Continuous Improvement Related Performance: A Bibliometric Study and Content Analysis

Giovanni Cláudio Pinto Condé and José Carlos de Toledo

Abstract Continuous Improvement (CI) can be useful as dynamic capability for the organization, therefore, an important factor for the organizational and operational performance. There are many publications on different aspects of CI, and it is essential to identify what the themes are being researched recently. A significant part of CI research is directly related to performance and, to point out those which are the main, this research aims to answer the following research questions (RQ): RQ1: What is the structure of the CI literature related to performance (CIrP)? RQ2: Which CIrP' themes are present in the past 5 years? The research was conducted through means of bibliographic coupling and content analysis. The themes present in the past 5 years are: (1) performance measurement and sustainability, covering performance measurement systems, key process indicators (KPI), green management, environmental performance; (2) kaizen and Lean thinking, what encompasses Lean and quality tools and concepts (e.g., cause and effect diagram, VSM, kanban); (3) quality, composed by TQM and its practices, organizational culture, quality management, quality standards, quality performance and ISO 9000; (4) Strategy and Innovation, that also cover innovation performance, innovation orientation, management innovation, innovation strategy and organizational learning; (5) Lean Six Sigma, considering that it also cover research related to CI projects and their failures; and (6) Lean, considering that the researches that form this cluster deal with Lean systems, Lean practices; Lean production; Lean implementation; Lean leadership, dynamic capabilities, systematic problem solving. In addition, this study identified IC research related to different performance modalities.

Keywords Continuous improvement · Performance · Bibliometric analysis · Bibliographic coupling · Content analysis · VOSviewer

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1 Introduction

Organizational performance is positively related to its dynamic capabilities [15]. Continuous improvement (CI) is described as a systematic effort to seek and apply new ways of doing work, that is, actively and repeatedly making process improvements and can be useful as dynamic capabilities for the organization [4]. Furthermore, continuous improvement is one of the measurable variables of operations management [13]. Research around CI has been carried out year after year since the late 1980s, and an important part of CI' research has been related to performance. Bibliometric analysis has been applied in the CI domain, such as statistical process control [21], Lean Six Sigma [41], Kaizen [3], or Six Sigma [31], while others explore intersections, for example, with Industry 4.0 [43]. However, there are other methodologies besides Lean, Six Sigma, Lean Six Sigma, such as, for example, Total Quality Management [40]. Moreover, there is no essay to understand the whole research structure on CIrP, using bibliometric techniques and content analysis. The present study aims to fill this gap in the literature as a way to contribute to research on CIrP.

In the present study techniques were organized to answer the following research questions: RQ1: What is the structure of the CI' literature related to performance (CIrP)? RQ2: Which CIrP' themes are present in the past 5 years? To answer these questions, a bibliometric and content analysis were applied. This paper makes the first essay to understand the research structure on CIrP, using bibliometric techniques and content analysis.

The remaining sections of this article are structured as follows: first, the research methodology used to perform the study is explained. The presentation and discussion of the findings follows. Finally, the conclusions are presented, including contributions, limitations, and proposition for further research.

2 Research Methodology

2.1 Bibliometric Analysis

To assure the accuracy of this study, it was used the 5-steps procedure based on Zupic and Čater [50]. In the step 1 (Research Design) it was defined the study goal. The purpose of this study is to answer the two research questions of this research. To answer those RQs, it was defined the methodology to achieve goals: bibliometric techniques were selected to answer the RQ1.

