

Review

# Sustainability and Kaizen: Business Model Trends in Healthcare

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**Abstract:** Kaizen, or continuous improvement, is a management tool that allows the identification of activities that have no value in the processes examined. This identification leads to the improvement of these processes within any organization and promotes economic and social sustainability, and to a lesser extent environmental sustainability. Kaizen, already widely and successfully employed in the industrial sector, is now being applied in the health sector. However, the health sector tends to publish only the results of how processes have been improved in finely focused areas and the resulting benefits. The majority of the benefits focus on time and cost reduction. In this study, the authors carried out a bibliometric analysis using the Scimat program, which maps the thematic evolution of Kaizen in the health sector and its relationship with sustainability, in order to promote the interest of the health sector for this type of process improvement. The findings confirm that the implementation of Kaizen is recent and constantly evolves and grows, and that it can help economic and social sustainability, and to a lesser extent environmental sustainability.

**Keywords:** healthcare; lean management; Kaizen; hospital

## 1. Introduction

In 2015, the general debate on sustainability led the United Nations to promote the Agenda for Sustainable Development 2030. This agenda includes 17 Sustainable Development Goals (SDGs), each with specific targets. The SDGs are interdependent and integrated (see Figure 1). SDGs aim to impact all levels of society, to reach all sectors, to encompass the ideas of equity, inclusion, and universality, and to operate in a single ecosystem [1,2].



**Figure 1.** The United Nations Sustainable Development Goals Project. Source: [Unsdgproject.Com](https://www.un.org/sustainabledevelopment/).

In line with this agenda, the Alliance for Natural Health (ANH) initially defined sustainable health as a complex system of interactive approaches for the restoration, management, and optimization of

human health that is ecologically based; demonstrates long-term environmental, economic, and social viability; integrates seamlessly into both human and non-human environments; yet remains unbiased towards any significant contributor to the healthcare system [3]. The sustainability of the healthcare system becomes a key component in prudently making full use of healthcare assets and more efficiently providing services [4,5].

The United Kingdom (UK) National Health Service (NHS) issued a report stating that most NHS leaders believe that sustainability is vital to the NHS, and that it is important to make multi-faceted changes to ensure the organization is more sustainable, even in the most challenging areas such as working with other groups and organizations and implementing changes in pathways, models of care, and infrastructure [5].

Some research argues that, in order for the development of a healthcare system to be deemed sustainable, it must demonstrate an improvement in services in relation to its base level in at least one of the areas of management, environmental factors, or social factors. Moreover, this change must be introduced without reducing the effectiveness, efficiency, and quality of the service provided [6].

Weisz [7] introduced three additional criteria to define a sustainable hospital and suggests sustainable decisions must consider all dimensions as a whole and evaluate the long-term effects and consequences. The three additional criteria are:

- (1) contribution to the preservation of nature by limiting the use of resources and other environmental pressures,
- (2) reduction of costs to the national economy, and
- (3) minimization of social burdens inside and outside the hospital.

Although hospitals have begun to produce natural resource use and environmental impact assessments, quite a few gaps remain in sustainability-based evidence because of a lack of detailed information to guide and assist decision making. For example, on the one hand, the treatment for some patients, such as in oncology, may not be favorable to the environment and can be aggressive to both humans and the environment. On the other hand, care for the environment in organizations most often involves an increase in the cost of resources. However, due to the importance of protecting the planet, there should be greater interest in research into hospital sustainability, as indicated by McGain and Naylor [8].

Sepetis [6], in their review of the literature, provided evidence of the interest in sustainability in the healthcare system and in hospitals, and concluded that most of the articles show information on the environmental impact on hospitals and the impact of climate change on the healthcare system. Additionally, both Aunar [5] and D'Andreamatteo [9] researched how adjusted healthcare enables sustainability in healthcare organizations including economic, social, and environmental factors. Unfortunately, their studies do not include the aspects of social and environmental performance.

Similarly, the work of Norazlan [10] and Jamaludin [11], while introducing the concept of sustainability, emphasized social and economic performance and stressed the need for research on policies that promote sustainable development management to achieve sustainability in healthcare performance while improving service quality.

Therefore, for a healthcare system to be sustainable, it is vital to establish strong relationships between its management, environmental, and social objectives on the one hand, and its sustainable development objectives on the other. In addition, given that sustainable development aims to facilitate continued day-to-day life without causing irreversible changes that may threaten quality of life in the future, the incorporation of management, environmental, and social policies in hospitals fosters a holistic view of all activities in the healthcare system and thus facilitates that goal [2]. In other words, the sustainable management of hospitals is now incorporating environmental, social, and management issues and is becoming part of the sustainable healthcare system. However, according to the World Health Organization (WHO) [12] and Elmontsri [13], healthcare facilities face insufficient dissemination of sustainability events mainly due to under-funding of the systems.

Faced with increasing pressure to not only meet all social requirements, but also to maintain the quality of customer care, healthcare organizations have started adopting management techniques and tools used in industry, such as the transfer of Lean thinking or the Kaizen concept [14–17]. Kaizen, or continuous improvement, is a basic principle of Lean production, which suggests that work systems must continuously evolve towards a better performance by addressing the weaknesses of previous designs [18]. Kaizen is characterized by small improvements made as part of everyday work [19] and its scope varies substantially, from individual operations to entire value streams [20]. Kaizen events produce a positive change in business outcomes and human resource results; however, sustaining or improving the results of a Kaizen event over time can be difficult for many organizations and has received little attention in empirical research to date [21] due to the challenges involved in workplace implementation of the various methodologies required, along with the collaboration of a wide range of stakeholders [22].

Research conducted in the health sector by Chahal and Fayza [23] indicates that controlling waste in the hospital can improve its level of economic, social, and ecological sustainability as well as provide a platform for larger scale Kaizen research and development. Others, such as Ishijima [24], point out how the introduction and dissemination of Kaizen instruments have a positive influence, in this case on sustainability within the Egyptian health sector. Moreover, all of these result in corresponding improvements in social impact and responsibility.

By focusing Kaizen within Lean, we can specify that continuous improvement is achieved by increasing value-added activities or reducing activities with no added value, by reducing the variation in process, and by altering bad working conditions. There is promising evidence that Lean promotes short-term improvements in both efficiency and quality of service. However, existing evidence also suggests that it is difficult to achieve sustainable results after an initial period of improvement. Moreover, there is only a limited understanding of the factors that influence said variation in results in different organizational settings [25].

Other studies, Anuar, Saad, and Yusoff [5,26], claim adjusted health care practices have a strong influence on sustainability in private hospitals. Further to these findings, Gowen, McFadden, and Settaluri [27] proposed the health care sector implement a Lean approach to support continuous quality improvement to reduce waste. They noted other transformation approaches such as Six Sigma, Total Quality Management (TQM), and Business Process Re-engineering appear to have inferior results in terms of sustainability, as evidenced in the healthcare systems of the United States and the United Kingdom [28]. Clearly, Lean thinking can reduce waste and defects in the healthcare sector to achieve sustainability [5]. In addition, the Elshennawy study [29] quantified the level of staff awareness of Lean tools using the Lean Sustainability Assessment Framework and found that approximately 80 percent of hospital managers had awareness of the various Lean tools including 5s, Continuous Improvement, Waste Removing, 5 Why's, and Value Stream Mapping (VSM). This study highlights to hospital managers the principal concerns in the practice of Lean and where to focus their methodology by improving levels of sustainability and performance. Meanwhile, Norazlan [10] in their conclusions showed a positive correlation between Kaizen and sustainable performance in the healthcare industry. Furthermore, it is believed that Kaizen can be applied not only in the healthcare industry, but also, perhaps more importantly, in the quality of service to patients and in customer satisfaction.

Ho [30] introduced the integrated Lean TQM model for sustainable development with the aim of minimizing waste in the organization. They found that Lean provides a powerful process tool allowing organizations to manage Continuous Improvement which in turn preserves the sustainability. Along the same line, Dellifrairie, Langabeer Ii, and Nembhard [31] found two popular tools, Lean and Six Sigma systems, capable of improving financial performance rather than clinical outcomes and efficiency. However, they based the improvement on the conceptual argument rather than evidence-based empirical research.

In other research, Souza and Alves [32] presented an innovative model for improving the sustainability of companies by integrating quality, environmental, social responsibility, and occupational

health and safety management systems with the Lean Manufacturing System. They introduced the Lean-Integrated Management System for Sustainability Improvement (LIMSSI) based on the rational use of resources and energy while involving and empowering company employees. LIMSSI can improve corporate sustainability performance making companies more sustainable and competitive.

Health care is a relevant topic for this research as it meets all the requirements of a sustainable organization based on the relevant areas. These areas include the adequate use of resources, the adaptability of the system to continuous social and economic change, its competitiveness, and the lowering of its environmental impact [33,34]. The objective is to improve the results of the application of these tools in healthcare, as noted by Costa and Godinho [35], Costa et al. [36], and Van Aken, Chandrasekaran, and Halman [37]. Interest in this topic has increased in recent years and more research is called for in this area [38,39].

Research by Aij [40] shows how healthcare organizations which have implemented Lean in a comprehensive and systematic manner have seen improvements in quality, patient safety, and employee satisfaction. However, few healthcare organizations have achieved a sustainable and long-term application of Lean, and their publications focused on showing the basic improvements in inventory reduction, cost reduction, and time reduction in different areas and hospital services [15–17,41,42].

Considering Aij [40], Aunar [5], and Ho [30], one could conclude there has been a paucity of research done to determine the direct relationship between adjusted healthcare practices and sustainability.

The focus of this paper is to carry out a systematic review of the literature using Scimat software to confirm there is a shortage of research in the health and sustainability sector and to encourage more research in this area. Although the topic of health and sustainability has started to trend, it is still limited, as noted by Souza and Alves [32], Garcia, Cintra, Torres, and Lima [43], RobecoSAM [44], and Rebelo, Santos, and Silva [45]. More than 40 years after the first warnings about the unsustainability of the production and consumption model, and with the potential conclusion of a future of imbalance and a total collapse of planet Earth, such problems and threats remain. Society has increasingly pushed companies to address ecological and social sustainability. More organizations are looking to corporate sustainability for the development of a competitive advantage. Thus, there is an unprecedented demand for sustainability (as WHO defined in its agenda to achieve the 17 SDGs by 2030 [46]), and a growing trend emerges in the implementation of management systems and lean manufacturing systems.

This paper is structured as follows: introduction, the presentation of research methodology, results, discussion, conclusions, and future lines of research.

## 2. Materials and Methods

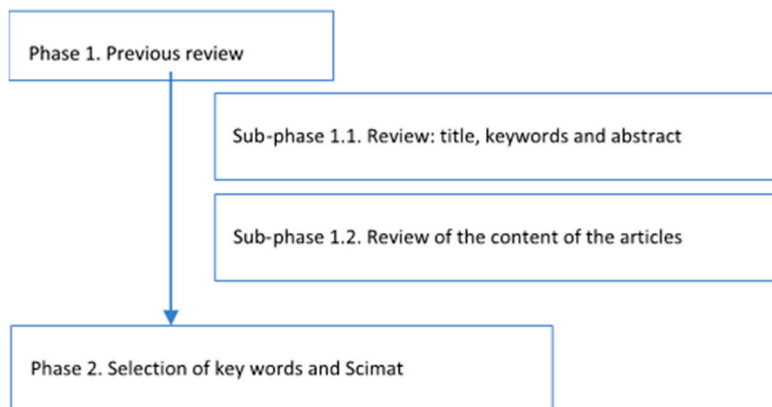
This study used bibliometric analysis, specifically the analysis of scientific maps, whose main objective is the discovery of the structural and dynamic aspects of scientific research. This analysis uses the software tool Scimat due to its robustness and its integration into a single tool most of the possibilities offered by similar programs. Scimat allowed us to conduct objective quantitative analysis of bibliographic material which enabled the organization of information as well as the identification of useful relationships within specified fields. Scimat ultimately allowed the detailed examination of research topics within and across domains. This type of analysis generates useful information for researchers that prevents duplicate work and promotes other research based on previous work, such as the relative value of the results uncovered during the review.

