JISHUKEN COMO UMA ESTRATÉGIA DA MANUFATURA ENXUTA – um exemplo de aplicação no setor têxtil

JISHUKEN AS A LEAN MANUFACTURING LEARNING STRATEGY – an example of application in the textile sector

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Resumo: Apesar dos conceitos da manufatura enxuta já serem aplicados desde 1950, algumas ferramentas foram pouco exploradas tanto no meio empresarial quanto acadêmico. Nesse contexto, para suprir esse gap, este artigo tem como objetivo analisar o jishuken, destacando seu conceito e como aplicá-lo de forma estratégica nas organizações. A metodologia utilizada foi uma revisão sistemática de literatura nas bases de dados *Science Direct, Engineering Village, Scopus e Springer* utilizando a palavra-chave *jishuken* e 16 artigos foram analisados. Após também foi realizada uma pesquisa-ação numa indústria têxtil do Brasil. Como resultados, há a definição de jishuken, que pode ser entendida como resolução de problemas em conjunto com o fornecedor e os oito passos para implementá-lo, assim como os benefícios associados. Também se verificou que nas indústrias têxteis o termo é utilizado de forma semelhante ao kaizen, mas não utilizada essa terminologia. Apesar da primeira publicação datada de 1993, a ferramenta ainda não é aplicada de forma sistêmica, estruturada e padronizada. A originalidade dessa pesquisa é contribuir com diretrizes para a implementação e disseminação da ferramenta *jishuken* de forma integrada ao *lean manufacturing*, gerando valor para os pesquisadores e para as empresas. Ainda, a aplicação dos oito passos na indústria têxtil, para o problema de malhas com manchas, reforça o conceito do *jishuken* e que os resultados podem ser disseminados para outros setores, reforçando as bases do *lean* do pensamento crítico, redução de desperdícios e inovação.

Palavras Chave: manufatura enxuta; prática; solução de problemas; melhoria de processo.

Abstract: *Although lean manufacturing concepts have been applied since the 1950s, some tools have been little explored in both business and academic circles. In order to fill this gap, this article aims to analyze jishuken, particularly its concept and how to apply it strategically in organizations. The methodology was a systematic literature review in the databases Science Direct, Engineering Village, Scopus and Springer, using the keyword jishuken, and 16 articles were analyzed. We also carried out an action research in a textile factory in Brazil. As for the results, there is a definition of jishuken, which means*

solving problems together with the supplier, and the eight steps to implement it, as well as the associated benefits. We also found that, in the textile industry, this term is used in a similar way to kaizen, but this terminology is not used. Although its first publication was in 1993, this tool is still not applied in a systemic, structured and standardized way. The novelty of this research is to contribute guidelines for the implementation and dissemination of the jishuken tool integrated with lean manufacturing, thus generating value for researchers and companies. Furthermore, the application of the eight steps in the textile industry to the problem of stained knitwear reinforces the concept of jishuken and that the results can be disseminated to other sectors, reinforcing the lean foundations of critical thinking, waste reduction and innovation.

Keywords: Lean production; practice; problem solving; process improvement.

INTRODUCTION

In recent years, the search for methodologies and tools that promote continuous improvement and increased efficiency in companies has become increasingly relevant for managers. In this context, Lean Manufacturing offers a variety of methods and tools that can make a significant contribution to boosting operational excellence. However, there are still some approaches that, despite being applied, are not widely disseminated and recognized, which limits the sharing of information and the development of these methods or tools. The literature shows that the most widely applied and well-known lean practices are value stream mapping (VSM), kaizen, kanban, 5S, poka yoke, SMED, andon, cellular layout, among others aimed at customer satisfaction by reducing lead times, costs and increasing quality (Dal Forno *et al*., 2014).

The term jishuken is still little explored in lean practices, not only in small and medium-sized companies, but also in large ones, especially those outside the automotive sector. The study by (Antosz; Stadnicka, 2017), which surveyed 49 companies, found

that 29% of them applied the 5S method and 20% applied 5W2H. Then, 16% of them use Single Minute Exchange of Die (SMED) and teamwork, followed by work standardization, cause-effect analysis and Total Productive Maintenance (TPM), with 12% of the responses. Finally, the tools that these small and medium-sized companies wanted to implement were also assessed, with 10% considering Global 8D, OEE (Overall Equipment Effectiveness), visual management (andon), kaizen and poka yoke. Jishuken was implemented in only 2% of these companies, and the same amount (2%) also wanted to implement it.

In this context, the aim of this article is to define the lean manufacturing term "jishuken" and present examples of its application in the textile industry. The originality and contribution are that there is still potential to use this practice and adapt it according to each culture, as well as to evolve in the sharing of knowledge in supply chain management.

This article is structured in five sections, the first of which, this one, introduces the subject. Section 2 describes the mixed methodology, that is, the research questions that this research will answer through a systematic literature review and action research in a Brazilian textile factory. Section 3 contains the results, which present the definition of the term jishuken, the state of the art of publications on this topic, the steps to implement and the evolution of the topic, with researchers and the main studies identified in the literature. This is followed by a practical application in which the jishuken was used to solve problems in the knitting process. Finally, there are conclusions and references.