Bibliometric analysis encompasses several scientific mapping techniques [10]. One of these techniques is bibliographic coupling. The assumption for bibliographic coupling is that two documents that share common references are similar in content [49]. The focus of this analysis is on the division of published documents into themes clusters based on their shared references [50]. Bibliographic coupling

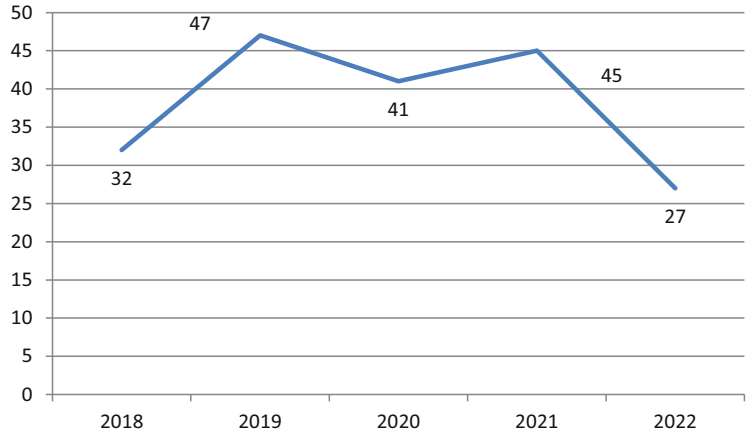

Fig. 1 Number of articles and reviews published per year – research on CIrP for 2018–2022' period (only approved documents)

should be used to analyze the relationships among citing publications to understand the periodical or present development of themes in a research field [10].

Content analysis of references was used to answer RQ2. In the step 2 (Compilation of bibliometric data) it was defined how many and which scientific databases would be used to perform the searches. In line with Niñerola et al. [31], it was chosen Web of Science (WoS) [8] and also Scopus to generate the document sample since they are the most important in Management [32] and also they allow the generation of metadata such as authors, number of citations; cited references, among others that is required to accomplish the bibliometric analysis.

Search string "continuous improvement" and "performance" was used with the following filters: year of publication from 2018 to 2022; articles and reviews published in journals; English language; nine Scopus' subject areas related to Operations Management: Engineering; Business, Management, and Accounting; Computer Science; Social Sciences; Decision Sciences; Environmental Science; Economics, Econometrics and Finance, Psychology and Multidisciplinary resulting in 985 documents (articles and reviews). Subsequently, the abstracts of those documents were read to eliminate those that did not deal with CIrP as a central theme, resulting in 192 approved documents. For this final document set, metadata were exported from Scopus database for using in the VOSviewer software (Fig. 1).

In the step 3 (Analysis) the decision for VOSviewer was motivated mainly for the possibility of use of two different databases: Web of Science (WoS), and Scopus [31, 48]. In the Step 4 (Visualization) graphical analysis using VOSviewer software enhances the investigation [48] (Fig. 2). Finally, in the Step 5 (Interpretation) it was followed the guidelines from Van Eck and Waltman [48]. Main references from each cluster allowed the identification of present development of themes on continuous improvement related performance.

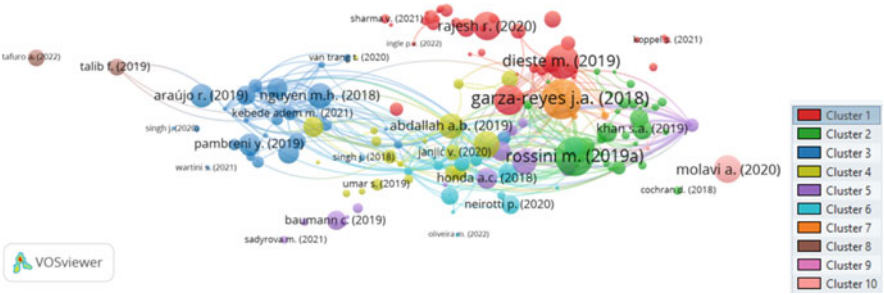

Fig. 2 Bibliographic coupling network research on CIrP for 2018–2022' period

2.2 Content Analysis

Content analysis consisted of reading the selected documents (articles and reviews) that stood out in each of document cluster from the bibliographic coupling analysis. Work files were built to organize and summarize information (authors, year of publication, keywords, number of citations) related to each document cluster identified in the bibliographic coupling analysis. The identification of present development of themes and main documents from the main clusters was obtained through bibliographic coupling technique and content analysis.

