CHAPTER
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Multicriteria approach applied to knowledge management: A review

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ABSTRACT
Purpose: This paper aims to propose a multicriteria knowledge management instrument, built from a comprehensive systematic review of the literature, to support decision-making.
Design/methodology/approach: The study consists of a systematic review of 20 articles, resulting from the InOrdinatio Index Method or Methodi Ordinatio (Pagani et al., 2017).
Findings: The use of the multicriteria approach as a tool in the evaluation or selection of methods or instruments for knowledge management resulted in 74 criteria, relevant to the definition of a knowledge management system considering the different scenarios. The findings demonstrate the complexity of a problem given the variety of criteria that can be used to assess or select different knowledge management systems. Additionally, it is possible to observe that there is no prioritization of one criterion when compared to another.
Research limitations/implications: The criteria found with the application of the InOrdinatio Index Method may not cover all the literature regarding the research topic. Yet, it is believed that the findings provide a valuable understanding of the current situation in this research field. The study proposes several future research directions, on how to verify the adherence of the criteria found in decision making in knowledge management systems.
Originality: To the best of the authors' knowledge, no systematic literature review about Knowledge Management with the application InOrdinatio Index method has previously been published in academic journals.

Keywords: Decision-making, Knowledge management, KM, Multicriteria approach, Literature review.

1 INTRODUCTION

A knowledge management process can be seen from two different perspectives, one centered on information and the other centered on learning processes (Meirelles and Gomes, 2008). Knowledge management consists of an integrated approach to the identification, management, and sharing of all an organization's information assets, including databases, documents, policies, and procedures, as well as competencies and experiences not clearly explained. Thus, knowing the different processes is essential to improving them.

Faced with such complexity, some studies have been carried out to apply techniques that assist in this process. According to Stirling (1997) communication about these alternatives and criteria applied in knowledge management is very important, with transparency and methodological rigor being two essential points for the development process, especially when it comes to multicriteria analysis.

In this sense, it is observed that multicriteria decision techniques can be useful, since they help in structuring clearly and systematically since knowledge management involves different aspects and many variables, which are often in conflict with each other (Refsgaard, 2006).

Knowledge of the technologies and methods currently applied is of great relevance, considering the complexity of this problem. In this way, bibliographic research when done in a structured way, following an ordered set of procedures for searching for solutions, attentive to the object of study, is a very useful tool in the definition of a robust bibliographic base and aligned to the theme, being able to punctual information for the scientific advancement of the area in question (Lima and Mioto, 2007).

Decision-making in organizations often takes on a strategic role. Establishing knowledge and information management can positively influence the results obtained in situations of greater complexity. With that, it is possible to improve the competitiveness of organizations.

In this sense, knowing different methods and tools will effectively help to solve problems, explore opportunities, or make decisions that improve knowledge and information management performance. Thus, this systematic literature review becomes relevant, through which it will be possible to identify existing gaps, as well as, to propose new practices. Lastly, this work aims to propose a multi-criteria knowledge management instrument, built from a comprehensive systematic review of the literature, to support decision-making.

2 THEORETICAL BACKGROUND

2.1 KNOWLEDGE AND INFORMATION MANAGEMENT

Knowledge management (KM) can be understood as systematic actions that when applied to people, technologies, and processes of an organization, can add value. Therefore, KM aims to support the creation, transfer and application of knowledge in organizations.

According to Bonatti (2015), knowledge management can be considered as an administration form that aims to take advantage of tacit knowledge, even as, it is responsible for conducting practices that seek the growth of organizations. For that, it is necessary the process of identification and knowledge mapping, which in turn, offer the database for the determination of new organizational practices.

For Jannuzzi *et al.* (2016) most work that deals with knowledge within organizations have their discussions essentially focused on making it a manageable resource. In this context, different studies propose models for knowledge management.

Hart (1986) highlights the diversity of factors involved in KM. To manage such diversity, it is important to integrate the different types of information and knowledge elements, such as creating opportunities for interaction and learning among human resources.

KM activities result in knowledge circulation processes. Consonant to Yahya and Goh (2002) there are five components: acquisition, documentation, transfer, creation and application of knowledge, while Hellebrandt *et al.* (2018) defined six main processes for knowledge management: identification, acquisition, development, distribution, use and protection of knowledge.

Wang *et al*. (2016) define knowledge acquisition, transfer and creation as three main activities of the knowledge management process. Nicolas (2004) characterizes knowledge management as a systematic process of creating, acquiring, disseminating, leveraging and using knowledge to obtain a competitive advantage and achieve an organization's objectives. Whereas Yahya and Goh (2002) explore in their work five areas of knowledge management: acquisition, documentation, transfer, creation and application.

Research has shown that KM projects focused mainly on identifying and capturing knowledge, connecting people to people electronically and sustaining an organization's capacity for growth and learning (Chong *et al*., 2000; Yahya and Goh, 2002). However, one of the main objectives of KM is to help create an organization that increases the capacity not only to obtain knowledge but also how to manage it more effectively, triggering better results.

Therefore, identifying the elements that can intervene in KM is essential for its instruments to have better results, so methodologies for assessing the efficiency of management systems, and relationships between its various factors, can be quite relevant. In this sense, Sangaiah *et al.* (2017) report that assessment tools for the integration of knowledge, team factors, technology and organization are not adequately available in the existing literature, constituting a gap to be explored.

Wang *et al.* (2016) reinforce that research has profound impacts on promoting the development and improvement of knowledge management. However, there is systematic methodology for assessment of knowledge management systems that deserves advancement. Most works refer to a previously established solution, without considering multiple factors.

In other words, it is necessary to establish an integrated system to allow the implementation of evaluation methods that encompass a wide range of criteria as well as different objectives, which are sometimes conflicting. Consequently, multicriteria decision-making methods are suitable tools for this problem, although, it is not commonly used.

2.2 MULTICRITERIA APPROACH APPLIED TO KNOWLEDGE MANAGEMENT

The decision-making process in an environment of high complexity or subjectivity, makes decision-making a way harder, as it can involve a high number of variables. In addition, decision problems can have different objectives, which sometimes conflict with each other.

Decision-making must systematically seek an option that presents the best performance, the best evaluation, or the best agreement between the expectations of the decision-maker considering the relationship between the elements.

In this sense, multicriteria methods add significant value to knowledge decision making, as they not only allow the approach to problems considered complex, but also give the decision-making process clarity and, consequently, transparency.

On this line, the theme of knowledge management and multicriteria methods is found in the literature, where the authors, in general, indicate techniques or strategies for the implementation and development of knowledge management within different organizational processes.

Méxas *et al.* (2011) conducted a bibliographic review study regarding the application of multicriteria tools for the selection of management information systems, in all 33 articles were noted. In this study, the authors observed that the Analytic Hierarchy Process (AHP) method was the most used (61% of applications).

To Meirelles and Gomes (2009) how a decision support method can be an effective knowledge management tool. The work showed how properly structured information allows capturing tacit knowledge, converting it into explicit knowledge, in addition to improving quality, such as streamlining the decision-making process.

Hellebrandt *et al*., (2018) propose a methodology based on the Network analysis method (ANP - Analytic Network Process) for the selection of knowledge management solutions in organizations, especially for the creation of new products. Whereas McKenzie *et al.* (2011) suggest an organizational guide on how to ensure better results in knowledge management in organizations, especially regarding the selection of knowledge managers. This guide is based on concepts discussed in the application of methods to aid decision-making.

3 RESEARCH DESIGN

3.1 BIBLIOGRAPHIC RESEARCH PROCEDURES

A structured literature review was carried out to build knowledge from the interests and delimitations of researchers about the main aspects that have been considered priorities for definitions of knowledge management and information in organizations.