RESEARCH METHODOLOGY

The methodology used in the research was the integrative review, as it designates current knowledge on a single topic in order to identify, analyze and synthesize data from independent studies for a potential beneficial impact on the subject. The steps

are: Designing the Search Protocol, Evaluating Alignment with Research Objectives, Developing the Research Profile and Identifying the Underlying Themes (Vasist; Krishnan, 2024).

The first step involved identifying the topic of the integrative review so that it would result in targeted and thorough analyses, with easy conclusions and applicability. Afterwards, we established the criteria for the study, i.e. search and inclusion, as well as the exclusion of studies, which was of great value for the reviewer's approach strategy. Then, we analyzed the resulting studies and interpreted the data.

The guiding questions for this article were:

a) What is jishuken?
b) What and how many publications are there on the subject?
c) Which lean tools is it related to?
d) What are the application steps?
e) How can jishuken be used in the textile industry?

We searched for publications in the databases on November 4, 2023, using the keyword "jishuken", without any year or area filters. There were 26 documents in the ScienceDirect database, followed by 8 in Engineering Village, none in Scielo, 9 in Scopus and 24 in Springer. After removing duplicate articles and selecting those that adhered to the theme, there were 16 articles for analysis.

To reinforce the theory, the research had an empirical part, carried out in a textile factory in Brazil that has been in existence for over a hundred years and already uses lean concepts in its management system. The adoption of the action research methodology, as reinforced by (Erro-Garcés; Alfaro-Tanco, 2020), proposes an implementation in the business field, as a way of improving relevant studies and serving as a reference for projects based on practical contribution, as well as active collaboration between researchers and professionals. This methodology is widely

used in operations management because it is used in conjunction with other methods, as there is usually a multidisciplinary team that actively participates in the solution.

RESULTS

Following the systematic literature review, this section answers the research questions. Starting with the history and definitions, the first publication to mention the term "Jishuken" dates back to 1993, entitled "Japan's Hidden Involvement in South African Manufacturing", in which the automobile sector in South Africa was restructured, following the installation of Japanese automakers in the country and the difficulty of competing with them. Thus, teams were formed to increase production flows and eliminate waste (Rogerson, 1993).

At the same time, jishukens were organized into special problem-solving groups, in which each supplier learned about kaizen with topics related to productivity, cost and quality (Hines, 1996). For Imai (1997), this practice is characterized as an intensive activity in the workplace with great participation from top management, summarized as self-learning.

In summary, Sako (2008) defined the term self-study, as well as referring to a group study activity made up of Toyota suppliers to improve the shop floor using the lean production system. As was generally the case with other lean tools, jishuken, or autonomous self-study groups, had already been used by Toyota with suppliers to transfer knowledge and reproduce production capacities for a long time, but it didn't become public until the 1990s (Sako, 2004).

Jishuken is both a technical problem-solving activity and a management development process that helps managers learn to be better teachers (Hall, 2006; Saito, 2009). Azevedo *et al*. (2015) used a variation of the term, called kojo jishuken (autonomous

factory study groups) that take place as the culmination of education and training for middle managers and first-line supervisors at Toyota.

According to Marksberry *et al*. (2010), jishuken aims to solve problems in the workplace that need management attention, and to correct, enrich and deepen management's understanding of the Toyota Production System (TPS) through the application of problem solving. The difference is that Jishuken only involves management teams to identify problems and implement countermeasures. Often, because they are improvement processes, there is a comparison with the quality control circles that were widely used in the 1990s. The difference is that jishuken focuses on kaizen within single divisions, whereas quality management encompasses multiple corporations and divisions. Automakers take a leading role in jishuken; however, it is noteworthy that suppliers express opinions and ideas in the communication process.

The aim of jishuken - group learning - is not to obtain new business, but to improve quality and processes in order to increase competitiveness (Wilhelm, 2011). In this vein, this article also identified the strategic advantages of applying this tool and the steps needed to implement it. It is worth mentioning that there is no consensus on whether jishuken is considered a practice, tool, approach or method.

Batra *et al*. (2016) add that "it is somewhat similar to Kaizen blitz wherein a dedicated team coherently attempts to find out a solution to a known problem area. Jishuken not only caters to this facet, but adds several other aspects. It is largely management driven and is done with the additional purposes of training those involved and stimulating other kaizen activity".

The research groups associated with Toyota are called jishuken; participation is voluntary if suppliers do not want instruction or interference from the association (Ishida; Magnusson; Nagahira, 2017).

According to Kumar *et al*. (2021), the term comes from Japanese, translating to Kanban Process Department or autonomous study group. The authors Kempegowda, Raghukiran and Reddy (2020) characterize it as time and motion studies.

In the research by Oliver (2022), the term jishuken is interpreted as a resource for the university-company consortium where it is considered a facilitator for the creation of a high-performance inter-organizational learning network. It is a small working group that shares strong embedded ties with other suppliers in order to exchange knowledge particularly relevant to the project itself.