As a result of using Scimat, we generated graphs in which the nodes represent identified keywords and the links between the nodes represent the observed relationships. In each case, the weight of the link indicates the number of coincidences. Thus, a thicker link indicates a higher number of coincidences. By grouping the words according to theme, we constructed a series of thematic networks. Each network is classified according to a specific keyword contained therein and a set of themes is determined for each period. From these thematic networks, we created diagrams to map the various relationships and, through a process of aggregation using Callon's measures of centrality and density

(along with their respective ranges), we placed each aggregate on a Cartesian axis divided into four quadrants to facilitate understanding of the information provided [47–50].

We carried out the publication analysis using the Web of Science database [51] during the month of April 2020 and initially the years of publication were unlimited. This search focused on coincidences of the keywords Kaizen, Lean, health, hospital and sustainab\*.

To achieve this search configuration, we carried out a first phase of bibliometric revision, which allowed us to test the configuration and to adjust the search words. The methodology had two phases as shown in the flow diagram in Figure 2:



**Figure 2.** Phases of search methodology. Source: own production.

In Phase 1, we executed a range of searches combining the various keywords: Kaizen, high performance work practices, health, public health, hospital, sustainable, and sustainability. The results of the number of articles ranged from 16 to 288. These results were analyzed with Scimat which indicated the results were poor with very few interactions. Based on these initial results, we performed a manual review consisting of two sub-phases. The first sub-phase involved the title, abstract, and keywords where the number of articles was reduced enough to meet the criteria of our search. In the second sub-phase, based on the results of the first sub-phase, we executed a reading of the documents and found the number of articles that met our search criteria was further reduced.

These initial results gave the first indication there is little academic interest in the relationship between Kaizen and sustainability in the health sector. In many of the results, the concept of sustainability appeared primarily because it is one of the objectives of Kaizen. Nevertheless, the articles focused mainly on the results when applying Kaizen.

From the results gathered in the first phase, we concluded two premises:

- There is a high probability of finding few results with our search criteria.
- This first phase should inform the focusing on the best combination of keywords following our research objective.

In the second phase and after the results of the first phase, we carried out various tests and combinations. As a result, we selected the following keywords: Kaizen, Lean, health, hospital, and sustainab\*. The results amounted to more than 10,000 articles and with the previous experience of phase 1, we decided to perform two keyword searches in order to minimize selection bias. The keyword combinations and number of resulting articles were as follows:

- (1) Kaizen, Lean, hospital, sustainab \*: 797 papers.
- (2) Kaizen, Lean, health, sustainab \*: 895 papers

The split into two searches, in addition to allowing a better analysis with Scimat for each of the searches, allowed analysis of whether there were significant differences between the two searches.

We found the differentiated analysis interesting because the keyword “hospital” only affects the tertiary health sector, while the keyword “health” affects all types of health-related services (hospitals, laboratories, primary care, etc.). The following section presents the results of the analysis.

### 3. Results

There were two stages to the bibliometric analysis performed. In the first phase (Section 3.1), the papers identified in the abovementioned searches were obtained from the Fundación Española para la Ciencia y la Tecnología (FECYT) website [51]. This is a public foundation supported by the Ministry of Science and Innovation whose goal is to strengthen the link between science and society through the promotion of open and inclusive scientific and cultural education. The papers were then analyzed using the Web of Science (WoS) database [52].

In the second phase (Section 3.2), the papers were analyzed using the Science Mapping Analysis Software Tool (Scimat).

#### 3.1. Web of Science Results

Web of Science (WoS) allows you to apply filters in order to conduct more specific analyses. Figures 3–5 show the results of three separate filter applications: year of publication (Figure 3), type of publication (Figure 4), and fields of publication (Figure 5).

The results shown in Figure 3 suggest that, in recent years, there has been a significant increase in the number of searches related to this set of keywords. With regards to the type of publication (article, book, review, proceeding papers, and editorial), Figure 4 shows clearly that the dominant format is the scientific article, while Figure 5 illustrates that the dominant fields of research connected with these keywords are engineering, business economics, operations research, computer science, and healthcare science.

That these keywords as objects of research are commonly found in the field of engineering is not surprising as Kaizen was born in the industrial sector [53–57]. However, it is interesting to note their frequent appearance in the other fields of study, particularly in relation to healthcare.

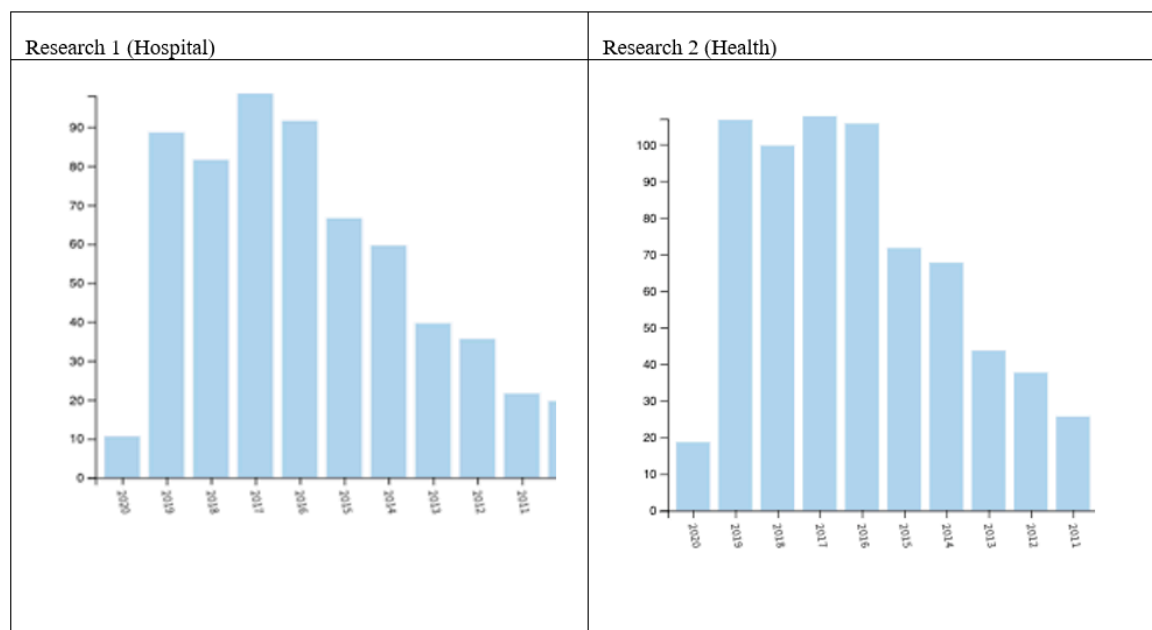


Figure 3. Year of publication. Source: Own elaboration (Web of Science (WoS)).

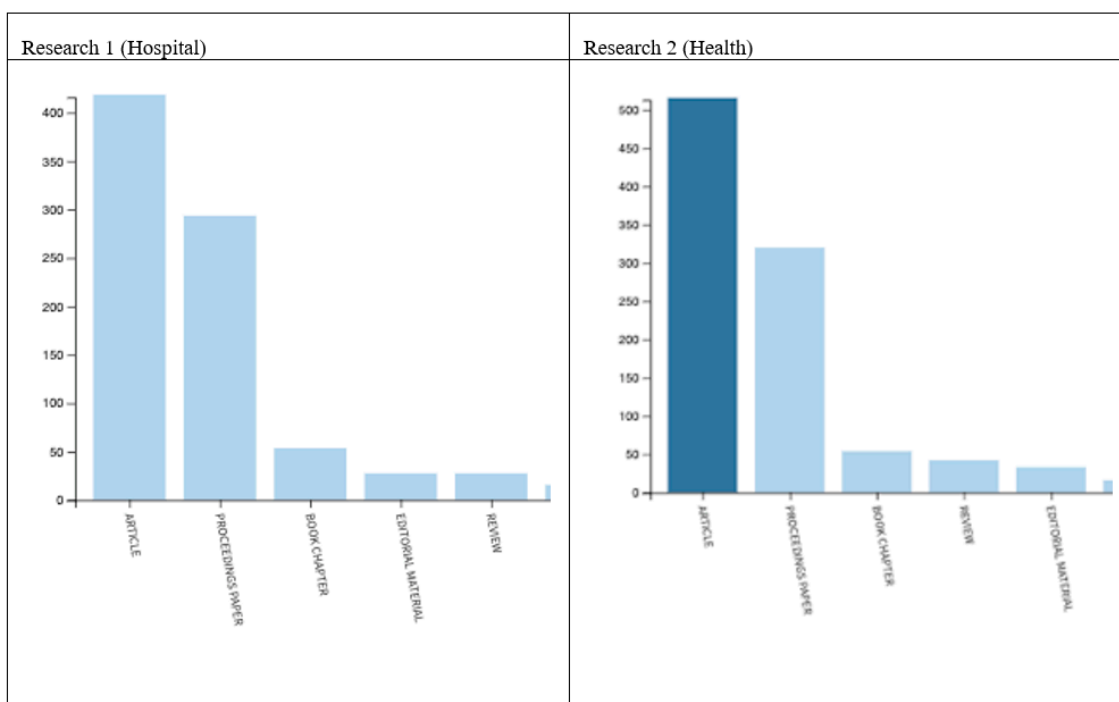


Figure 4. Type of publication. Source: Own elaboration (WoS).

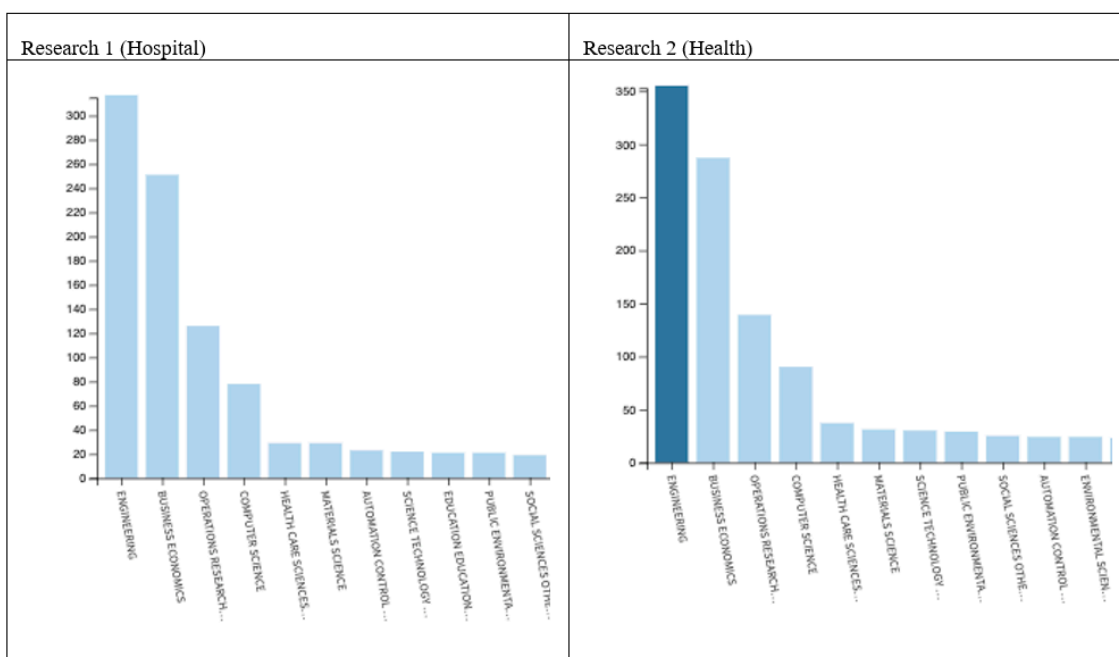


Figure 5. Fields of publication. Source: Own elaboration (WoS).