The literature review adopted was the Ordinatio Methodi protocol (Pagani *et al*., 2017) as the basis for the bibliographic exploration. The methodology was selected since it includes a multiple criteria approach to support the relevant works in the literature, classifying the articles according to their scientific relevance, by the InOrdinatio Index.

This intervention method considers the impact factor of the journal in which the work was published, the number of article citations and the difference between the year of publication and the year of development of the research. This methodology covers nine stages of the investigation.

In the first stage, the research theme was established, which sought to identify the main criteria related to knowledge and information management in organizations.

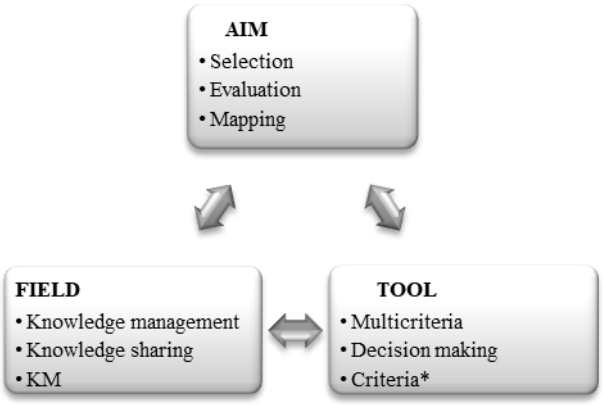
In the second stage, a preliminary search of keywords in databases was conducted, in which a search was carried out in repositories (databases of related works) previously selected with adherence to the scope and in the peer-reviewed literature.

To carry out the research, we opted for the use of two databases: the Scopus and Science Direct databases. The following criteria were used to select databases: 1) Access; 2) Boolean expressions; 3) Import into search software; and, 4) Representativeness.

Therefore, this research was restricted to the Scopus and Science Direct databases. Another delimitation corresponds to the search options in the databases used, which were restricted to the search option in a topic, in which the search takes place searching for the terms informed in the title, in the abstract and the keywords of the publications.

In the third stage, the research axes were defined. Due to the existence of synonyms, the following terms were combined in three axes (Figure 1).

Figure 1 – Keywords of investigation



Search: Authors (2022).

The fourth phase consists of searching the articles in the databases, according to the group of established combinations. Then 27 combinations were generated to perform the search for articles in the databases, using the Boolean expression and for the connection of words (Table I).

As support for bibliographic management, Mendeley software was used. The results of this phase reach a gross bibliographic portfolio of 564 articles.

Table I- Keywords of investigation

Keyword Combinations		
Selection and Decision making and Knowledge management	Selection and Criteria and Knowledge management	Selection and Multicriteria and Knowledge management
Evaluation and Decision making and Knowledge management	Evaluation and Criteria and Knowledge management	Evaluation and Multicriteria and Knowledge management
Mapping and Decision making and Knowledge management	Mapping and Criteria and Knowledge management	Mapping and Multicriteria and Knowledge management
Selection and Decision making and Knowledge sharing	Selection and Criteria and Knowledge sharing	Selection and Multicriteria and Knowledge sharing
Evaluation and Decision making and Knowledge sharing	Evaluation and Criteria and Knowledge sharing	Evaluation and Multicriteria and Knowledge sharing
Mapping and Decision making and Knowledge sharing	Mapping and Criteria and Knowledge sharing	Mapping and Multicriteria and Knowledge sharing
Selection and Decision making and KM	Selection and Criteria and KM	Selection and Multicriteria and KM
Evaluation and Decision making and KM	Evaluation and Criteria and KM	Evaluation and Multicriteria and KM
Mapping and Decision making and KM	Mapping and Criteria and KM	Mapping and Multicriteria and KM

Search: Authors (2022).

In the general bibliography, a procedure for filtering repeated articles, non-relevant books and conferences and misaligned themes, phase 5, was applied, resulting in 351 potential articles. Subsequently, papers whose title, abstract, or keyword was not related to the researched topic were rejected, resulting in a total of 144 articles in the final portfolio.

Phase 6 refers to the Impact and relevance factor. In this phase, the Journal Citation Report (JCR) and SCImago Journal Rank (SJR), year of publication and number of citations of articles on the Google Scholar website were verified.

The seventh phase of the methodology is the calculation of the InOrdinatio number. InOdinatio was calculated, as shown in equation (1):

$$InOr = \{IF/1{,}000\} + \{\propto [10 - (Ry - Py)]\} + \{Nc\} \quad (1)$$

Where:

IF: Impact factor;

Ry: Survey year;

Py: Publication year;

Nc: Number of citations.

Then, the articles were classified in descending order by the InOrdinatio Index and those with an index equal to or greater than 50 were selected. With the ranking of the articles, in the eighth phase the 144 articles selected for analysis were downloaded.

In the final phase, a full reading and systematic analysis of the work was done. Therefore, the 144 selected articles were read and analyzed in their entirety and 20 were considered to compose the final bibliographic portfolio.

4 RESULTS

Based on the keywords combinations and the work delimitations, it was possible to start the search process in the databases. The search results for the 27 keyword combinations are shown in Table II.

Table II - Number of articles found in the databases

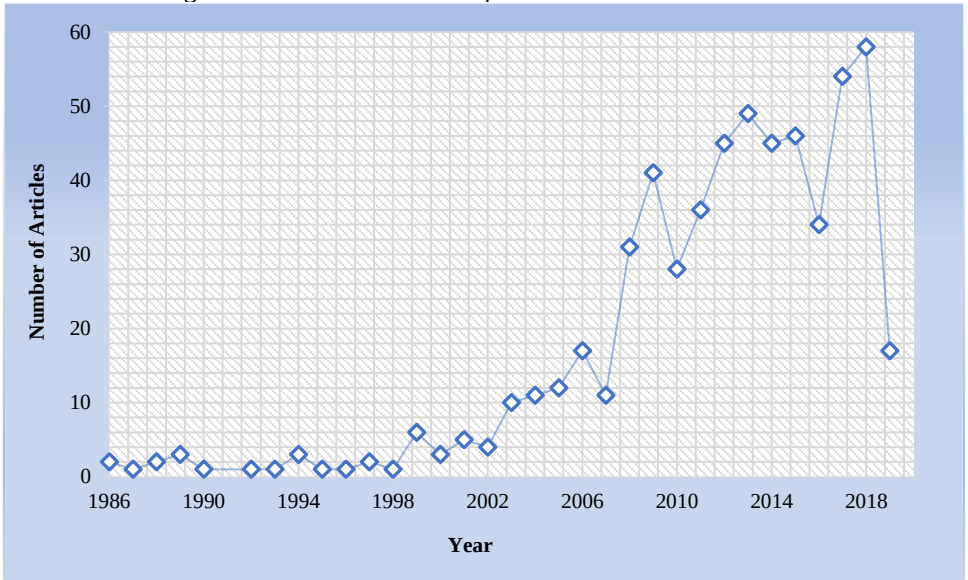
Caracterização das buscas		
Total combinations	27 combinations / 3 axes	
Search filter	Title, abstract or keywords	
Secondary filter	Review articles / Research articles	
Database	ScienceDirect	524
	Scopus	640
Duplicates	410	
Total	754	

Search: Authors (2022).

In order to verify the adequacy of the chosen keywords, an adherence test was performed. At random, 3 articles were selected. It was possible to verify the presence of all keywords, so that there was no need to change the initial keywords.

In the next stage of reading titles and eliminating duplicates, 190 articles were eliminated, leaving a data set of the strategic research application of 564 non-duplicated articles with titles aligned to the research theme between 1986 to 2020. With this data set, a graph was made to know the temporal distribution of publications related to the theme (Figure 2).