Thus, based on the definitions found in the literature, we conclude that jishuken is a practice that contributes to personal development because it involves multidisciplinary groups solving problems or applying short-term improvements, transmitting knowledge among those involved and making use of other different tools (Coelho; Dal Forno; Splieter, 2023). Although brainstorming, Ishikawa diagrams and PDCA are widely used in industry, these tools are often employed individually and in isolation.

Table 1 lists the analyzed articles, summarizing the aims of each one, the authors and their origins and the journal in which they were published, in descending time order.

Table 1 - Analysis of articles about jishuken

Source	Journal	Country	Focus (aim)
(Oliver, 2022)	The Journal of Technology Transfer	Israel	Identify the benefits of collaborative knowledge, in which the jishuken is considered a facilitator for the creation of a learning network within university-company consortia.

(Kumar et al., 2021)	Material Today: Proceedings	India	Analyze the increase in productivity on an assembly line in a manufacturing company by reducing cycle time in the Toyota Production System (TPS) through the jishuken activity
(Kempegowda; Raghukiran; Reddy, 2020)	International Journal of Mechatronics and Automation	India	Implement automated guided vehicles (AGVs) instead of manual material handling using optical logic sensors or normal obstacle detection sensors for effective AGV obstacle detection.
(Freitas et al., 2019)	Procedia Manufacturing	Portugal	Improve the efficiency of a hybrid logistics warehouse
(Antosz; Stadnicka, 2017)	Procedia Engineering	Poland	Analyze the implementation of lean in small companies in Poland
(Ishida; Magnusson; Nagahira, 2017)	Futures	Japan	Investigate the effects of relations between suppliers and consumers, especially in the introduction of new technologies such as electric vehicles
(Batra et al., 2016)	SAE intenational	India	Investigate the importance of Value Stream Mapping (VSM) and applying jishuken to improve the precision tooling process in the automotive industry
(Camuffo; Wilhelm, 2016)	Journal of Organization Design	Netherlands and Italy	Analyze how Toyota deviated from its original lean configuration between 2000 and 2010.
(Azevedo et al., 2015)	Information Systems	Brazil	Address strategic management, enabling capacity-based planning and improved decision-making. To do this, the semantics of the ArchiMate Business Strategy and Evaluation Concepts was analyzed
(Arunagiri; Gnanavelbabu, 2014)	Procedia Engineering	India	Assess the five most used and most impactful lean tools in 91 automotive companies
(Purwaningrum; Evers; Yaniasih, 2012)	Procedia Social and Behavioral Sciences	Germany	Assess whether the cluster improves the performance of companies, of which there are two types (automaker with tier 1 suppliers and university-company)

(Wilhelm, 2011)	Journal of Operation Management	Netherlands	Investigate supplier-supplier cooperation in the Japanese and German automotive industries
(Wilhelm; Kohlbacher, 2011)	Asian Business & Management	Netherlands	Identify how knowledge co-creation occurs in the Toyota network
(Marksberry et al., 2010)	Journal of Manufacturing Technology Management	United States	Analyze the kaizen activities directed at Toyota management called Jishuken
(Sako, 2008)	Labour Economics	United Kingdom	Analyze the importance of the industry from the point of view of generating knowledge, which is the starting point for research.
(Rogerson, 1993)	GeoJournal	South Africa	Analyze the involvement of lean culture dissemination in South African manufacturing companies

Source: The authors.

Analysis of the searches revealed a total of 16 publications on the subject of jishuken. Among these publications, India stands out as the country with the highest number of contributions, accounting for four occurrences. The author Miriam Wilhelm, from the University of Groningen (Netherlands), stood out by presenting more than one study on the subject, starting in 2011, and in collaboration with the author Kohlbacher in Japan, and in 2016 in Italy with Camuffo. In both studies, the contributions were on topics such as supplier cooperation and the co-creation of knowledge in automotive industries (Camuffo; Wilhelm, 2016; Wilhelm, 2011; Wilhelm; Kohlbacher, 2011).As for the journals, none stood out, but most of them are focused on the area of operations management.

It was noticeable that, in practice, jishuken can be confused with kaizen. Table 2 describes the differences between the two.

Table 2 - differences between jishuken and kaizen

Jishuken	Kaizen
Special problem-solving research groups	Guidance in the process
Voluntary participation	Improvement in small steps
Involves people from different companies or sectors	Guidance for those involved

Source: The authors.

STEPS AND STRATEGIES FOR USING JISHUKEN

To facilitate the application of jishuken in the day-to-day running of industries, there are some strategic steps for its implementation, which can vary from five to eight stages. The authors (Liker; Hoseus, 2008; Marksberry *et al*., 2010; Ohno, 1988); suggest eight steps, which consist of:

Step 1 - clarify the problem;
Step 2 - break down the problem;
Step 3 - target setting;
Step 4 - root cause analysis;
Step 5 - develop countermeasures;
Step 6 - see countermeasure through;
Step 7 - monitor both results and processes and;
Step 8 - standardize successful processes.

