

Irena PAWŁYSZYN¹, Agata KOŁODZIEJ, Klaudia KRAWCZYK

IMPACT OF LEAN SOLUTIONS IMPLEMENTATION ON EMPLOYEE EFFICIENCY – A CASE STUDY OF A FURNITURE COMPANY

DOI: 10.21008/j.0239-9415.2024.090.01

The furniture industry is developing dynamically and Poland is one of the leading furniture exporters in the world, which creates a significant opportunity for companies in this sector to use Lean Management as a strategic approach to improve processes and achieve competitive advantage on the market.

This article analyses the main waste-related problems in a selected SME operating in the furniture industry. The aim of the study is to assess the impact of Lean solutions on employee work efficiency. The data necessary for the analysis were collected using the observational method within the company. In order to compare the effects of implementing the proposed Lean Management solutions, ratio analysis was used. The research findings led to the development of Lean Management solutions that meet the individual needs of the company and involve the elimination of waste. The effects obtained were presented using the indicator method, comparing the efficiency improvements achieved with the original state before implementation. The introduction of Lean solutions, namely standardization, Visual Management, Kaizen, and 5S, resulted in an improvement in the efficiency indicator, particularly in the context of employee working time. The efficiency indicator was assessed in relation to the employee working time. The increase in efficiency ranged from 15 to 77 percentage points. These results clearly indicate that the introduced solutions increased employee efficiency and accelerated the production process.

Keywords: implementation, efficiency, waste, furniture industry, Lean Manufacturing

¹ Poznan University of Technology, Faculty of Engineering Management. ORCID: 0000-0002-5054-6314.



1. INTRODUCTION

Today, companies, including those in Poland, strive to gain a competitive advantage in the market. Constant market competition, changing and dynamic economic conditions, and globalization processes encourage companies to implement new management concepts that help them follow the current trends. Increasingly, organizations strive to improve their processes using the tools and methods of Lean Manufacturing. Lean production is the basis for the proper functioning of enterprises by implementing a culture of continuous improvement and work standardization (Küpper et al., 2017). The literature on the subject indicates that the implementation of Lean solutions in a company is its first step towards Industry 4.0, because it is precisely the “leaned” processes in the company combined with modern technologies that give rise to a company operating in accordance with the Lean 4.0 concept (Bittencourt et al., 2021; Buer et al., 2018; Mofolasayo et al., 2022; Buer et al., 2021). However, a significant part of Polish companies, especially in the SME sector, have not yet taken a step (Pawłyszyn, 2021), and therefore the processes implemented in them and the resources used for this purpose are not properly managed and do not produce competitive results that are achieved by companies implementing Lean Manufacturing.

The key to the success of manufacturing companies in the SME sector (but not only) is the implementation of a systemic way of thinking about production processes in their reality, thanks to which it is possible to improve their efficiency (Marić, Medaković, 2023; Deshmukh et al., 2022). It is obvious that effectively functioning processes will contribute to faster order fulfillment and increase customer satisfaction, as well as lower production costs and increase the company’s profitability. Additionally, improved processes will contribute to building a competitive advantage and will enable the company to adapt to changing market conditions. While the SME sector (taking into account the gross value added generated by enterprises) is responsible for almost 50% of Poland’s GDP (PARP, 2022), efforts should be made to initiate the implementation of the Lean concept in companies belonging to a given sector, as such an approach will improve not only the functioning of the selected industry but also the economy of the whole country.

The concept of Lean Manufacturing has been widely described in the scientific literature. One of the recent studies related to this topic focuses, among others, on aspects related to corporate social responsibility (CSR) (Chiarini et al., 2023; Ivanaj et al., 2021), sustainable development (Elemure et al., 2023; Rajarajeswari, Anbalagan, 2023), or links to the Industry 4.0 (Moraes et al., 2023; Rahargjo et al., 2023). Despite the extensive analysis of the subject under consideration, many Polish companies are still in the early stages of Lean Manufacturing.

However, it is worth emphasizing that even the first steps towards lean processes bring considerable efficiency benefits. Therefore, in this article, it was decided to analyze the case study of a medium-sized company from the furniture industry,



which began to implement selected solutions that fit the context of the concept discussed. Attention was paid to a company from the furniture industry, as Poland is one of the leaders in the world in terms of the value of furniture production and export. More than 90% of manufactured products of this type are estimated to be sold abroad (Chmieliński et al., 2017), and the share of the furniture industry in CAC is estimated at 2.3% (Kochman, 2020).

The purpose of this article is to assess the impact of Lean solutions on the efficiency of employee work through the example of a selected company in the SME sector operating in the furniture industry. The furniture industry is still dynamically developing, which is why the surveyed SME decided to expand its knowledge of Lean Manufacturing and entered the Lean way by implementing specific solutions, thus wishing to increase its competitiveness in the market. Due to the implementation of the selected solutions, the company obtained the first results. Therefore, the research question in this article concerns the analysis of the efficiency results obtained in the company thanks to the implementation of Lean Manufacturing, and it reads: How does the elimination of waste affect the efficiency results in the surveyed company?

This paper explores the proposed answers to this question, based on the analysis of Lean Manufacturing solutions implemented in a selected furniture company.

2. LITERATURE REVIEW

The concept of Lean Manufacturing focuses on the systematic and continuous creation of value for the customer, expressed in the delivery of desirable and good quality products while reducing or eliminating activities that do not bring any added value. Buer et al. identified Lean Manufacturing as a process that focuses on eliminating waste in the manufacturing process by identifying redundant activities, improving the process, and creating standardized practices (Buer et al., 2018).