### 3.2. SCIMAT Results

Scimat is an open-source software tool which performs science mapping analysis within a longitudinal framework. It provides different modules that help the analyst carry out all the steps of the science mapping workflow. In addition, Scimat presents three key features that are remarkable in respect to other science mapping software tools: (a) a powerful preprocessing module to clean the raw bibliographical data, (b) the use of bibliometric measures to study the impact of each studied element, and (c) a wizard to construct the analysis [47,48,57,58].

Figure 6 shows the Scimat configuration used in this investigation:

- Unit of analysis: Words (authorRole=true, sourceRole=true, addedRole=false)
- Kind of network: Co-occurrence
- Normalization measure: Equivalence index
- Cluster algorithm: Centers simples
  - Max cluster size: 12
  - Min cluster size: 3
- Evolution measure: Inclusion index
- Overlapping measure: Jaccard index

Figure 6. Analysis configuration—Scimat.

A performance analysis protocol was established for each of the keywords, which in turn has a chain of connections that set the trend of the node. In addition, the number of papers and the number of keywords were defined as necessary parameters for the analysis.

As a first step and in order to facilitate as detailed an analysis as possible, all of the data collected from 1986 to 2020 were compiled prior to being divided into two periods: 1986–2003 and 2004–2020.

Based on the results obtained for these two periods, it was noted that most of the research conducted falls in the period from 2004–2020. As the goal of this study is to determine if interest in this field of research has changed over time, this period was again divided into two shorter timeframes, i.e., 2004–2013 and 2014–2020, where the years 2014–2020 were found to contain most of the research, as shown below in Figures 7 and 8.

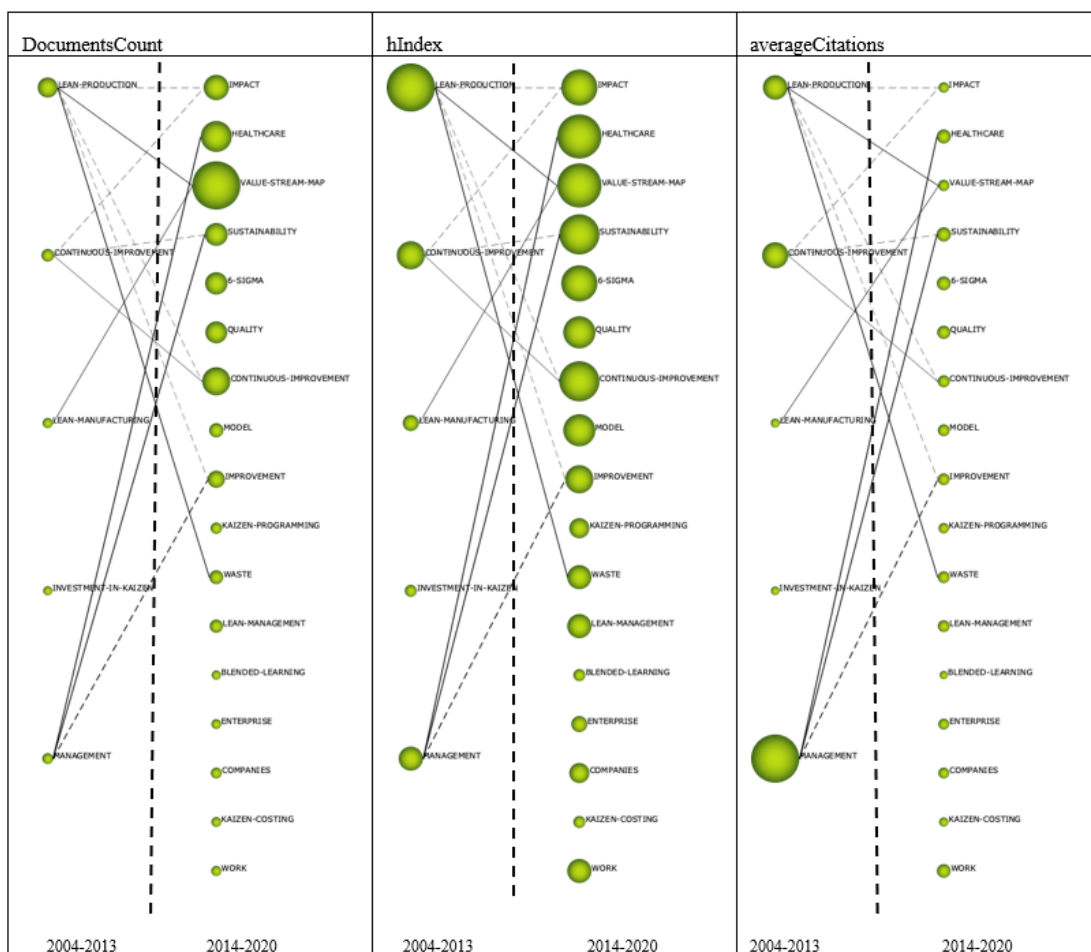


Figure 7. Evolution map. Study 1 (Hospital). Source: Own elaboration—Scimat.



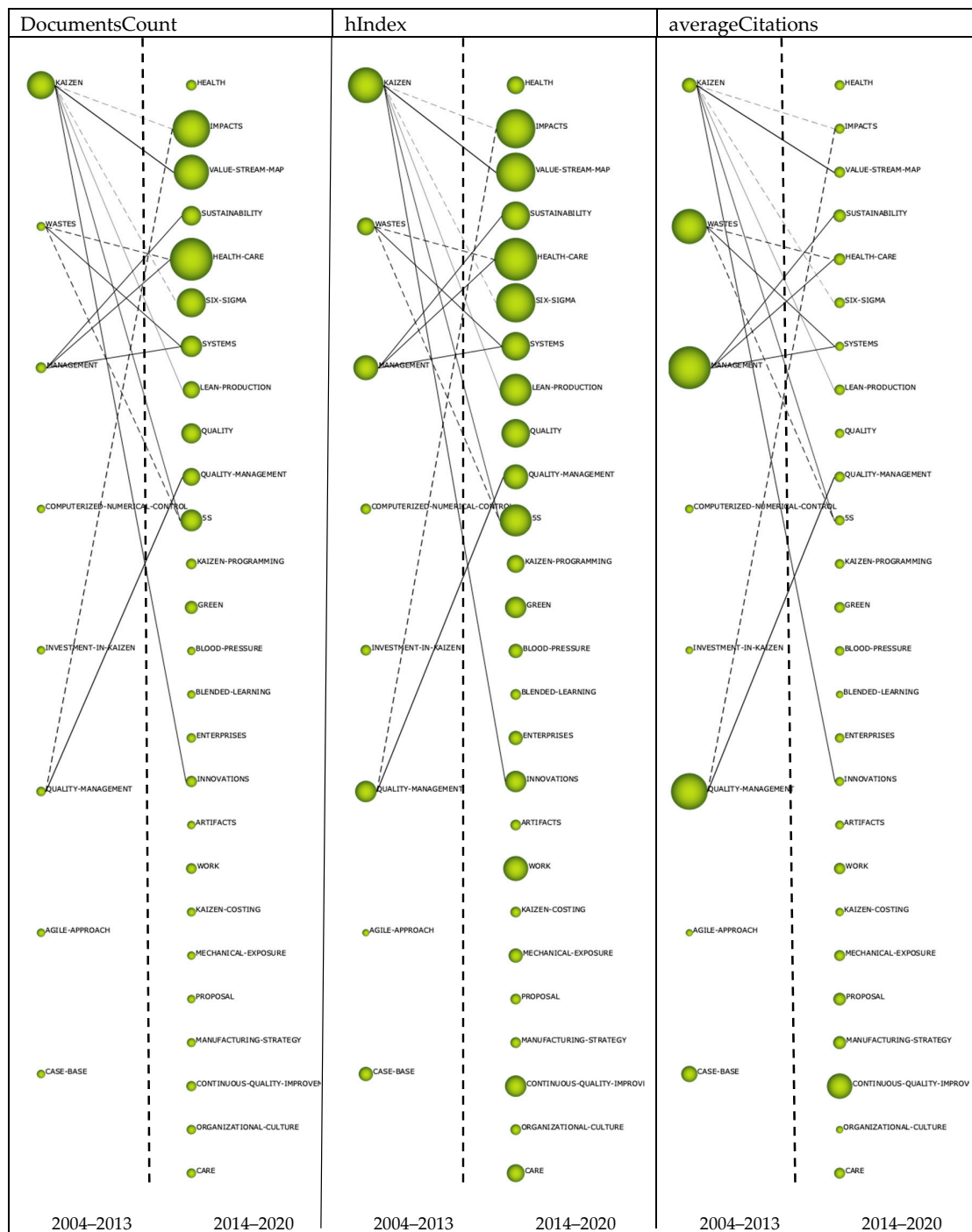


Figure 8. Evolution map. Study 2 (Health). Source: Own elaboration–Scimat.

As shown in Figure 7, five research topics are identified in the 2004–2013 DocumentsCount section, i.e., Lean production, continuous improvement, Lean manufacturing, investment in Kaizen, and management. However, during the period 2014–2020, there is a much broader range of identified issues. Of the 15, themes surrounding healthcare, value stream mapping, and sustainability stand out, with only the issue of continuous improvement remaining from the prior period.

It is possible, therefore, to differentiate between subjects with reliable connections to issues in the first period (continuous lines), such as healthcare, value stream mapping, sustainability, continuous improvement, and waste, and subjects with weaker connections (dotted lines), e.g., impact and improvement.

Focusing on the hIndex and averageCitations results, they generally follow the same pattern as for DocumentsCount, except for the size of the spheres in averageCitations in the period 2004–2013, which is a logical reduction.

Looking at Figure 7, it can be stated that the interest in Kaizen methodology in relation with the healthcare field began during the period 2014–2020 (Study 1: Hospital).

As shown in Figure 8 (DocumentsCount), eight research topics were identified in the first period, i.e., Kaizen, waste, management, computerized, investment in Kaizen, quality-management, agile-approach, and case-base. However, during the second period, a further 17 topics are found related to previous searches, with the most relevant being impacts, value stream map, sustainability, health-care, Six-Sigma, systems, Lean-production, quality management, and 5S. Again, only one theme from the prior period remained, that being quality management.

In regard to the connections between themes, we found that value stream map, sustainability, health-care, quality management, and innovations had strong, reliable connections, whereas impact and Six-Sigma had weaker connections.

Furthermore, upon closer review of hIndex and averageCitations in Study 1 (Figure 7), there were no substantial changes to report, except for the size of the spheres in averageCitations.

As a general conclusion, therefore, one might say that in the last 7 years there has been a marked increase in interest regarding the application of Kaizen (Lean) based methodologies to the health sector.

### 3.2.1. Keyword Analysis

With regards specifically to keywords and the conceptual and thematic evolution in the literature, an initial analysis was conducted to observe the chronological evolution of patterns related to overlap, continuity, and discontinuity. To this end, two keyword searches were prioritized for each of two periods—1986–2003 and 2004–2020.

