sciendo

Management Systems in Production Engineering

2025, Volume 33, Issue 3, pp. 354-361

Date of submission of the article to the Editor: 01/2025
Date of acceptance of the article by the Editor: 07/2025

DOI 10.2478/mspe-2025-0033

5S METHOD USAGE FOR THE IMPROVEMENT OF PRODUCTION PROCESS IN THE MANUFACTURING COMPANY

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Abstract:
In the face of growing competition and dynamically changing market requirements, manufacturing companies are forced to continuously improve their processes, increase operational efficiency and reduce costs. The key factor enabling the achievement of these goals is the implementation of organizational tools supporting work optimization. The aim of this study was to analyze the possibilities of improving operational efficiency by applying the 5S methodology at selected work stations in a manufacturing company. The research was preceded by a diagnosis of the existing state, which revealed a number of irregularities in the organization of work stations and suboptimal use of work space. As a result of implementing the 5S method, including the stages of sorting, systematization, cleaning, standardization and self-discipline, measurable effects were obtained that improved the course of production processes. A significant reduction in the time of operation execution was observed – even by 40% – at the work stations covered by the implementation, as well as an improvement in work ergonomics, clarity of organizational rules and increased employee involvement in maintaining order. The obtained results confirm the validity and effectiveness of implementing lean management tools in production conditions.

Key words: manufacturing effectiveness, Lean Manufacturing tools, 5S, improving workplace organization

INTRODUCTION

Modern industrial enterprises, operating among strong competition and increasing quality requirements are constantly seeking solutions to streamline production processes. One of the most effective tools to support work organization and eliminate waste is the 5S method, rooted in the Japanese philosophy of quality management. It focuses on organizing the work environment, standardizing activities, and fostering organizational discipline.

The article presents the implementation of the 5S methodology in a company specializing in the production of high-quality steel components, such as forged plowshares and plow parts. By employing modern machining technologies and a powder coating system, the company achieves high quality standards for its products.

In response to growing market demands and the need to enhance efficiency and reduce operational costs, a decision was made to conduct an in-depth analysis of work organization at key production workstations. The aim was to identify problem areas related to workspace management, tool and material placement, as well as the daily functioning of workstations. The analysis results served as the basis for implementing improvement measures focused on increasing efficiency and minimizing losses.

At an early stage of the diagnosis, significant irregularities were identified, such as a lack of standardization and ineffective workspace management. These issues negatively impacted task completion times and production costs. It was found that a significant portion of operators' working time was wasted on searching for tools, materials, or reorganizing workstations, which led to a decline in overall productivity.

The analysis covered selected workstations critical to the production process, including those operating milling machines, plasma cutters, and bench drills. Significant levels of disorganization were observed, and the lack of clearly defined rules for storing equipment resulted in extended operational times and increased unit costs.

Based on the collected data, a decision was made to implement improvement measures aimed at enhancing work organization and eliminating non-productive activities. The implementation of the 5S method was recognized as a key element of the improvement process – a powerful tool enabling the organization of the work environment, standardization of procedures, and development of a culture of continuous improvement.

Introducing the 5S methodology in such a demanding production environment marked a significant step toward further improving operational efficiency, work ergonomics, and enhancing safety and productivity.

LITERATURE REVIEW

The 5S method, one of the key tools for improving workplace organization, has been widely described in the literature both as a standalone technique and as a component of broader quality and production management strategies. Originating from Japanese quality management culture, its name derives from the first letters of five Japanese words: Seiri (sorting), Seiton (systematization), Seiso (sweeping/cleaning), Seiketsu (standardization), and Shitsuke (self-discipline). It was first extensively applied in Toyota plants as part of the developing Lean philosophy. Its goal is to create an organized, transparent, and safe work environment, which consequently leads to waste reduction, improved efficiency, and enhanced process quality [1, 2, 3, 4, 5, 6].

The 5S method consists of five stages, each corresponding to specific actions to improve workplace organization. The first stage, Seiri (Sorting), involves separating unnecessary tools, materials, and items from those that are essential. The aim is to eliminate redundant elements that may cause clutter or delays. The second stage, Seiton (Systematization), involves arranging the remaining items in a logical and ergonomic manner, ensuring they are easily accessible and always in their designated place. The third stage, Seiso (Sweeping/Cleaning), entails regular cleaning of the workplace and machines, which not only maintains order but also enables quicker detection of potential failures or irregularities. The fourth stage, Seiketsu (Standardization), focuses on creating consistent procedures and standards to ensure the sustainability of the achieved order and facilitate its monitoring. The final stage, Shitsuke (Self-discipline), involves reinforcing habits and building an organizational culture based on responsibility and the engagement of all employees in maintaining the implemented principles [7, 8, 9, 10, 11, 12].