3 Results

In this section, the results of the bibliometric analysis and content analysis are presented.

3.1 Bibliometric Analysis Results

Evolution of CIrP Research Publications
After filtering process previously indicated, the evolution of 192 CIrP research publications, considering the number of articles and reviews per year, was obtained for the 2018–2022' period is shown in Fig. 1.

Cluster Analysis
The VOSviewer software processes the metadata and generates the bibliographic coupling network resulting, automatically, in a certain number of clusters, which depends on the diversity of treatment of the topic within the document sample [48]. Each cluster is considered to share common references, and therefore is considered similar in content [49]. For the final document sample of this study, ten clusters were identified (Fig. 2). In addition to automatically generating clusters,

Table 1 Clusters for bibliographic coupling

Cluster #	Number of linked documents[a]	Most cited documents	Number of citations[b]
#1	35	Choudhary et al. [7]	72
		Rajesh [35]	64
		Medne and Lapina [25]	27
#2	32	Rossini et al. [37]	116
		Tortorella et al. [45]	53
		Khan et al. [19]	32
#3	30	Nguyen et al. [33]	51
		Araújo et al. [5]	43
		Pambreni et al. [34]	37
#4	19	Abdallah et al. [1]	49
		Jimoh et al. [18]	33
#5	17	Costa et al. [9]	46
		Honda et al. [16]	34
# 6	13	Secchi and Camuffo [39]	29
		van Assen [47]	28
		Mohaghegh et al. [26]	13
#7	3	Garza-Reyes et al. [14]	128
#8	3	Talib et al. [44]	23
#9	2	Nae and Severin [30]	5
#10	2	Molavi et al. [27]	62

Note: [a]Only 156 out of 192 approved documents take part of the 10 clusters; [b]Number of citations according Scopus database

VOSviewer software informs which references make up each cluster. More cited documents and number of linked documents for the ten clusters is shown in Table 1. This result answers the RQ1: What is the structure of the CI' literature related to performance (CIrP)?

Cluster Nomenclature

Clusters can receive a nomenclature based on terms from their title, keywords, and abstract of those documents (articles and reviews) that make up each cluster [12]. To ensure understanding and naming the clusters, it was performed a content analysis by reading the documents.

3.2 Content Analysis Results

The CIrP research is presented below, answering the RQ2: Which CIrP' themes are present in the past 5 years? The CIrP was divided into ten themes clusters based on their shared references [50]. It includes the name chosen for the main clusters (numbered from cluster #1 to cluster #6, according to Table 1) and also theirs

respective main topics of the most cited and the more recent document from each named cluster.

Cluster#1 named "performance measurement and sustainability" since it bring together the largest set of research related to performance measurement systems, key process indicators (KPI), green management, environmental performance. Choudhary et al. [7] performed one of the main studies in this research theme. It was a case study using the Green Integrated Value Stream Mapping (GIVSM), a new tool that integrates Lean and Green management paradigms in a company in the United Kingdom, demonstrating a positive effect on operational efficiency and effectiveness and on environmental performance. Another influential study was the research that was oriented to deal with sustainability issues and questions emerging from assessments as a means to improve future sustainability performance in Indian companies [35]. Another popular study was carried out by Medne and Lapina [25] who investigated the process of measuring sustainability by seeking to identify how process-oriented indicators are linked to an organization's strategy in the context of sustainable development. Lai et al. [20] established a model that allows pragmatically evaluating the performance of hospital facilities management, using ten KPIs and use of the process analytical network (ANP) method.

