blocking traffic in the production area. This arrangement must consider the workflow so that each stage of production, from cutting fabric to sewing and embroidery, can be carried out smoothly, thereby eliminating existing waste.

Cleanliness is the key to a healthy and efficient work environment. In the application of *Seiso*, cleaning the work area is not just about sweeping or mopping the floor, but also involves maintaining every tool and material used. From the results of observations on the production floor of QRS Batik, cloth dust, leftover thread, and small pieces of cloth were still found piled up on the worktable or around the machine. Routine cleaning needs to be done to prevent these tools from being damaged and to maintain optimal production quality. For example, sewing machines must be cleaned of dust every day to maintain their performance. Trash bins must always be available near the worktable, so that workers can immediately dispose of leftover cloth without having to let them scatter. In addition, the ironing area and cutting table also need to be kept clean so that the batik cloth being processed remains in good condition.

Once the sorting, arranging, and cleaning processes are implemented, the next step is *Seiketsu* which is to ensure that these standards of cleanliness and order are consistently maintained. In QRS Batik, this can be done by creating clear rules regarding the placement of tools, storage of materials, and routine cleaning. For example, a label system can be implemented on shelves for storing fabrics or sewing tools to ensure that all items are returned to their place after use. In addition, the layout of the production area can be marked or marked with visual markers such as lines on the floor to indicate the work area of each machine or table. These standards must be documented and regularly monitored to ensure they are followed by all workers, preventing confusion or inconsistencies in the use of production tools and materials.

The last element of 5S, namely *Shitsuke* or sustain, emphasizes the formation of a disciplined work culture in complying with all established procedures. In the batik convection industry, it is crucial for workers to develop the habit of maintaining cleanliness and organization, as well as adhering to the procedures for arranging tools that have been established. To instill this discipline, regular training for all workers is essential. They must understand the importance of following each step of 5S, including tidying up, cleaning, and maintaining production tools. Based on direct observation, supervision has been conducted, but its implementation has not been optimal due to many rules being overlooked. Therefore, re-training for supervisors is necessary to ensure the more effective implementation of 5S. With improved discipline, the batik convection process will not only become more efficient but also foster a safer and more comfortable working environment.

3.4. The Application of Andon

To support the performance of deaf and mute employees, Andon is used to facilitate the detection of problems or obstacles in the production process so that the owner can easily help solve problems and handle them efficiently. Andon is used simply by using LED lights whose colour changes can be controlled using a remote control.

If there is a problem, then the employees of QRS Batik can press the colour button according to the category of the problem experienced. The colours used are green, yellow, and red. The three colours have their own meanings which are described in the Table 2.

Table 2 Proposed Andon Design

Design Process		
Green	**Yellow**	**Red**
The process is running well and no issues.	There are minor issues, like design errors that can still be corrected without halting production.	There are major issues, like design not meeting demand specifications, so production need to be stopped, and design should be fixed.
Measuring and cutting process		
Green	**Yellow**	**Red**
Measurement and cutting process are running well.	There are minor issues in measuring or cutting process that is still can be fixed without halting production.	There are major issues in measurement and cutting process that require production process termination.
Sewing process		
Green	**Yellow**	**Red**
Sewing process is running well.	There are minor delays or breakdowns that can be resolved during the process.	There are major disruptions like machine breakdowns or sewing errors require immediate intervention.
Finishing process		
Green	**Yellow**	**Red**
Product is finished followed quality standard.	There are minor defects that require small repairs.	There are major defects that require quality re-inspection or re-processing.

By paying attention to the use of the right colours in each work operation, workers can easily communicate and forward the issues encountered during the production process. The implementation of Andon effectively minimizes various types of waste in the production process. It reduces waiting time by enabling real-time problem detection, allowing issues to be quickly identified and addressed. Additionally, it minimizes defects by ensuring a swift response to detected obstacles, resolving problems before the production process continues. Furthermore, Andon helps prevent overprocessing by immediately signaling when a process exceeds the required specifications, thereby eliminating unnecessary steps.

4. Conclusion

This study provides recommendations for improvements to overcome seven types of waste that occur in the production process of QRS Batik SME through the implementation of the 5S, Kanban, and Andon methods. The 5S method is expected to create a cleaner, more organized, and more efficient work environment, which will help reduce inefficient movements, waiting times, and product defects. Meanwhile, Kanban is recommended as a visual tool to optimize the flow of information and production, which can reduce overproduction, inventory accumulation, and waiting times. The implementation of Andon is also proposed as a solution for real-time problem detection, which aims to maintain a smooth production flow and ensure product quality is maintained.

