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ASSESSMENT OF THE USEFULNESS OF THE IMPLEMENTATION OF THE KAIZEN METHOD IN THE CONSTRUCTION INDUSTRY

Natalia BRYCHT

Czestochowa University of Technology, Faculty of Civil Engineering; natalia.brycht@pcz.pl,
ORCID: 0000-0002-7372-7492

Purpose: The aim of the article is to present and assess the usefulness of the Kaizen method in the management and organization processes of enterprises from the construction sector.
Design/methodology/approach: The research includes identifying tools in the area of Kaizen philosophy, assessing the possibilities of its implementation in the construction industry and identifying the most beneficial solutions. Elements of statistical and observational methods were used, as well as analyzes of literature reports. SWOT analysis was used to determine the level of suitability of the Kaizen method.
Findings: The conducted research showed the need to implement Lean Management tools in the structures of construction companies, in particular the Kaizen method. However, certain barriers have also been noticed, limiting their use in the Polish construction industry.
Research limitations/implications: The research presented is only a preliminary analysis, which is a starting point for further research on the use of the Kaizen method in construction, the method of selecting its tools and the benefits resulting from them. Due to knowledge, financial and technological deficiencies of construction companies, it is impossible to fully assess the analyzed aspect in the area of all types of enterprises.
Practical implications: The obtained results show the positive impact of the Lean Management method on the functioning of the enterprise. Thanks to the use of Kaizen tools, it is possible to increase the efficiency of the company and solve most problems, including the generation of large amounts of waste, insufficient financial resources for planned projects, low level of competitiveness on the market, disorganization of work and lack of timeliness of initiated implementations. The presented SWOT analysis can be successfully used as a tool supporting the decision-making process aimed at adopting an appropriate company strategy. Thanks to its simplicity and speed of execution, it allows you to save time and initially reject unfavorable solutions. Moreover, an important factor in favor of its use is the ability to adjust the criteria and weights determined by the established preferences of a given company.
Originality/value: The added value of the article is a practical presentation of the use of SWOT analysis to determine the most advantageous strategy necessary to be undertaken by construction companies in order to implement the principles of Lean Management.
Keywords: construction industry, Kaizen, Lean Construction, Lean Management, SWOT analysis.
Category of the paper: Research paper.

1. Introduction

Nowadays, special emphasis is placed on personal development and continuous improvement in almost every sphere of life. This also translates into all sectors of the economy. One of them is the construction industry, which has been constantly developing in recent years, as evidenced by a large number of both volume and linear projects. However, construction faces many problems at the economic, organizational and environmental levels. According to statistical data, the construction sector contributes approximately 30% to waste generation worldwide every year. In Poland, according to estimated data from the Statistics Poland, 12 018 000 Mg of construction waste was generated in 2022, of which 49.3% is still landfilled (Statistics Poland, 2023). Moreover, insufficient financial resources to carry out renovations, failure to meet the deadlines for commenced projects, huge amounts of waste generated from demolitions, renovations and construction sites, often low quality of services provided and manufactured products, and accident rates are the main barriers preventing improvement of the efficiency of construction companies. Many of them can be solved by implementing Lean Management (LM) tools borrowed from the Japanese manufacturing industry (Aureliano et al., 2019; Babalola et al., 2019). LM principles are aimed at eliminating waste at every stage of the company's activity, which is intended to result in an increase in the quality of services provided and goods produced. At the same time, it is reflected in the overall assessment of the company's work and its place in the industry. In the era of increasing social ecological awareness, the idea of Lean Management appears as an opportunity to solve many problems at the local level, as well as in the global context. By implementing LM techniques, methods and tools in every segment of the economy, it is possible to maintain sustainable development in the construction sector at the appropriate level (Hussain et al., 2019). Such action makes it possible to realistically prevent the waste of natural resources, the accumulation of huge amounts of construction waste and environmental pollution (Dębska et al., 2020; Solaimani, Sedighi, 2020; Yücenur, Şenol, 2021). Data from 2021 indicate the consumption of natural resources at the level of over 100 billion tons globally, with the share of the construction sector amounting to approximately 50% (Brycht, 2024). The studies (Du et al., 2023; Hąbek et al., 2023; Jakubiec, 2022; Mazur, Momeni, 2018; Stronczek, 2024; Ulewicz et al., 2021) present the results of research on assessing the usefulness of applying Lean principles in the automotive industry, production, ceramics or prefabricated buildings. Another issue worth attention is the integration of Industry 4.0 with LM principles (Wolniak, Grebski, 2023a, 2023b). This approach enables increasing operational efficiency, reducing costs and minimizing waste generated.