The study by Arunagiri and Gnanavelbabu (2014) found that 89% of the 91 assessed automotive companies agreed with the positive impact of the eight jishuken steps.

The steps followed by Purwaningrum, Evers and Yaniasih (2012) were an initial meeting, presentation of the report with feedback provided by the senior engineer,

gemba on the shop floor, problem solving by the suppliers within 40 days, implementation to solve the problem, and then the leaders are responsible for driving improvements.

For Batra *et al*. (2016), who used jishuken in precision tool manufacturers in India, the steps followed were: establishment of kaizen cell, introduction to kanban and FIFO systems; uptime increment for machine tools.

The "Jishuken study groups" are designed to help suppliers improve their shop floors by refining the application of TPS. "Jishuken study groups" are obliged to choose a specific theme and identify a specific factory area for the group to study. In this case, the group chose production variation with low demand and changes in the model mix (Azevedo *et al*., 2015).

According to (Ram Kumar *et al*., 2021), the steps are: a) identify the area of improvement; b) form the team consisting of a leader, people from different departments and a quality representative; c) the participants ask questions about various tasks related to the area of change; d) the leader manages the spreadsheet with the problems and proposed solutions, as well as those responsible for the changes. For this step, the 5W2H tool is usually used as a support. Finally; e) the leader meets with the people responsible for each area to agree on the kaizens to be carried out, which are integrated into the jishuken.

For Kempegowda, Raghukiran and Reddy (2020), implementation consists only of the activities of noting and timing operations and then analyzing the activities that add and do not add value. The authors carried out critical path routing and tracking on a car assembly line. The implemented Automated Guided Vehicles (AGVs) are battery powered and are capable of automatically charging their batteries on the move by means of a contactless charger. The time and motion study focused on the transportation of transmission components for a small car from the machining line to the assembly line.

Jishukens are continuously applied to develop the interpersonal skills of management so that they understand the correct way to train and support kaizen. In addition, (Marksberry *et al*., 2010) add that, as part of the organizational culture, they have the function of communicating, maintaining and reinforcing values, beliefs and behaviors, known as the Toyota Way. Employee participation in jishukens gives management a common language and a common approach to solving standard problems throughout the company.

Thus, Table 3 shows that companies apply jishuken in order to increase productivity, improve communication with suppliers and product quality, provide a more pleasant working environment, improve operating processes to reduce cycle times and problem solving, standardize processes, to help managers make decisions, achieve better predictive maintenance planning and also to reduce setup, respectively.

Table 3 – results obtained with the application of jishuken

Reference	cycle time	Operation	Quality	Productivity	setup	Predictive maintenance	Decision making	Problem solving	Standardization	Suppliers	work environment
(Oliver, 2022)										x	
(Kumar et al., 2021)	x	x									
(Kempegowda; Raghukiran; Reddy, 2020)			x	x							
(Freitas et al., 2019)	x	x		x							x

(Ishida et al., 2017)			x	x						x	
(Antosz; Stadnicka, 2017)		x	x								
(Batra et al., 2016)	x			x	x	x					
(Azevedo et al., 2015)		x		x				x	x	x	x
(Arunagiri; Gnanavelbabu, 2014)			x	x		x					
(Purwaningrum; Evers; Yaniasih, 2012)							x			x	x
(Wilhelm, 2011)			x							x	
(Wilhelm; Kohlbacher, 2011)								x		x	x
(Marksberry et al., 2010)			x	x			x	x	x		

Source: The authors.

The study by Arunagiri and Gnanavelbabu (2014) proved that increased productivity is directly related to tools such as 5S, overall equipment effectiveness, problem-solving methodology, Pareto analysis and waste elimination.

Among the main applications, communication among jishuken members allows suppliers to gather a variety of information, which should lead to opportunities to obtain information or make predictions about the future of even new technologies developed in collaboration, as described in the studies on electric vehicles (Letterie *et al*., 2008) (Ishida; Magnusson; Nagahira, 2017). This also reinforced that horizontal communication between suppliers also involves discussions related to existing technologies.

The study by Freitas *et al*. (2019) mentions that the jishuken technique lasted fifteen days and was carried out to improve the efficiency of the hybrid warehouse. This activity aimed to introduce lean practices, with the main objectives of optimizing storage space, improving the glass preparation process and its flows. The current layout has been designed and the material flows have been identified. The different tasks relating to the preparation of the glasses were then balanced and time wastage identified using Value Stream Mapping (VSM).

The article by Marksberry *et al.* (2010) described how jishukens work within the Toyota system, in this case the plant located in the United States, to continuously improve managers' understanding of this management system, both for solving concrete problems and to support the manager's functions in communicating, training and teaching problem-solving in production. The authors concluded that jishuken is an example of a technique that is only successful when incorporated into the right organizational culture. When integrated into long-term continuous improvement throughout the plant, jishukens can be extremely effective in developing management's ability to lead and teach others how to conduct kaizen and problem solving daily.