Figure 2 – Number of articles published between 1986-2020



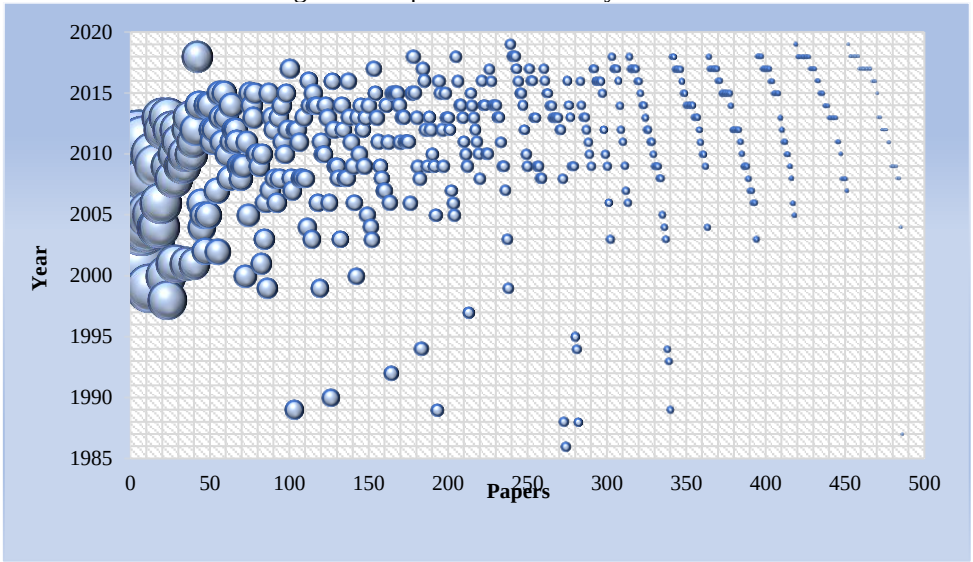
Search: Authors (2022).

In Figure 2, it is possible to notice an upward trend, with a significant increase in the marginal growth rate during the last years, with more than 70% of the articles published since 2010. It is also noticed that the peaks occurred in the years 2017 and 2018. The first quarter of 2020 shows that it might maintain the average of the last years.

Based on 564 articles, the articles with the highest scientific recognition were selected, by surveying the number of citations for each publication, according to Google Scholar (http://scholar.google.com.br/), a survey conducted between March 10 and 15, 2020.

Once the citations number was defined for each article, the Pareto rule (80/20) was established as the cut-off point for the full reading of abstracts. This percentile restriction determines that articles with more than 33 citations are selected for a second evaluation. In this way, 133 articles were found, constituting 20% of the total sample, and 431 with citations below 33, constituting 80% of the sample (Figure 3).

Figure 3 - Papers distribution by citation



Search: Authors (2022).

After scientific recognition, the abstracts were read in full. In this stage, 68 articles were eliminated, and 65 articles aligned with the research objectives were moved to the new stage.

The bibliographic portfolio was defined after reading the selected articles that were found in full and available free on the CAPES (Coordination of Improvement of Higher Level Personnel) portal database. From 65 articles selected in the previous steps, 2 articles were not available in full. After reading the 63 articles a total of 20 articles were aligned with the research objectives, which constituted the bibliographic portfolio (Table III).

Table III - Bibliographic portfolio

Authors	Article	IF	Year	Ci	InOrdinatio
Ernst *et al.* (2003)	Patent information for strategic technology management	0,330	2003	743	693
Yahya and Goh (2002)	Managing human resources toward achieving knowledge management	2,053	2002	652	592
Wu *et al.*, (2008)	Choosing knowledge management strategies by using a combined ANP and DEMATEL approach	3,928	2008	489	489
Lemon *et al.*, (2004)	Organizational culture as a knowledge repository for increased innovative capacity	3,265	2004	356	316
Ngai *et al.*, (2005)	Evaluation of knowledge management tools using AHP	3,928	2005	298	268
Calabrese *et al.*, (2013)	Using Fuzzy AHP to manage Intellectual Capital assets: An application to the ICT service industry	3,928	2013	188	238
Poch *et al.*, (2004)	Designing and building real environmental decision support systems	1,920	2004	276	236
Poston *et al.*, (2005)	Effective use of knowledge management systems: A process model of content ratings and credibility indicators	0,000	2005	263	233

Tseng *et al*., (2011)	Using a hybrid MCDM model to evaluate firm environmental knowledge management in uncertainty	3,907	2011	145	175
Wu *et al*., (2012)	Segmenting critical factors for successful knowledge management implementation using the fuzzy DEMATEL method	3,907	2012	123	163
Fan *et al*., (2009)	Evaluating knowledge management capability of organizations: a fuzzy linguistic method	3,928	2009	142	152
Majchrzak *et al.*, (2004)	Knowledge Reuse for Innovation	2,822	2004	192	152
Nicolas *et al*., (2004)	Knowledge management impacts the decision-making process	2,053	2004	192	152
Boyko *et al*., (2012)	Deliberative dialogues as a mechanism for knowledge translation and exchange in health systems decision-making	2,733	2012	109	149
Tseng *et al*., (2010)	An assessment of cause and effect decision-making model for firm environmental knowledge management capacities in uncertainty	1,687	2010	121	141
Sangaiah *et al*., (2017)	An integrated fuzzy DEMATEL, TOPSIS, and ELECTRE approach for evaluating knowledge transfer effectiveness concerning GSD project outcome	4,213	2017	42	132
Wang *et al*., (2016)	A synthetic method for knowledge management performance evaluation based on triangular fuzzy number and group support systems	3,907	2016	38	118
Gopal *et al*., (2018)	Integration of fuzzy DEMATEL and FMCDM approach for evaluating knowledge transfer effectiveness concerning GSD project outcome	1,699	2018	13	113
McKenzie *et al.*, (2011)	Developing organizational decision-making capability: A knowledge manager's guide	2,053	2011	77	107
Hellebrandt *et al*., (2018)	ANP-based knowledge management solutions framework for the long-term complaint knowledge transfer	0,630	2018	1	101

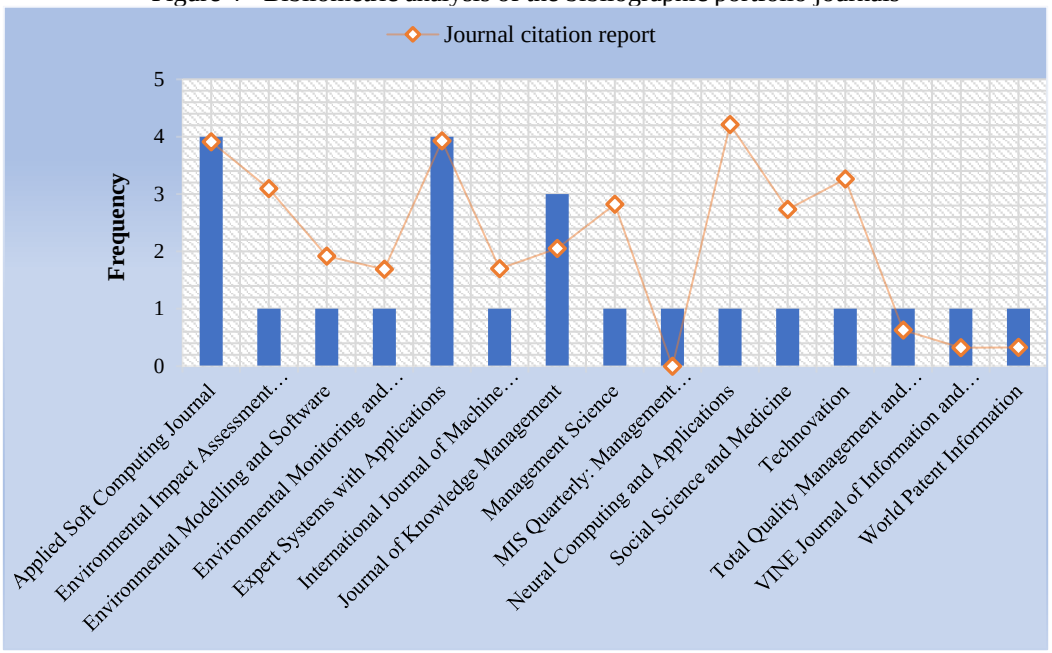
*Where: Impact Factor (IF); Citations (Ci).
Search: Authors (2022).