Although these methods have not been implemented, the results of this study show great potential to improve the efficiency, productivity, and inclusiveness of deaf and mute workers at QRS Batik SME if these recommendations are implemented properly. This study is expected to be a reference for other MSMEs in adopting a lean manufacturing approach to increase competitiveness and maximize the use of resources effectively and efficiently.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Kumar N, Shahzeb Hasan S, Srivastava K, Akhtar R, Kumar Yadav R, Choubey VK. Lean manufacturing techniques and its implementation: A review. Mater Today Proc 2022;64:1188–92. https://doi.org/10.1016/j.matpr.2022.03.481.

[2] Ohno T. Toyota Production System Beyond Large-Scale Production. New York: Productivity Press; 1988.

[3] Osada T. Sikap Kerja 5S. Jakarta: PPM; 2002.

[4] Riyanto AGP, Fuadi AZ, Murti MA. Andon System using Industrial IoT for Controlled Production Line by conventional PLC. International Journal of Engineering Research & Technology 2020;9:95–9.

[5] Powell DJ. Kanban for Lean Production in High Mix, Low Volume Environments. IFAC-PapersOnLine 2018;51:140–3. https://doi.org/10.1016/j.ifacol.2018.08.248.

[6] Hartini S, Nabila NS, Azzahra F, Prastawa H, Widharto Y. Lean Manufacturing to Improve the Efficiency in A Small and Medium Enterprise: Case in Tofu Production Processes. Proceedings of the 3rd Asia Pacific International Conference on Industrial Engineering and Operation, Johor Bahru: 2022.

[7] Gaspersz V. Lean Six Sigma for Manufacturing and Services Industries. Jakarta: PT Gramedia Pustaka Utama; 2007.

[8] Widodo SM, Astanti RD, Ai TJ, Samadhi TMAA. Seven-waste framework of waste identification and elimination for computer-based administrative work. The TQM Journal 2021;33:773–803. https://doi.org/10.1108/TQM-04-2020-0072.

[9] Kanabar B, Piparva KG, Pandya D, Kanabar RB. The Impact and Challenges of the Implementation of 5S Methodology in Healthcare Settings: A Systematic Review. Cureus 2024;16. https://doi.org/10.7759/cureus.64634.

[10] Bathe ProfA. Implementation of 5s in Small Scale Industry. Int J Res Appl Sci Eng Technol 2018;6:2871–8. https://doi.org/10.22214/ijraset.2018.3630.

[11] Oktafiani IS, Subiyantoro S. Application of 5S Management in Improving the Quality of Furniture Production in Meubel Karya Agung of Ponorogo Regency. PALAPA 2022;10:45–60. https://doi.org/10.36088/palapa.v10i1.1658.

[12] Faritov A. The Kanban method as a tool for managing engineering Foresight projects in the formation of the foundations of engineering competence in the field of scientific and technical creativity of students. Scientific Research and Development Socio-Humanitarian Research and Technology 2023;11:6–12. https://doi.org/10.12737/2306-1731-2022-11-4-6-12.

[13] Sudiatmika IPGA, Putra IMAW, Artana WW. The Implementation of Gated Recurrent Unit (GRU) for Gold Price Prediction Using Yahoo Finance Data: A Case Study and Analysis. Brilliance: Research of Artificial Intelligence 2024;4:176–84. https://doi.org/10.47709/brilliance.v4i1.3865.

[14] Purba VCS, Lalujan V, Phangnesia C. An Implementation of Internet of Things for Digitalization of Kanban Production System. Jurnal Sistem Cerdas 2024;7:87–97. https://doi.org/10.37396/jsc.v7i1.383.

[15] Oliveira M, Lopes N, Sá JC, Pereira MT. Implementation of a Standardized Replenishment System and Kanban Application in the Metalworking Industry. Flexible Automation and Intelligent Manufacturing: Establishing Bridges for More Sustainable Manufacturing Systems, 2024, p. 267–74. https://doi.org/10.1007/978-3-031-38165-2_32.

[16] Purmala YA, Sudarto S. Analysis of machine repair time prediction using machine learning at one of leading footwear manufacturers in Indonesia. IAES International Journal of Artificial Intelligence (IJ-AI) 2023;12:1727. https://doi.org/10.11591/ijai.v12.i4.pp1727-1734.