The literature emphasizes that the 5S method serves as a foundation for implementing more advanced Lean tools, such as TPM (Total Productive Maintenance), SMED (Single-Minute Exchange of Die), or Just-in-Time. An organized workplace promotes process flow, reduces downtime, and improves safety and ergonomics. Studies show that implementing 5S can significantly shorten production cycle times, reduce costs, and increase employee satisfaction [13, 14].

The 5S method has found widespread application across various industrial sectors, including automotive, metallurgical, food processing, and the production of machinery and equipment components. Practical examples demonstrate that even relatively simple organizational actions can yield measurable results, such as reduced changeover times, fewer errors, improved operational flow, and increased employee engagement [14, 15].

For instance, studies conducted in metal industry manufacturing plants showed that the application of 5S led to a 20-30% reduction in workstation preparation times and a decrease in complaints due to improved component traceability [15, 16]. Additionally, a typical production efficiency increase of around 15% was observed, alongside significant improvements in ergonomics and workplace safety [17].

International studies [17, 18] clearly indicate that the success of 5S implementation depends on the full commitment of all organizational levels and continuous oversight of each stage's execution.

Despite its numerous benefits, implementing the 5S method can also encounter challenges. The literature [19, 20, 21, 22, 23, 24, 25] points issues such as employee resistance to change, lack of management commitment, insufficient training, and a lack of continuity in maintaining established standards. The key to success lies in the engagement of the entire organization and the development of a culture of continuous improvement.

RESEARCH METHODOLOGY

The implementation of 5S methodology in the manufacturing enterprise should be a systematic process and realistically rely on the actual needs of the employees, as well as their workspace requirements. The study focuses on three key workstations: the milling machine operation station, the plasma cutting station and the bench drill station.

Once the production process review and selecting the workspaces for 5S methodology implementation were done the company's management formed a project team responsible for deploying the tool. The team members included 5S leader, the production manager, machine operators at selected workstations and shift supervisors. The team created a schedule of activities related to the 5S implementation presented in Table 1.

Table 1

Schedule of 5S method implementation to selected workspaces in manufacturing

5S stage	Detailed actions	Responsible	Execution time	Notes
Pre-work	Establishing a project team, training employees	Production manager, 5S leader	Week 1	Information meeting, implementation plan
Seiri (Sorting)	Equipment inventory, eliminating unnecessary items	Machine operators, 5S leader	Week 2	Labeling, tool division
Seiton (Systematization)	Organization of tools, implementation of shadow boards, and labeling	Machine operators	Week 3	Shelfs, containers, colored labels
Seiso (Sweeping/cleaning)	Thorough cleaning of stations, inspection of machines	Machine operators	Week 4	List of contamination sources, cleaning supplies
	Implementation of cleaning schedule	5S leader	Week 4	Daily tasks assigned to the employees
Seiketsu (Standardizarion)	Instructions and checklists preparation	5S leader, Production manager	Week 5	Paper and electronic versions
	Visual markings, information boards	Project Team	Week 5	Pictograms, workstation maps, color-coding
Shitsuke (Self-discipline)	Internal audits, periodic inspections	Shift supervisor, Project Team	Starting week 6	Monthly audits
	Motivational system and engagement evaluation	Management	Starting week 6	Points, Team awards
Monitoring	Comparison of data before and after implementation (working time, downtime, etc.)	Management	Week 8	Final report
	Conclusions, recommendations for further improvement	Project Team	Week 9	Possible expansion to other areas

Presented in Table 1, schedule of 5S metodology implemetation aimed to organize and systemise actions related to reorganization of selected workstations in manufacturing company. Its primary purpose was to define the subsequent stages of implementation, assign responsible individuals, and establish timeframes, enabling effective monitoring of progress and task coordination. The schedule also served as a project management tool, facilitating resource planning, avoiding downtime, and maintaining consistency of activities across different company departments. By applying the schedule, it was possible to ensure production continuity while implementing organizational changes, which contributed to the overall efficiency of the initiative and reduced the risk of potential delays or misunderstandings in the communication of the implementation team.