4.1 RESULTS SYSTEMIC ANALYSIS

Some analyzes were performed based on the bibliographic portfolio, to define: (i) journals relevance; (ii) scientific recognition of articles; (iii) leading authors; and (iv) most popular keywords.

Figure 4 presents a graphic of the bibliographic portfolio journals.

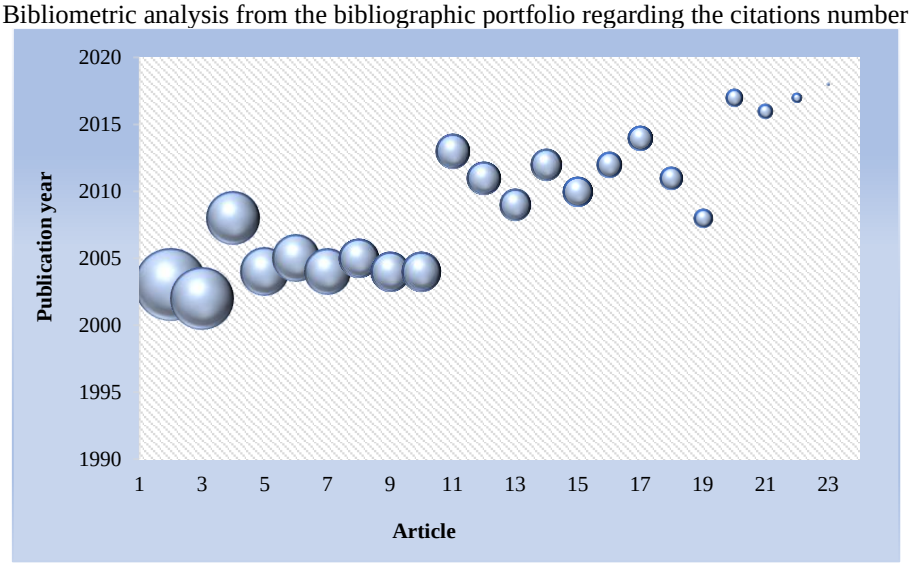
Figure 4 - Bibliometric analysis of the bibliographic portfolio journals



Search: Authors (2022).

Among the 20 articles in the bibliographic portfolio, 4 (17.4%) were published by the Applied Soft Computing Journal, 4 (17.4%) by the journal Expert Systems with Applications and 3 (13.1%) by the Journal of Knowledge Management. This demonstrates the high degree of interest of these journals in the subject of this research. It is important to highlight, the high impact factor of all the journals to which the theme was submitted and accepted for publication, which highlights the importance of the study.

Figure 5 - Bibliometric analysis from the bibliographic portfolio regarding the citations number per article

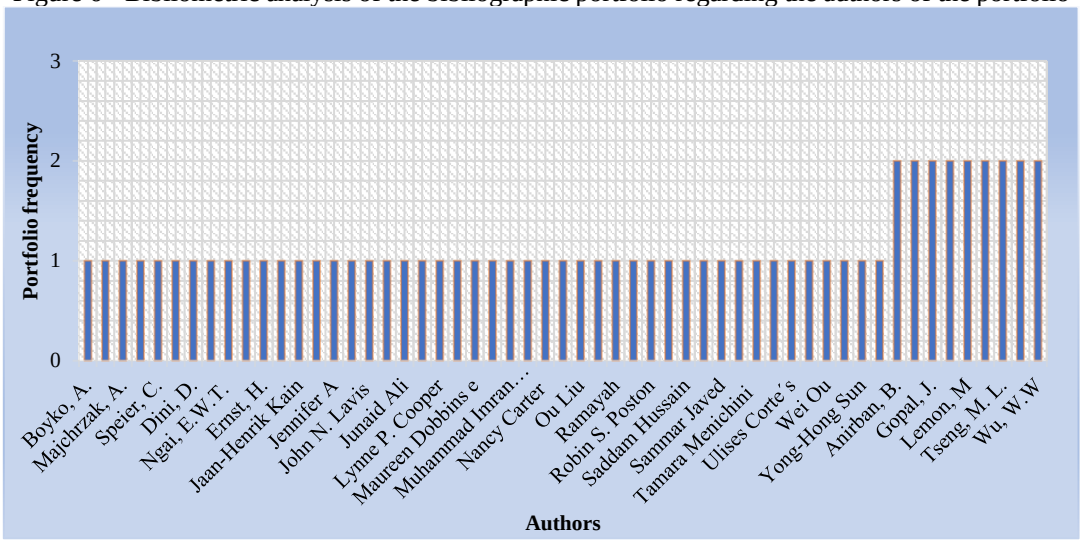


Search: Authors (2022).

As shown in Figure 5, it was found that the article "Patent information for strategic technology management" showed a high prominence considering that it had the highest number of citations, around 743 citations, followed by the article "Managing human resources towards achieving knowledge management", which presented a citation number of 654 during the research period.

According to the analysis regarding the authors of the bibliographic portfolio (Figure 6), it was possible to verify that the authors Anirban, B.; Gopal, J.; Wang, J.; Lemon, M; Li, M; Tseng, M. L.; Wu, W.W; they have presented greater prominence, however not like the others.

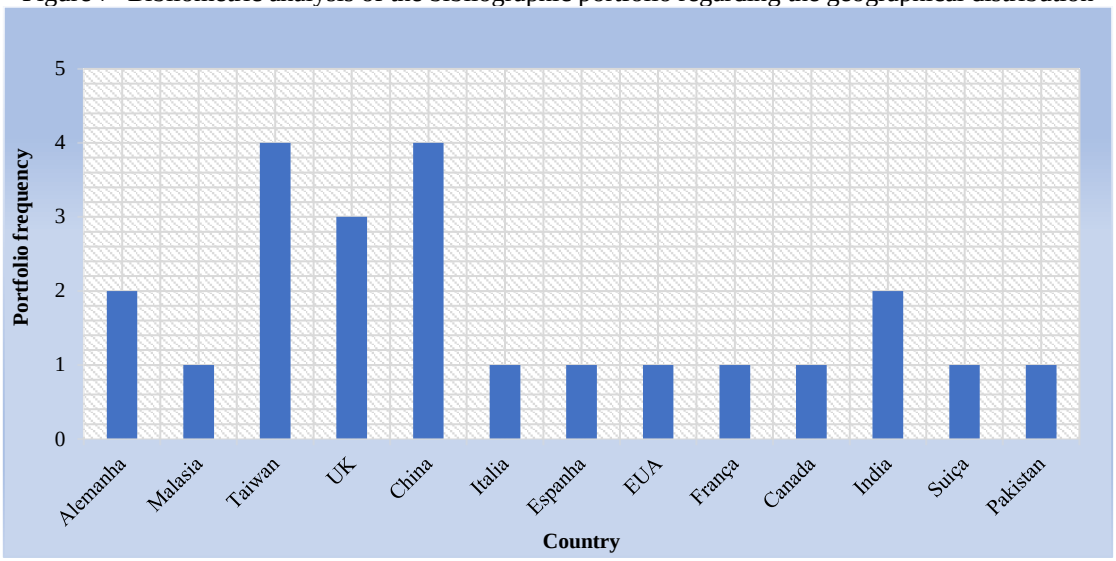
Figure 6 - Bibliometric analysis of the bibliographic portfolio regarding the authors of the portfolio



Search: Authors (2022).