The overarching goal of the concept is to identify problems and causes of waste, and to prevent their occurrence. Therefore, employing a variety of methods and techniques is extremely helpful (Pawłyszyn, 2021, p. 25). These tools, techniques, and methods can be used in both production and service processes. Among them, we can distinguish well-known approaches such as 5S, Kanban, Kaizen, Just in Time, Visual Management, SMED, TPM (Eow et al., 2014), as well as the lesser-known ones like Kamishibai, One Point Lesson, Hoshin Kanri, and Chaku Chaku. It is estimated that there are over 100 Lean tools (Hallihan, 1996, p. 34), and their diversity means that they can be used across all industries. Lean tools, methods, and techniques can be categorized according to their purpose and intended application. The following categories can be distinguished (Pawłowski, Pawłowski, Trzcieliński, 2010, pp. 27-28):

- development of the product and its introduction to the market;



- system analysis and mapping;
- improvement;
- production;
- quality;
- procurement and distribution;
- people.

Specific tools should be adapted to the company's needs and the qualifications of its employees. However, there is no single method or list for implementing the Lean tools. They must correspond to specific problems and cover the area to be improved.

In addition, according to the industry implementation manual, it is crucial to understand that the system a company chooses should ensure the durability and correct use of specific tools (Kagan, Jakubik, 2019, pp. 17-19). Correctness is understood as the development of standards (instructions) for employing a given method or technique, i.e., determining who and how to use a given tool, as well as establishing how and by whom the knowledge of that method or technique will be conveyed to employees. To identify errors and causes of waste, it may be necessary to standardize work (as one of the Lean tools) at each position in the company (Sayer, Williams, 2015, p. 95). Precise guidelines and instructions for performing work will have a positive impact on the implementation of further techniques and facilitate the transition to Lean Management. In the scientific circle, some argue that the first step in implementing Lean Management should be the proper organization of the workplace, i.e., through the use of the 5S method (Gundlach, 2009, p. 22). Resolving disputes about the sequence in which individual techniques should be implemented requires meticulous consideration by the company's management; however, it is clear that using only a few tools will not guarantee the intended success (Pawłyszyn, 2017, p. 179). It is crucial to recognize that a given organization functions as a unified whole. Therefore, to be able to implement Lean and achieve the expected results, it is necessary to remember not only about improving production but also on enhancing other areas by using numerous, diverse tools. All employees should be involved in this process, and the use of resources should be minimized to achieve increased efficiency, customer satisfaction, as well as reduced enterprise costs (Pawłyszyn, 2019, pp. 50-51). Every company strives to improve its processes to reduce production time and costs, which can translate into gaining an advantage in its operating environment. The concept of Lean Management is one of many possibilities for effective management of production and logistics processes. Lean Management is focused on eliminating waste by using appropriate principles and techniques. The goal is to create the greatest possible added value for the customer. Although the Lean philosophy is not new, in some companies its introduction is defined as innovative. However, it should be remembered that implementing Lean Management in an organization is most often associated with a change of mindset compared to traditional management methods.

3. RESEARCH METHODS

The subject of the study is the evaluation of activities carried out by a selected company that align with the Lean concept and contribute to improving its efficiency. The article also shows the Lean Manufacturing solutions implemented by the examined entity, which eliminate waste from its processes, and includes calculations of efficiency indicators before and after their implementation. A case study was chosen as the research method.

A case study, as a widely used method in empirical analyses, examines a current phenomenon in a real-life situation. It allows the researcher to examine the data in a specific context. The use of a case study was dictated by the desire to gain a deeper understanding of a single “case” embedded in its real context. In this article, the selected case is an SME in the furniture industry, and a thorough analysis of its real-world experiences is presented. The knowledge obtained from the case study can be used to better understand the phenomena occurring in other entities similar to the one analyzed and thus improve their activities. In other words, the case study enables the researcher to become involved in the research topic and gradually narrow it down and refine it according to the chosen research direction.

In addition, case study analysis allows for a more in-depth observation of processes and the effectiveness of implemented changes. Direct observation allows the researcher to notice subtle differences and nuances that may be missed in a broader studies covering many companies. Another argument for choosing a case study is the possibility of obtaining detailed data and deep insight into employee reactions to change. Ultimately, case studies can serve as a basis for developing theories and models that can be applied in other contexts.

The methodology of the conducted research was divided into five stages:

- case study selection – the selection of the analyzed company producing upholstered furniture was dictated by three aspects: 1) the company belongs to a sector of great importance for the country, i.e. the SME sector (the company employs about 80 employees in 14 departments); 2) the company operates in the furniture industry, in which Poland is one of the world leaders, so it is very important for companies belonging to it to develop with the times to maintain their competitive position; 3) the company is at the beginning of the path related to the implementation of Lean Manufacturing;
- observation and data collection – direct observations were made to collect data concerning the production processes implemented in the company; observation of the processes enabled understanding of the actual course of the processes taking place; observation both before and after the implementation of changes lasted 5 working days;
- analysis – at this stage, the collected information was processed to analyze changes in the functioning of the production process in the selected enterprise before and after the implementation of the selected Lean tools;

- calculation of efficiency indicators – the analyses made it possible to calculate efficiency indicators and compare them in the context of the production stages considered;
- conclusion – the last step of the research consisted of concluding the analyses made.

One of the research methods used in this work is ratio analysis. The basic indicator that was analyzed during the research was the efficiency indicator. Efficiency is defined as the ratio of productive time to available time, where productive time is available time reduced by efficiency losses (micro stops, losses related to machine start-up or searching for tools, etc.) (Furman, 2014). Efficiency is expressed as a percentage, and its formula is as follows:

$$E = (\text{time available} - \text{efficiency losses}) / \text{time available} \times 100 \quad (1)$$

The introduction of Lean Manufacturing solutions in the company can help to remove barriers and obstacles that affect the employee's work efficiency. By eliminating waste, the employee can focus on real tasks and activities, which contributes to increasing work efficiency. For this reason, the emphasis in this article has been placed on a given indicator to check whether the solutions implemented in the company had an impact on its value.