In the aspect of the construction industry, the implementation of LM methods is called Lean Construction (LC). Introducing appropriate Lean tools into the structures of construction companies allows you to reduce waste, reduce costs, and shorten the investment implementation time. Moreover, it provides an opportunity to increase the level of efficiency by introducing

changes that streamline processes already at their initial stages (Bugdol et al., 2020; Singh, Kumar, 2021). It also reduces the impact of buildings on the natural environment already during the construction phase (Aristizábal-Monsalve et al., 2022). Proper organization and management of the enterprise, supported by appropriately selected techniques, should cover three main areas: quality, environment and safety. Maintaining these three aspects at the appropriate level can significantly contribute to solving most of the problems faced by companies in the construction sector. In the context of the quality of manufactured products, it is worth paying attention to the product production control systems discussed in (Prasalska-Nikoniuk et al., 2022) in accordance with applicable standards. It was found that both systems improve product quality, but the ISO system provides greater opportunities for efficient management of the entire organization, including: adapting to current market needs and supporting sustainable development. Among the many proposals for Lean tools, the Kaizen concept deserves special attention, the main assumption of which is continuous improvement. As part of Kaizen, it is possible to use other techniques, such as the 5S method, Poka-Yoke or the PDCA cycle. However, the introduction of Lean principles is associated with certain limitations, mainly related to the low level of knowledge of the staff, lack of financial resources, legal barriers and technological infrastructure (Ulewicz, R., Ulewicz, M., 2020; Żebrucki, Kruczek, 2018). Therefore, it is so important that when deciding to implement Lean tools, you make the right choice by conducting a detailed "pros and cons" analysis and following the practical principles of implementing the Lean concept (Dombrowski, Mielke, 2014). In order to make the right decision, scientists propose various types of algorithms and methods, as discussed in (Ansah, Sorooshian, 2017; Nowotarski et al., 2021). Due to the frequent need to make quick decisions, it is worth considering using a supporting tool such as SWOT analysis (Brycht, 2022; Brycht, Ulewicz, 2023). Easy and quick analysis allows you to save time and perform a preliminary selection of unnecessary solutions from a range of LM tools.

The aim of the article was to assess the usefulness of implementing the Kaizen concept in enterprises from the construction sector using SWOT analysis.

2. Kaizen concept

The foundation of the Kaizen philosophy is the concept of continuous improvement of both the services provided, manufactured products and the skills of the staff. In the context of the construction industry, this is an important aspect due to the possibility of, for example, reducing the number of road renovations necessary (Brycht, 2021) or other defects related to incorrect production of the product, as well as reducing additional costs and saving time. Similar to other Lean Management tools, the Kaizen method involves identifying and eliminating waste and implementing activities aimed at added value in order to increase the level of company

productivity. To achieve the intended results within the Kaizen concept, various techniques are used, including: PDCA cycle, 5S method and Poka-Yoke. In the first stage of the PDCA cycle (Plan – Do – Check – Act), a plan is created that defines the goal, existing problems and ways to introduce the necessary improvements. The next step is to perform it, observe the test process and draw appropriate conclusions. The third step is to check the correctness of the plan implementation and the achieved effects by comparing the actual situation with the assumed results. The final stage is to act in accordance with the introduced improvements, provided that the expected results are achieved, while all procedures should be standardized (Obora, 2010; Starosta, 2016).