When analyzing the geographical distribution (Figure 7) it was possible to observe that Asian countries were the most present in the bibliographic portfolio, with 17.4% of the articles published by organizations in Taiwan; 17.4% in China; 8.7% in India; 4.4% in Pakistan and 4.4% in Malaysia.

Figure 7- Bibliometric analysis of the bibliographic portfolio regarding the geographical distribution



Search: Authors (2022).

4.2 CRITERIA FOR KNOWLEDGE MANAGEMENT

The proper definition of the evaluation criteria is essential to guarantee the quality of the decision, since these are the attributes that make up the evaluation axis (Leoneti *et al*., 2010; Campos, 2011; Kalbar *et al*., 2012 a).

From the full reading of the papers 74 criteria were raised in the systematic literature review. Tables IV and V present the criteria considered by the authors as relevant to the definition of a knowledge management system considering the different scenarios.

Table IV - Criteria taken from the bibliographic portfolio

Authors	**Criteria**
Ernst (2003)	Cooperation intensity; Activity and quality of patents; Technology sharing; Technological scope; R&D.
Yahya and Goh (2002)	Technological and organizational structure; Institutional objective; Business directions; Creativity; Distribution of capital; Emotional intelligence of the group Investment.
Wu (2008)	Institutional objective; Incentives; Top management support; Costs; Time; Culture and people; Communication.
Lemon and Sahota (2004)	Organizational culture; Organizational structure; Social context.
Ngaiet *et al*., (2005)	GC objectives; Scalability; Manageability; Security; Flexibility; Integration; capability; Costs.
Calabrese *et al.*, (2013)	Know-how; Individual skills; Motivation; Leadership; Creativity; Ability to innovate; Ability to solve problems; Flexibility.
Poch *et al*., (2004)	Costs; Regulation.
Poston and Speier (2005)	Quality indicators; Credibility; Classification; Context.
Tseng (2011)	Infrastructure Management; Capacity; Support from top management; Marketing capacity; Institutional objective; R&D; Innovation capacity.
Wu (2012)	Top management support; Communication; Culture and people; Sharing; Incentives; Credibility; Time; Security; IT.
Fan *et al.*, (2009)	Technology; Structure; Culture.

Majchrzak *et al*., (2004)	Credibility; Relevance; Adaptability.
Nicolas (2004)	Context; Organizational strategy; Personalization; Technological scope.
Boyko *et al*., (2012)	Context; Training; Commitment; Transparency; Period; Size; Facilitation; Communication skills.
Tseng (2010)	Infrastructure capacity; Process capacity; Marketing capacity; R&D capacity; Innovation capacity.
Sangaiah *et al*., (2017)	Effectiveness indicators; Experiences; Technology and tools; Communication; Creativity; Objectives; Incentives; Motivation.
Wang *et al*., (2016)	KM Process Structure; Economic benefits; Efficiency; Absorption capacity; Culture.
Gopal *et al*., (2018)	Information context; Human capital; Infrastructure and IT; Organizational context; Effectiveness of KM.
McKenzie *et al*., (2011)	Reliability; Organizational structure; Ability to learn; Individual attributes; Socialization; Collaboration; Context; Relevance; Human capital.

Search: Authors (2022).

The analysis of Table IV demonstrates the complexity of the problem given the variety of criteria that can be used to evaluate or select different knowledge management systems. In addition, it is possible to observe that there is no prioritization of one criterion when compared to another (Table V).

Table V- Representativeness of criteria

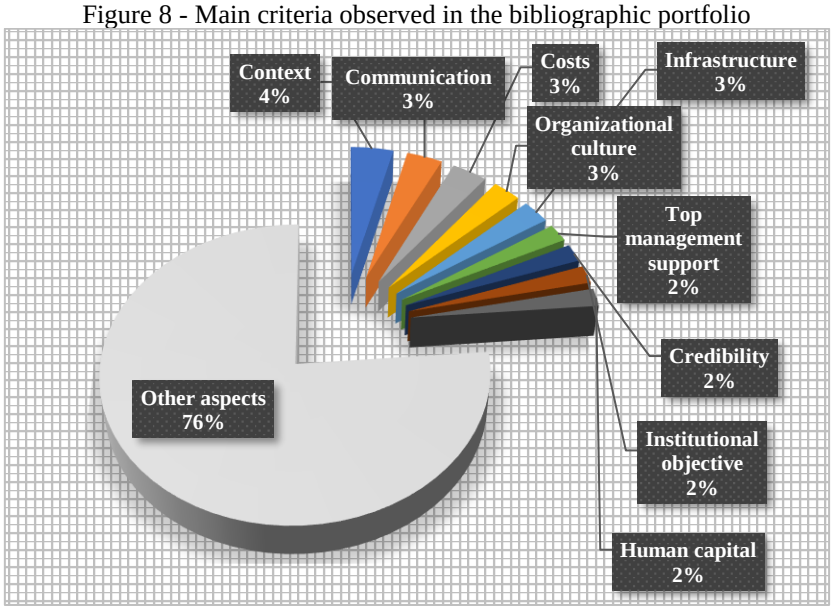
Criteria	**Freq.**	**%**	**Authors**
Context	6	5%	Nicolas (2004); Lemon; Sahota (2004); Poston; Speier (2005); McKenzie *et al*., (2011); Boyko et al., (2012); Gopal *et al*., (2018)
Communication	5	4%	Wu (2008); Wu (2012); Boyko *et al*., (2012); Sangaiah; Gopal; Basu (2017); Hellebrandt, Heine; Schmitt (2018)
Costs	5	4%	Yahya and Goh (2002); Poch *et al*., (2004); Ngai *et al*., (2005); Wu (2008); Hellebrandt *et al*. (2018)
Institutional objective	5	5%	Yahya and Goh (2002); Ngai *et al*., (2005); Wu (2008); Tseng (2011); Sangaiah *et al*., (2017)
Organizational culture	4	3%	Wu (2008); Fan *et al*., (2009); Wu (2012); Wang *et al*., (2016)
Infrastructure	4	3%	Fan *et al*., (2009); Tseng (2010); Tseng (2011); Gopal *et al*., (2018)
Top management support	3	3%	Wu (2008); Tseng (2011); Wu (2012)
Credibility	3	3%	Majchrzak *et al*., (2004); Poston, Speier (2005); Wu (2012)
Human capital	3	3%	McKenzie *et al*., (2011); Calabrese, Costa, Menichini (2013); Gopal *et al*., (2018)
Creativity	3	3%	Yahya, Goh (2002); Calabrese, Costa, Menichini (2013); Sangaiah *et al*., (2017)
Incentives	3	3%	Wu (2008); Wu (2012); Sangaiah *et al*., (2017)
Marketing capacity	2	2%	Tseng (2010); Tseng (2011)
R&D Capacity	2	2%	Tseng (2010); Tseng (2011)
Technological scope	2	2%	Ernst (2003); Fan *et al*., (2009)
Relevance	2	2%	McKenzie *et al*., (2011); Majchrzak *et al*., (2004)
Socialization	2	2%	Nicolas (2004); McKenzie *et al*., (2011)
Technology	2	2%	Nicolas (2004); Sangaiah *et al*., (2017)
Innovation capacity	2	2%	Tseng (2010); Tseng (2011)
Motivation	2	2%	Calabrese *et al*., (2013); Sangaiah *et al*., (2017)
Safety	2	2%	Ngai *et al*., (2005); Wu (2012)
Organizational structure	2	2%	Wang *et al*., (2016); McKenzie *et al*., (2011)

