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THE RELATIONSHIP BETWEEN MAKING-DO WASTE AND GOOD MANAGEMENT PRACTICES IN THE CONSTRUCTION INDUSTRY: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

The need within the construction market to increase control, performance, reduce waste and impacts on the environment is of utmost importance. In order to fully understand and contextualize the construction management process and help managers make decisions, this study aims to investigate studies through a systematic literature review which address the relationship between good management practices and losses from making-do within good construction practices. The search for articles was conducted in the Scopus, Science Direct and Web of Science databases. This diagnosis revealed the good management practices presented in the literature, which can be facilitating activities or good practices that reduce losses from making-do, guarantee compliance with the minimum requirements of the complete kit or the resilience of the process. The categories of knowledge gaps were structured into: Industry 4.0 and 5.0, Big Data, Multi-criteria decision making, Discrete event simulation, Resilience and Literature review.

KEYWORDS

Making-do. Wastes. Lean construction. Reworking. Planning.

INTRODUCTION

The construction sector becomes competitive when the market and segmentation impose such a perspective, demanding quality and performance from construction companies. As a result, it is necessary to increase control and performance, reduce waste and impacts on the environment (Adewuyi et al. 2014; Ansah et al., 2016). This environment is conducive to applying methodologies, principles and concepts such as lean construction with the aim of reducing costs, waste, improving predictability, and increasing transparency, among other aspects related to production performance.

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The use of lean construction concepts within the planning, execution and control of operational flows and their processes in civil construction ensures that the cost of productivity is achieved with the minimum of available resources. Thus, the high production cost within the civil construction process is related to the waste that exists throughout the construction processes and should be understood as any inefficiency in the use of equipment, materials, labor and capital (Formoso et al., 1997; Viana et al., 2012).

Proponents of lean thinking argue that reducing and eliminating waste leads to improved conversions (Womack and Jones, 1996). Waste measurement has been widely used in the manufacturing industry to evaluate the performance of production systems, as it generally allows areas for potential improvement and the main causes of inefficiencies to be identified (Ohno, 1988; Dinis-Carvalho et al., 2015).

An analysis of areas for potential improvements and identifying the main causes of inefficiency guarantee the existence of a complete kit of activities. The complete kit concept was presented by Ronen (1992), which is the set of components, drawings, documents and information necessary to complete a specific assembly, subassembly or process, highlighting the importance of starting activities only when all the resources necessary for its execution are met.

An important increase in lean construction was the designation by Koskela (2004) of a new category of losses, losses from making-do, supported by the concept of a complete kit proposed by Ronen and added to the widely known and applied list of Ohno (1997) and Shingo (1989).

Since then, research related to ways of using the concept of loss from making-do to minimize or eliminate activities which do not add value to the process has been developed at various stages of the life cycle (from project conception to maintenance), such as in project preparation, in construction site logistics (Ghanem et al., 2018); in the supply chain and its relationships (Taggart, Koskela and Rooke, 2014); in production slack (Fireman, Saurin and Formoso, 2018); in the development or increase of methods or tools, virtual or not, to facilitate the identification of these losses (Sommer, 2010; Fireman, 2012; Leão; Formoso; Isatto, 2016); or identifying other losses in a discussion of cause and consequence in relation to the loss from making-do (Formoso et al., 2011; Fireman, Formoso and Isatto, 2013; Santos and Santos, 2017; Pérez, Costa and Gonçalves, 2016; Pérez; Costa, 2018; Amaral, 2023).

The management process is the logical sequencing of four steps: planning, organizing, directing and controlling to achieve a certain objective. In this sense, Almeida (2002) emphasizes that process management involves evaluating each phase of the process and seeking the best way to execute it with excellence. Thus, the importance of the manager and the concept of resilience is highlighted, which for Hollnagel and Woods (2005) is the ability to recognize, adapt and absorb variations, changes, disturbances, ruptures and surprises, especially those which the system was not designed for, as it is from them that the management process takes place.

In view of the above, this study proposes to investigate the development of work on the relationships between good management practices and losses from making-do within civil construction through a systematic literature review (SLR) in order to understand and contextualize the management process of civil construction and aid managers in decision-making.

Work found in the bibliometric research phase indicates that incorporating good practices can reduce losses (Grosskopf, 2013). They also confirm that activities which do not add value account for more than half of all activities in a project (Daniel et al., 2019; Nassri et al., 2023).

Good practices in the construction field can be understood as solutions used to suppress interruptions in some activity on the construction site (Mesquita, 2014), but it can also be seen as the best way identified by a professional to satisfactorily complete a task (Cleto et al., 2011); in addition, according to the perspective of Sáez et al. (2014), practices which enable better management of processes in order to favor reduced material waste. This means that good

practices do not have a unanimous definition in the literature and can be applied to different knowledge areas. Herein, we highlight those good practices used on construction sites and which are based on the philosophy of lean construction, which can be called good lean practices or just lean practices (Liker; Meier, 2008).