It is noticeable that all the studies on jishuken applications were in Toyota, with (Kumar *et al*., 2021) on the assembly line in India, and the aforementioned (Marksberry *et al*., 2010) in the North American Toyota assembly plant. (Ishida et al., 2017)investigated the effects of different characteristics of the supplier-customer

relationship, as well as relationships in the Japanese Toyota automotive industry and how they influence predictions about future disruptive technologies. Along the same lines, Purwaningrum, Evers and Yaniasih (2012) evaluated the Toyota motors industrial cluster in Indonesia. Finally, Wilhelm (2011) carried out a multiple case study in the Japanese and German automobile industries to analyze supplier-supplier interaction, focusing on the inherent tension between cooperation and competition. Sako (2004) used jishuken to improve organizational capabilities with the suppliers of the Honda, Nissan and Toyota automobile companies.

Almost all of the other applications focused on the "transportation" sector, such as bus manufacturing companies in Portugal (Freitas *et al*., 2019) 91 automotive industries in India Arunagiri; Gnanavelbabu, 2014), car assembly line in India (Kempegowda; Raghukiran; Reddy, 2020) , the Indian precision tool industry (Batra *et al*., 2016) , 49 small automotive and aviation companies in Poland (Antosz; Stadnicka, 2017) and even an energy supplier in Europe (Azevedo *et al*., 2015). In addition, the study by (Oliver, 2022) interpreted the term in the assessment of Israel's innovation ecosystem, as a resource for the university-business consortium where jishuken is considered a facilitator for the creation of a high-performance inter-organizational learning network; it is a small work group where they share strong embedded ties with other suppliers, in order to exchange knowledge particularly relevant to the project itself.

APPLICATION OF JISHUKEN IN THE TEXTILE INDUSTRY

In the industry, jishuken is widely used by analysts and managers, although this terminology is not always used. To illustrate this, the authors participated in one of the processes in the textile industry. This company is located in Blumenau, Santa Catarina, Brazil, and has existed since 1880, with the main product being white t-shirts. The eight steps of jishuken were followed in knitwear processing. Knitwear processing is an important part of textile production, and can often

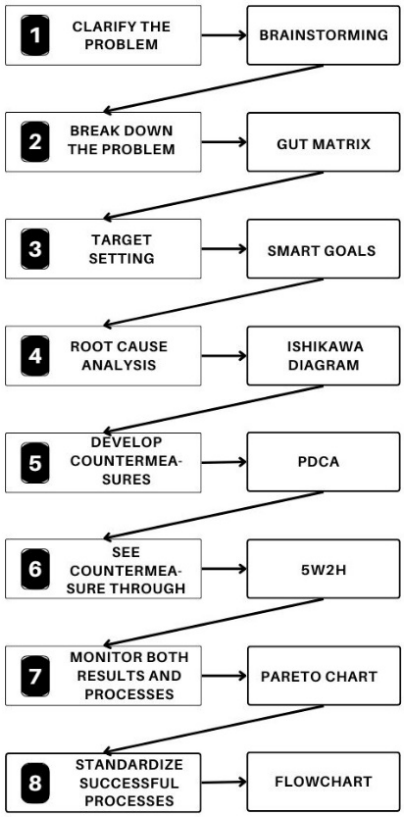
present challenges in terms of quality and efficiency. Some common issues that the jishuken team can identify include inconsistent coloring problems, material waste, long production cycle times or stains. Figure 1 illustrates the identified problem.

Figure 1 - Example of the problem studied (stained knitwear)

Source: The authors.

Generally, the quality tools, which are an important pillar of lean, are used as support, including brainstorming, PDCA, GUT matrix, Smart, Ishikawa, flowchart and Pareto diagram (Figure 2).

Figure 2 - Jishuken steps and their relationship with the quality tools



Source: The authors.

***Brainstorming*:** it is used by groups, conducted and planned by a moderator with the aim of raising possible solutions to problems, not prejudging the ideas raised and combining ideas in the search for new ones (Bonnardel; Didier, 2020). This is the moment when everyone in the group should present their perception of the problem to be studied so that the group is aligned with the current situation.

GUT *Matrix*: a tool that helps prioritize actions. In the case of group work, it is even more important to apply it in order to eliminate personal interests in the problems raised. The problems are analyzed in relation to their severity, urgency and tendency, and are given scores for each of these criteria (Villas Boas Mello; Guimarães; Mello, 2022).Thus, in the *jishuken* group, this tool is suggested for classifying the ideas raised during Brainstorming and direct the work group's actions with the collective in mind, rather than individual ideas.

SMART *goals*: SMART goals originate from the concept of management by objectives and, when they are set, they need to meet the following conditions: be specific, measurable, achievable, realistic and time-bound. The more specific the goal, the more motivated the team is to achieve it and the easier it is to manage the work team (Rietbergen; Blok, 2010). As the *Jishuken* group has a limited time frame, it is important to define the goals correctly in order to achieve the group's objectives. The use of this tool is important to improve the efficiency and alignment of the group, thus increasing the chance of success in achieving objectives.