The conducted study is important because it concerns the assessment of activities in the company that are consistent with the Lean Manufacturing concept, which is crucial for improving efficiency in the small and medium-sized enterprise sector. The selection of a specific company from the furniture industry, which is in the phase of introducing Lean solutions, allows for obtaining practical and measurable results, which increases the usefulness of the knowledge gained during the research.

The credibility of the study is based on the applied case study analysis method, which allows for in-depth observation of actual production processes and their changes in the context of implementing Lean tools. Additionally, the use and calculation of efficiency indicators before and after the implementation of Lean solutions allow for a reliable assessment of the impact of these activities on work efficiency. Therefore, the results of the study may be useful not only for the analyzed company, but also for other entities from a similar industry.

4. RESULTS

The analyzed company operates a single-shift system from Monday to Friday from 6:00 a.m. to 2:00 p.m. In total, about 80 people are employed in 14 departments, which classifies the company as a medium-sized enterprise. The company has the following production departments: carpentry, assembly, modeling shop, paint shop, cutting, sewing, gluing, and upholstery.



The analyzed company performs custom-made production (sofas, chairs, couches, beds, etc.) and has taken the first steps on the Lean path. Production in an enterprise is usually planned a month in advance, and its size depends directly on the amount of goods ordered by buyers. The company carries out production to the customer's order (Make To Order – MTO).

The proper functioning of the company according to the Lean Manufacturing concept is conditioned by recognizing waste occurring in the company, analyzing it, implementing the proposed improvements, and measuring the effectiveness of the implemented solutions to determine further directions for improvement or repair work.

During the initial observations in the company, various types of waste were observed. Striving to eliminate them, selected solutions were proposed that fit the Lean concept, which was then implemented by the company. Subsequent observations made it possible to compare the state before and after the implementation of the proposed changes.

The first waste noticed was related to improper management of the production space. At the station in the assembly plant no. 2 there was a rack in which there were unordered screws. There was no separation or sorting by size or purpose. In this case, unnecessary traffic resulting from the long time spent searching for individual elements was included in the waste. These materials were stored in original cardboard boxes without any visible distinction, which made it much more difficult to find the right screw. The implementation of standardization² and Visual Management³ allowed the company to reduce the time spent searching for screws by production employees. Elimination of unnecessary waste was possible due to the use of multicolored workshop containers and their appropriate description (fig. 1). For each type of screw, an appropriate color of the container has been assigned along with a description of the size. The containers on the shelves were arranged in order of increasing bolt lengths: the bolt with the shortest length on the left, the bolt with the largest length on the right. In addition, the shelves for the screws have been placed at an angle on the workstation to make it easier to pick up the fasteners. The arrangement of the shelves described above was also intended to improve the ergonomics of the production team.

² Standardization is the act of establishing, for real or potential problems, common and reusable rules aimed at achieving an optimal degree of order in a given context (Chruściel, 2022).

³ Visual management – a tool used to organize, visualize and evaluate the processes taking place in the company (Knop, 2016).

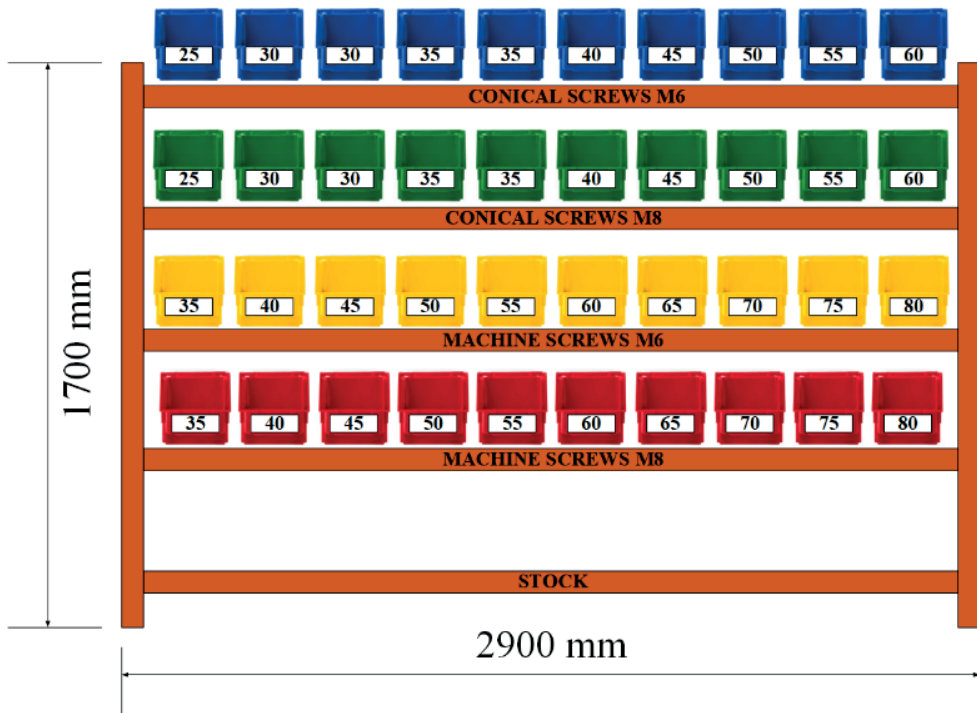


Fig. 1. Visualization of the rack organization for fasteners

Before the changes were implemented in the company, the average time to produce one piece of furniture was about 10 minutes. During this time, it took an employee on average 2 minutes to find the right connecting elements. Therefore, the average employee efficiency was calculated as follows:

$$E_{11} = (10 - 2) / 10 \times 100 = 80\% \quad (2)$$

After implementing the proposed changes, the average time required to produce one of the same elements is 9 minutes, with 0.5 minutes allocated to searching for connecting elements. This means that the employee's current efficiency is as follows:

$$E_{12} = (9 - 0.5) / 9 \times 100 = 94\% \quad (3)$$

The use of standardization and Visual Management resulted in a 14 percentage points increase in employee efficiency.