Adopting good practices on construction sites leads to improvement in aspects which encompass this environment (Grosskopf, 2013). According to the author, there is a reduction in the executive schedule of projects, reducing delays, as well as an improvement in quality, lower costs, in addition to cooperating with the reduction of environmental impacts all being considered among the benefits caused by adopting these practices.

A SLR aims to identify a set of completed studies which address a given research question and evaluate their results to highlight conclusions on a given subject through a protocol. The SLR protocol used in this work is detailed in the materials and methods section.

Thus, the good management practices raised can be techniques, concepts, facilitating activities or good practices as long as they reduce losses from making-do, guarantee compliance with the minimum requirements of the complete kit or the resilience of the process. These good practices were arranged at each stage of the construction life cycle according to their history or potential application. The phases of the construction life cycle will be defined based on the concepts proposed by Gobin (1993).

METHOD

MATERIALS AND METHODS

A Systematic Literature Review (RSL) is a review planned to answer a specific problem using explicit and systematic methods to identify, select and evaluate studies, and then critically analyze the data present in them that relate to the research questions (Rother, 2007). The guidelines proposed by Kitchenham (2004) were used in order to define the method for preparing the systematic mapping of literature, dividing the study into three stages as described in Figure 1.

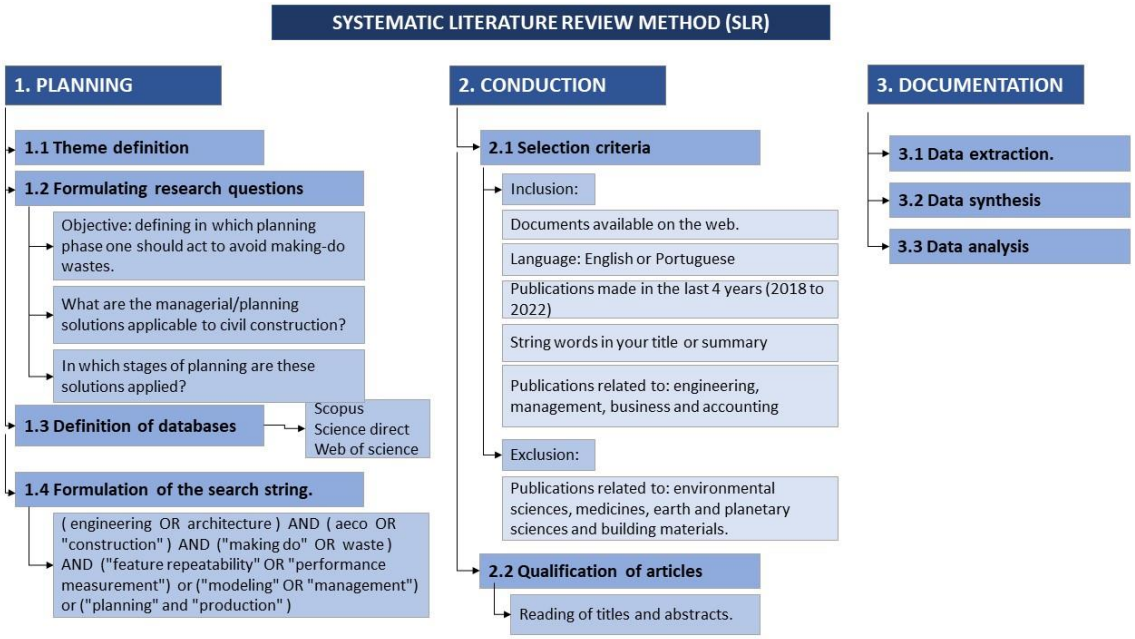

Figure 1: Systematic literature review (SLR) method (source: the authors)

RESEARCH STAGES

Planning

The possible good management practices which are used in different types of industries and can be used within the life cycle phases of the construction industry can be outlined during the planning stage. Thus, the following research questions were formulated: "What are the good management/planning practices applicable to civil construction?" and "In which planning phases are these good practices applied?"

Next, data from articles published in the following databases were collected to conduct the SLR: Scopus (access at: https://www.scopus.com/), Science Direct (access at https://www.sciencedirect.com/) and Web of Science - SciELO Citation Index (access at: https://www.webofscience.com/). The choice of these databases is justified by the greater number of articles related to the research areas of engineering and management. These databases have summaries and citations of articles covering national and international titles in the scientific and technical fields. These databases have tools which enable analyzing the impact of an article, as well as ranking of journals, author profiles, number of articles published by a journal and frequency of use of scientific terms, enabling an analysis of publication trends.

An advanced search was used on all platforms using the following string: (engineering OR architecture) AND (AECO OR "construction") AND ("making do" OR waste) AND ("feature repeatability" OR "performance measurement") or ("modeling" OR "management") or ("planning" and "production").

SLR Conduct

Figure 2 describes the methodology for selecting and extracting articles from the researched databases.