Kaizen, Lean, hospital, and sustainab\* (Study 1, shown in the left column of all figures), and Kaizen, Lean, health, and sustainab\* (Study 2, shown in the right column in all figures).

The first analysis includes all years (1986–2020), whereas the second analysis was conducted on the two shorter periods (1986–2003, 2004–2020).

As shown in Figure 9, Scimat allowed us to observe the presence and evolution of the keywords with each circle representing the indicated time period along with the related number of keyword occurrences:

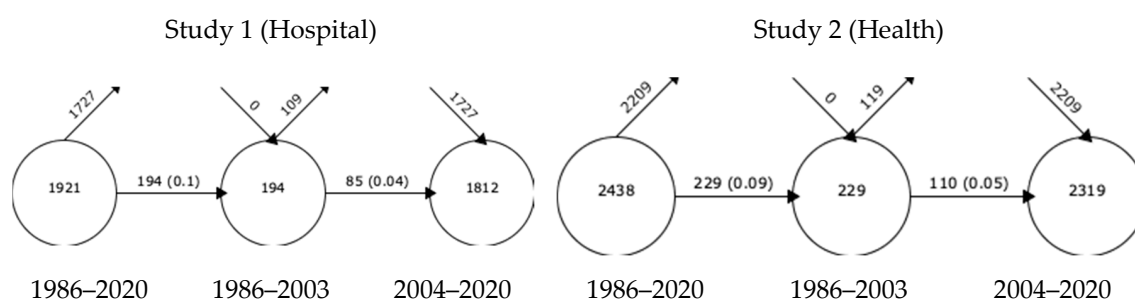


Figure 9. Longitudinal results (entire period). Source: Own elaboration—Scimat.

The longitudinal results can be interpreted using two approaches. The first is by focusing on the arrows between time periods, while the second involves analysis of the outgoing and ingoing arrows.

In the first instance, the numbers on the arrows between time periods represent shared keywords with the stability index, or overlap, reported in parentheses. In the case of Study 1, for example, we find the following results: 194 (0.1) and 85 (0.04). This indicates that, in the period 1986–2020, there are 1921 keywords of which 194 are shared with the period 1986–2003. Of those 194 keywords, 85 are shared with the 2004–2020 period, in which there is a total of 1812 keywords. Therefore, of the 1921 keywords identified in the entire period (1986–2020), approximately 95% (1812) are unique to the 2004–2020 period.

The second approach involves the outgoing and incoming arrows. The outgoing arrows indicate the number of keywords that are shared between time periods. To clarify, in the case of Study 1, the outgoing arrow from 1983–2020 indicates that, of the 1921 keywords, 1727 are also found in another time period. In this case, they coincide with 2014–2020, which is apparent from the 1727 reported on that time period’s ingoing arrow.

If we look at Figure 9, the right column shows similar results, with the majority of the keywords appearing in the 2004–2020 time period. This initial observation resulted in the decision to focus further longitudinal analysis on the period from 2004–2020.

When studying the past 16 years (Figure 10), although the percentage is less than the 95% observed in the previous analysis, it is evident that there remains a significant difference between the two time periods, with the 2014–2020 period having a higher incidence of keywords and, thus, indicating increased academic interest during those years.

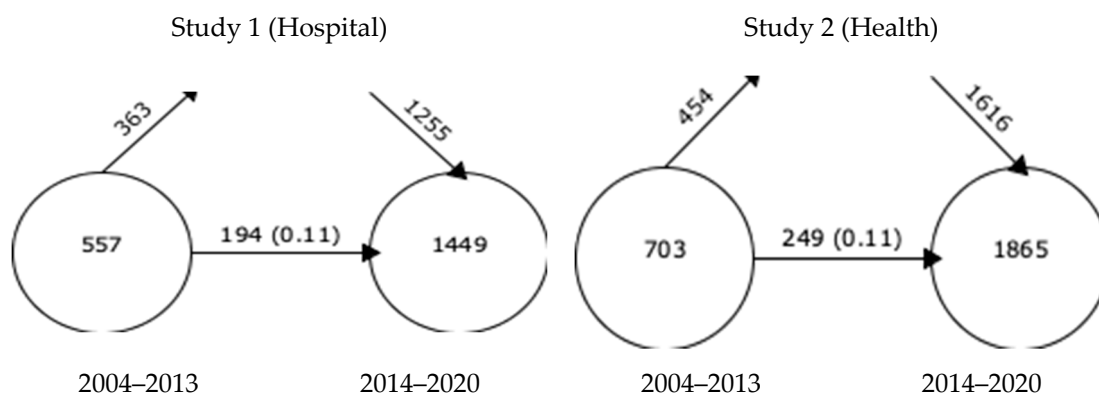


Figure 10. Longitudinal results (2004–2020). Source: Own elaboration—Scimat.

### 3.2.2. Strategics Diagrams

The longitudinal results and the evolution maps having been presented, attention can shift to the information provided by the strategic diagrams. The strategic diagrams produced by Scimat place the identified themes in different quadrants according to their density and centrality, as shown in Figure 11. Centrality can be interpreted as the external cohesion of the network since it measures the degree of interaction of a system with other networks, while density can be understood as the internal cohesion of the network since it measures the inner strength of the network [57,58].

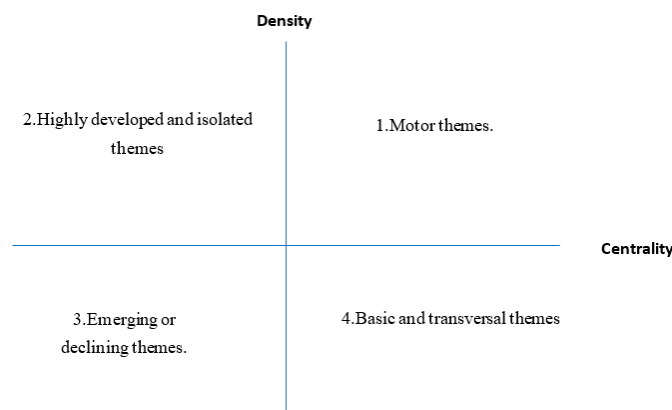


Figure 11. Strategic diagram. Source: [56].

The strategic diagram presented in Figure 12 shows that the target keywords included in this study (in terms of density and centrality) are mainly situated in the following sectors: motor themes

and basic themes, with the size of the sphere being directly proportional to the number of documents linked to each research topic (Figures 21–25).

To better observe the evolution of the topics in the different periods (Figures 12–16), the corresponding figures are shown below and then compared.

Analysis of the positions of the various topics in the strategic diagrams for the 1986–2020 period, Figure 12, revealed that the fields pivoted around numerous themes, among which the analysis of value stream mapping, health-care, impact, sustainability, Six-Sigma, quality, improvement, and model stand out in both Study 1 (Hospital) and Study 2 (Health), whereby it is important to emphasize the fact that these themes are present in both.

The main differences between Study 1 and Study 2 are the locations of these themes in the specific strategic diagrams. In Study 1, for instance, sustainability is grouped in quadrant 1—motor themes whereas, in Study 2, it is in quadrant 4—basic and transversal themes. In addition, sphere size is also distinct, such as is the case with health-care.

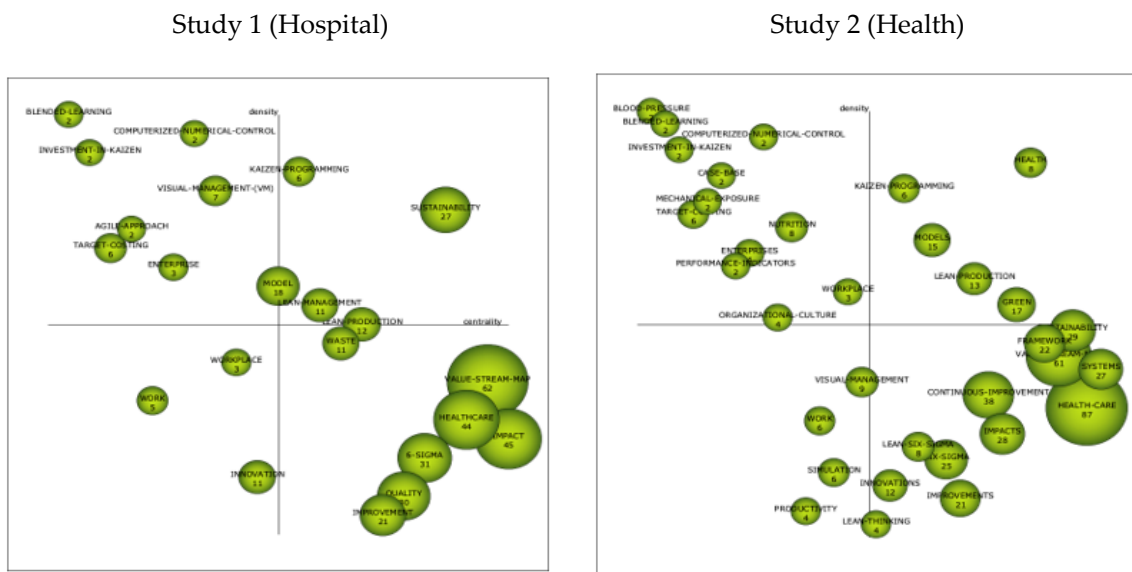


Figure 12. Core documents (1986–2020 period).

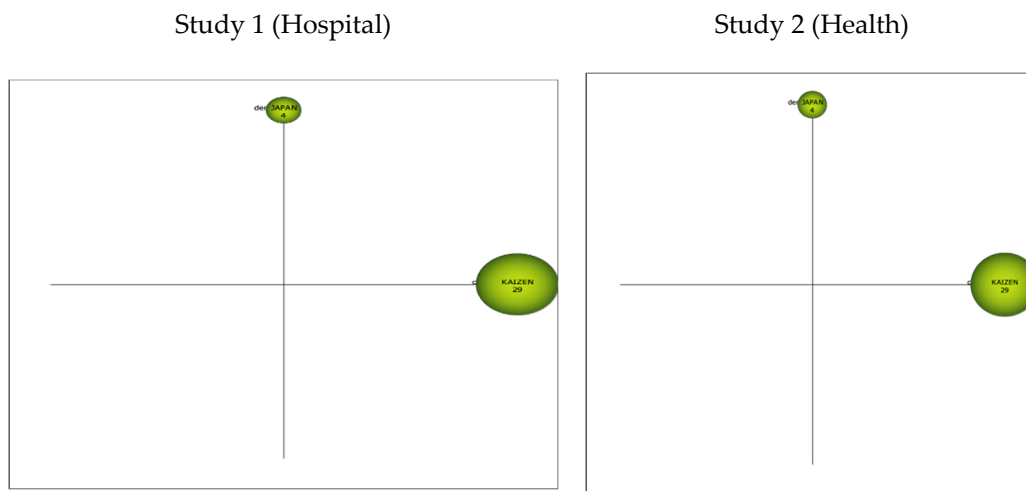


Figure 13. Core documents (1986–2003 period). Source: Own elaboration—Scimat.