Another waste in the production workspace turned out to be tables without height adjustment. They were particularly troublesome for employees in the assembly department as they were forced to assume uncomfortable positions while assembling various elements. The specificity of the tasks performed in this department required

employees to often bend, squat, and lift furniture, and the tables were not adjusted to their height. Therefore, many employees complained about back pain, which decreased their efficiency and job satisfaction. According to the main principle of Kaizen, the right solution in this case turned out to be the replacement of traditional tables with pneumatic tables featuring foot-adjustable height. These tables allow employees to adjust the height based on the specific tasks they are performing, significantly improving workplace ergonomics. The implementation of this solution improved employees' satisfaction. It should be noted that ergonomics at work is one of the key issues in the Kaizen philosophy⁴.

A deeper analysis of the production process showed an incorrect organization of employees' work and, more precisely, an incorrect assignment of duties. This was especially noticeable with the CNC lathe operator. The duties of this employee included placing pieces of wood inside the working machine, picking up ready-made wooden elements, and responding to a sudden failure. On average, these activities took him 45 seconds (maximum 60 seconds).

On the other hand, the processing time of the elements by the machine (and therefore the operator's waiting time) was about 5 minutes. The employee is required to be close to the machine in the event of sudden failures, which will be indicated by light and sound signals.

To increase the worker's efficiency, it was proposed to increase the scope of their duties by adding simple assembly tasks in the free space next to the machine, where a work table could be placed. While the machine was processing, the operator could perform assembly work, and if necessary, react to any operational problems.

Implemented according to the Kaizen approach, this change relieved assembly workers and eliminated unnecessary waiting time. This also translated into greater employee participation in the work performed and greater flexibility of production. Due to this improvement, the efficiency of the CNC lathe operator increased from 15% to 92%:

$$E_{21} = (300 - 255) / 300 \times 100 = 15\% \quad (4)$$

$$E_{22} = (300 - 25) / 300 \times 100 = 92\% \quad (5)$$

Cluttered workstations were another waste-generating problem, primarily caused by the fact that the work tools did not have specific places assigned, which caused chaos and also translated into distraction and a decline in workplace safety. This problem was particularly noticeable in the assembly departments. In assembly plant No. 1, each employee had a dedicated workstation consisting of a table and a shelf

⁴ Kaizen (continuous improvement) – a philosophy that assumes continuous improvement, including the introduction of even minor changes and motivating employees to propose improvements and take an active part in their implementation (Pomietlorz, 2015).

with the necessary tools and materials. To make it easier for employees to keep their workstations tidy, it was justified to implement the 5S method⁵. This method was implemented as a pilot at selected stations in the assembly plant (fig. 2). At that time, redundant items were separated and removed from the workstations and only those needed were left. Then, all tools were assigned specific locations, so that their designated arrangement made them easier to find. For this purpose, Kaizen foam was used, with recesses cut to match the shape of each tool. The use of this solution allowed to avoid the movement of tools on the work table. This solution was supplemented with Visual Management. To facilitate the quick identification of connecting elements and semi-finished products, color-coded containers and information plates were introduced. To create ergonomic workstations, shelves and Kaizen foam were set at an angle that made it easier for employees to retrieve tools. The next step was to develop a habit among employees to clean up the workplace, which included arranging tools and materials in previously designated places. The key aspect of this step was to extend the scope of the employee's duties to include the daily maintenance of order at their workstations. Additionally, the company initiated periodic 5S audits to verify compliance with the 5S principles.

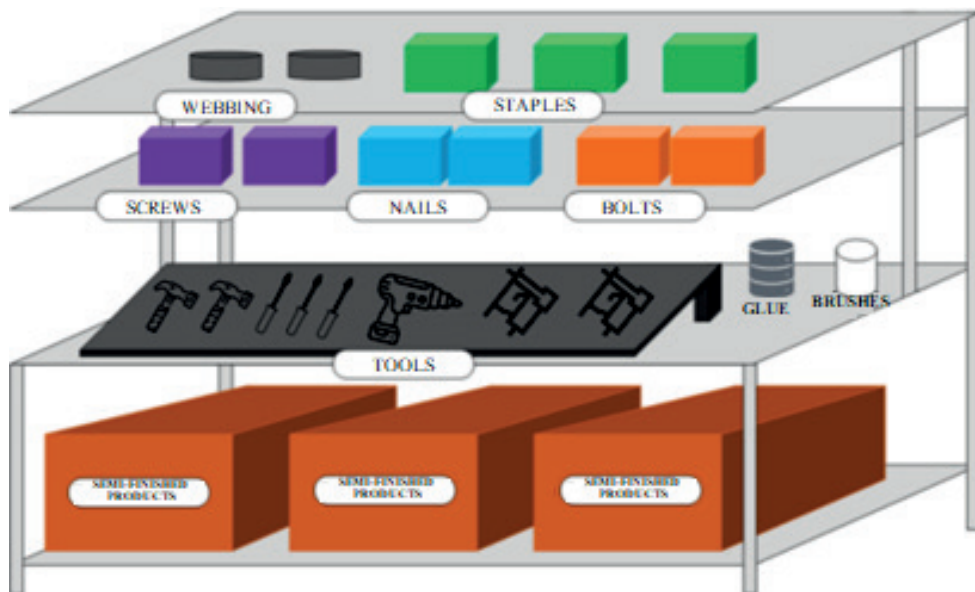


Fig. 2. Organization of the assembly station

⁵ 5S is a methodology that is one of the basic LM tools, and its name refers to five Japanese words concerning the principles of proper organisation of the workplace (Józwiakowski, 2015).