Ishikawa *diagram*: this tool helps work groups to correlate cause and effect. By using this tool, the group can analyze problems, classifying the causes according to the 6 M's (manpower, mother nature, machinery, measurement, material and method), in order to identify the main factors or those that contribute most to the occurrence of the problem. It is important that the group is aligned on the definition of the problem (Habib; Rizvan; Ahmed, 2023). The *Ishikawa* diagram helps groups to organize the information gathered, classifying each of the causes raised by the group and starting the analysis and possible impact of each of the pieces of information. If the group is well aligned in the use of this tool, it helps to plan actions and also contributes to achieving the group's objectives.

PDCA: PDCA is a versatile tool that can be used in the main industrial actions aimed at process improvement. The PDCA cycle consists of 4 stages: Plan, Do, Check and Act. The Plan phase is where data generation and analysis take place. The Do

phase consists of carrying out what was planned in the previous stage. The Check phase consists of collecting data after implementing the actions in the Do stage and comparing it with the data collected in the Plan stage. Finally, the Act phase will depend on the analysis of the results collected in the Check phase. If the goals are achieved, implemented actions must be standardized. If the goals are not achieved, the PDCA cycle must be repeated (Ferreira *et al*., 2020). The *Jishuken* group applies this tool in an integrated way with the other suggested tools. In the Plan stage, Brainstorming, GUT Matrix, SMART Goals and Ishikawa Diagram are used. 5W2H is used in the Do stage to implement the planned actions, while the Pareto Chart is used to check the results, and the Flowchart to standardize and support the results the group achieved.

5W2H: this tool is used to structure actions in an organized way. 5W2H refers to the terms: What, When, Why, Where, Who, How and How Much. At this stage of the process, which takes place after analysis of the problem, investigating the causes and devising intervention strategies, it is important to develop a well-structured action plan that involves all group participants in a systemic way. Thus, adopting 5W2H at this stage can significantly increase the likelihood of success in implementing the actions, ensuring that everyone involved clearly understands their responsibilities and that the steps to be followed are well defined.

Pareto chart: Vilfredo Pareto was a sociologist and economist who first noticed and reported his observation that around 80 percent of wealth is concentrated in 20 percent of the population. This principle was applied to quality control by Juran and Deming, who also call it the 80/20 Rule, whereby treating 20% of the causes eliminates 80% of the problems (Alkiayat, 2021). Performance indicators should be created to monitor the process and track the effectiveness of the implemented actions. If the previous tools have been well applied and the causes correctly identified, as well as actions established and implemented to eliminate the causes, improvements in this tracking tend to be significant.

Flowchart: a tool that graphically represents different tasks or stages in a process. It should present as much information as possible in an objective way, using agreed symbology, but not limited to this, including the critical points and limits of the process (Kane, 2022). Flowcharts can be used to formalize the new standard achieved, and jishuken groups can use it to disseminate acquired knowledge in a summarized and visual way, making it understandable to everyone involved in the operation or process in question. By using this tool, it becomes possible to describe the steps to be followed, the procedures to be adopted and the interaction between the different stages of the process.

Table 4 shows the steps suggested for the application of jishuken and what was achieved in practice.

Table 4 - example of the application of jishuken in a textile factory

Steps	Actions	Adopted actions
1	Clarify the problem	Brainstorming with the Quality, Production, Maintenance and Engineering areas. Problem with stained knitwear batches during processing.
2	Break down the problem	Identification of priority areas - pre-bleaching problems.
3	Set the goal	Define criteria for solutions such as realistic, measurable and assignable. The goal is to eliminate or reduce stains.
4	Root cause analysis	Define the source of the problem (production or process). Operational error identified, such as partial neutralization of hydrogen peroxide.
5	Develop countermeasures	Strategic planning is drawn up and suppliers and customers are involved in the process. In this case, the countermeasures were to use catalase enzymes.
6	Implement countermeasures	An action plan is drawn up with the people responsible and dates according to 5W2H.
7	Monitor results and processes	Developed indicators, Pareto chart of reasons for knitwear batches with stain problems.
8	Standardize successful processes	Training for those involved and drawing up a detailed flowchart of the pre-bleaching procedure.

Source: The authors.

For a successful application of jishuken, the methodology suggested by (Marksberry *et al*., 2010) classifies it into internal cycles, i.e. people who work directly in the place that presents the problem to be solved, and external cycles, which are made up of people who are part of a chain of help for solving the problem. The flow is cyclical until the solution to the problem is found and applied successfully to the areas involved.

The practical application confirmed what (Marksberry *et al.,* 2010) had observed:

- Encouraging communication among work groups as a way of reaching a common understanding;
- Learning opportunities, including the team getting help when kaizen starts to slow down over time in their department;
- Maintaining the organizational culture, reinforcing the company's values, beliefs and behaviors.

CONCLUSIONS

The aim of this article was to disseminate the lean practice called jishuken, as well as to define it, present its implementation steps and the main authors who have published on this subject. First, we carried out a systematic literature review to meet these criteria. Then, to illustrate, we described an action research project on the application of jishuken in the textile industry in Brazil.