Study 1 (Hospital)

Study 2 (Health)

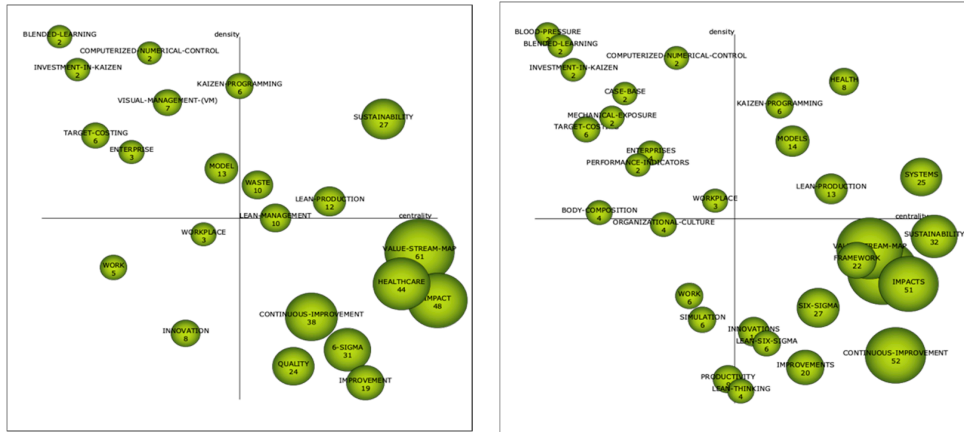


Figure 14. Core documents (2004–2020 period). Source: Own elaboration—Scimat.

Study 1 (Hospital)

Study 2 (Health)

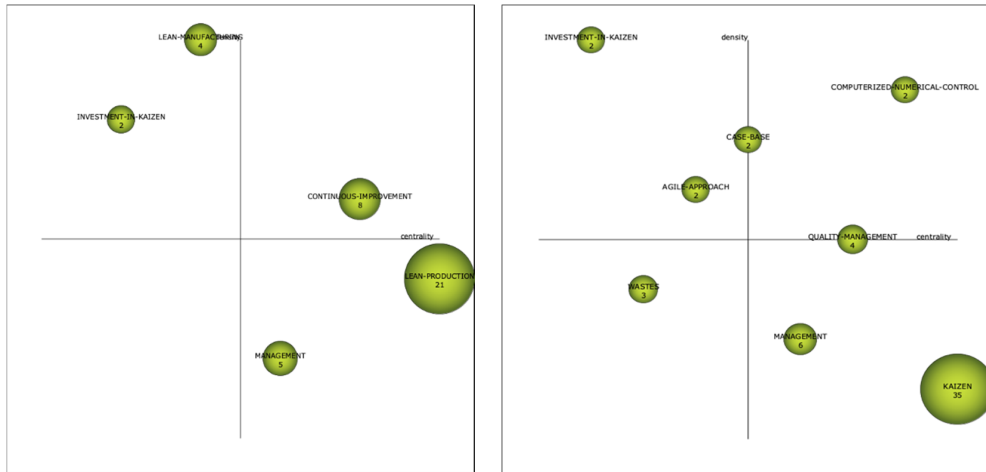


Figure 15. Core documents (2004–2013 period). Source: Own elaboration—Scimat.

Study 1 (Hospital)

Study 2 (Health)

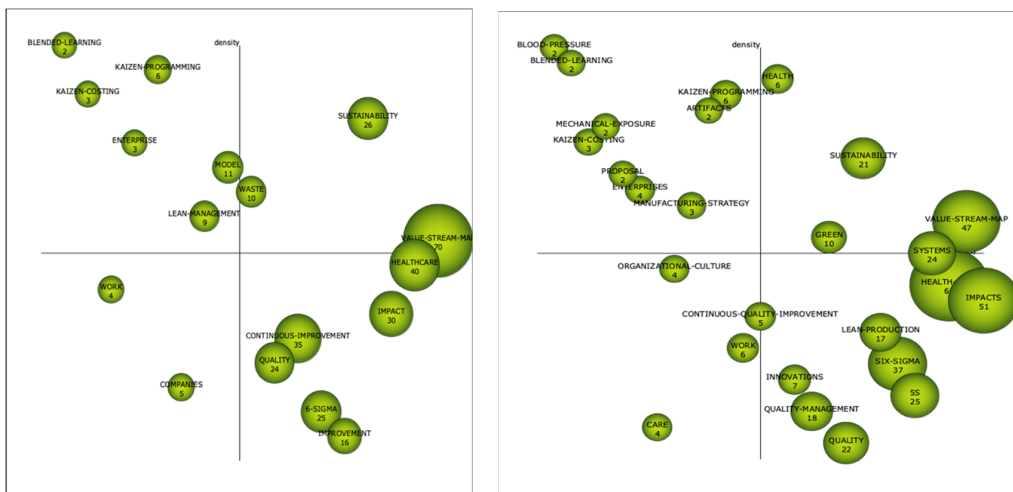


Figure 16. Core documents (2014–2020 period). Source: Own elaboration—Scimat.

However, in both cases, the keywords that are the subject of this investigation are generally found in quadrant 4—basic and transversal themes excepting sustainability and health, which are found in quadrant 1—motor themes. Kaizen is the only theme which does not appear in this strategic map.

Figures 17 and 18 present the performance measurements related to each time period’s themes, i.e., number of documents, citations of those documents, and h-index of the documents.

Name	coreDocumentsdocumentsCount	coreDocumentshIndex	coreDocumentsaverageCitations	coreDocumentssumCitations
SUSTAINABILITY	27	9	12.22	330
VALUE-STREAM-MAP	62	12	8.58	532
HEALTHCARE	44	12	11.59	510
IMPACT	45	10	9.6	432
6-SIGMA	31	7	10.23	317
QUALITY	30	6	9.8	294
LEAN-PRODUCTION	12	7	17.67	212
MODEL	18	9	36.22	652
IMPROVEMENT	21	6	9.24	194
WASTE	11	4	5.45	60
LEAN-MANAGEMENT	11	4	5.55	61
KAIZEN-PROGRAMMING	6	3	4	24
INNOVATION	11	4	17.27	190
VISUAL-MANAGEMENT-(VM)	7	5	8.71	61
BLENDED-LEARNING	2	1	0.5	1
COMPUTERIZED-NUMERICAL-CONTROL	2	1	2.5	5
INVESTMENT-IN-KAIZEN	2	1	1	2
TARGET-COSTING	6	3	8.33	50
ENTERPRISE	3	2	4.67	14
AGILE-APPROACH	2	0	0	0
WORKPLACE	3	2	6.67	20
WORK	5	5	11.8	59

Figure 17. Performance of the themes—hospital (1986–2020). Source: own elaboration—Scimat.

Name	coreDocumentsdocumentsCount	coreDocumentshIndex	coreDocumentsaverageCitations	coreDocumentssumCitations
HEALTH	8	3	4.12	33
VALUE-STREAM-MAP	61	12	8.87	541
GREEN	17	7	51.76	880
HEALTH-CARE	87	14	10.29	895
SUSTAINABILITY	29	7	9	261
SIX-SIGMA	25	7	7.52	188
IMPACTS	28	8	34.54	967
LEAN-PRODUCTION	13	7	17.31	225
SYSTEMS	27	10	19.78	534
CONTINUOUS-IMPROVEMENT	38	9	11.95	454
MODELS	15	7	15.27	229
IMPROVEMENTS	21	6	14.48	304
FRAMEWORK	22	6	4.91	108
KAIZEN-PROGRAMMING	6	3	4.17	25
INNOVATIONS	12	4	5.25	63
BLOOD-PRESSURE	2	2	4	8
NUTRITION	8	6	12.38	99
LEAN-SIX-SIGMA	8	5	21.88	175
BLENDED-LEARNING	2	1	0.5	1
COMPUTERIZED-NUMERICAL-CONTROL	2	1	2.5	5
ENTERPRISES	4	2	4	16
INVESTMENT-IN-KAIZEN	2	1	1	2
TARGET-COSTING	6	3	8.33	50
WORK	6	5	10	60
VISUAL-MANAGEMENT	9	4	5	45
SIMULATION	6	3	2.5	15
CASE-BASE	2	2	15.5	31
MECHANICAL-EXPOSURE	2	2	6.5	13
WORKPLACE	3	2	6.67	20
PERFORMANCE-INDICATORS	2	1	9.5	19
ORGANIZATIONAL-CULTURE	4	1	0.25	1
PRODUCTIVITY	4	1	1.5	6
LEAN-THINKING	4	2	66.25	265

Figure 18. Performance of the themes—health (1986–2020). Source: own elaboration—Scimat.

The performance measurements indicate that value-stream-map, impact, health-care, Six-Sigma, quality, and sustainability are the themes with the largest number of documents, while consumer is the theme with the highest number of citations and h-index. In addition, three themes are seen to be highly cited: interview, case-study, and commitment.

Surprisingly, the number of themes has decreased significantly in this period, 1986–2020 (see Figure 13), and an analysis of the positions of the different themes in the strategic diagrams revealed that the field revolved around only two themes: Kaizen and Japan.

We can be confident that this is an accurate representation as Kaizen is a Japanese term indicating changing for the better or continuously improving per Imai [59] and Chiarini et al. [60]. In the early years of publications, the place of origin of the methodology was frequently cited, while as more papers were published, the country of origin was ignored. This occurs not only in health publications, but also in the general Kaizen literature. Kaizen is defined as “continuous improvement for better quality, safety and productivity with the work culture and everyone’s participation” [18]. The Kaizen concept is based on “the idea that there is always room for improvement in a process. Originally used in the manufacturing sector, the Kaizen concept now appears often in-service industries, such as office, aviation, hotel and hospital services” [25,53,61].

In Figure 14, it is evident that the positions of the different topics for the period 2004–2020 are similar to those for the entire time period (Figure 12). The main difference is in the size of the spheres, so there have been changes as regards the number of documents associated with the keywords. For example, sustainability had 27–29 (Figure 12) and now has 27–32 (Figure 14). Although this is not a significant difference, it is sufficient reason to divide the 16-year period into two similar time periods for separate investigation: 2004–2013 (Figure 15) and 2014–2020 (Figure 16).

Figures 13 and 14 show a big difference in the number of fields. In Figure 15 the number of fields pivoted around 5 (Study 1) and 8 (Study 2), whereas in Figure 16 this number pivoted around 17 (Study 1) and 26 (Study 2). Among that number, the themes of Lean-Production, Kaizen, and continuous improvement stand out. As with previous results, these themes are motor themes and basic themes, too.

In Figure 16 (2014–2020), it is evident that there is a strong similarity in results with Figure 12 (1986–2020) and Figure 14 (2004–2020) because the same time period is covered in all three. On the other hand, in the period 2004–2013, the number of fields of interest drops dramatically.

This still suggests, therefore, that this research should focus on the period 2014–2020 (Figure 16) as that is the point at which the number of themes of interest increased.

Looking at the performance measures of the themes for the period 2014–2020 (Figures 19 and 20) the results are practically the same as those discussed in Figures 17 and 18 and, as such, they require no further discussion.

Name	coreDocumentsdocumentsCount	coreDocumentsshIndex	coreDocumentsaverageCitations	coreDocumentssumCitations
HEALTHCARE	44	12	11.59	510
SUSTAINABILITY	27	9	12.22	330
VALUE-STREAM-MAP	61	12	8.7	531
IMPACT	48	10	9.27	445
6-SIGMA	31	9	15.55	482
LEAN-PRODUCTION	12	7	17.67	212
QUALITY	24	6	8.38	201
CONTINUOUS-IMPROVEMENT	38	9	11.18	425
MODEL	13	7	14.62	190
IMPROVEMENT	19	6	9.89	188
KAIZEN-PROGRAMMING	6	3	4	24
WASTE	10	4	6	60
LEAN-MANAGEMENT	10	4	5.8	58
VISUAL-MANAGEMENT-(VM)	7	5	8.71	61
BLENDED-LEARNING	2	1	0.5	1
COMPUTERIZED-NUMERICAL-CONTROL	2	1	2.5	5
INNOVATION	8	2	1.5	12
INVESTMENT-IN-KAIZEN	2	1	1	2
TARGET-COSTING	6	3	8.33	50
ENTERPRISE	3	2	4.67	14
WORKPLACE	3	2	6.67	20
WORK	5	5	11.8	59

Figure 19. Performance of the themes—hospital (2014–2020). Source: own elaboration—Scimat.