Fig. 1 Plasma cutting station before and after implementation of 5S methodology

RESULTS OF RESEARCH

Prior to introducing the changes to the production workspaces lack of organization was clear, which significantly impacted the productivity of machine operations and effectiveness of processes. At the band saw and milling station, tools were scattered in random places, which made it difficult to quickly access necessary components. Parts intended for processing were mixed with waste, as well as some tools had no assigned storage locations, which caused additional chaos.

The plasma cutting machine station organization level was similar – elements required for work were stored with used parts and waste, which led to frequent mistakes and extended the working time of operators who lost valuable minutes to find the right tools. Fig. 1 shows the plasma cutting machine station before and after the implementation of the 5S methodology.

The milling machine station before 5S implementation was disorganized; tools and parts were randomly placed, which caused delays and extended the operator's work time as he searched for the items he needed. This reduced efficiency and created a risk of damage and a safety hazard. As part of 5S implementation, the workspace was tidied up, permanent places for tools were designated, and work organization was improved. Figure 2 shows the milling machine station before and after 5S implementation.

The drilling station lacked designated tool locations, which caused unnecessary confusion and extended the time it took to prepare the machine for work. The situation not only reduced efficiency, but also increased the risk of damage to equipment and tools and endangered the safety of machine operators.

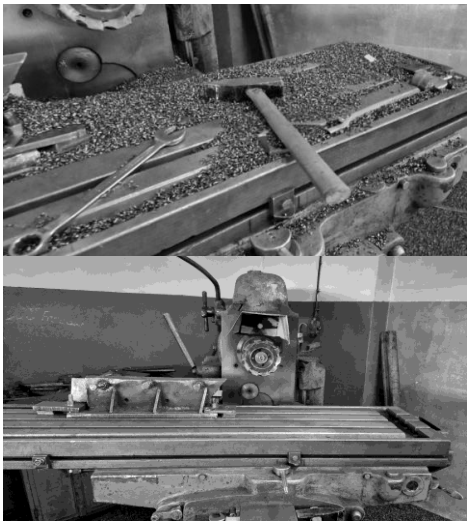

Fig. 2 Milling machine station before and after implementation of 5S methodology

Figure 3 shows the drilling station before and after the implementation of the 5S methodology.

Fig. 3 Drilling station before and after the implementation of 5S methodology

Due to the lack of standardization, production station operators had to spend extra time searching for the right tools and materials. Disorganization led to a waste of time and resources, which translated into lower efficiency and higher operating costs.

A number of improvements were introduced at the band saw station to better organize work and increase efficiency. In accordance with the principles of the 5S method, unnecessary items were eliminated and permanent places were allocated for key tools, such as a flat wrench, which the operator uses to adjust the blade tension. This key was placed on the control panel housing, which allows for quick access and putting it away in a designated place after each use. In addition, the space around the saw was organized to minimize the time needed to search for tools and materials. The station was designated with storage zones for elements ready for cutting and waste, which allowed for better material management and limiting unnecessary movements of the operator. Thanks to standardization, the risk of accidental start-up of the device and collisions was also reduced, which additionally improved work safety. The appearance of the station before and after the implementation of the 5S methodology is shown in Fig. 4.

Fig. 4 Band saw station before and after the implementation of 5S methodology

At the band saw station, as a result of the changes introduced, a significant reduction in operating time for key activities was noted. As shown in the Figure 5, the implementation of the 5S methodology allowed for reduction in operating time by approximately 13.6%.

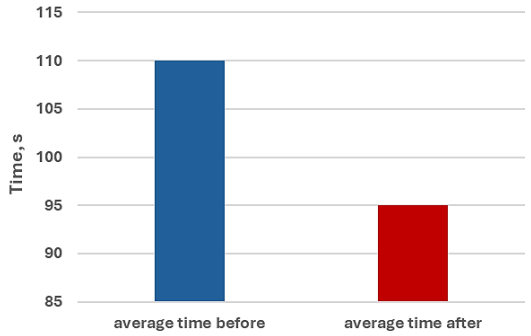

Fig. 5 Band saw machine preparation time before and after the implementation of 5S method

Another important measurement concerned the machine setting, the results of which are illustrated in Fig. 6. Thanks to the implementation of the 5S methodology, the operation time was reduced by 40%. Reducing this time directly influenced the increase in work efficiency.

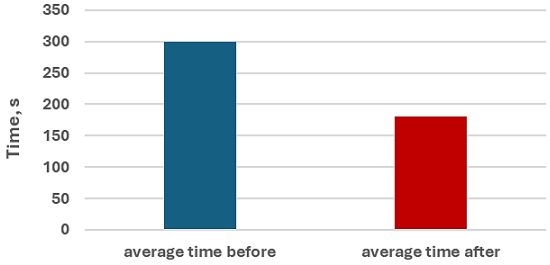

Fig. 6 Band saw machine setting time before and after the implementation of 5S method

The last measurement, presented in Fig. 7, concerned the cutting operation at the band saw station.