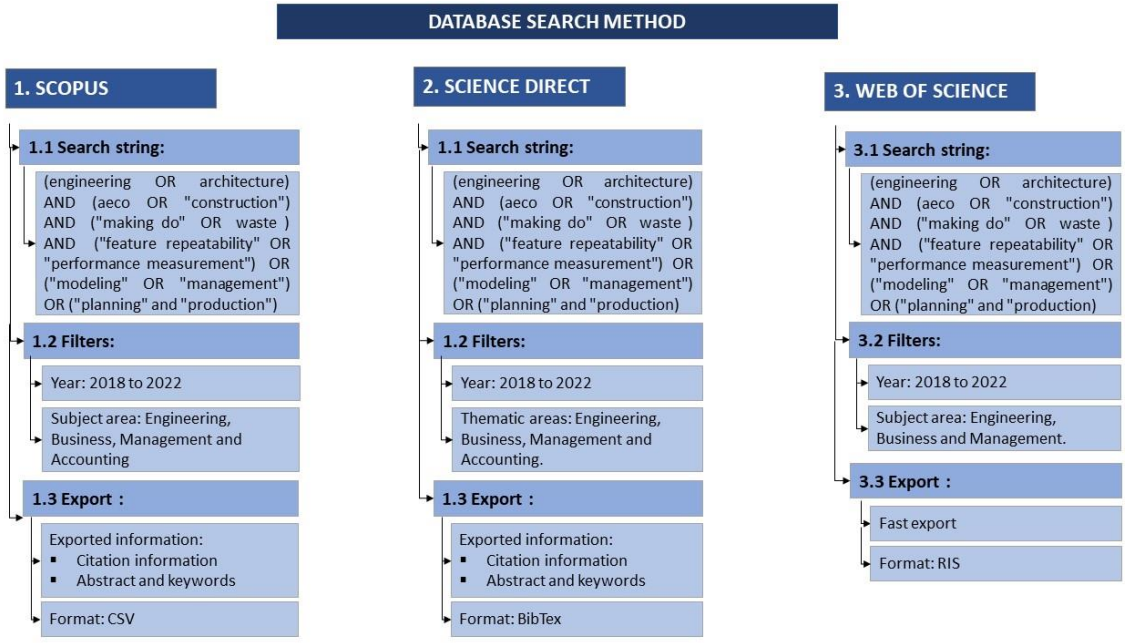

Figure 2: Database search method (source: the authors)

After data collection, all documents obtained at this stage were imported to the Rayann website (accessed at https://rayyan.ai/) and the studies were managed there. The choice of documents began following the protocol:

- Removal of duplicate files;
- Selection and exclusion based on reading the title and then the abstracts, following the following criteria.

Definition of inclusion criteria:

- Work related to: engineering, management, business and accounting.
- Documents available on the web;
- Language: English or Portuguese;
- Publications in the last 4 years (2018 to 2022);
- String words in the title or summary.

Definition of exclusion criteria:

- Work related to: environmental sciences, medicines, earth and planetary sciences and construction materials.
- Works that do not meet the inclusion criteria.

Documentation

We attempted to perform a bibliographic analysis during the documentation stage. This analysis considered the following parameters: selected articles, authors, number of annual publications, place and institution of publication and main keywords. Complementing the documentation stage, the selected articles were divided according to the application of the concepts presented and how they can be used within the phases of the construction industry's life cycle. The construction life cycle phases were divided following the three categories proposed by Gobin (1993) as detailed in image 4.

Microsoft Excel® was used to analyze the data from the selected articles, which had the function of standardizing relevant data such as title, authors, year, publication annals and references for use in the Microsoft Power BI® program.

RESULTS AND DISCUSSION

Searches in the databases according to the method represented in Figure 2 returned a total of 1,411 works, of which 36 were discarded because they were repeated in different databases. Thus, 1,375 publications were analyzed, distributed according to graph 1. The database that presented the highest number of results was Web of Science with 40.87%, followed by Scopus with 29.74% and Science Direct with 29.38% of the works.

After selection and exclusion of repeated publications, the article selection stage began. The results of this stage are presented in Table 1. After reading the title, 173 articles (12% of the total) were selected, and then the number was reduced to 114 (8% of the total) after reading the abstracts. No articles were obtained through snowball sampling. Thus, the number of articles analyzed remained at 114.

Table 1: Quantity of articles in the SLR stages (soruce: the authors)

STAGE	RESULT
Found in all databases	1411
Found in all databases (excluding repeats)	1375
Selected after reading the title	173
Selected after reading the title and abstract	114

The relationship between the total number of publications in the databases and the publications selected after reading the title and abstract following the inclusion and exclusion criteria described in the methodology are represented in Figure 3. The database that presented the largest number of selected articles was Scopus with 40.36%, followed by Web of Science with 38.60% and Science Direct with 21.04%.

