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UNDERUSED LEAN MANUFACTURING TOOLS IN THE TEXTILE INDUSTRY

FERRAMENTAS DO LEAN MANUFACTURING SUBUTILIZADAS NA INDÚSTRIA

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RESUMO

Lean manufacturing consists of reducing waste generated in the production process and since 1950 when the Toyota Production System emerged, its concepts and tool applications go beyond production. However, there are still some practices that are not fully applied or known, especially in the Brazilian textile industry. Therefore, the objective of this article is to identify the least widespread term of lean manufacturing in the literature, define and describe benefits of the application. The methodology consisted of a systematic review of literature in databases. Preliminary results showed that the least widespread term in the textile industry is yamazumi, which can be understood as demand balancing. Future studies will correlate whether this gap may be associated with the problems of demand forecasting errors that this sector experiences in practice.

Palavras-chave: continuous Improvement; lean Manufacturing; yamazumi.

1 INTRODUÇÃO

With growing global competitiveness, Brazilian companies are constantly seeking offer more competitive prices, improve quality management, reduce waste and optimize production processes. (COELHO et al, 2023). The implementation of the approachlean emerges as the cycle that, in the long term, generates sustainable and productive results. THE Adoption of lean manufacturing promotes continuous and substantial improvements, enabling companies to produce more with fewer resources, maintaining quality (DOS ANJOS et al,2022).

Studying the less widespread lean terms in the textile industry allows you to explore new opportunities, innovate processes, solve specific challenges and adapt to changes, promoting

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efficiency and competitiveness. The objective of this research is to identify in the industry textile the least widespread term, practice or tool of lean manufacturing across the literature. Seeks to answer questions about what is the least known term in manufacturing lean and how it is conceptualized. Therefore, the question to be answered in this article is “what is the practice least found in the literature on lean manufacturing in the textile industry and which are the results replicable for this sector?”

2 METHODOLOGY

The methodology adopted in this research was a systematic literature review, “an approach that uses databases to investigate a specific topic, highlighting a strategy for specific intervention through explicit and systematized search methods, critical analysis and synthesis of selected information” (Rf and Mc, 2007). The five steps to conducting a systematic review are detailed in Figure 1.

Figure 1 – Five phases of the process of preparing the systematic review carried out

1	Define the question	“What is the least common term in the textile industry in the last 5 years?”
2	Search for evidence	Use of the ScienceDirect , *Engineering Village, and Springer;* Search keyword, “the name of the term” and then “the term name” and *“textile”;* *“all fields”* option with and without limitations; Boolean indicator *“and”;*
3	Review and select studies	• Analysis using comparative graphs and informative tables;
4	Analyze quality methodological study	• Qualitative analysis of documents;
5	Present the results	• Present and conceptualize the less widespread term of *lean manufacturing* in the textile industry;

Source: Author (2023)

The terms used for research were lean manufacturing terms, being them: poke yoke, takt time, andon, heijunka, hoshin, yamashumi, chaku chaku, kakushin, jidoka, kaikaku, SMED.

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The search resulted in 30,817 articles, 3,845 for the term poka yoke, 1,339 for heijunka, 453 for kakushin, 2,841 for takt time, 1,875 for hoshin, 8,113 for jidoka, 8,166 for andon, 671 for yamazumi, 957 for kaikaku, 270 for chaku chaku and 8,587 for SMED.

3 RESULTS AND DISCUSSIONS

The search for publications in the databases was carried out on November 18, 2023, using as search terms and then the term with *textile* in the keywords without include any other country or area filter, and considering summaries, keywords andtitles. The results found are expressed in Figure 2.

Figure 2 – Number of publications in the Engineering Village, ScienceDirect and Springer databases

	Search by term						Search for the term + *textile*					
	Engineering village		*Science Direct*		*Springer*		*Engineering village*		*Science Direct*		*Springer*	
	<2019	>2019	<2019	>2019	<2019	>2019	<2019	>2019	<2019	>2019		
Poka Yoke	206	82	562	203	2200	143	4	3	51	28	220	143
Heijunka	0	0	208	85	763	73	0	0	23	18	96	73
Kakushin	0	0	35	2	313	20	0	0	4	0	59	20
Takt Time	304	101	666	299	954	140	3	2	39	29	164	140
Hoshin	305	32	384	66	889	51	0	0	15	7	75	51
Jidoka	62	32	250	100	944	111	5	4	29	16	149	111
Andon	355	20	3620	366	3112	168	1	1	72	21	262	168
Yamazumi	45	11	272	52	237	13	1	0	5	2	20	13
Kaikaku	6	0	73	18	649	53	0	0	9	3	93	53
Chaku Chaku	6	2	27	17	159	14	0	0	5	5	21	14
SMED	434	125	3493	983	2771	163	13	8	134	56	244	163

Source: Author (2023)

As a criterion for defining which term was least widespread in the last five years of lean manufacturing in the textile industry, the term with the fewest publications was considered since 2019 in searches for the term along with textile, with this the term least published through the individual evaluation of each database. With this, the least terms widespread found was yamazumi. When analyzing publications referring to the term yamazumi, only articles from magazine or

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conference and in the ScienceDirect database published after 2019 and found when searching for the term only. With the conditions established, sixteen articles were found and analyzed in Figure 3 with the descriptive summary about each article found.