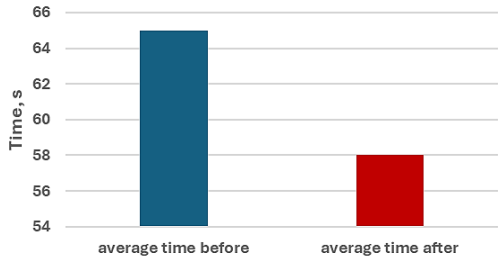

Fig. 7 Band saw machine cutting time before and after the implementation of 5S method

The 10.8% reduction in cutting operation time, although smaller compared to the previous parameters, also contributes to the overall increase in efficiency at the band saw station.

To accurately assess the impact of implementing the 5S method at the band saw station, calculations of operating times were carried out on the example of a production series consisting of 10 "Atlas" blades, as shown in Fig. 8.

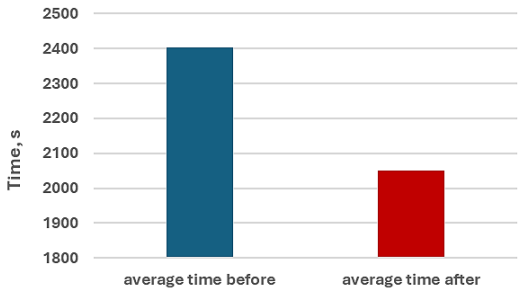

Fig. 8 Band saw average production time before and after the implementation of 5S method

As shown in Fig. 8, the total time needed to produce a series of blades after introducing organizational changes was shortened by about 19.34%, which significantly improved the efficiency of work at this station.

At the milling machine station, similarly to the case of the band saw, the introduction of the 5S method resulted in a noticeable reduction of operating times by 15% for the most important activities, as shown in Fig. 9.

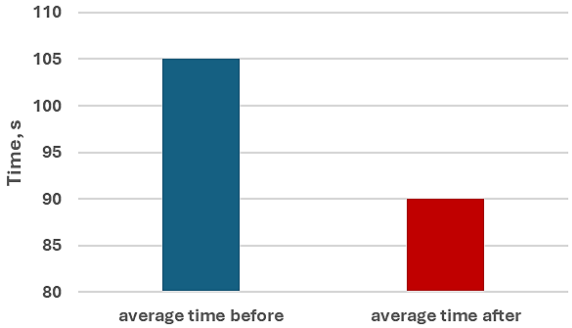

Fig. 9 Milling machine preparation time before and after the implementation of 5S method

Following, Fig. 10 illustrates the changes in the average milling machine setup time. In this case, a reduction of up to 38% was achieved. Reducing the machine setup time is of significant importance for improving the work of operators at the station and increasing the overall efficiency.

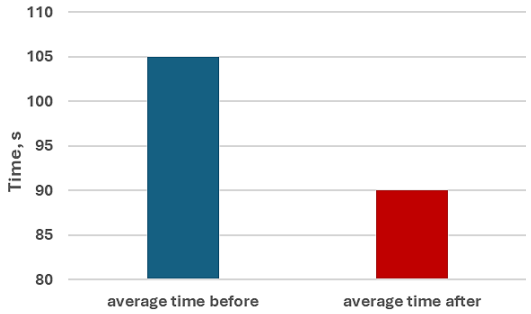

Fig. 10 Milling machine setting time before and after the implementation of 5S method

Fig. 11 presents changes in the milling operation time, after introducing improvements it decreased by about 14%. Although the difference in the milling operation time is smaller than in the case of other activities, it also has a positive impact on the overall work efficiency at the milling station.

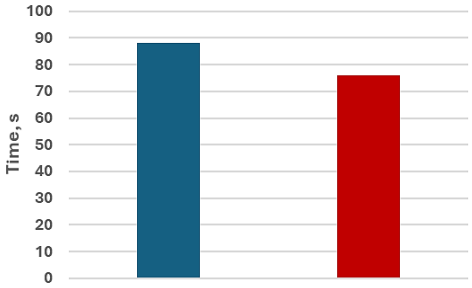

Fig. 11 Milling machine operation time before and after the implementation of 5S method

At the milling machine station, in order to analyse the effectiveness of introducing the 5S method, measurements of operating times were also carried out on the example of a series of 10 "Atlas" blades. The total time of making a series of blades was shortened by about 19.68%, as shown in Fig. 12.