Name	coreDocumentsdocumentsCount	coreDocumentshIndex	coreDocumentsaverageCitations	coreDocumentssumCitations
HEALTH	8	3	4.12	33
VALUE-STREAM-MAP	60	12	9	540
IMPACTS	51	11	23.78	1,213
SUSTAINABILITY	32	9	9.81	314
HEALTH-CARE	66	13	12.79	844
LEAN-PRODUCTION	13	7	17.31	225
SIX-SIGMA	27	7	7.15	193
SYSTEMS	25	7	7.68	192
CONTINUOUS-IMPROVEMENT	52	12	9.6	499
MODELS	14	7	66.57	932
IMPROVEMENTS	20	7	16.15	323
FRAMEWORK	22	6	4.91	108
KAIZEN-PROGRAMMING	6	3	4.17	25
BLOOD-PRESSURE	2	2	4	8
INNOVATIONS	11	4	2.36	26
BLENDED-LEARNING	2	1	0.5	1
COMPUTERIZED-NUMERICAL-CONTROL	2	1	2.5	5
ENTERPRISES	4	2	4	16
LEAN-SIX-SIGMA	6	4	27.67	166
INVESTMENT-IN-KAIZEN	2	1	1	2
TARGET-COSTING	6	3	8.33	50
WORK	6	5	10	60
SIMULATION	6	3	2.5	15
PRODUCTIVITY	9	1	0.67	6
CASE-BASE	2	2	15.5	31
MECHANICAL-EXPOSURE	2	2	6.5	13
BODY-COMPOSITION	4	3	22	88
WORKPLACE	3	2	6.67	20
PERFORMANCE-INDICATORS	2	1	9.5	19
ORGANIZATIONAL-CULTURE	4	1	0.25	1
LEAN-THINKING	4	2	66.25	265

**Figure 20.** Performance of the themes—health (2004–2020). Source: own elaboration—Scimat.

The results shown so far indicate that most of the health research related to Kaizen and sustainability was conducted in the last 7 years (2014–2020), and that the topics are distributed, predominantly, in two quadrants: highly developed and isolated topics (2) and basic and transversal topics (4).

These quadrants indicate a growth of interest of the health sector towards these methodological approaches and are also considered those that favor the development and consolidation of a field of knowledge based on its density and centrality. Consequently, for the remainder of the discussion, attention will be focused on the results obtained with Scimat for the period 2014–2020.

### 3.2.3. Thematic Networks

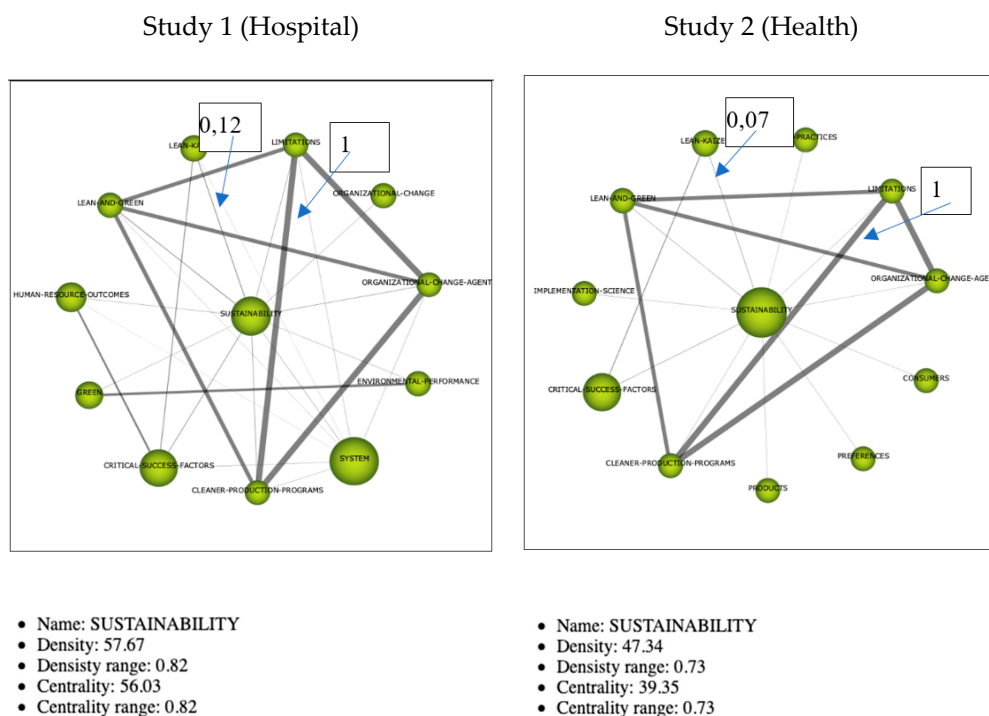
A thematic network is a set of different and interconnected keywords. Each thematic network is tagged using the name of the most significant keyword to the associated topic. The volume of the sphere indicates the number of documents associated with the keywords while the thickness of the lines between spheres is proportional to the equivalence index, i.e., the number of documents shared [47,48].

#### Cluster Sustainability

In the thematic area sustainability, 27 and 32 papers appear the two studies, respectively (hospital and health). This thematic area is found in the motor themes quadrant (Figure 16) and covers topics mainly related to critical success factors, such as organizational-change-agent, cleaner-production-programs, Lean and green, limitations, Lean-Kaizen, and Lean-practices.

When looking at Figure 21, of note is a subtle relationship between sustainability and Lean-Kaizen in Study 1 (hospital), with an equivalence index of 0.12. Similarly, in Study 2 (health), the same relationship appears but the equivalence index lowers from 0.12 to 0.07, indicating that the number of documents sharing sustainability and Lean-Kaizen is not very high.





**Figure 21.** Cluster sustainability (2014–2020 period). Source: Own elaboration—Scimat.

Furthermore, variations are observed in the cluster information regarding density, density range, centrality, and centrality range.

Customers have become more and more aware of the damaging impact of industry on the environment and more cautious when purchasing goods or services. Hence, although it can be stated that the demand for sustainability comes from the companies themselves, the governments, legislative bodies, the greatest demand is on the part of consumers [62].

The health impacts of climate change and other environmental challenges are increasing, indicating that care professionals should practice healthcare sustainably [63].

Vergunst [64] argues that for an organization to be sustainable it must go beyond the traditional “bottom line” of “profit against loss” and consider the environmental and social impacts of doing business. He also considers that, for an organization to be sustainable, it must:

- balance its books,
- measure and manage its environmental impacts (e.g., air pollution, CO<sub>2</sub> emissions), and
- consider its social obligations (health and well-being of employees and clients).

Currently, research on organizational sustainability tends to classify organizations as complex adaptive social systems, where the process of achieving sustainability occurs in a complex dynamic environment in which sustainability should be viewed as a strategy to be applied in the present to build a viable organizational future [65,66].

Sustainability first became an important notion in healthcare in 1987, when the World Commission on Environment and Development famously defined it as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [67]. As a direct result of the Commission’s report, numerous initiatives were launched, such as the United Nations’ Sustainable Development Goals in 2015 [68].

#### Cluster Healthcare-Health

The thematic area of healthcare has an output of 44 and 66 publications in Studies 1 and 2, respectively (hospital and health). This theme is found in the basic and transversal themes quadrant

next to the motor themes quadrant (Figure 16) and covers themes that were mostly related to management, quality improvement, and Lean.

As Figure 22 shows, healthcare and Lean have an equivalence index of 0.09 in both investigations, which again indicates that the number of documents sharing the terms is low.

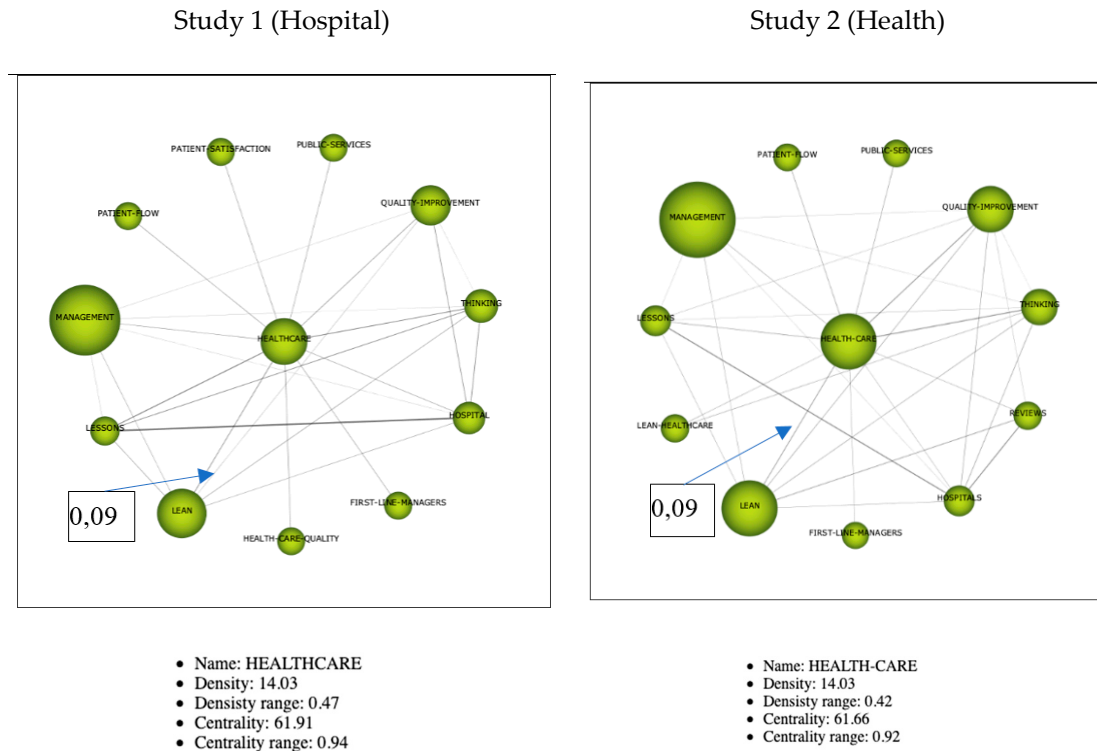


Figure 22. Cluster healthcare (2014–2020 period). Source: Own elaboration—Scimat.

With the keyword “health” in Study 1, no thematic network appears, and while it does appear in Study 2, it is not interconnected with our search objective (see Figure 23). This result is logical because the primary health-related research is not usually conducted within the context of management, but rather in the development and improvement of the quality of patient-related services, such as treatment, surgery, etc. Nevertheless, in recent years this kind of research has been acquiring greater interest and when observing the Lean-management and Lean-production clusters (Figures 24 and 25), we note a slight interrelationship in this area.

Within the context of healthcare, the term sustainability refers to the capacity to sustain programs to provide care and treatment. Health services, professional organizations, and training institutions are increasingly forming climate and sustainability position statements and policies accordingly [69].