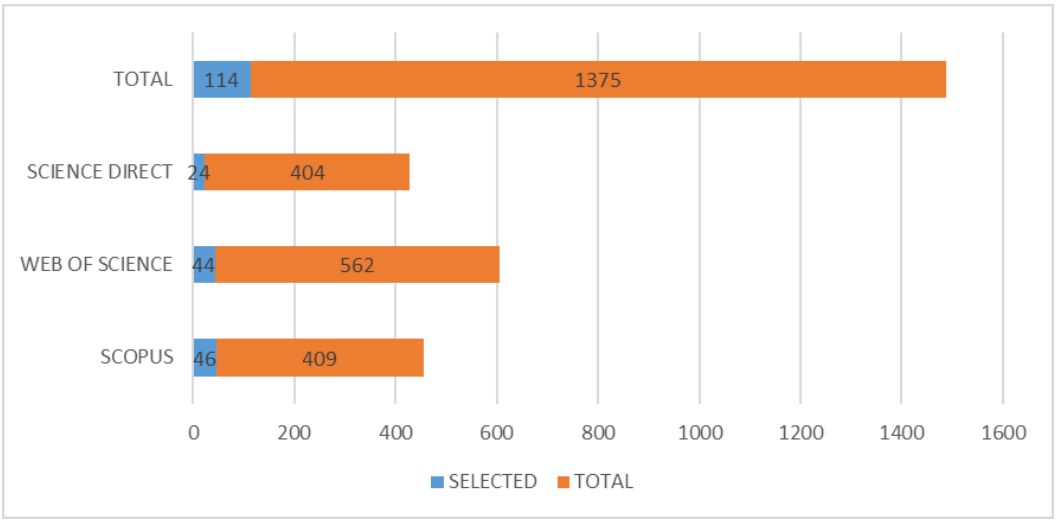

Figure 3: Number of publications selected by database (source: the authors)

Using Power BI, an interactive dashboard was created with a summary of the main results from the analyzes. These started from the analysis of the quantity of publications over the years, shown in Figure 4. The time frame determined in this work was between 2018 and 2022, with the objective of selecting the most recent publications on the proposed topic. Thus, a small variation was observed in the number of works published between the given period, highlighting the years 2020 and 2022 as those with the highest number of publications with 25 and 28 works published, respectively.

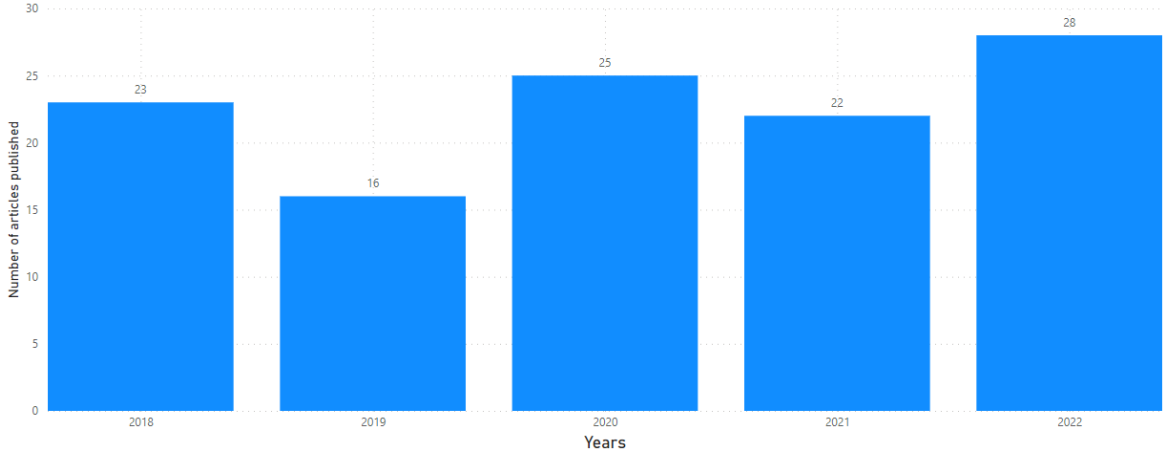

Figure 4: Number of articles published over the years. (source: the authors)

The analyzes continue with the place of publication of the articles. The number of journals which published more than one article from the selected sample was low. Those that had more than 3 publications are shown in graph 3. The Ambiente Construído Journal can be highlighted, which presented 23 publications, corresponding to 20.17% of the total sample. Table 2 describes the importance of the International Group for Lean Construction (IGLC) for the topic by relating the number of publications per journal and the number of publications at the congress in the same time frame as the study (last 4 years), applying the same inclusion and exclusion criteria as the SLR protocol.