Cluster#2 named "kaizen and Lean thinking" considering that this set of research applies these concepts together with other Lean and quality tools and concepts (e.g., cause and effect diagram, VSM, kanban, 5S, takt time, among others. Rossini et al. [37] examined the impact of the interrelationship between the adoption of Industry 4.0 technologies and the implementation of Lean practices on the operational performance of 108 European companies, performing data analysis using multivariate techniques. Another important research in this theme investigated and confirmed that employee's involvement (EI) constitutes the mediating link between Industry 4.0 technologies and improved operational performance, reinforcing the importance of practices related to EI [45]. Moreover, in an interior design case company CI techniques (kaizen, 5S and project selection) were implemented, studied and analyzed resulting in money and time savings [19]. Recently, a 5S implementation study in a plastic machine manufacturing company determined the relationship of 5S with productivity using hypothesis testing and thus revealed the perspective of 5S to realize business performance parameters [23].

Cluster#3 named "Quality" considering that it covers TQM and its practices, organizational culture, quality management, quality standards, quality performance and ISO 9000. Nguyen et al. [33] investigated the relationship between quality management practices and sustainability performance in companies in Vietnam and also identified four quality management practices that result in a positive impact on sustainability performance. In another important research in this theme, textile industries in Portugal were studied through a research model consisting of three hypotheses, to analyze how the culture of quality influences the performance of the organization. The results indicated that the error detection culture negatively influences performance, while the creative culture and continuous improvement positively influence performance [5]. Moreover, in small and medium enterprises in the service sector in Malaysia it was investigated, through questionnaires and multiple

linear regression analysis, the impact of each of the four critical elements of TQM (customer focus, continuous improvement, strategic basis and total employee involvement), taken as variables, and confirmed that all they positively impact organization performance [34]. Recently, a study dedicated to improving the operational performance and competitiveness of microenterprises through the action research approach was performed. In such a study, specific characteristics of the companies were identified and considered filtering which initiatives to improve performance according to the specific needs of each micro-enterprise. Initiatives such as 5S, single minute exchange of die (SMED), suggestion schemes, layout improvements, management training, visual management, capacity building, were considered adequate to improve operational performance [17].

Cluster#4 named "Strategy and Innovation", that also cover innovation performance, innovation orientation, management innovation, innovation strategy and organizational learning. Abdallah et al. [1] empirically investigated the relationships between innovation orientation (IO), Lean manufacturing (LM) and innovation performance using exploratory factor analysis, confirmatory factor analysis and structural equation modeling. The results indicate that innovation-oriented companies tend to adopt both soft and hard LM aspects; however these do not have a significant effect on innovation. These results indicate that having an IO is vital to improving both LM and innovation performance. Another important research in this theme analyzed the nature of the relationships between TQM practices and organizational performance on different performance measures and thereby confirmed their significant effects. In addition, the study highlights the importance of valuing the implementation of TQM practices and adopting the correct CI strategies [18].

Cluster#5 named "Lean Six Sigma" considering that it also cover research related to CI projects and their failures. An important study analyzed the cause and effect association between the human factors as a means of fostering a Sustainable Continuous Improvement (SCI) environment. It results to the generation of a relationship map that distinguishes the different forms of action from soft practices and also revealed that the key to an SCI lies in the total engagement of the workforce to be mobilized and supported by top management, using kaizen events, effective communication and training [9]. Another significant research in this theme was a literature review regarding the implementation of Six Sigma and Lean Six Sigma (LSS) principles in hospitals, including 33 case studies that concluded that LSS can significantly contribute to improving process performance by reducing operating costs resulting in significant savings [16].

Cluster#6 named "Lean" considering that the researches that form this cluster deal with Lean systems, Lean practices; Lean production; Lean implementation; Lean leadership, dynamic capabilities, systematic problem solving and also aspects related to Lean soft practices. In an important unsuccessful case study of Lean implementation, it was abducted that the allocation of implementation tasks led to the failure of the initiative and a testable research proposition was also presented [39]. In another influential study dedicated to contribute to research on culture for continuous improvement, the relationship between top management leadership styles and Lean was explored in Dutch organizations. In that study, a positive