Time	2	2%	Wu (2008); Wu (2012)
Technology sharing	1	1%	Ernst (2003)
Flexibility	1	1%	Ngai *et al*., (2005)
Adaptability	1	1%	Majchrzak *et al*., (2004)
Patent activity and quality	1	1%	Ernst (2003)
Individual attributes	1	1%	McKenzie *et al*., (2011)
Economic benefits	1	1%	Wang *et al*., (2016)
Absorption capacity	1	1%	Wang *et al*., (2016)
Manage ability	1	1%	Tseng (2011)
Integration capability	1	1%	Ngai *et al*., (2005)
Process capability	1	1%	Tseng (2010)
Ability to solve problems	1	1%	Calabrese *et al*., (2013)
Learn capacity	1	1%	McKenzie *et al*., (2011)
Training	1	1%	Boyko *et al*.,(2012)
Classification	1	1%	Poston, Speier (2005)
Collaboration	1	1%	McKenzie *et al*.,(2011)
Sharing	1	1%	Wu (2012)
Commitment	1	1%	Boyko *et al.*, (2012)
Reliability	1	1%	McKenzie *et al.*, (2011)
Information context/knowledge	1	1%	Gopal *et al*., (2018)
Cooperation	1	1%	Ernst (2003)
Organizational culture	1	1%	Lemon and Sahota (2004)
Business directions	1	1%	Yahya and Goh (2002)
Effectiveness of KM	1	1%	Gopal *et al*., (2018)
Efficiency	1	1%	Wang *et al*., (2016)
Efforts	1	1%	Hellebrandt *et al*., itt (2018)
Scalability	1	1%	Ngai *et al*., (2005)
Organizational strategy	1	1%	Nicolas (2004)
Organizational structure	1	1%	Lemon and Sahota (2004)
Technological and organizational structure	1	1%	Yahya and Goh (2002)
Experiences	1	1%	Sangaiah *et al*., (2017)
Facilitation	1	1%	Boyko *et al*., (2012)
Flexibility	1	1%	Calabrese *et al*., (2013)
Functionality	1	1%	Hellebrandt *et al*., (2018)
Ability to innovate	1	1%	Calabrese *et al*., (2013)
Manager skills	1	1%	Ngai et al., (2005)
Effectiveness indicators	1	1%	Sangaiah *et al*., (2017)
Quality Indicators	1	1%	Poston and Speier (2005)
Group emotional intelligence	1	1%	Yahya and Goh (2002)
Investment	1	1%	Yahya and Goh (2002)
Know-how	1	1%	Calabrese *et al*., (2013)
Leadership	1	1%	Calabrese *et al*., (2013)
Business	1	1%	Hellebrandt *et al*., (2018)
R & D	1	1%	Ernst (2003)
Period	1	1%	Boyko *et al.*, (2012)
Customization	1	1%	Nicolas (2004)
KM process	1	1%	Wang *et al*., (2016)
Regulations	1	1%	Poch *et al*., (2004)
Size	1	1%	Boyko *et al*., (2012)
Technology Information	1	1%	Wu (2012)
Transparency	1	1%	Boyko *et al*., (2012)

Search: Authors (2022).

The high variability of the criteria can be better observed in Figure 8. Where about 76% of the criteria are different, that is, they are mentioned only once in the literature.

Figure 8 - Main criteria observed in the bibliographic portfolio



Search: Authors (2022).

4.3 MECHANISMS AND CHANNELS FOR KNOWLEDGE MANAGEMENT

This section provides an overview of aspects related to knowledge management considered as mechanisms and channels for facilitators for the flow of information and knowledge within organizations.

Table VI presents the main mechanisms and channels for knowledge management in organizations, taken from the bibliographic portfolio.

Table VI - Mechanisms and channels for knowledge management in organizations

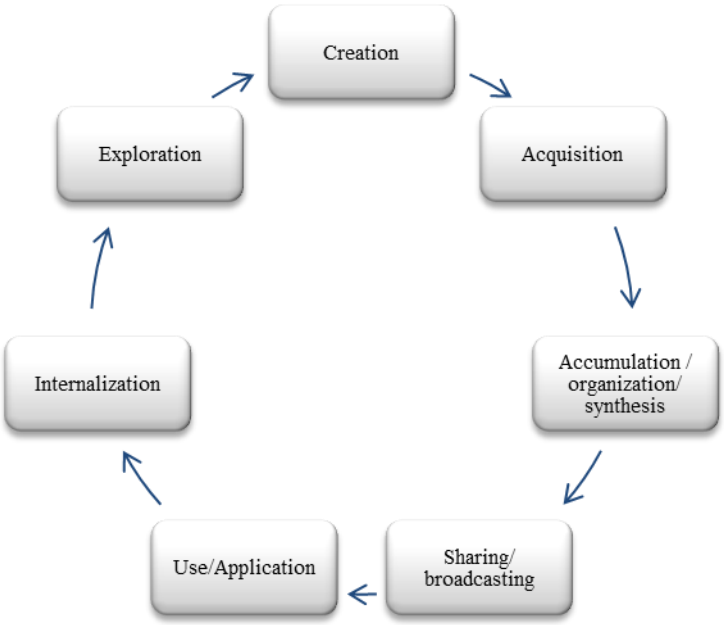
Authors	**Mechanisms**
Ernst (2003)	Patent Licensing means R&D
Yahya and Goh (2002)	Training; Daily human resource tasks; Communication between employees; Human portals; Operation networks; engaging in double-loop learning; Instructional books, Databases
Lemon and Sahota (2004)	Audit; Direct experiences and observations; Mission, vision and values; Teamwork; Organizational memory; Training.
Ngai *et al.*, (2005)	IT Tools; Database; Information system; Training; Network service; Licensing.
Calabrese *et al.*, (2013)	Intellectual capital; R&D; Innovative Processes; Relationship with stakeholders; Training.
Poch *et al.*, (2004)	Database; Observation and experimentation; Sensors; Literature review; Interviews.
Poston and Speier (2005)	Data base; Internet.
Tseng (2011)	R&D; Guided knowledge acquisition; Integration between departments.
Wu (2012)	Management groups; Database; Individual knowledge.
Fan *et al.*, (2009)	Opinion groups; Managers; TI; Intellectual capital; Interviews.
Majchrzak *et al.*, (2004)	Database; Models; Prototypes; Meetings; Experiences; Replication; Insights.
Nicolas (2004)	Intellectual capital; Integration; Database; Idea Groups; Events.
Boyko *et al.*, (2012)	Meetings; News; Database; Search; Groups.
Tseng (2010)	Market information; Success stories; Skills; Bank; Case studies; Expert groups.

Sangaiah *et al.*, (2017)	Management groups; Search; Troubleshooting groups; TI; Expert groups.
Wang *et al.*, (2016)	Search; Management groups; Audits; Meetings; Systematic reviews; Lessons learned; Internet.
Gopal *et al.*, (2018)	Questionnaires; Integration; Work teams; Technology; Organizational elements; Empirical studies; Human capital.
McKenzie *et al.*, (2011)	Interviews; Events; Groups; Database; Insights; Experiences; Evidence.
Hellebrandt *et al.*, (2018)	Standardization; Systematic description of failures; Lessons learned; Methodologies; Case study; Prototypes; Training.

Search: Authors (2022).