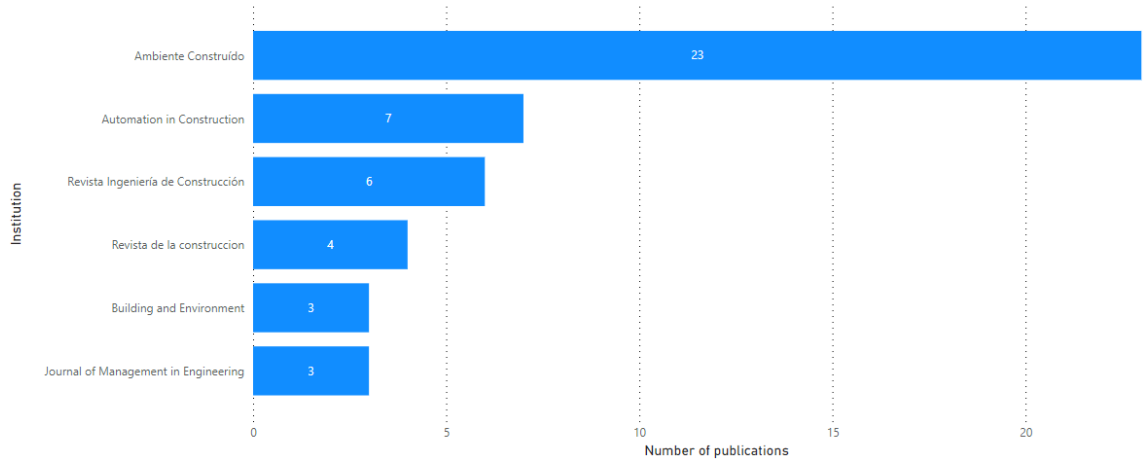

Figure 35: Number of publications by institution (source: the authors)

The recurrence of the main words which appear in the title and summary of the selected articles was analyzed, as represented in the word cloud (Figure 6). It is then possible to identify themes that, despite not being addressed in the string, are present in studies, for example: the centrality is formed by the terms “waste” and “industry”, showing that a large part of the publications are related to losses in industries. Relevantly, we have the terms “construction” and “building” highlighting the study topic of this review. Another interesting fact is that even though the terms “BIM” and “Lean” are not present in the string, they were terms of great occurrence in the selected works. This presence demonstrates an integration between the subjects present in the terms of the string, mainly when relating the concepts of these terms with the terms of the string: “feature repeatability” and “performance measurement”) since the concepts of the BIM and Lean methodology are directly linked to procedural methodologies with the aim of standardizing processes and increasing performance within the production chain. Thus, these terms can be considered as guiding research when questioning how losses due to making-do are related to BIM and lean methodologies, and how and what is the advantage of integrating these concepts for the decision maker within the construction site.

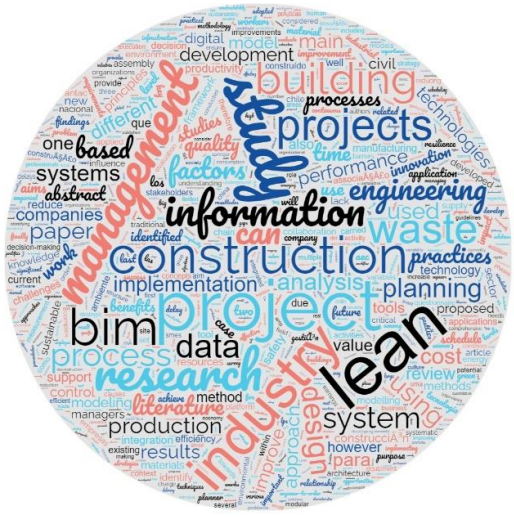

Figure 6: Word cloud. (source: the authors)

Finally, a complete reading of the articles published in 2022 was done in order to identify and understand the most current good management and planning practices and in which phases of the construction life cycle these could be applied. Figure 7 summarizes the life cycle phases of the development of traditional civil construction projects and was adapted from the illustration proposed by Gobin (1993).

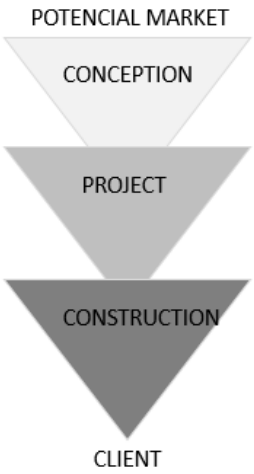

Figure 7: Phases of the traditional life cycle of civil construction projects. (source: Adapted from Gobin (1993)).

The construction life cycle phases for this analysis were divided following the three categories proposed by Gobin (1993), as detailed in Figure 8. However, the programming stage is replaced by "Conception and feasibility" in order to better characterize it. Thus, the results were divided and analyzed following the construction life cycle stages: "Conception and feasibility", "Project" and "Construction". A fourth category was created called "N.A." (not applicable) for articles which analyzed the topic in an industry other than the construction industry.

From a complete reading of the articles, it was possible to identify good management and planning practices used in different types of industries and which can be used within the phases of the construction industry's life cycle. Table 3 and Figure 8 illustrate the distribution of good practices highlighted in the articles in each phase of the construction life cycle, as well as those that were not applied in the construction industry but presented applicability and satisfactory results in other industries.