We observed that the few existing publications may be due to the numerous ways of calling the term jishuken, due to the adaptation of Japanese culture in other countries. Because it is a less widespread lean practice, it is often used under another name or even implemented without this name, and sometimes the concepts of Jishuken, Kaizen and Kaikaku are mixed up, since some definitions have characterized it as kaizen events or group study.

In this context, even though the textile industry is older than the automotive industry, this sector still needs to further explore jishuken. Considering this tool as an active learning method, its application in the textile industry is extremely important for developing leadership and problem-solving skills as well as sustaining a lean culture. Therefore, its application in a textile company located in Santa Catarina proved the theoretical results of the analyzed articles. In addition, it was possible to integrate jishuken with quality tools, thus allowing the team to acquire knowledge and solve problems. The development of multidisciplinary teams helped to reinforce lessons learned, such as disseminating problem-solving through practical experience and developing participants' skills to sustain the lean culture.

Finally, many authors emphasize that jishuken is an evolution of kaizen, creating a continuous drive for innovation. Therefore, it is necessary to reflect critically: "what can we learn from each improvement?", thus keeping the focus on value from the customer's point of view and with sustained changes over time.

Future studies could disseminate other lean manufacturing tools such as mizusumashi, hoshin kanri, Kakushin, Yamazumi, Kaikaku, Chaku Chaku, among others, and also relate them to the knowledge of managers and the results obtained on the shop floor, comparing them with the definitions in the literature.

REFERENCES

ALKIAYAT, M. A Practical Guide to Creating a Pareto Chart as a Quality Improvement Tool. *Global Journal on Quality and Safety in Healthcare*, Cincinnati, v. 4, n. 2, p. 83–84, maio 2021.

ANTOSZ, K.; STADNICKA, D. Lean Philosophy Implementation in SMEs – Study Results. *Procedia Engineering*, [London], v. 182, p. 25–32, 2017.

ARUNAGIRI, P.; GNANAVELBABU, A. Identification of High Impact Lean Production Tools in Automobile Industries using Weighted Average Method. *Procedia Engineering*, [London], v. 97, p. 2072–2080, 2014.

AZEVEDO, C. L. B.; LACOB, M-E.; ALMEIDA, J. P. A.; SINDEREN, M. v.; PIRES, L. F.; GUIZZARDI, G. Modeling resources and capabilities in enterprise architecture. *Information Systems*, Oxford, v. 54, p. 235–262, dez. 2015.

BATRA, R.; NANDA, S.; SINGHAL, S.; SINGARI, R. Study of Lean Production System Using Value Stream Mapping in Manufacturing Sector and Subsequent Implementation in Tool Room. *SAE Technical Paper*, [*s. l.*], p. 1-12, 2016. DOI: https://doi.org/10.4271/2016-01-0342

BONNARDEL, N.; DIDIER, J. Brainstorming variants to favor creative design. *Applied Ergonomics*, Guildford, v. 83, p. 102987, fev. 2020.

CAMUFFO, A.; WILHELM, M. Complementarities and organizational (Mis)fit: a retrospective analysis of the Toyota recall crisis. *Journal of Organization Design*, [London], v. 5, n. 1, p. 1-13, 2016.

COELHO, J. T.; DAL FORNO, A. J.; SPLIETER, A. M. Jishuken: exemplos de aplicaçao na indústria têxtil. *In*: SANTOS, D. L.; CÔRREA, J. de J. (ed.). *Discuta Lean - Melhores Práticas*. 4. ed. Brusque: Agora, 2023. v. 4, p. 9–16.

DAL FORNO, A. J. D. et al. Value stream mapping: A study about the problems and challenges found in the literature from the past 15 years about application of Lean tools. *International Journal of Advanced Manufacturing Technology*, London, v. 72, n. 5/8, p. 779-790, 2014.

ERRO-GARCÉS, A.; ALFARO-TANCO, J. A. Action Research as a Meta-Methodology in the Management Field. *International Journal of Qualitative Methods*, [Edmonton], v. 19, p. 1-11, 2020.

FERREIRA, S.; MARTINS, L.; SILVA, F. J. G.; CASAIS, R. B.; CAMPILHO, R. D. S. G.; SÁ, J. C. A novel approach to improve maintenance operations. *Procedia Manufacturing*, Amsterdam, v. 51, p. 1531–1537, 2020.

FREITAS, A. M.; SILVA, F. J. G.; FERREIRA, L. P.; SÁ, J. C.; PEREIRA, M. T.; PEREIRA, J. Improving efficiency in a hybrid warehouse: a case study. *Procedia Manufacturing*, Amsterdam, v. 38, p. 1074–1084, 2019.

HABIB, M. A.; RIZVAN, R.; AHMED, S. Implementing lean manufacturing for improvement of operational performance in a labeling and packaging plant: a case study in Bangladesh. *Results in Engineering*, Amsterdam, v. 17, p. 100818, mar. 2023.