The 5S method based on 5 principles (sorting, systematics, cleaning, standardization, self-discipline) allows you to create an ergonomic workplace with little financial outlay, which increases the efficiency and productivity of the company (Veres et al., 2018). The concept requires the involvement of all company employees (Lizak, 2016). Based on eliminating waste, it is particularly important in environmental terms. The need to select waste generated at the workplace is part of the activities related to the mandatory segregation of construction waste by type according to Polish legal regulations. Creating optimal working conditions has an impact on Occupational Safety and Health (OSH) due to the possibility of reducing the level of accidents in workplaces (Ulewicz, Lazar, 2019).

Poka-Yoke is a principle of preventing errors during the implementation of a given process. It is focused on eliminating the possibility of a defective product, which is often due to the human factor (Antonelli et al., 2024). The second purpose of Poka-Yoke is to correct irregularities after identifying the defect that has occurred. Thanks to these two aspects, putting a defective product into service is minimized as much as possible, which translates into added value for the company (Saurin et al., 2012).

The essence of using the Kaizen method is to introduce small changes to improve processes, which are assumed to result in measurable benefits in the long term, which is primarily the improvement of product quality. This allows for sustainable and gradual introduction of changes using the so-called "small steps", thanks to which it is possible to constantly monitor the stages of its application. This approach, which focuses on how to achieve a result (process), not on the result itself, is called process thinking. There are two types of Kaizen: process and flow. The first one is used at individual workstations in order to introduce improvements, the second one refers to the introduction of changes in a larger area in order to achieve a more effective flow of information and materials. The practical application of the Kaizen method is based on 10 fundamental principles:

- problems create opportunities,
- ask “Why?” 5 times – 5 why? method,
- take ideas from everyone,
- think about solutions that can be implemented,
- reject the established state of affairs,

- excuses that something cannot be done are unnecessary,
- choose simple solutions, without waiting for the perfect ones,
- use your wits instead of money,
- correct mistakes on an ongoing basis,
- improvement is endless.

The presented principles can be easily introduced into the organizational structures of enterprises with low financial outlay, which is the strong point of the presented method (Gabryelewicz et al., 2015). In the face of financial problems that construction companies often struggle with, this is a chance to introduce significant changes without burdening the budget with additional costs. The need to constantly engage employees promotes their development and motivates them to continue their activities, which creates favorable conditions for improving their professional competences and allows for the acquisition of new qualified specialists. Thanks to this, the level of competitiveness of small and medium-sized enterprises on the labor market also increases (Maarof, Mahmud, 2016).

In addition to many advantages, the Kaizen method also has certain limitations, including the need for continuous involvement of employees at all levels of the plant's hierarchy. Constantly encouraging employees to continuously improve by conducting training and workshops is aimed at raising the level of awareness of the benefits of implementing its principles in the context of the entire enterprise. This is a necessary condition to achieve effectiveness and maximum efficiency and improve quality. The limited scope of application of the method is also important. If it is necessary to introduce large, one-off changes, this method will not correspond to the expected effects of work of a particularly large enterprise.

3. Methodology of research

The research was conducted using the observational method and a literature review in order to identify the most frequently used Lean tools in the construction sector. On this basis, the Kaizen method was selected, the level of usefulness of its implementation in construction companies was determined using a SWOT analysis (Pickton, Wright, 1998; Piercy, Giles, 1989). Data regarding the Kaizen method obtained from literature sources were categorized and defined as the criteria for the analysis. Then they were assessed using a rating scale ranging from 1 to 3, where 1 means a low level of influence, 2 - medium level of influence, 3 - high level of influence of a given feature. In each category, three key features were defined, in accordance with the author's assumptions, to which particular weights were assigned. The sum of the weights in each category was 1. The next stage was to calculate the weighted values and add them up, which provided the basis for performing appropriate mathematical

operations and determining one of the distinguished strategies that should be adopted in a construction company:

- aggressive (maxi-maxi) – strengths and opportunities predominate,
- conservative (maxi-mini) – strengths and threats predominate,
- competitive (mini-maxi) – weaknesses and opportunities predominate,
- defensive (mini-mini) – weaknesses and threats predominate.