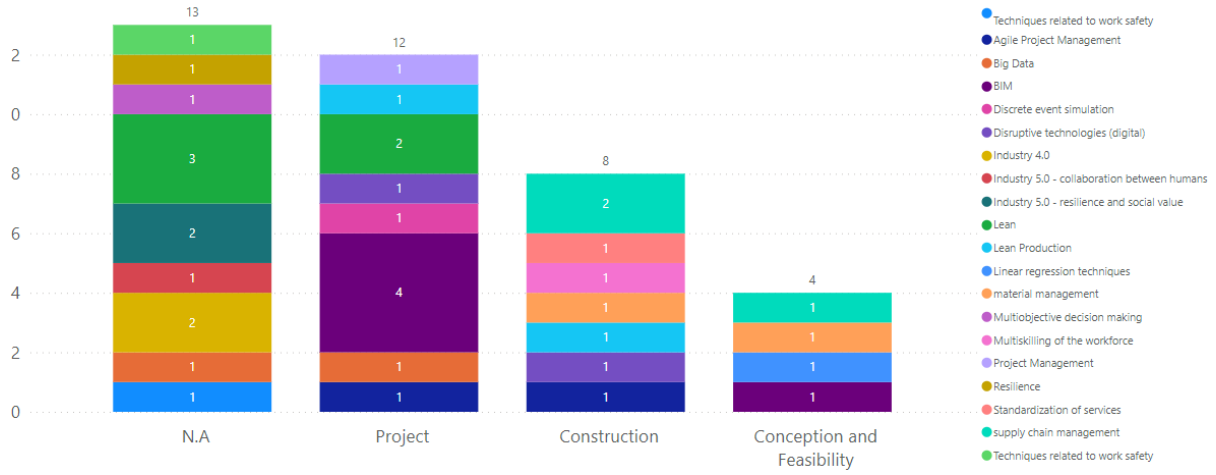

Figure 8: Distribution of articles selected in the databases in the year 2022 by the life cycle phase of construction management solutions (source: the authors)

Table 3: Distribution of good practices throughout the construction life cycle. (source: the authors)

	CONCEPTION	CONSTRUCTION	PROJECT	NA	TOTAL
BIM	1		4		5
Lean			2	3	5
Supply Chain Management	1	2			3
Agile Project Management		1	1		2
Big Data			1	1	2
Disruptive Technologies (Digital)		1	1		2
Industry 4.0				2	2
Industry 5.0				2	2
Lean Production	1	1	1		3
Material Management		1			1
Techniques Related to Work Safety				1	1
Discrete Event Simulation			1		1
Industry 5.0 - Collaboration Between Human	1			1	2
Linear Regression Techniques					0
Multiobjective Decision Making				1	1
Multiskilling of the Workforce		1			1
Project Management			1		1
Resilience				1	1
Standardization Of Services		1			1
TOTAL	4	8	12	12	36

Knowledge gaps related to good management practices within the context of the construction industry were identified (Table 4). These were divided and analyzed into categories, and the works that use literature review as a method were separated into the “Systematic Review” category, since they present several gaps on the topic covered.

The knowledge gaps presented in Table 4 highlight the lack of studies focused on tools which could be instrumental in planning and decision-making in civil construction. The lack of research on the topic of resilience and the industrial revolutions 4.0 and 5.0 is very evident. These themes involve tools which are dedicated to promoting collaboration between humans, resilience, social value, and customer experience, and should be considered as a suggestion for future work. These themes are related to the also absent concepts of big data, multi-criteria decision making and simulation of discrete events, since these are focused on the knowledge area which studies how to treat, analyze and obtain information from a large set of data. Data analysis is very important for defining tools that enable the civil construction industry to evolve to the level of industry 4.0 and 5.0.

Table 4: Category of knowledge gaps and their selection criteria. (Chart 1 source: the authors)

CATEGORY OF KNOWLEDGE GAPS	SELECTION CRITERIA
Industry 4.0 and 5.0	Articles that address tools dedicated to collaboration between humans, resilience and social value. Research on the concepts of industry 4.0 and 5.0 in civil construction.
Big Data	Articles covering Big Data research in construction safety, site management, heritage conservation and project waste minimization and quality improvements.
Multiobjective decision-making	Articles that address decision-making research on the post-disaster topic using hard data.
Discrete event simulation	Articles that evaluate the simultaneous integration of DES, ABM and SD modeling solutions.
Resilience	Research related to the importance of resilience in the organizational structure of companies.
Literature review	Articles which are SLR and present several knowledge gaps on the topics: Lean; BIM; Solutions related to work safety; Multiobjective decision-making; Supply chain management; Materials management; Disruptive technologies (digital).

These tools are linked to the knowledge area that deals with processing, analyzing and obtaining information from sets of presented data sets, and can be applied to BIM and Lean philosophies. These approaches not only extend the principles of lean construction, but also add assertiveness to decision making.

Despite not being explicitly mentioned in the knowledge gap categories, the concept of making-do can be considered a relevant gap. The lack of management techniques in construction can result in tasks being started or continued even in the complete absence of inputs, leading to a reduction in performance and characterizing losses due to making-do. Highlighting this gap is crucial to improving practices and efficiency in the construction sector.

CONCLUSION

From the systematic literature review it was possible to meet the proposed general objective of identifying and understanding the most current good management and planning practices and in which phases of the construction life cycle these could be applied. The search for understanding losses from making-do at construction sites led to the perception that the use of certain good practices imply actions which can be considered beneficial to the process, but that there are still no studies that correlate such good management practices to the concept of losses from making-do, since no works were returned after applying the SLR research protocol in which the term “making-do” was present in their title or abstract. Good management practices lead to the understanding that those which bring benefits to the process must be studied and their applications correlated with the occurrences of losses from making-do in the different development stages of civil construction projects, and so this question requires new research to be conducted.