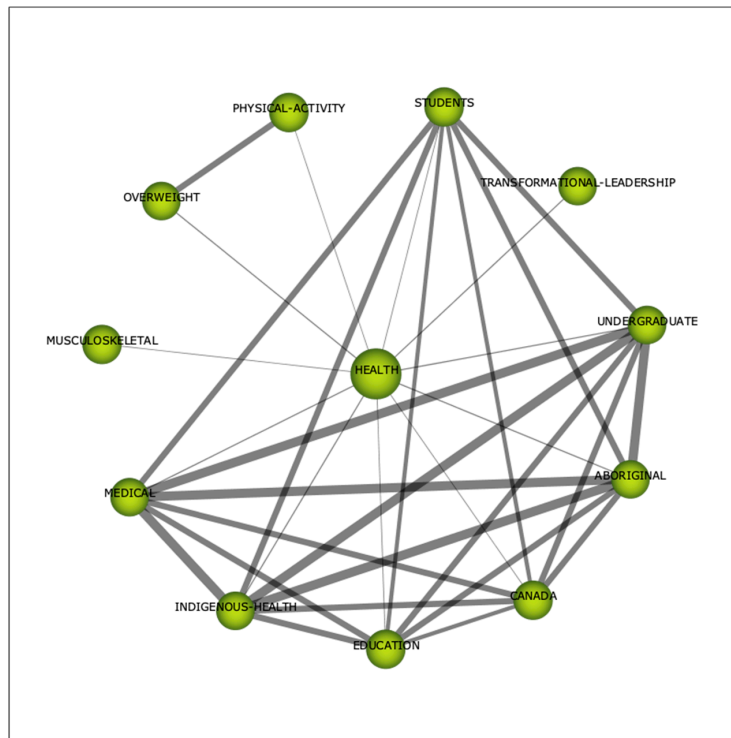
The problem is that this sector has a lot of unique aspects to consider:

- High-quality healthcare is diminishing as interventions become more expensive, patient expectations increase, and resources become more constrained [1]. Moreover, the sector is under increasing pressure to provide timely healthcare assistance to taxpayers that claim to be paying their taxes in exchange for a reasonable level of service [70].
- Increases in hospital costs are usually recognized as threatening sustainability [5] because healthcare systems seem to be faced with cost reductions at the same time as demand is increasing [70].
- Healthcare systems need healthcare models which contribute to sustainability’s development. Inter-system collaborative networks are essential because there are multiple stakeholders involved, e.g., professionals (clinicians and non-clinical professions), managers, patients, providers of healthcare products, scientists, and governments/policy makers.

Study 1 (Hospital)

Study 2 (Health)

No results appear

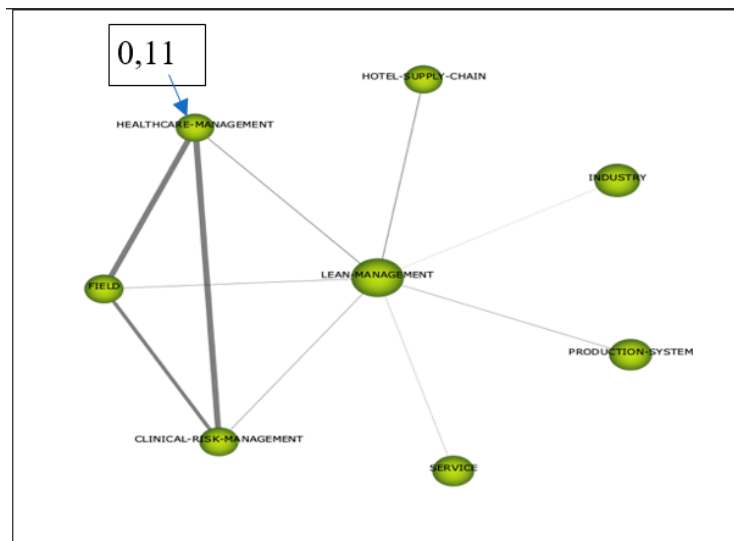


- Name: HEALTH
- Density: 143.06
- Density range: 0.92
- Centrality: 17.02
- Centrality range: 0.54

Figure 23. Cluster health (2014–2020 period). Source: Own elaboration—Scimat.

Study 1 (Hospital)

Study 2 (Health)



No results appear

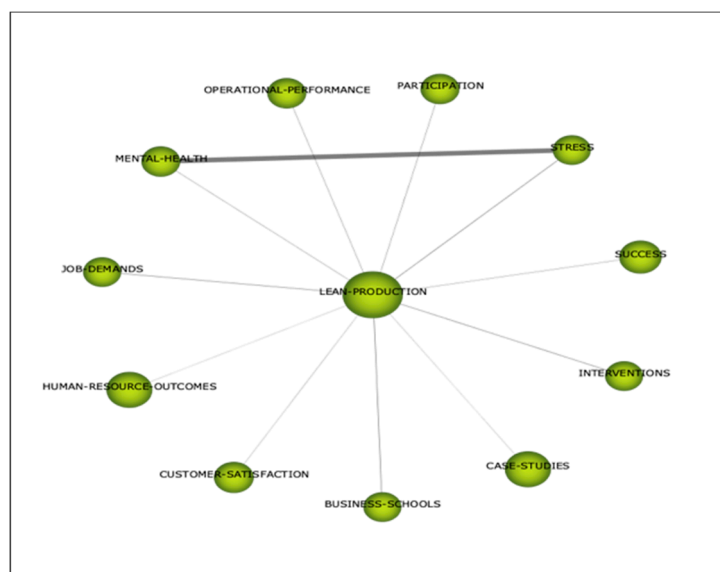
- Name: LEAN-MANAGEMENT
- Density: 28.49
- Density range: 0.59
- Centrality: 17.56
- Centrality range: 0.41

Figure 24. Cluster Lean management (2014–2020 period). Source: Own elaboration—Scimat.

Study 1 (Hospital)

Health Study 2 (Health)

No results appear



- Name: LEAN-PRODUCTION
- Density: 10.47
- Density range: 0.31
- Centrality: 41.76
- Centrality range: 0.77

**Figure 25.** Cluster Lean production (2014–2020 period). Source: Own elaboration—Scimat.

Generally, healthcare research typically focuses on patient outcomes rather than on economic costs, but this is increasingly recognized as insufficient [71].

Currently, little research exists surrounding the organizational factors that contribute to the development of social sustainability-oriented healthcare systems. It is crucial, therefore, that more studies are not only conducted to investigate appropriate healthcare models which embed those principles, and which aim to provide services to promote, restore, and improve the health indicators of the population, but also that they do so within the context of facing unfair distribution of resources as well as increasing healthcare demands [72].

A more structured approach to evaluating healthcare that considers its full cost is therefore required so that savings can be made without compromising quality and long-term sustainability.

#### Cluster Kaizen

As this keyword was evident across all time periods and is one of the main focal points of this study, the discussion will consider the results from all years (1986–2020).

In the period 1986–2020, the thematic area of Kaizen has no results, but the thematic area of continuous improvement appears with 38 documents covering topics related to enablers, inhibitors, performance measurement, and human resource management, among others. There are only two lines of interaction: inhibitors—facilitators and the concurrent engineering approach—agility, with the rest of the topics unrelated (see Figure 26).

Study 1 (Hospital)

Study 2 (Health)

No results appear

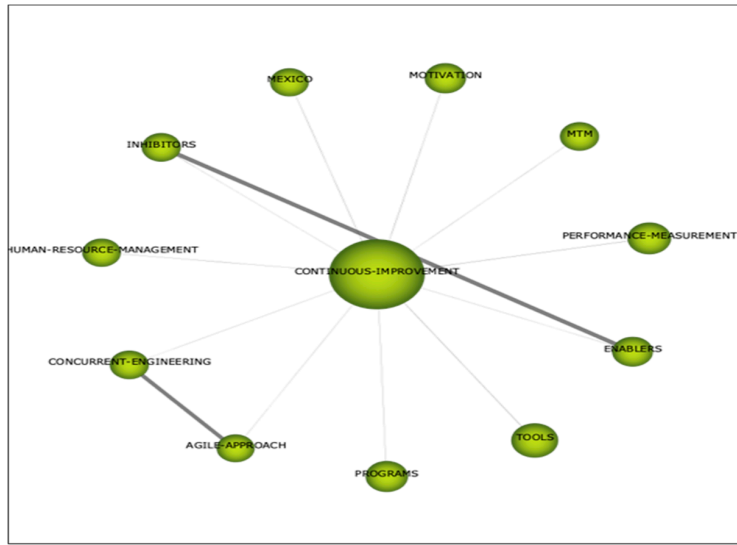
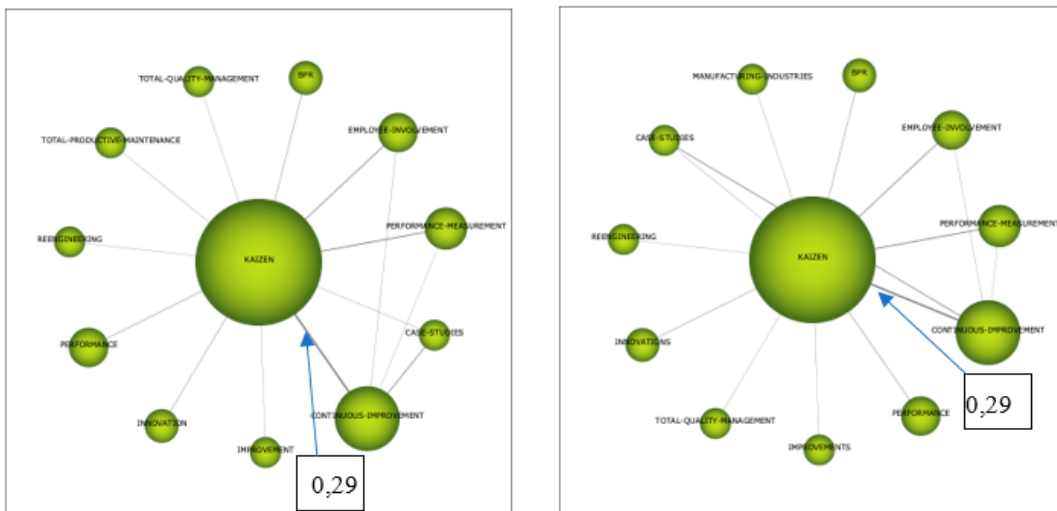


Figure 26. Cluster continuous improvement (all years). Source: Own elaboration—Scimat.

Figure 27 shows the results of both studies for the 1986–2003 period. These results have the same range of density, centrality, and range of centrality as well as a similar pattern of outcomes related to the subject matter. They cover topics that are mainly related to continuous improvement, performance measurement, employee involvement, total quality management, and engineering.

Study 1 (Hospital)

Study 2 (Health)



- Name: KAIZEN
- Density: 11.44
- Density range: 0.5
- Centrality: 5.69
- Centrality range: 1

- Name: KAIZEN
- Density: 11.44
- Density range: 0.5
- Centrality: 5.69
- Centrality range: 1

Figure 27. Cluster Kaizen (1986–2003 period). Source: Own elaboration—Scimat.

Furthermore, it can also be seen that most of them have spheres with practically the same volume, suggesting they have more or less the same number of associated documents. Moreover, they have the same line thickness, indicating that the number of documents they share is comparable.

Surprisingly, although there are no results with Kaizen in the period 2004–2020, there are results with continuous improvement (Figure 28). In this period, the results are similar to those in Figure 22, with the main difference being that, in this period, results were obtained for both investigations, hospital and health.