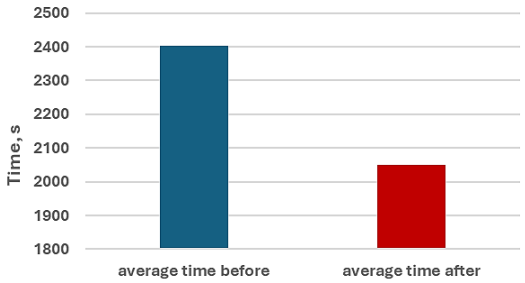

Fig. 12 Milling machine average production time before and after the implementation of 5S method

Thanks to the standardization of the milling machine station and the introduction of the 5S method, a significant reduction in operating times was observed, which translates into more efficient use of the operators' working time and reduced operating costs.

The next station where the 5S methodology was implemented was the plasma cutting station. Here, the times of

preparing the station, setting the machine and cutting operations were also measured, as shown in Fig. 13 and 14.

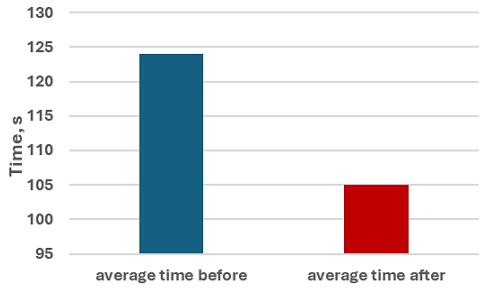

Fig. 13 Plasma cutting station preparation time before and after the implementation of 5S method

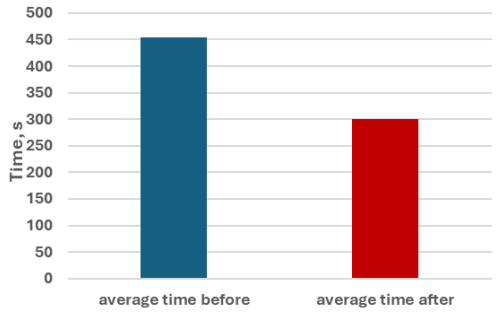

Fig. 14 Plasma cutting machine setting time before and after the implementation of 5S method

Thanks to the introduced changes, it was possible to shorten the preparation time of the plasma cutting machine station by approx. 15% (Fig. 13), and the machine setting time by as much as 33%. This confirms the effectiveness of the introduced organizational changes and resulted in increased productivity at the analysed station.
In case of cutting operations, time remained at 62 s both before as well as after the implementation of the 5S method. The time of this operation depends on the machine program and process automation, which emphasizes that the introduction of 5S standards mainly affects manual and organizational processes.
At the plasma cutting machine station, in order to determine the effectiveness of the changes introduced as part of the 5S method, an analysis of operating times was also tested on the example of the production of a series of 10 "Atlas" blades. As shown in the data in Fig. 15, after the implementation of the 5S method, it was possible to reduce the time by 14.11%.

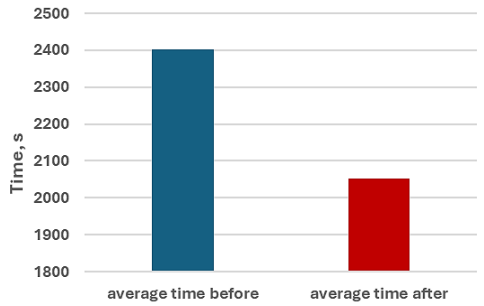

Fig. 15 Plasma cutting machine average production time before and after the implementation of 5S method

It is worth emphasizing that the 5S method at the plasma cutting machine station mainly influenced the shortening of the preparation time of the station and the machine setting. The unit time of the cutting operation remained unchanged, as it is determined solely by the machine control program. Despite the limitation, achieved reduction in total time by over 14% for a series of 10 elements is a significant benefit for the company.
The changes introduced at the drilling station allowed for significant improvements in work organization and shortening of operating times. Thanks to the reorganization of the workspace, designation of places for specific tools and elimination of unnecessary items, this time was shortened by 8.4% (Fig. 16), which translated into the improvement of the operator's work and faster access to the necessary tools.