relationship was found between Lean sponsorship and encouragement of improvement by senior management; a negative relationship was also identified between servant leadership and the use of Lean tools, while a positive relationship was found in relation to empowered leadership. At the end, a relationship between contemporary leadership styles and Lean practices were not found [47]. Recently, an empirical study analyzed the relationship between continuous improvement in product performance and process innovation. It as compared the results in different CI programs and evaluating four CI practices (culture, people, strategy and top management) through a web survey applied in Brazilian manufactures. The results indicated that continuous improvement is related to the four types of innovation performance regardless of the continuous improvement program applied [22]. Finally, Mohaghegh et al. [26] empirically investigated the relationships between lean management practices, dynamic capabilities, and sustainable business performance, using the dynamic capabilities approach. This study deals with concepts involving systematic problem solving that seem to be effective for sustainable development. It involved the application of interaction in 99 Italian manufacturing companies and the use of partial least squares structural modeling.

It was not possible to determine an appropriate name that represented each of the last four clusters due to the small number of documents that compose them: cluster #7 has 3 documents; cluster #8 has 2; cluster #9 has 2, and cluster #10 has 2 documents. Standing out among these are the studies of Garza-Reyes et al. [14] and Molavi et al. [27].

3.3 Performance Modalities Related to Continuous Improvement

In addition to pointing out CirP cluster themes, the present study showed that the literature offers different performance modalities related to continuous improvement. The three most recurrent performance modalities related to continuous improvement are: (a) operational performance ([36, 38, 45]; and, [17]); (b) organizational performance (e.g., [19, 34]; and, [18]); and, (c) financial performance [6, 24, 42]. Other modalities were also identified: innovation performance (e.g., [1, 22]); environmental performance (e.g., [46]); sustainability performance (e.g., [33]); employee performance (e.g., [2]); safety performance [11], market performance (e.g., [29]) and supply chain performance (e.g., [28]).

4 Conclusion

A methodology merging bibliographic coupling and content analysis was able to answer the two research questions: RQ1, what is the structure of the CI literature related to performance (CIrP)? and RQ2, which CIrP' themes are present in the past 5 years? The structure of the CI related to performance, in this case represented by bibliographic coupling network, is shown in Fig. 2 and it is complemented by its main documents for each cluster (Table 1).

The CIrP' themes present in the past 5 years are: [1] performance measurement and sustainability, covering performance measurement systems, key process indicators (KPI), green management, environmental performance; [2] kaizen and Lean thinking, what encompasses and quality tools and concepts (e.g., cause and effect diagram, VSM, kanban, 5S, takt time); [3] quality, composed by TQM and its practices, organizational culture, quality management, quality standards, quality performance and ISO 9000; [4] Strategy and Innovation, that also cover innovation performance, innovation orientation, management innovation, innovation strategy and organizational learning; [5] Lean Six Sigma, considering that it also cover research related to CI projects and their failures; and [6] Lean, considering that the researches that form this cluster deal with Lean systems, Lean practices; Lean production; Lean implementation; Lean leadership, dynamic capabilities, systematic problem solving and also aspects related to Lean soft practices.

It was observed that several topics were not listed as part of the six clusters identified in this study. This is the case, for example, of Industry 4.0, mentioned in the content analysis of the works in clusters #2 [37, 45], but which are not characterized as part of the six cluster themes. Likewise, publications dealing with other popular topics such as knowledge management, decision marking, among others, are also dispersed in different clusters and, for this reason, do not make up any of the six indicated in this study.

This study is limited to two scientific databases (Scopus and Web of Sciences). Future studies could explore the other ones. Moreover, further research should be undertaken by delving deeper into one or more of the six main cluster themes identified in this study. Furthermore, the research gaps indicated in the publications that compose each of the six clusters themes need to be mapped. Finally, it could be important to know which affiliations and researchers are conducting research on each of the six themes present and which journals are publishing such research.

At the end, each of the six present themes represent a different starting points for researches on CIrP. Moreover, this paper makes the first essay to understand the research structure on CIrP, using bibliometric techniques and content analysis.

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