In the case of observing the work of the employees at the workstations in assembly No. 1, it was noticed that at the workstations where the 5S method was implemented, the employees spend on average one minute searching for tools while making one chair frame. As a result, each chair frame took 20 minutes to produce. This time was increased to 25 minutes for fitters working at the workstations where 5S has not been applied, of which 5 minutes were spent on needless traffic, such as looking for the appropriate tools for the job. It is estimated that the comprehensive implementation of the 5S method in all assembly stations will increase the work efficiency of employees from 80% to 95%:

$$E_{31} = (25 - 5) / 25 \times 100 = 80\% \quad (6)$$

$$E_{32} = (20 - 1) / 20 \times 100 = 95\% \quad (7)$$

The last noted waste was the difficulty in accessing handy manuals and technological cards which were not available at the workstations. This is somewhat justifiable because it would be impractical to store all paperwork at workstations due to the wide variety of furniture models available. Employees, when they are unsure of the method of making individual elements, semi-finished products, or finished products, are forced to check the appropriate technological cards directly with their managers. Unfortunately, in order not to waste time, very often employees prefer to rely on their memory, which translates into the formation of incorrectly made semi-finished products and finished products. Once they decide to check the necessary information, finding the right documentation is time-consuming. The solution then is to standardize and digitize the entire documentation together with its extension with photos of individual products. Once a proper database is in place, a tablet should be guaranteed in each department, re-calling to designate the appropriate places for them. To do this, mark the places where tablets are stored with tape, as well as information stickers to avoid losing them. Tablets themselves should also be marked with information stickers so that if a tablet is taken from another department, the employee knows where the tablet should be returned. Each tablet should contain workplace instructions, technological cards, and photos of finished products (fig. 3). The implementation of such a solution will primarily save time, prevent errors, and facilitate the process of onboarding new employees. The use of tablets can be problematic, especially for older employees, so it is crucial to train employees in the use of such a system. The given solution has not yet been fully implemented in the enterprise, and therefore, it is difficult to indicate its impact on the efficiency of work performed by employees. Nevertheless, it is worth noting that it is not only in line with the paradigm of the Lean concept but is also the first step for a company operating in line with Industry 4.0.

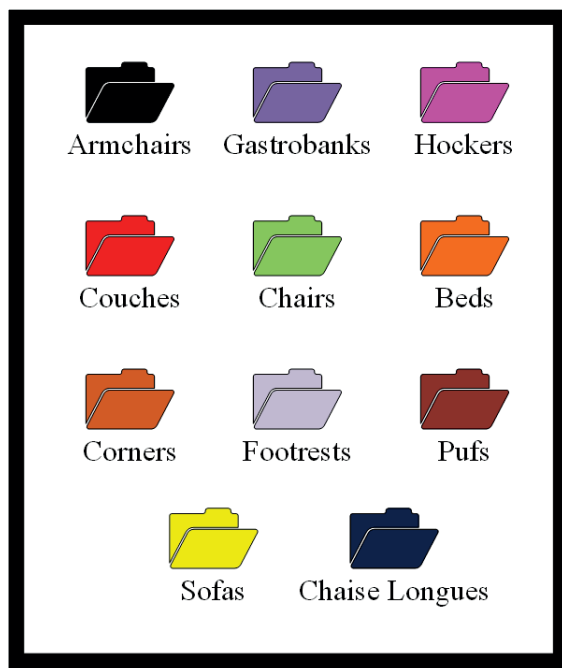


Fig. 3. Visualization of the tablet screen with technological documentation

Table 1 presents the estimated implementation timeline, the approximate gross costs of purchasing materials and conducting the necessary training, as well as the preliminary designation of the persons responsible for coordinating the implementation of specific improvements and those directly involved in this process.

Table 1. Improvement in the production area

Improvement	Implementation time	Implementation Coordinator	Physical Onboarding Person	Costs [gross]
1. Tidying up the station at assembly no. 2 by using appropriately marked containers for connecting elements	2 weeks	Upholstery and Installation Manager No. 2	Assembly workers No. 2, Employee Supply	Workshop containers (40 pcs) – PLN 796 Information plates (5 pcs) – PLN 29.95 Self-adhesive labels (4 sheets) – PLN 35.96 In total: PLN 861.91
2. Replacement of ordinary tables on assembly No. 2 with pneumatic tables	1 month	Production Manager	Workshop employees, Employee Supply	Pneumatic table (3 pcs) – PLN 20 992.41 In total: PLN 20 992.41

Improvement	Implementation time	Implementation Coordinator	Physical Onboarding Person	Costs [gross]
3. Increasing the scope of duties of the CNC machine tool operator by adding more tasks while waiting for the machine to make wooden elements	1 week	Carpentry and Assembly Manager No. 1	Carpenter (CNC operator)	Workbench – PLN 329.99 Employee training – PLN 200 In total: PLN 529.99
4. Tidying up the position at assembly no. 1 by using a shadow board with Kaizen foam and using marked containers for connecting elements	3 weeks	Carpentry and Assembly Manager No. 1	Assembly Workers No. 1, Employee Supply	Storage containers (30 pcs) – 2 675.4 PLN Workshop containers (90 pcs) – PLN 1 007.1 Information plates (90 pcs) – PLN 539.1 Kaizen foam (10 pcs) – PLN 550 Employee training – 1 250 PLN In total: PLN 6 021.6
5. Ensuring the availability of tablets containing the necessary technological information in individual departments	6 months	Production Manager	Model shop workers, Employee Supply	Tablet (9 pcs) – 4 941 PLN In total: PLN 4 941

The total costs of the proposed improvements were set at PLN 33 349.91.

5. DISCUSSION

For the last three decades, Lean Manufacturing has been one of the most widely used business strategies (Sony, 2018) and can be applied to any type of production environment (Shahin et al., 2020). A literature review confirms that most Lean Manufacturing implementations take place in large companies (Pech, Vaněček, 2018). However, as indicated above, the economy of Poland, like that of many other European countries, is primarily driven on SMEs, which constitute the majority of participants in the enterprise sector, so their development and proper functioning should be the focus of attention.