The number of articles published over the years shows a growing interest in the topic of management solutions for the phases of the civil construction life cycle, reinforcing the current extremely competitive context of civil construction.

The result of distributing the solutions highlighted in the articles in each phase of the construction life cycle made it possible to evaluate in which phase action should be taken to avoid wastes due to making-do. The design phase was the one that presented the greatest number of management solutions, highlighting the importance of this stage for the positive

results of construction projects. Among the solutions we can highlight for the project stage: BIM, Lean, Agile project management, Big Data, discrete event simulation and disruptive digital technologies.

However, it was possible to observe concepts that are not explored in the construction industry, such as: industry 4.0 and 5.0 concepts such as resilience and social value, multi-criteria decision making and techniques related to occupational safety, so it is not possible to prove empirically the real effectiveness of the application of these concepts within the development of construction projects.

Many articles entered the "literature review" category highlight a predominant trend of theoretical analyzes and conceptual reviews related to civil construction. In the context of the Brazilian construction industry, it is necessary to advance further with work that relates the concepts of: Lean, BIM, solutions related to workplace safety, multi-criteria decision making, supply chain management, materials management and disruptive (digital) technologies. in practice, demonstrating the effective application of concepts in the construction industry.

In the field of Lean and BIM, it is important to carry out empirical research, with Brazilian case studies, that highlight how these philosophies are implemented in real projects in Brazil, highlighting cases of success and challenges faced, providing relevant data on the effectiveness of these approaches and relating with concepts such as productivity, formal and informal service packages and the occurrence of improvisations and process resilience.

About solutions related to occupational safety, supply chain management, materials management. Collecting this data and analyzing it using methods to support multi-criteria decision-making is crucial, integrating these concepts into everyday practices within the construction site. This would contribute to the consolidation of these methodologies and good practices and would provide data that guided the manager in decision-making and continuous improvement practices.

Considering disruptive technologies, which are those that significantly revolutionize and improve tools, as well as new services and products, it is essential to study them for application within the construction site. Studies that present new technologies such as BIM, internet of things, efficient data management and augmented reality can provide interesting perspectives on the real scenario of technology application within Brazilian construction companies.

Therefore, influencing research applied to case studies is essential to fill the gap between theory and practice in civil construction, therefore, studies that relate wastes due to making-do in civil construction with the concepts of industry 4.0 can be suggested as future work. and 5.0, Big Data, multi-criteria decision-making methods, discrete event simulation and resilience.

REFERENCES

Ansah, Richard Hannis; Sorooshian, Shahryar; Mustafa, Shariman Bin. Lean construction: an effective approach for project management. ARPN Journal of Engineering and Applied Sciences, v. 11, n. 3, p. 1607-1612, 2016.

Adewuyi, T. O.; Idoro, G. I.; Ikpo, I. J. Empirical evaluation of construction material waste generated on sites in Nigeria. Civil Engineering Dimension, v. 16, n. 2, p. 96-103, 2014.

Amaral, T. G.; Brandão, C. M.; Elias, K. V., Braga, P. B. Identificação de perdas por improvisação em canteiros de obra. Revista Eletrônica de Engenharia Civil, volume 15, REEC, 2019.

Amaral, T. G.; Brandão, C. M.; Elias, K. V., Braga, P. B. Dynamic method to identify and analyze waste by making-do in construction sites. Gestão & Produção. 2021.

Amaral, T. G. A., Braga, P. B. D, Vieira, S.V, & Barros Neto, J. P. Relations Between reconditions, Categories and Impacts of Making-Do Wastes. Proceedings of the 30th Annual Conference of the International Group for Lean Construction (IGLC30), 1111-1122. Edmonton, Canada, 2022. doi.org/10.24928/2022/0219

Associação Brasileira De Normas Soluções. NBR 12721: Avaliação de custos de construção para incorporação imobiliária e outras disposições para condomínios edilícios. Rio de Janeiro, 2005.

CBIC. Cresce dificuldade para contratar mão de obra qualificada na construção civil. Informativo da Indústria da Construção. 2022. Disponível em: < https://cbic.org.br/wp-content/uploads/2022/04/apresentaciao-pesquisa-mao-de-obra-2-fase-v3.pdf >. Acesso em: 12 ago. 2022.

Daniel, E.I.; Garcia, D.; Marasini, R.; Oshodi, O. Improving Construction

Management Practice in the Gibraltar Construction Industry. In: Annual Conference Of The International Group For Lean Construction, 27th, 2019, Dublin, Ireland. Proceedings […] Ireland. 2019.

Dinis-Carvalho J., Moreira, F., Bragança, S., Costa E., Alves, A., Sousa, R. Waste Identification Diagrams, Production Planning and Control, Accepted for publication, 2014.

Färe, Rolf; Grosskopf, Shawna; Lovell, Ca Knox. The measurement of efficiency of production. Springer Science & Business Media, 2013.

Fireman, M. C. T. Proposta de método de controle integrado entre produção e qualidade com mensuração de perdas por making-do e pacotes informais. Dissertação (Pós-graduação em Engenharia Civil) – Programa de Pós-Graduação em Engenharia Civil, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2012.