As part of the research, a literature review of publications from the last 10 years was also performed, based on data contained in the SCOPUS database (Scopus – Document search, 2024). The obtained results, in the form of the number of studies, were obtained by entering specific keywords: "Kaizen", "PDCA cycle", "5S tool" and "Poka-Yoke". The results of the review were presented by individual European Union member states, and a code system in accordance with the ISO 3166 standard was used to record their names: AT - Austria, BE - Belgium, HR - Croatia, CZ - The Czech Republic, DK - Denmark, EE - Estonia, FI - Finland, FR - France, DE - Germany, GR - Greece, IE - Ireland, IT - Italy, LV - Latvia, LT - Lithuania, LU - Luxembourg, NL - Netherlands, PL - Poland, PT - Portugal, RO - Romania, SK - Slovakia, SI - Slovenia, ES - Spain and SE - Sweden. Due to the lack of sufficient data in the analyzed database, countries that did not record at least 1 publication among all the selected keywords are not presented in Figure 2.

4. Research results and discussion

The research included a detailed analysis of the usefulness of the Kaizen method in construction industry enterprises. In order to determine the action strategy needed to be adopted, a SWOT analysis was used. The collected data are summarized in Table 1 and given the form of criteria assessed in terms of the impact on the economic, organizational and environmental effects of construction processes. The possibility of continuous improvement, eliminating areas of waste, simplicity of use and low implementation cost were assessed. The evaluation also took into account the need for continuous involvement of the entire staff, limitations in the scope of use and waiting time to obtain results.

The conducted research highlighted the strengths and weaknesses of the Kaizen method as well as the opportunities and threats resulting from its introduction into the organizational structures of the company. The analysis showed the strongest side of the method (simplicity and low cost of implementation) rated at 1.35, and the weakest (the need for continuous involvement of all employees) at 1.5. Among the advantages, the ability to eliminating waste was also highly rated (0.9), and the smallest negative impact among the weaknesses is the limited scope of use (0.2). According to research, the implementation of the Kaizen method will improve the quality of products and services provided (1.05), economic and ecological

savings (1.05) and improve the competitiveness of small and medium-sized enterprises (SMEs) (0.9). Unfortunately, there are also certain threats that may, to some extent, affect the final effect of the Kaizen method implementation. These are: the need to constantly monitor the progress of work (1.2), the need to periodically organize training and workshops (1.05) and the need to introduce an attractive motivation system, which was indicated as the barrier with the lowest impact (0.5).

Table 1.
The summary of data on the Kaizen method divided into categories with an assessment

Strengths				**Weaknesses**			
Criterion	**Rating**	**Weight**	**Weighted value**	**Criterion**	**Rating**	**Weight**	**Weighted value**
Continuous improvement of processes and products	2	0.25	0.5	Limited scope of use	1	0.2	0.2
Eliminating waste	3	0.3	0.9	The need for continuous involvement of all employees	3	0.5	1.5
Simplicity and low cost of implementation	3	0.45	1.35	A long-term process of obtaining results	2	0.3	0.6
SUM		**1**	**2.75**	**SUM**		**1**	**2.3**
Opportunities				**Threats**			
Criterion	**Rating**	**Weight**	**Weighted value**	**Criterion**	**Rating**	**Weight**	**Weighted value**
Improving the quality of products and services	3	0.35	1.05	The need for continuous monitoring of work progress	3	0.4	1.2
Economic and ecological savings (natural resources, reducing the amount of waste generated and reducing costs)	3	0.35	1.05	Necessity to introduce an attractive motivational system	2	0.25	0.5
Improving the competitiveness of SMEs	3	0.3	0.9	The need to organize training and workshops periodically	3	0.35	1.05
SUM		**1**	**3**	**SUM**		**1**	**2.75**

Source: own study.

The obtained results show the dominance of the "strengths" of the method (2.75) over the "weaknesses" (2.3) and the dominance of the "opportunities" (3.0) over the "threats" (2.75). As a result, this allows you to determine the strategy of action needed by the company, as shown in Figure 1. In order to obtain the intended benefits from the implementation of the Kaizen method in the most optimal conditions, the construction company should adopt an aggressive strategy (maxi-maxi). It involves using strengths at the highest possible level, which will allow achieving maximum opportunities and strengthen the correlation between the two analyzed categories: strengths - opportunities.