The amount of literature on the implementation of Lean solutions in the furniture industry is limited. For example, Gazoli de Olivera et al. (2019) in his work provide a case study of the partial implementation of Lean Manufacturing in a medium-sized

furniture industry, aimed at increasing productivity. The authors focus mainly on value stream mapping (VSM). Similarly, Güner Gören (2016) considers Lean in the furniture industry focusing on VSM in combination with simulation with simulation. In turn, Guzel and Asiabi (2022) present not only VSM, but also solutions related to Kaizen, 5S, standard work, layout plan, and single-piece flow techniques. Wang et al. (2012) focused on analyzing engineering performance in the context of Lean solutions. Abu et al. (2021), on the other hand, studied the challenges and barriers encountered during the implementation of Lean Manufacturing in the furniture industry. This study complements and expands the knowledge of the implementation of Lean solutions in the environment of enterprises operating in the furniture industry and, on the basis of specific examples, enables others to improve their processes.

The exemplary enterprise that has been considered in this article belongs to the SME sector. Its initial experience with implementing the Lean Manufacturing concept shows efficiency improvement even with small, non-cardinal and non-drastic changes. The company started the implementation with standard and one of the most understandable Lean tools for employees, namely 5S, Visual Management, standardization, and Kaizen solutions. Figure 4 shows the change in the efficiency index in relation to three of five solutions proposed and implemented in the company, for which appropriate measurements were made. The columns marked in blue indicate the existing state in the company, while the columns marked in green show the change in indicator after the implementation of individual solutions in the company.

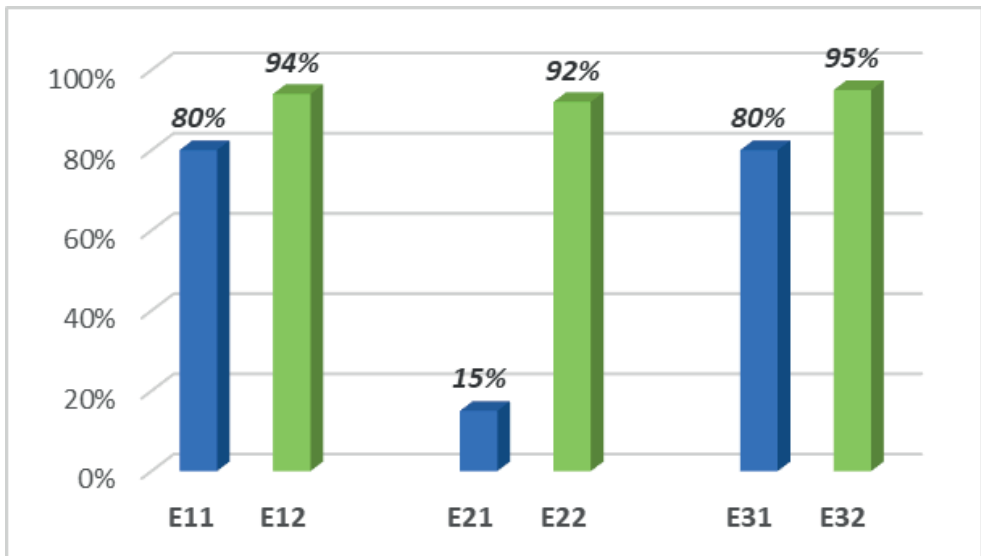


Fig. 4. Changing the effect indicator for individual Lean elements

It can be seen that each solution implemented according to the Lean concept improved the efficiency indicator. A particularly significant increase was visible in the case of the second solution, which involved changing the assignment of tasks to an employee operating the CNC lathe. The efficiency index in this case increased by 77 percentage points. In the remaining two cases, the change in the indicator oscillated around 15%. The results clearly show that the solutions implemented in the furniture company contributed to the increase in the employee work efficiency and thus to a more efficient implementation of the production process.

Parallel to the increased work efficiency, there was a greater involvement of the employees, also due to the improvement of the conditions and ergonomics of their workstations. It should be emphasized that the better the working conditions of employees, the more satisfied they are with their work, leading to increased motivation to take further Lean actions and create innovations.

The implementation of new improvements in enterprises is a very important aspect of the proper functioning of processes to increase competitiveness in the market. In order to stand out from other companies, it is necessary to eliminate any barriers or waste that are not an added value, on the contrary. This is especially important for SMEs, which are more flexible in relation to market changes than larger enterprises (Cegliński, 2016). The implementation of Lean solutions in these enterprises will not only allow them to increase their flexibility, but will also enable them to perform their existing tasks in a more effective, and thus more competitive way. In addition, more effective use of the company's resources will help generate savings that can be used to develop innovation, for which SMEs often lack resources.

6. CONCLUSIONS

The purpose of this article was to assess the impact of Lean solutions on the efficiency of employee work through the example of a selected company in the SME sector operating in the furniture industry. The analyses carried out indicate that the improvements implemented in the surveyed company are directly related to the minimization of various types of waste, which may be unnecessary movement of operators or their unnecessary waiting time. Basing the company's goals on the pillars of the Lean Manufacturing concept, which are the values, knowledge of employees, and cooperation between individual units, leads to increased efficiency, as demonstrated in the analyzed case study.

Continuous development is important, but realistically, it should be taken into account that not every organization in the SME sector has sufficient resources to implement costly changes. The solution may be the implementation of the principles of the Lean Manufacturing concept, which will allow the implementation of visible changes with minimal investment while delivering measurable benefits.



The limitation of the presented research is the fragmentary analysis of the effectiveness of selected stages of the production process. Further work should focus on analyzing the effectiveness of the entire production process, as a comprehensive analysis will allow for the actual assessment of the impact of the implemented solutions on customer order fulfillment time.