Formoso, C.T.; Sommer, L.; Koskela, L.; Isatto, E. L. An Exploratory Study on the Measurement and Analysis of Making-do in Construction Sites. In: Annual Conference of the International Group for Lean Construction, 19th, Lima, 2011. Proceedings… Lima, 2011.

Formoso, C. T.; Sommer, L.; Koskela, L.; Isatto, E. L. The identification and analysis of making-do waste: insights from two Brazilian construction sites. Ambiente Construído, v. 17, n. 3, p. 183-197, jul. /set. 2017.

Formoso, C.T., Cesare, C.M., Lantelme, E.M.V, Soibelman, L.. As perdas na construção civil: conceitos, classificações e seu papel na melhoria do setor (pp. 1-11). Porto Alegre: UFRGS/NORIE, 1997

Ghanem, Malek et al. A new perspective of construction logistics and production control: An exploratory study. In: Annual Conference of the International Group for Lean Construction. International Group for Lean Construction (IGLC), 2018. p. 992-1001.

GOBIN, C. Le cycle conception-construction-maintenance, la démarche pro-active, une méthodologie reproductible à d´autres opérations. In: BOBROFF, J. (ORG.). La gestion de projet dans la construction – enjeux, organisation, methodes et metiers. Paris, École Nationale des Ponts et Chaussées, 1993. p.67-82.

Javanmardi, A.; Zhang, Y.X.; Liu, Y.C.; Yang, S.J.; Yu, X.X.; Liu, M.; Hsiang, S.M. Manager Perception and Decision for Making-do in China v.s. In the U.S. In: ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION, 27., Dublin, 2019.

Kitchenham, Barbara. Procedures for performing systematic reviews. Keele, UK, Keele University, v. 33, n. 2004, p. 1-26, 2004.

Koskela, L. Application of the new production philosophy to construction. Stanford University Stanford, CA, 1992.

Koskela, L. An Exploration Towards a Production Theory and its Application to Construction. Thesis (Ph.D) – Technical Research Centre of Finland, Espoo, 2000.

Koskela, L. Making-do – The Eighth Category of Waste. In: Annual Conference of the International Group for Lean Construction, 12, 2004, Dinamarca. Proceedings…Dinamarca, 2004.

Leão, C. F. Proposta de Modelo Para Controle Integrado da Produção e da Qualidade Utilizando Tecnologia de Informação. Porto Alegre, 2014. 179 f. Dissertação (Mestrado em

Engenharia) – Programa de Pós-Graduação em Engenharia Civil, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2014.

Nassri, S. et al. Labor waste in housing construction projects: an empirical study. Smart and Sustainable Built Environment, v. 12, n. 2, pág. 325-340, 2023.

Ohno, T. O Sistema Toyota de Produção: além da produção em larga escala. Porto Alegre: Bookman, 1997.

Ronen, B. The Complete Kit Concept. Int. J. Prod. Res., Vol. 30 No. 10, pp. 2457 – 2466. 1992.

Rother, Edna Terezinha. Revisión sistemática X Revisión narrativa. Acta paulista de enfermagem, v. 20, p. v-vi, 2007.

Santos, D.G. "Modelo de gestão de processos na construção civil para identificação de atividades facilitadoras", Doutora Diss. Pos-Graduação no Programa de Engenharia de Produção, Universidade Federal de Santa Catarina, 2004.

Santos, P. R. R.; Santos, D. de G. Investigação de perdas devido ao trabalho inacabado e o seu impacto no tempo de ciclo dos processos construtivos. Ambiente Construído, Porto Alegre, v. 17, n. 2, p. 39-52, abr./jun. 2017.

Santos, E. M.; Fontenele, A. D.; Machado, M. L.; Barros Neto, J. P.; Amaral, T. G. Analysis of Making-do Waste at Site in Fortaleza, Ceará, Brazil. In: Annual Conference of the International Group for Lean Construction, 28th, Berkeley, IGLC, Berkeley, 2020.

Shingo, S. A Study of the Toyota Production System. New York: Productivity Press: 257 p., 1989.

Sommer, L. Contribuições Para Um Método de Identificação de Perdas Por improvisação em Canteiros de Obras. Porto Alegre, 2010. 150 f. Dissertação (Mestrado em Engenharia Civil) – Programa de Pós-Graduação em Engenharia Civil, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2010.

Taggart, Martin; Koskela, Lauri; ROOKE, John. The role of the supply chain in the elimination and reduction of construction rework and defects: an action research approach. Construction Management and Economics, v. 32, n. 7-8, p. 829-842, 2014.

Viana, D.D., Formoso, C.F., Kalsaas, B.T. Waste in construction: a systematic literature review on empirical studies. In Proceedings of the 20th Annual Conference of the International Group for Lean Construction. San Diego, California: Montezume Publishing,2012

Womack, James P.; Jones, Daniel T. Beyond Toyota: How to root out waste and pursue perfection. Harvard business review, v. 74, n. 5, p. 140-151, 1996.