These mechanisms and channels are extremely important for knowledge management, since it is through them that knowledge can circulate in its different processes and phases (Figure 9).

Figure 9 - Systematization of knowledge management



Source: Adapted from Majchrzak *et al.*, (2004); Nicolas (2004); Ngai *et al.*, (2005); Fan *et al.*, (2009); Boyko *et al.*, (2012); Wu (2012); Wang *et al.*, (2016); Hellebrandt et al., (2018).

In addition, these instruments can make tacit knowledge explicit. Therefore, understanding the development of resources related to knowledge management makes it possible to influence all existing steps in an organization, directly and indirectly. The use of these tools helps managers to develop different action strategies.

In this way, it can provide the acceleration of these processes, as well as guarantee higher levels of efficiency to the knowledge management sector, and consequently, improve all aspects of an organization (Wang *et al.*, 2016).

Table VII presents the main mechanisms most frequently in the bibliographic portfolio.

Table VII - Main mechanisms and channels for knowledge management in organizations

Mechanisms	Authors	Freq	%
Management groups	Nicolas (2004); Ngai *et al*., (2005); Fan *et al*., (2009); Boyko *et al*., (2012); Tseng (2010); McKenzie *et al*., (2011); Wu (2012); Wang *et al.* ,(2016); Sangaiah *et al*., (2017); Gopal *et al*., (2018)	10	10%
Database	Yahya and Goh (2002); Nicolas (2004); Poch *et al*., (2004); Majchrzak *et al*., (2004); Ngai *et al*., (2005); Poston and Speier (2005); McKenzie *et al.*, (2011); Boyko *et al*., (2012); Wu (2012)	9	9%
Intellectual capital	Nicolas (2004); Fan *et al*., (2009); Wu (2012); Calabrese *et al*., (2013); Gopal *et al*., (2018)	5	5%
TI	Ngai *et al*., (2005); Fan *et al*. (2009); Calabrese *et al*., (2013); Sangaiah *et al*., (2017); Gopal *et al*., (2018)	5	5%
Training	Yahya and Goh (2002); Lemon and Sahota (2004); Ngai *et al*., (2005); Calabrese *et al*., (2013); Hellebrandt *et al*., (2018)	5	5%
Search	Poch *et al*., (2004); Boyko *et al*., (2012); Wang *et al*., (2016); Sangaiah *et al*., (2017)	4	4%
Interviews	Fan *et al*., (2009); Poch *et al*., (2004); McKenzie *et al*., (2011)	3	3%
Case study	Tseng (2010); Hellebrandt *et al*., (2018); Gopal *et al*., (2018)	3	3%
Experiences	Lemon and Sahota (2004); Majchrzak *et al*., (2004); McKenzie *et al*., (2011)	3	3%
Integration	Nicolas (2004); Tseng (2011); Gopal *et al*., (2018)	3	3%
R&D	Ernst (2003); Tseng (2011); Calabrese *et al*., (2013)	3	3%
Meetings / discussions	Majchrzak *et al*., (2004); Boyko *et al*., (2012); Wang *et al*., (2016)	3	3%
Audit	Lemon and Sahota (2004); Wang *et al*., (2016)	2	2%
Events	Nicolas (2004); McKenzie *et al*., (2011)	2	2%
Insights	Majchrzak *et al*., (2004); McKenzie *et al*., (2011)	2	2%
Internet	Poston and Speier (2005); Wang *et al*., (2016)	2	2%
Lessons learned	Wang *et al*., (2016); Hellebrandt *et al*., (2018)	2	2%
Prototypes	Majchrzak *et al*., (2004); Hellebrandt *et al*., (2018)	2	2%
Other criteria		28	28%

Search: Authors (2022).

4.4 BARRIERS TO KNOWLEDGE MANAGEMENT

Currently, companies are subject to a market environment impacted daily by different needs. To meet global competition concerning these challenges, companies need to design as well as anticipate problems they may face, this paper sought, completely, through the extensive systematic literature review, expand knowledge the main barriers to the management of knowledge and information.

Table VIII presents the difficulties faced in knowledge management according to the articles from the bibliographic portfolio.

Table VIII - Barriers to knowledge management in organizations

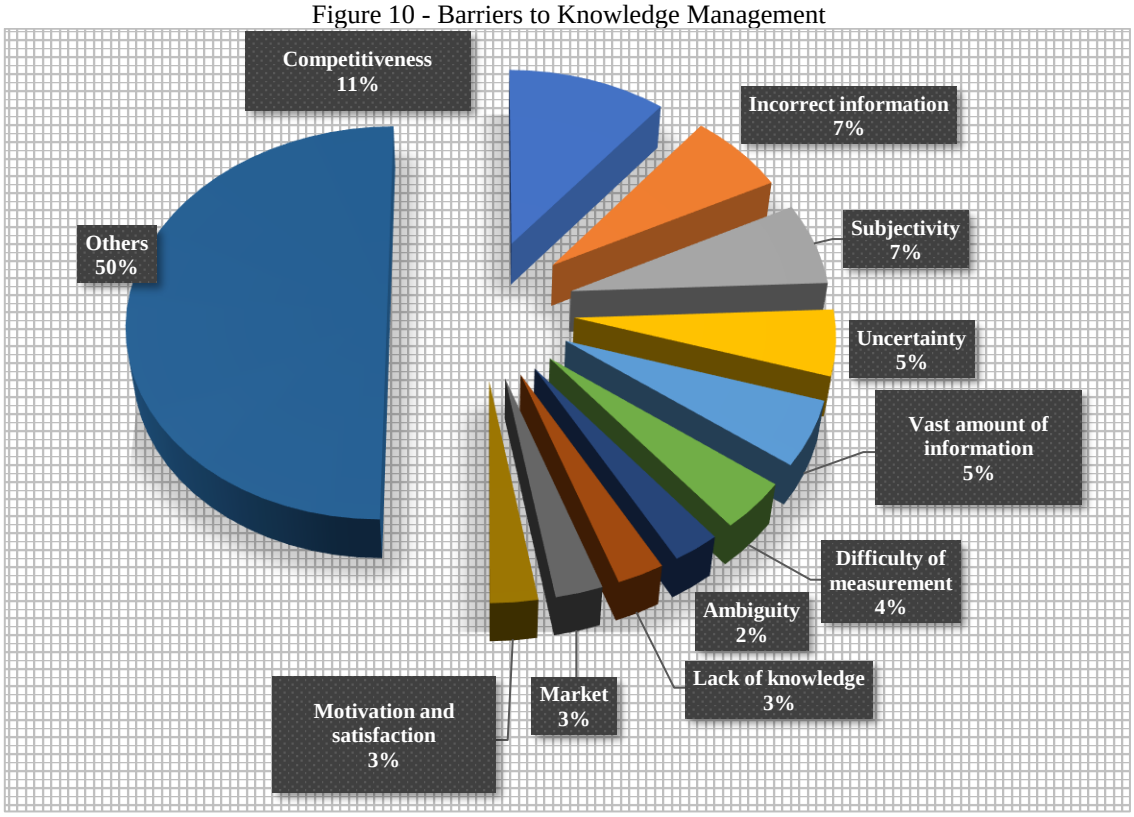
Authors	Barriers
Ernst (2003)	Trade secrets; Competitive technological position; Leading company distance; Economic quality of the company.
Yahya and Goh (2002)	Competitiveness among colleagues; Centralized/decentralized KM; Organizational history and culture; Work conditions.
Wu (2008)	The educational level of employees;
Lemon and Sahota (2004)	The educational level of employees; Global economy; Organizational bureaucratic structure.