In the era of globalization, competition is extremely high. In the fight for a high market position, innovative and effective concepts, such as Lean Manufacturing, are helpful, allowing enterprises to obtain measurable benefits and gradually prepare them to operate in the conditions of Industry 4.0.

LITERATURE

- Abu, F., Saman, M.Z.M., Garza-Reyes, J.A., Gholami, H., Zakuan, N. (2021). Challenges in the implementation of lean manufacturing in the wood and furniture industry. *Journal of Manufacturing Technology Management*, 33(1), 103-123, <https://doi.org/10.1108/JMTM-01-2021-0029>.
- Bittencourt, V., Alves, A.C., Leão, C.P. (2021). Industry 4.0 triggered by Lean Thinking: Insights from a systematic literature review. *International Journal of Production Research*, 59(5), 1496-1510, <https://doi.org/10.1080/00207543.2020.1832274>.
- Buer, S.V., Semini, M., Strandhagen, J.O., Sgarbossa, F. (2021). The complementary effect of lean manufacturing and digitalisation on operational performance. *International Journal of Production Research*, 59, 1976-1992, <https://doi.org/10.1080/00207543.2020.1790684>.
- Buer, S.V., Strandhagen, J.O., Chan, F.T.S. (2018). The link between Industry 4.0 and lean manufacturing: Mapping current research and establishing a research agenda. *International Journal of Production Research*, 56(8), 2924-2940.
- Cegliński, P. (2016). Przewagi konkurencyjne małych i średnich przedsiębiorstw. *Acta Universitatis Nicolai Copernici. Zarządzanie*, XLIII, 3, 169, http://dx.doi.org/10.12775/AUNC_ZARZ.2016.038.
- Chiarini, A., Conti, E., Zhou, P. (2023). Lean and corporate social responsibility: a systematic literature review. *Total Quality Management & Business Excellence*, 34(5-6), 637-671, <https://doi.org/10.1080/14783363.2022.2090920>.
- Chmieliński, R., Gałązka, A., Grochowina, S., Krzemińska, J., Krzyna, D., Trawka, J., Wiza, R. (2017). *Rynek meblarski w Polsce. Raport KPMG*.
- Chruściel, P. (2022). Schemat rozwiązywania problemów na przykładzie przedsiębiorstwa produkcyjnego z branży opakowań przemysłowych. *Zarządzanie i Jakość*, 4(4), 58-73.
- Deshmukh, M., Gangele, A., Gope, D.K., Dewangan, S. (2022). Study and implementation of lean manufacturing strategies: A literature review. *Materials Today: Proceedings*, 62(3), 1491-1492, <https://doi.org/10.1016/j.matpr.2022.02.155>.
- Elemure, I., Dhakal, H.N., Leseure, M., Radulovic, J. (2023). Integration of Lean Green and Sustainability in Manufacturing: A Review on Current State and Future Perspectives. *Sustainability*, 15(13), 10261, <https://doi.org/10.3390/su151310261>.



- Eow, T.C., Ahmed, S., Dahari, M. (2014). Implementation of value stream mapping (VSM) in SMEs – identification of waste for continuous improvement. *Journal of Applied Science and Agriculture*, 9(2), 18-26.
- Furman, J. (2014). Wdrażanie wybranych narzędzi koncepcji Lean Manufacturing w przedsiębiorstwie produkcyjnym. In: R. Knosala (ed.). *Innowacje w zarządzaniu i inżynierii produkcji*, vol. 1. Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją, 247-256.
- Gazoli de Oliveira, A.L., da Rocha Junior, W.R. (2019). Productivity improvement through the implementation of lean manufacturing in a medium-sized furniture industry: a case study. *South African Journal of Industrial Engineering*, 30(4), 172-188.
- Gundlach, M. (2009). Praktyki 5S jako pierwszy krok do wdrożenia produkcji odchudzonej w przedsiębiorstwie produkcyjnym. Rozwinięcie teorii 6S. *Zeszyty naukowe. Organizacja i Zarządzanie*, 1064, 19-40.
- Güner Gören, H. (2017). Value stream mapping and simulation for lean manufacturing: A case study in furniture industry. *Pamukkale University Journal of Engineering Sciences*, 23(4), 462-469, <https://doi.org/10.5505/pajes.2016.59251>.
- Guzel, D., Asiabi, A.S. (2022). Increasing Productivity of Furniture Factory with Lean Manufacturing Techniques (Case Study). *Tehnički Glasnik*, 16(1), 82-92, <https://doi.org/10.31803/tg-20211010121240>.
- Hallihan, A. (1996). *The development of a practical framework for the implementation of JIT manufacturing*. Bedford: Cranfield University, School of Industrial and Manufacturing Science.
- Ivanaj, S., Collet, M., Gendron, C., Friser, A. (2021). Lean and CSR, contradictions and complementarities: Toward an effective managerial solution. *Quality Management Journal*, 28(4), 205-222, <https://doi.org/10.1080/10686967.2021.1962775>.
- Józwiakowski, P. (2015). Lean Management – metoda racjonalnego zarządzania produkcją. *Zeszyty Naukowe DWSPiT. Studia z Nauk Technicznych*, 4, 33-46.
- Kagan, R., Jakubik, M. (2019). *Na rozdrożach Lean Management. Przewodnik wdrożeniowy dla menadżerów*. Wrocław: Lean Enterprise Institute Polska.
- Knop, K. (2016). Zarządzanie wizualne jako istotny element w doskonaleniu firmy produkcyjnej. *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie*, 87, 237-250.
- Kochman, A. (2020). *Kwartalny przegląd danych statystycznych dotyczących polskiego meblarstwa oraz wybrane informacje o rynkach zagranicznych (obraz tuż przed COVID-19, I kwartał 2020 r.)*. Polski Fundusz Rozwoju.
- Küpper, D., Heidemann, A., Ströhle, J., Spindelndreier, D., Knizek, C. (2017). *When Lean meets Industry 4.0: The next level of operational excellence*. Boston: Boston Consulting Group.
- Marić, B., Medaković, V. (2023). Approach to development of the lean concept project. *Acta Technica Corviniensis – Bulletin of Engineering*, XVI, 87-92.
- Mofolasayo, A., Young, S., Martinez, P., Ahmad, R. (2022). How to adapt lean practices in SMEs to support Industry 4.0 in manufacturing. *Procedia Computer Science*, 200, 934-943, <https://doi.org/10.1016/j.procs.2022.01.291>.