Figure 3 – Number Description of articles found

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AUTHOR	YEAR	AREA	OBJECTIVE	OTHER TERMS
Ahmed, Syed; Parvath aneni; Shareef	2023	Packaging	Investigate gaps in the current kitting process	Analysis of Effects of Failure Modes Process; Flowchart; *Plan For Every Part*
Asadi; Jackso n; Fundin;	2019	Mechanics	Investigate the implications of realizing mix flexibility in an assembly system for product modularity	-
Asano *et al*	2022	Medicine	Analyze the time course of meningeal inflammation	-
Baker *et al.*	2020	Psychology	Understand how argumentative interactions involving *role-play* (role-play)	-
Biercewicz; S ulich; Soẏoducho- Pelc;	2022	Education	Propose management improvements in an educational game	-
Dias *et al.*	2019	Metallurgy	Describe the 14 implemented process improvement measures	5s
Fold; Jósvai;	2021	Mechanics	Propose a way to increase the indicator using your own hybrid analysis	*Takt time*
Huang *et al.*	2019	Automation	Present a multi-agent system composed of several systems Low-cost embedded Arduino	Value Stream Mapping (VSM); Dynamic Value Stream Mapping (DVSM)
Inoue *et al.*	2020	Medicine	Analyze the management of type I internal leakage	-
Conrad , Sommer , Shareef	2023	Agriculture	Reduce packaging time and material costs in a warehouse	Spaghetti diagram; *Kaban;* *Poka yoke;* Analysis of Mode and Effects Failure; Flowchart;
Kumar *et al.*	2021	Mechanics	Improve the efficiency of a sheathing unit production line by implementing three different line balancing techniques	*Takt time*
Machusky; Jherbert- Berger;	2022	Medicine	Address the story and Current challenges in working with online learning infrastructure.	-

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Obata; Morimoto; Miyanoshita;	2019	Agriculture	Solve the problem of insect pests on a plantation	-
Pawlewski; Anholcer;	2019	Logistics	Present the use of a relational database model in modeling manufacturing systems	*Plan For Every Part;* SMED; VSM; Flowchart;
Pinion; Ignacio; Rabbit,	2022	Aeronautics	Propose models for defining work standards to optimize response time indicators, number of operators, training costs and balancing load	*Takt time;*
REKE; Powell; MOGOS	2022	Motorsports	Present preliminary results of applying TPS concepts in Norwegian companies	*Just in time; Kaizen; Heijunka; Jidoka;* 5s; TPM; Standardized work; 5 because

Source: Author (2023)

To better understand the term, the definition addressed by each article was identified to the term yamazumi, as shown in Figure 4.

Figure 4 – Definition of yamazumi by articles found in the search

Author	Definition
Ahmed, Syed; Parvathaneni; Shareef	Chart to visualize the proportions of activities with and without added value
Asadi; Jackson; Fundin;	Work balancing to reduce the difference between the cycle times of each workstation.
Dias *et al.*	Chart to analyze the performance of machines and employees
Fold; Jósvai;	Practical visual application
Huang *et al.*	A *takt time* display format
Conrad , Sommer , Shareef	A comprehensive and careful time study considering the movements and waiting times of employees who are required to complete the task
Kumar *et al.*	It is the visual representation of working time in a cell, station or production line, used as an effective tool for improvement activities in production lines
Pawlewski; Anholcer;	Graphs for analyzing results
Pinion; Ignacio; Rabbit	Load Balancing Optimization
Reke; Mogos	Load capacity

Source: Author (2023)

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The actors' articles Baker et al (2020), Biercewicz; Sulich; Soÿoducho-Pelc (2022), Asano et al (2022), Machusky; Jherbert-Berger (2022), Inoue et al (2020) were disregarded in references and citations, and also in the article by the authors Obata; Morimoto; Miyanoshita (2019) was also disregarded because the term was just the name of a website project. Finally, it was understood that yamazumi is a term that helps in balancing the line of production in order to provide clarity for performance in machine and employee times, can be presented with several different looks, but its structure will always have the standard to be a stacked column chart.

4 FINAL CONSIDERATIONS

To analyze the most underused terms of lean manufacturing in the textile industry, we investigated through the number of publications in periodicals and conferences in the databases ScienceDirect, Engineering Village, and Springer data from the terms: poke yoke, takt time, andon, heijunka, hoshin, yamashumi, chaku chaku, kakushin, jidoka, kaikaku, SMED. To defining the underused term, the term with fewer publications was used as a criterion after 2019 separately observing the results for each database, with only the 15 articles in the search for yamashumi plus textile in a delimitation of articles in congress and periodicals until 2019, the term yamashumi is concluded as the least underused term, and for To be able to conceptualize the term, we used the publications found on sciente direct in the search by the term only with the year delimitation being after 2019 and selecting only articles of periodicals and congress. When analyzing the documents found for yamashumi, they were 16 articles were analyzed, in which the author, year of publication, area of application, objective and other frequently encountered terms. In short, the concept was defined as "demand balancing" through the evaluation of 11 of these articles, represented in stacked column charts.