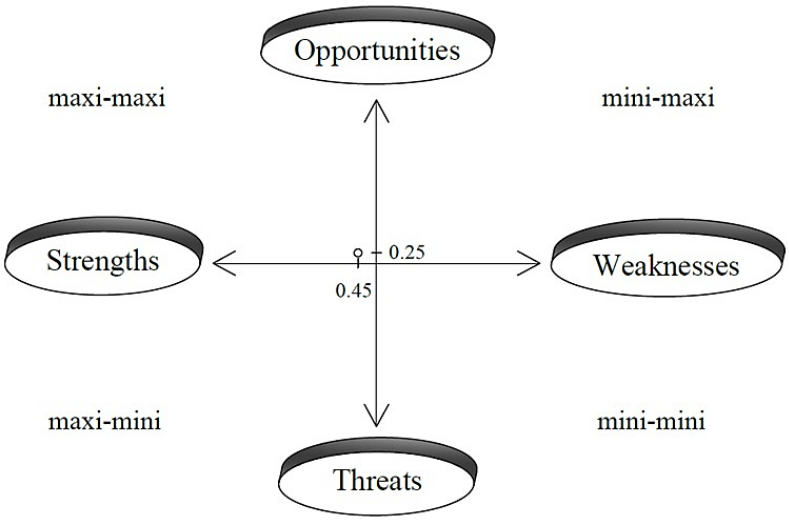

Figure 1. Graph of the strategy for applying the Kaizen method in a construction company.
Source: own study.

The second stage of the research was to analyze the SCOPUS database in terms of publications from the last 10 years from European Union member states. The subject of the research were works searched for the following keywords: "Kaizen" (122 publications), "PDCA cycle" (27 publications), "5S tool" (43 publications) and "Poka-Yoke" (43 publications), which was presented in Figure 2. The obtained data indicate that Poland is one of the few countries out of 27 Member States where works have been published for each defined keyword. The total number of publications is 39, which gives it second place after Spain (41 publications). The greatest interest is related to the issue of the Kaizen method (122 publications), most of which are in Spain (26 publications). The lowest number of results was obtained after searching for "PDCA cycle", with the largest number of publications recorded in Germany (5 publications). The same number of publications (43 publications) was recorded for the keywords: “5S tool” and “Poka-Yoke”. The issue of 5S was most frequently discussed in Portugal (16 publications), and Poka-Yoke in Poland (14 publications).