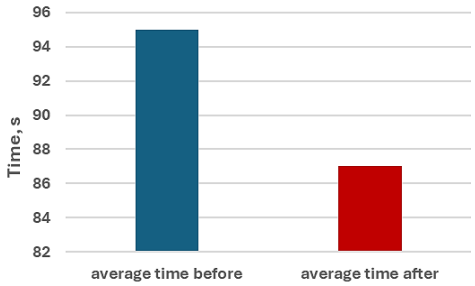

Fig. 16 Drilling station preparation time before and after the implementation of 5S method

Changes in the time of setting up the machine at the drilling station are shown in Fig. 17. Thanks to the standardization of procedures and better arrangement of tools, it was possible to shorten the time of these operations by 20%. Such a significant reduction in time allows the operator to prepare the machine more effectively and minimizes the time spent on settings.

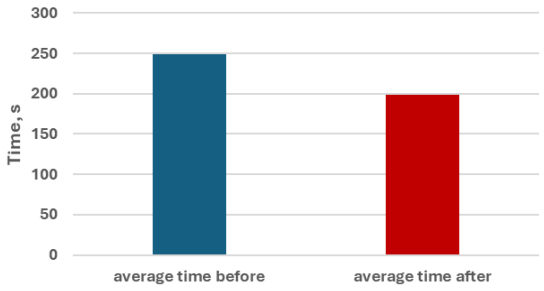

Fig. 17 Drilling machine setting time before and after the implementation of 5S method

In the case of drilling operations, as shown in Figure 18, the average drilling operation time was reduced by 9.3%. Thanks to better tool organization and elimination of interference, the machine operator can now perform the operation in a shorter time, which directly affects the increase in the efficiency of the station.

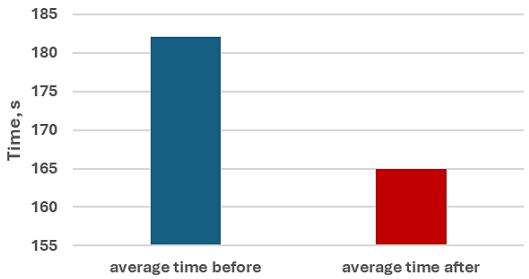

Fig. 18 Drilling machine operation time before and after the implementation of 5S method

The last station for which the effectiveness of the 5S method implementation was measured was the drilling station. Here too, the analysis was carried out on the example of a production series consisting of 10 "Atlas" blades. Thanks to the changes applied, the production time was reduced by almost 14% (Fig. 19), which indicates significant financial benefits for the analysed company.

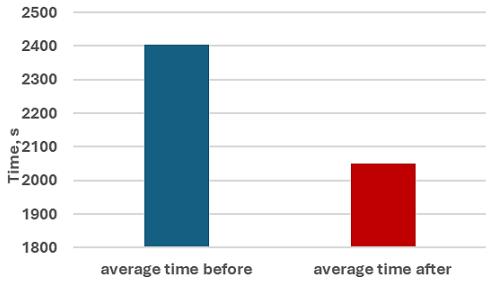

Fig. 19 Drilling station average production time before and after the implementation of 5S method

The introduction of the 5S method contributed to a significant improvement in the organization of work at production stations, which translated into a reduction in operating times and improved efficiency. Standardization of processes not only reduced the time required to perform operations, but also reduced production costs through better organization and the elimination of waste.

CONCLUSIONS

Based on the analysis of the organizational state of selected workstations at Prasmet Manufacturing Company – covering the band saw, milling machine, plasma cutter, and bench drill – a number of significant irregularities hindering efficient production operations were identified. Diagnosed issues, such as disorganized workspace, lack of standardized procedures, suboptimal tool placement, and limited access to materials, prompted the company owner to decide on implementing the 5S methodology as a tool to streamline processes at the identified workstations.

The implementation of the 5S method significantly improved work organization at the analysed workstations. Systematic organization of the workspace, designation and labelling of tool storage areas, and the introduction of standardization principles enhanced resource transparency and accessibility, directly contributing to a reduction in operation times. Measurements showed a significant decrease in total operational times: by 29.90% at the band saw workstation, 27.88% at the milling machine, 14.11% at the plasma cutter, and 13.98% at the bench drill.

The achieved reduction in operational times led to an increase in overall production efficiency and a decrease in the company's operational costs. The reduced time required for individual operations enabled better utilization of human resources, improved production flow, and created conditions for further process improvement. These results confirm the validity of implementing systematic organization and work standardization methods to enhance the plant's competitiveness in an industry driven by high quality and precision.

ACKNOWLEDGEMENTS

The article is financed by the funds number BK-201/RM1/2024 (11/010/BK_24/0054).

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