HALL, A. *Introduction to Lean*: sustainable quality systems design – integrated leadership competencies from the viewpoints of dynamic scientific inquiry learning & toyota's lean system principals. Lexington, KY: Arlie Hall, 2006.

HINES, P. Network sourcing. *European Journal of Purchasing & Supply Management*, [*s. l.*], v. 2, n. 1, p. 7–20, mar. 1996.

IMAI, M. *Gemba Kaizen***:** a commonsense low-cost approach to management. New York: McGraw-Hill, 1997.

ISHIDA, S.; MAGNUSSON, M.; NAGAHIRA, A. Factors influencing Japanese auto suppliers' predictions about the future of new technologies an exploratory study of electric vehicles. *Futures*, Guilford, v. 89, p. 38–59, 2017.

KANE, V. E. Useful paths for identifying Lean Six Sigma improvement opportunities. *International Journal of Quality & Reliability Management*, Leeds, v. 39, n. 8, p. 2058–2077, 2022.

KEMPEGOWDA, V. H.; RAGHUKIRAN, N.; REDDY, K. J. Productivity enhancement by using programmable logic controller-based automated guided vehicles for material handlingInt. International Journal of Mechatronics and Automation, [*s. l.*], v. 7, n. 4, p. 175-181, 2020.

KUMAR, S.; NATHAN, V. N.; ASHIQUE, S. I. M.; RAJKUMAR, V.; KARTHICK, P. A. Productivity enhancement and cycle time reduction in toyota production system through jishuken activity – Case study. *Materials Today: Proceedings*, Cambridge, v. 37, p. 964–966, 2021. DOI: https://doi.org/10.1016/j.matpr.2020.06.181.

LETTERIE, W.; HAGEDOORN, J.; KRANENBURG, H. v.; PALM, F. Information gathering through alliances. *Journal of Economic Behavior & Organization*, Amsterdam, v. 66, n. 2, p. 176–194, 2008.

LIKER, J.; HOSEUS, M. *Toyota culture*: the heart and soul of the Toyota Way**.** New York: McGraw Hill, 2008.

MARKSBERRY, P.; BADURDEEN, F.; GREGORY, B.; KREAFLE, K. Management directed kaizen: Toyota's Jishuken process for management development. *Journal of Manufacturing Technology Management*, Leeds, v. 21, n. 6, p. 670–686, 2010.

OHNO, T. *Toyota production system*: beyond large scale production**.** New York: Productivity Press, 1988.

OLIVER, A. L. Holistic ecosystems for enhancing innovative collaborations in university–industry consortia. *The Journal of Technology Transfer*, Indianapolis, v. 47, n. 5, p. 1612–1628, 2022.

PURWANINGRUM, F.; EVERS, H.-D.; YANIASIH. Knowledge Flow in the Academia-industry Collaboration or Supply Chain Linkage? Case Study of the Automotive

Industries in the Jababeka Cluster. *Procedia Social and Behavioral Sciences*, [New York], v. 52, p. 62–71, 2012.

RIETBERGEN, M. G.; BLOK, K. Setting SMART targets for industrial energy use and industrial energy efficiency. *Energy Policy*, Guildford, v. 38, n. 8, p. 4339–4354, 2010.

ROGERSON, C. M. Japan's Hidden Involvement in South African Manufacturing. *Geo Journal*, [*s. l.*], v. 30, n. 1, p. 99-107, 1993.

SAITO, K. *Regular Subscription Face-to-Face Discussion on Research and Development (Two-part Series: 2)*. [*S. l: s.n.*], 2009. Disponível em: http://www.nsc.co.jp.

SAKO, M. Supplier development at Honda, Nissan and Toyota: comparative case studies of organizational capability enhancement. *Industrial and Corporate Change*, Oxford, v. 13, n. 2, p. 281–308, 2004.

SAKO, M. Do industries matter? *Labour Economics*, Amsterdam, v. 15, n. 4, p. 673–686, 2008.

VASIST, P. N.; KRISHNAN, S. Navigating the Ethical Terrain Around the Challenges of Fake News and False Narratives: An Integrative Literature Review and a Proposed Agenda for Future Research. *Journal of Business Ethics*, Dordrecht, v. 196, p. 473-493, 2024.

VILLAS BOAS MELLO, J. A.; GUIMARÃES, B. Jorge Pinto; MELLO, A. J Ribeiro. SWOT analysis and GUT matrix for business management and problem solving: an application in a Brazilian case-study. *Cuadernos de Gestión*, Bizkaia, v. 22, n. 1, p. 81–93, 2022.

WILHELM, M. M. Managing coopetition through horizontal supply chain relations: Linking dyadic and network levels of analysis. *Journal of Operations Management*, [*s. l.*], v. 29, n. 7–8, p. 663–676, nov. 2011.

WILHELM, M. M.; KOHLBACHER, F. Co-opetition and knowledge co-creation in Japanese supplier-networks: The case of Toyota. *Asian Business and Management*, [Houndsmills], v. 10, p. 55-86, 2011.