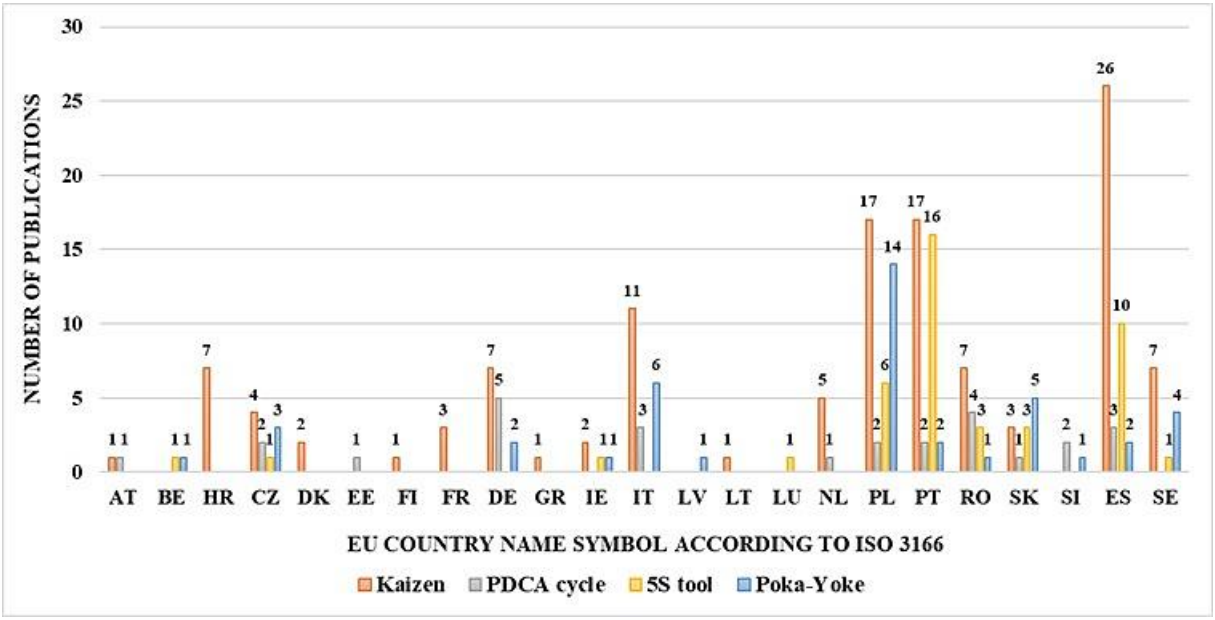

Figure 2. Number of publications after keywords in European Union member states in 2014-2024.
Source: own study based on SCOPUS database.

Figure 3 shows the percentage of Polish publications in the last decade divided into defined keywords. Based on the results obtained, it was found that in Poland issues related to the Kaizen concept were most frequently analyzed (43.6%), and the fewest studies were published on the PDCA cycle (only 5.1%).

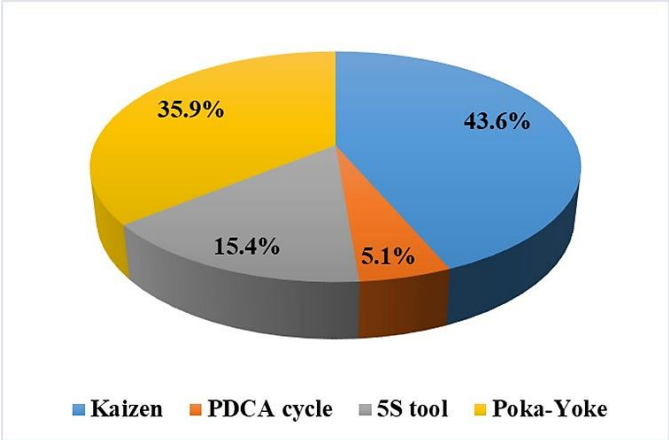

Figure 3. Percentage of Polish publications divided by keywords in the years 2014 - 2024.
Source: own study based on SCOPUS database.

5. Conclusions

The conducted research has shown that the implementation of the Kaizen concept in the organizational structures of construction companies allows for achieving measurable benefits, including time savings, cost reduction, improvement of the quality of products and services

provided, and reduction of waste, e.g. by saving natural resources and minimizing the waste generated. Therefore, the idea of Kaizen fits perfectly into the principles of sustainable development. It is an opportunity for small and medium-sized enterprises to solve problems in an uncomplicated way due to the simplicity and low financial outlays needed to implement the method. In addition to the ecological and economic aspects, the Kaizen method increases the competitiveness of the company by focusing on raising the awareness and qualifications of employees. Based on the research, it was found that in order to achieve maximum benefits resulting from the implementation of the Kaizen concept, the company should adopt an aggressive strategy (maxi-maxi), which involves using the potential of the presented method as much as possible. The weakness of the Kaizen method is the need for continuous involvement of all employees, which necessitates the need to organize regular training and introduce an attractive motivational system. The second disadvantage is the limited scope of use, especially in situations requiring radical measures to quickly achieve the required results.

The literature review indicates a growing interest in Lean in the construction sector in the European Union countries. The highest indexing of the Kaizen method was recorded in Spain (21.3%) and Poland (13.9%). However, the barrier of insufficient knowledge and too low awareness of enterprise staff is still a serious limitation to the effective implementation of Lean principles in the structures of the construction industry.

The implementation of the Kaizen method in construction companies is a real chance to solve many economic, ecological and organizational problems. However, this requires the adoption of an appropriate strategy of action, which depends on conducting a detailed analysis and selecting appropriate tools to support the decision-making process.

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