REFERÊNCIAS

AHMED, Syed; PARVATHANENI, Dileep; SHAREEF, Iqbal. Reorganização do estoque para melhorar a eficiência da montagem de kits e maximizar a utilização do espaço. Cartas de Fabricação, v. 35, p. 1366-1377, 2023.

ASADI, Narges; JACKSON, Esteiras; FUNDIN, Anders. Implicações da realização de flexibilidade de mix em sistemas de montagem para modularidade de produtos – um estudo de caso. Revista de Sistemas de manufatura , v. 52, p. 13-22, 2019.

ASANO, Hinami et al. Infiltração de células imunes periféricas no bulbo olfatório em um modelo de rato com inflamação nasal aguda. Jornal de Neuroimunologia , v. 368, p. 577897, 2022.

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BAKER, Michael J. et al. Argumentação, Eureka e emoção: Uma análise de projetos grupais na formação em design criativo. Aprendizagem, cultura e interação social , v. 26, p. 100436, 2020.

BIERCEWICZ, Konrad; SULICH, Adam; SOŁODUCHO-PELC, Letycja. As propostas de melhorias para o engajamento e comportamentos sustentáveis dos jogadores em jogos gerenciais. Procedia Ciência da Computação, v. 1509-1518, 2022.

COELHO, J. T. ; Dal Forno, A.J. ; SPLIETER, A. M. . Jishuken: exemplos de aplicaçao na indústria têxtil. In: Daniel Lorenzon dos Santos e Joziel de Jesus Côrrea. (Org.),. 4ed.Brusque: Agora, 2023, v. 4, p. 9-16 DIAS, José António et al. Melhorando o processo de atendimento de pedidos em uma metalúrgica. Procedia Manufacturing , v. 1031-1038, 2019.

DOBRA, Pedro; JÓSVAI, János. Aprimoramento de OEE por meio de análise híbrida nas linhas de montagem semiautomáticas automotivas. Procedia Manufacturing , v. 184-190, 2021.

DOS ANJOS, Natália Caetano et al. Proposta conceitual de vantagens da adoção de lean manufacturing pela indústria têxtil e de confecção.2022.

HUANG, Zhuoyu et al. Indústria 4.0: Desenvolvimento de um sistema multiagente para mapeamento dinâmico de fluxo de valor em PMEs. Jornal de Sistemas de Manufatura , v. 1-12, 2019.

INOUE, Kentaro et al. As plaquetas refletem o destino do endoleak tipo II após o reparo endovascular do aneurisma. Revista de Cirurgia Vascular , v. 72, n. 2, pág. 541-548. e1, 2020.

KONRAD, Kyle; SOMMER, Mitchell; SHAREEF, Iqbal. Consolidação e padronização de caixas usando sistemas de manufatura enxuta. Cartas de Fabricação , v. 35, p. 1264-1275, 2023.

KUMAR, R. Nithish; MOHAN, R.; GOBINATH, N. Improvement in production line efficiency of hemming unit using line balancing techniques. Materials Today: Proceedings, v. 46, p. 1459-1463, 2021.

MACHUSKY, John A.; HERBERT-BERGER, Katherine G. Compreendendo a infraestrutura de aprendizagem on-line nas escolas de ensino fundamental e médio dos EUA: uma revisão dos desafios e tendências emergentes. Revista Internacional de Pesquisa Educacional , v. 114, p. 101993, 2022.

OBATA, Hiroki; MORIMOTO, Katsura; MIYANOSHITA, Akihiro. Descoberta dos gorgulhos do milho da era Jomon em Hokkaido, Japão e seu significado. Revista de Ciência Arqueológica: Relatórios , v. 23, p. 137-156, 2019.

PAWLEWSKI, Pawel; ANHOLCER, Marcin. Template de banco de dados relacional na modelagem de simulação de sistemas de manufatura. IFAC-PapersOnLine , v. 13, pág. 1744-1748, 2019. PINHÃO, Júlia da Matta Oliveira Borsato;

IGNACIO, Aníbal Alberto Vilcapoma; COELHO, Ormeu. Um modelo matemático de programação inteira com balanceamento de linha e escalonamento para otimização de trabalho padrão: Uma aplicação realista para linhas de montagem de motores de aeronaves. Computadores e Engenharia Industrial , v. 173, p. 108652, 2022.

REKE, Eivind; POWELL, Daryl; MOGOS, Maria Flávia. Aplicar os fundamentos do TPS para criar um sistema de manufatura resiliente e responsivo. Procedia CIRP , v. 1221-1225, 2022