- Moraes, A., Carvalho, A.M., Sampaio, P. (2023). Lean and Industry 4.0: A Review of the relationship, its limitations, and the path ahead with Industry 5.0. *Machines*, 11(4), 443, <https://doi.org/10.3390/machines11040443>.
- PARP (2022). *Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce*. Warszawa.
- Pawłowski, E., Pawłowski, K., Trzcieliński, S. (2010). *Metody i narzędzia Lean Manufacturing*. Poznań: Wydawnictwo Politechniki Poznańskiej.
- Pawłyszyn, I. (2017). Pierwsze kroki na drodze „wyszczuplenia” – wdrożenie Lean Management w organizacji. *Zeszyty Naukowe Politechniki Poznańskiej. Organizacja i Zarządzanie*, 72, 175-186, <https://doi.org/10.21008/j.0239-9415.2017.072.13>.
- Pawłyszyn, I. (2019). Symbiosis between the Lean Manufacturing concept and progressive informatization. *Business Informatics*, 3(53), 49-61, <https://doi.org/10.15611/ie.2019.3.04>.
- Pawłyszyn, I. (2021). *Modelowanie dyfuzji innowacji w przedsiębiorstwach klastrów sieciowych na przykładzie wdrożenia koncepcji Lean Management*. Poznań: Wydawnictwo Politechniki Poznańskiej.
- Pech, M., Vaněček, D. (2018). Methods of Lean Production to Improve Quality in Manufacturing. *Quality Innovation Prosperity*, 22(2), 1-15, <https://doi.org/10.12776/qip.v22i2.1096>.
- Pomietlorz, M. (2015). *Istota koncepcji Lean Manufacturing*. Konferencja Przemysł 4.0 a Zarządzanie i Inżynieria Produkcji, 1(4), 613-621.
- Rahardjo, B., Wang, F.K., Yeh, R.H., Chen, Y.P. (2023). Lean Manufacturing in Industry 4.0: A Smart and Sustainable Manufacturing System. *Machines*, 11(1), 72, <https://doi.org/10.3390/machines11010072>.
- Rajarajeswari, C., Anbalagan, C. (2023). Integration of the green and lean principles for more sustainable development: A case study. *Materials Today: Proceedings*, 2214-7853, <https://doi.org/10.1016/j.matpr.2023.03.275>.
- Sayer, N.J., William, B. (2015). *Lean dla bystrzaków*. Gliwice: Helion.
- Shahin, M., Chen, F.F., Bouzary, H., Krishnaiyer, K. (2020). Integration of Lean practices and Industry 4.0 technologies: smart manufacturing for next-generation enterprises. *The International Journal of Advanced Manufacturing Technology*, 107, 2927-2936, <https://doi.org/10.1007/s00170-020-05124-0>.
- Sony, M. (2018). Industry 4.0 and lean management: a proposed integration model and research propositions. *Production & Manufacturing Research*, 6(1), 416-432, <https://doi.org/10.1080/21693277.2018.1540949>.
- Wang, C., Quesada-Pineda, H., Espinoza, O. (2012). Lean Evaluation of an Engineering Process: A Case Study in Furniture Industry. *Journal of Forest Products Business Research*, 9(1), 1-11.

WPLYW WDROŻENIA ROZWIĄZAŃ LEAN NA EFEKTYWNOŚĆ PRACOWNIKÓW NA PRZYKŁADZIE PRZEDSIĘBIORSTWA Z BRANŻY MEBLOWEJ – STUDIUM PRZYPADKU

Streszczenie

Branża meblarska dynamicznie się rozwija, a Polska jest jednym z liderów wśród eksporterów mebli na świecie, co stwarza dla firm z tego sektora ogromną szansę na wykorzystanie Lean Management jako strategii doskonalenia procesów i osiągnięcia przewagi konkurencyjnej. W pracy dokonano analizy głównych problemów związanych z marnotrawstwem w wybranej firmie z sektora MŚP działającej w branży meblarskiej. Celem badania jest przedstawienie wpływu rozwiązań Lean na efektywność pracy pracowników. Dane niezbędne do analizy zebrano metodą obserwacyjną w badanym przedsiębiorstwie. W celu porównania efektów wdrożenia zaproponowanych rozwiązań z zakresu Lean Management wykorzystano analizę wskaźnikową. Efektem badań są propozycje rozwiązań z zakresu Lean Management odpowiadające indywidualnym potrzebom przedsiębiorstwa, które zakładają eliminację powstających w nim marnotrawstw. Uzyskane efekty przedstawiono przy wykorzystaniu metody wskaźnikowej, a wyniki porównano ze stanem pierwotnym. Wprowadzenie rozwiązań zgodnych z koncepcją Lean, a mianowicie standaryzacji, Visual Management, Kaizen oraz 5S, spowodowało we wszystkich przypadkach poprawę wskaźnika efektywności. Wskaźnik efektywności rozpatrywany był w odniesieniu do czasu pracy pracowników. Wzrost efektywności wyniósł od 15 do 77 punktów procentowych. Wyniki te jednoznacznie wskazują, że wprowadzone rozwiązania przyczyniły się do zwiększenia efektywności pracowników firmy meblowej oraz przyspieszyły proces produkcyjny.

Słowa kluczowe: implementacja, efektywność, Lean Manufacturing, marnotrawstwo, branża meblowa