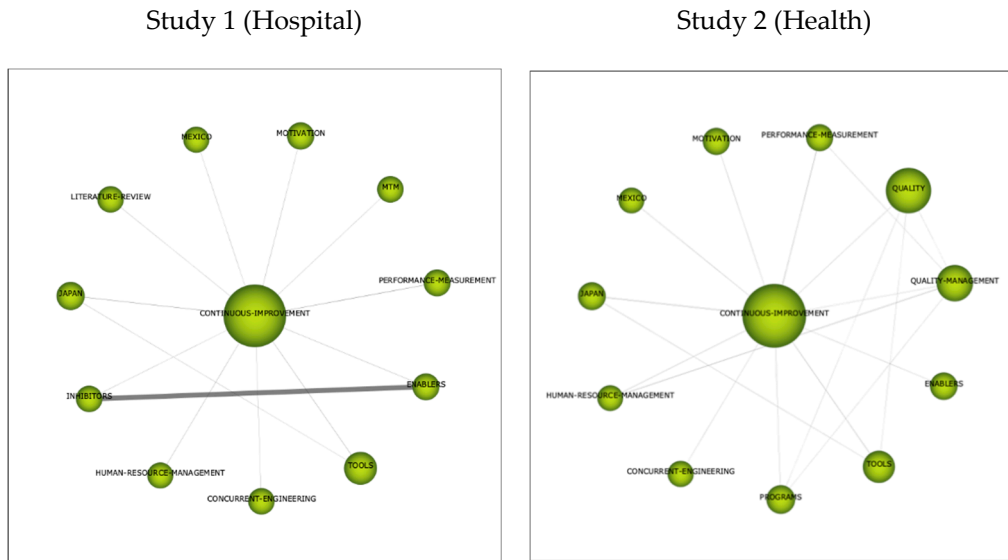
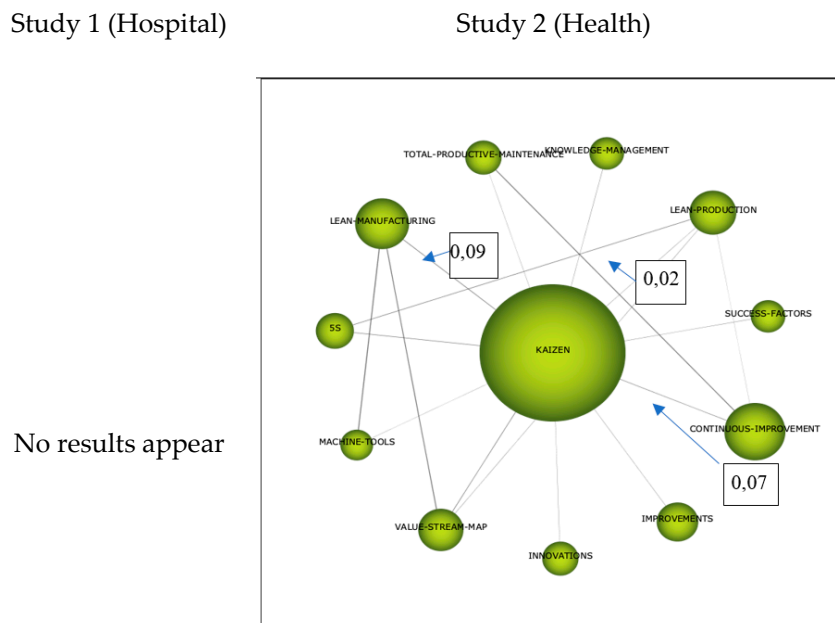


Figure 28. Cluster continuous improvement (2004–2020 period). Source: Own elaboration—Scimat.

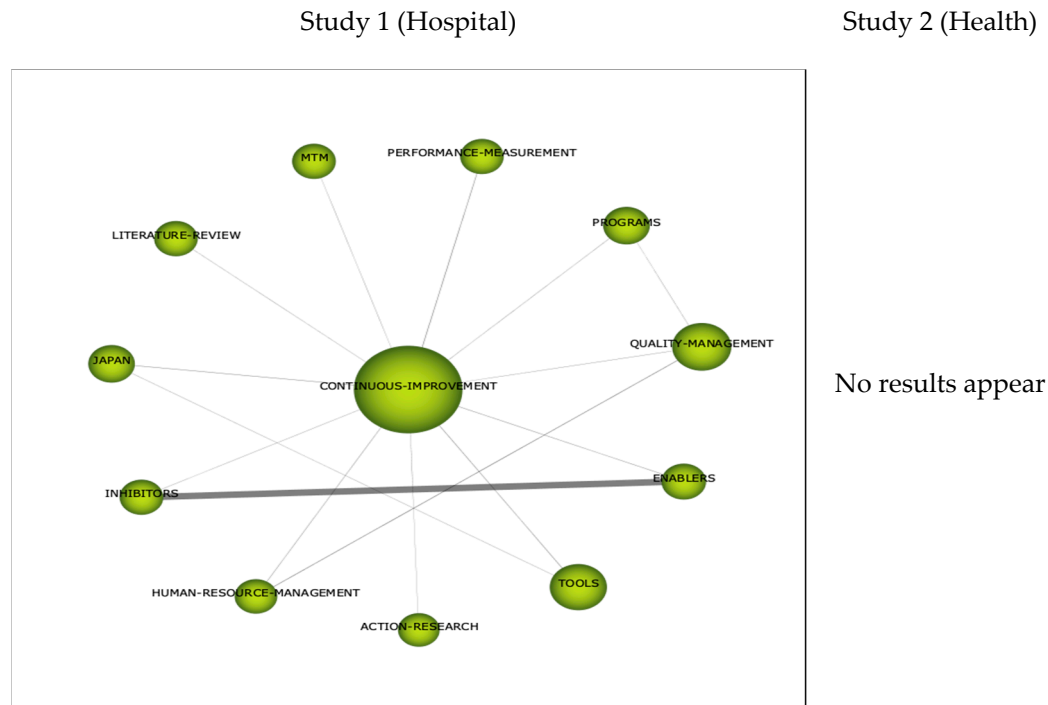
While in the 2004–2013 period, once more, the thematic area Kaizen appears but only in connection with health as shown in Figure 29.



- Name: KAIZEN
- Density: 9.31
- Density range: 0.12
- Centrality: 67.47
- Centrality range: 1

Figure 29. Cluster Kaizen (2004–2013 period). Source: Own elaboration—Scimat.

Finally, in the 2014–2020 period, there are again no results with the Kaizen thematic area, but Figure 30 shows that the results associated with continuous improvement are similar to those shown in Figures 26 and 28.



**Figure 30.** Cluster continuous improvement (Period 2014–2020). Source: Own elaboration—Scimat.

Kaizen was developed by the Japanese company Toyota in the mid-1950s and was initially known as the Toyota Production System (TPS) before later being called “lean thinking” by Womack et al. [54] and Womack and Jones [55] within the context of Western manufacturing companies.

Kaizen has a demonstrated facility in connection with objectives like sustainability, but academic research interest to date has focused on other benefits such as: cost reduction, process improvements, time savings, reduced queuing, investment savings, reduced wasted medication, improved patient admission time, reduced average time to first appointment, etc. [39,72,73].

Regardless of all the benefits Lean brings to the context in which it is implemented, the literature also shows that Lean faces substantial barriers that inhibit its potential success, such as implementation difficulties and the costs of sustainability [70,74,75].

This research shows that, increasingly in the health sector, implementing Lean tools contributes to continuous improvement and to achieving sustainable development objectives, yet the results of exist research remain underpublicized and should be disseminated more widely.

#### 4. Discussion and Conclusions

The United Nations has already promoted the Sustainable Development Agenda for 2030, which sets out 17 Sustainable Development Goals whose aim is to impact all levels of society, reach all sectors, encompass equity, inclusion, and universality, as well as to operate in an ecosystem. In order to do so, companies must attend to three distinct areas: social, economic, and environmental. These goals are intended to help society live today without causing irreversible change that threatens the life and health of future generations.

We live in a society where the demand for sustainable quality reaches both businesses and governments, mainly on the part of consumers. Consumers have become increasingly demanding and aware of the harmful environmental impacts of many companies, not only those belonging to the

industrial sector but also those in the service sector. As a result, consumers are more cautious and particularly when buying goods or services.

The health sector is not exempt from this obligation and faces pressure that requires them not only to improve quality and care, but also to manage business resources effectively and efficiently through the need to incorporate highly sustainable management practices. For precisely this reason, the Alliance for Natural Health defined the concept of sustainable health and the sustainability of the health care system as beginning to be viewed as a key component in making full use of health care assets in a prudent manner and providing services more efficiently by meeting specified Sustainable Development Goals.

Faced with these new management challenges, many hospitals are beginning to pay attention to methodologies with a proven record of success in the industrial sector in their attempt to improve the sustainable management of their end products. One of those tools is Kaizen/continuous improvement/Lean.

Kaizen, which aims to identify and eliminate those activities that do not add value or reduce costs within companies, is characterized by small improvements incorporated mainly in the operational processes with the aim of improving the quality of service and reduction of time required, among other things. It also allows improvements in environmental character and collective social responsibility in the business nucleus.

In 1987, the World Commission on Environment and Development defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs”, and we believe this is slowly being assumed and embodied by contemporary organizations. Environmental, social, and governance issues are now being incorporated into the sustainable management of hospitals and are becoming part of the sustainable health care system through the application of industry sector methodologies.

As this bibliometric analysis shows, there is current interest on the part of the health sector with regards to the implementation of tools such as Kaizen for the continuous improvement of business management in all its aspects including sustainability. Moreover, this bibliometric analysis allows us to draw the following further conclusions:

- The interest in continuous improvement tools/Kaizen/Lean in the health sector has grown in the last 6 or 7 years.
- The majority of published work with regard to the implementation of this type of methodology in the health sector centers around the need to create a more agile and functional organization in the short term, such as making basic improvements in inventory reduction, cost reduction, and time reduction.
- Although it cannot be said that no results have been obtained that improve sustainability, the current long-term maintenance of continuous improvements in different sectors does not constitute a reference of study.
- On some occasions, the treatment required to reduce the morbidity and mortality of chronic diseases are unfavorable to environmental sustainability.
- In many organizations, caring for the environment is a long-term challenge and means increasing resource costs, which makes it impossible to take care of the environment.
- There is insufficient dissemination of sustainability programs.
- Organizations experience difficulties in implementing new work methodologies that require training and involvement of the different hierarchy levels.
- Improving an organization’s processes by eliminating critical points (those that do not add value) can improve the level of economic, social, and environmental sustainability.
- Sustainability of results after the initial period of short-term gains is difficult to achieve.
- There is limited understanding of the factors that influence the variation in results across different organizational environments



- There is no doubt that Lean thinking achieves sustainability in the health care sector.
- While managers are aware of the improvements that can be achieved, they lack the commitment to generate a business culture.
- Few health care organizations have achieved sustainable, long-term implementation of Lean.
- There should be organizational commitment to achieving corporate sustainability which should be included in their approach to social responsibility.
- The lack of existing research in this area results in significant limitations in the ability to observe a direct relationship between adjusted health care practices and sustainability.

## 5. Future Lines of Research

Following the bibliometric analysis, it would be interesting to improve and promote the study of exploratory qualitative research that will, in the long term, enable further improvement of the health sector, given that this sector is currently undergoing continuous change and there is a need for new management models focused on sustainability. The following are the future lines of research considered to be of most relevance:

- To identify barriers and enablers in connection with the wider promotion and sustainability of continuous improvement among health personnel, i.e., not only promoted by process departments.
- To develop models that promote sustainability in health, not only in its economic aspect, but also in its social and environmental contexts.
- To identify and develop models that are adapted to the different types of services in the health sector: primary, secondary, and tertiary care.

It would be interesting for future lines of research to observe the impact of Kaizen on sustainability by following other more mathematical definitions which make sustainability measurable and achievable, for example, Daly's approach [76], which would allow us to observe the impact of improvements in a quantifiable way rather than only in a qualitative way as was the focus of this paper.

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