Ngai *et al*., (2005)	Competitiveness; Difficulty of measurement; Conflicting perspectives; Lack of knowledge.
Calabrese *et al*., (2013)	Organizational climate; Motivation and satisfaction; R&D investments; Efficiency of procedures.
Poch *et al*., (2004)	Heterogeneity of scales; Process instability; Characterization difficulty; Vast amount of information; Control difficulty; Inaccuracy of information.
Poston and Speier (2005)	The vast amount of information; Incorrect information; Disoriented managers.
Tseng (2011)	Competitiveness; Loss of information; Distorted information; Integration between departments; Subjectivity of judgments; Rapid changes.
Wu (2012)	GC informality; Different priorities; Different processes at the same time; Difficulty measuring; Constant changes; Motivation.
Fan *et al*., (2009)	Competitiveness; Data redundancy; Market changes; Human perception; Subjectivity; Difficulty in valuation.
Majchrzak *et al*., (2004)	Data manipulation; Lack of experience; Access; Lack of credibility; Adaptation problems.
Nicolas (2004)	Uncertainty; Complexity; Ambiguity.
Tseng (2010)	Competitiveness; Uncertainty; Vast amount of information; Subjectivity; Many departments.
Sangaiah *et al*., (2017)	Subjectivity; Uncertainty.
Wang *et al*., (2016)	Competitiveness; Lack of resources.
Gopal *et al*., (2018)	Costs; Schedule; Personal satisfaction; Collaboration; Subjectivity.
McKenzie *et al*., (2011)	Competitiveness; Ambiguity; Contradictions; Lack of information; Pressure; Uncertainty.
Hellebrandt *et al*., (2018)	Time; Quality requirements; Market; Redundancy; Vast amount of information.

Search: Authors (2022).

Knowing the possible barriers, as well as difficulties that knowledge can face within an organization is undoubtedly fundamental to the success of the management sector. According to Nicolas (2004), not only understanding these barriers, but mainly, foreseeing them allows the organization to take a proactive stance in face of existing problems and, consequently, improve its entire system. Figure 10 shows the main barriers cited by the authors of the bibliographic portfolio.

Figure 10 - Barriers to Knowledge Management

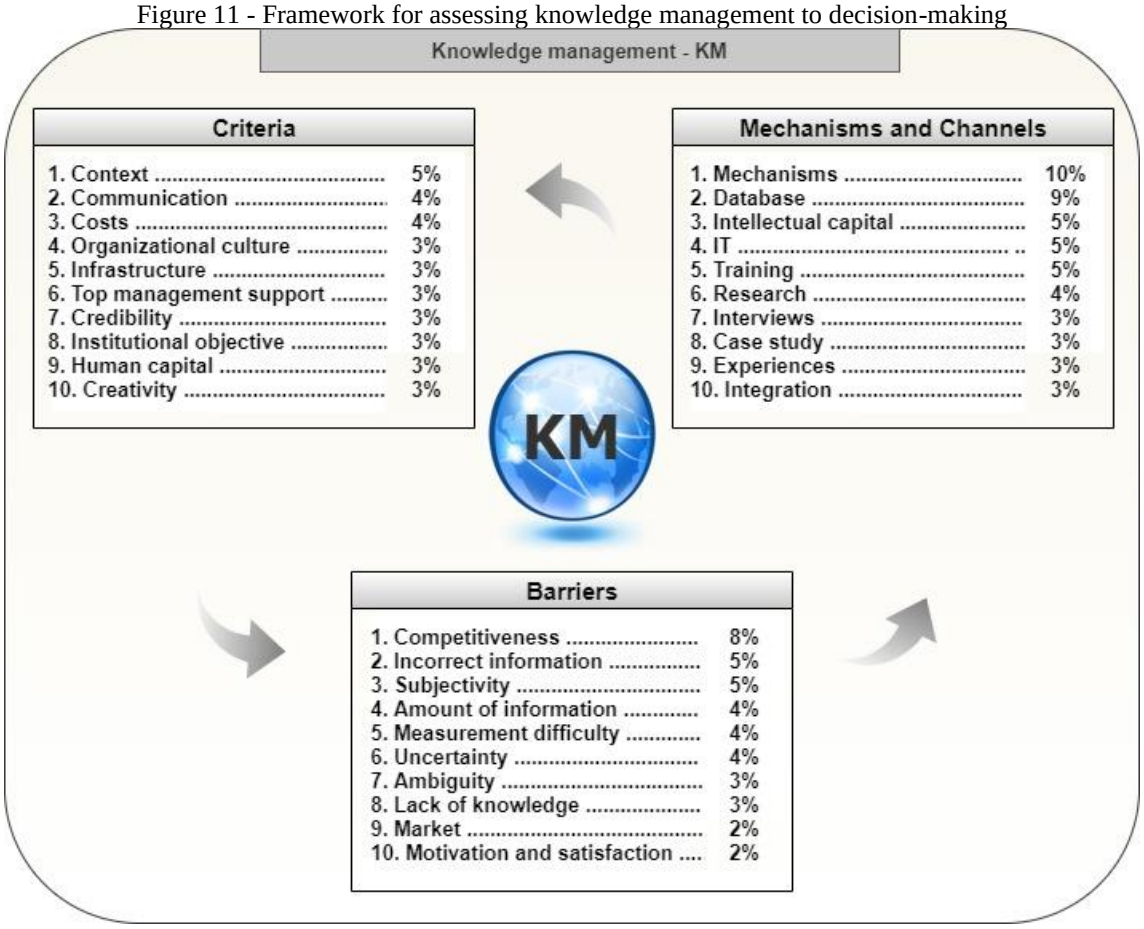


Search: Authors (2022).

4.5 MULTICRITERIA MODEL FOR SUPPORTING DECISIONS IN THE KNOWLEDGE MANAGEMENT FIELD

In this chapter, the defined criteria and alternatives are presented, as well as the final model of support for decision making, applied to the definition of the knowledge management system, as shown in Figure 11.

Figure 11 - Framework for assessing knowledge management to decision-making



Search: Authors (2022).

The presented approach provides an overview of the integration of KM aspects. Presenting, in this way, a theoretical prototype that specifically addresses information and knowledge transfers in organizations, and their interferences. To supply a practical need, since works in this sense are limited or have no application in practice.

Therefore, proposing a KM model is an appropriate option, as it aims to support and facilitate the flow of knowledge within organizations. In addition, oriented to KM systems, that is, systematic approaches to managing knowledge, as well as management tools, can be applied to implement and support the KM model.

There are countless scientific contributions to the systematization of KM solutions. Since, through this, it is possible to contribute to the orientation of the transfer process and other knowledge flows in an organization, as well as to clarify criteria, subcriteria, barriers, mechanisms and channels involved in decision-making problems within the scope of KM. This allows this process to be less subjective, and consequently more efficient.

The selection of suitable KM solutions depends on the desired objective, resources and specific preferences of the company among other relevant factors (referred to in this work as criteria).

Consequently, the selection of this process can be characterized as a decision-making problem with multiple criteria.

It is important to emphasize that a multi-criteria approach of this nature must be periodically used in order to allow continuous monitoring of KM systems.

The proposal for selecting criteria for decision making is recommended because, in general, organizations are faced with the availability of increasingly scarce financial resources for the management and execution of their activities, hence the need to seek to identify the criteria considered more critical.

5 CONCLUSION

Bibliometrics is a statistical tool that allows mapping and generating different indicators for the treatment and management of information and knowledge, in this case, applied to decision making to prioritize knowledge management system.

In general, this work enabled the recognition of important aspects for future research related to the theme: decision making for knowledge management actions. At the end of the process, 20 scientifically recognized articles were selected and aligned with the topic at hand. Of these, it was possible to extract information such as: prominent authors; journals relevant to this area of knowledge; place of publication; among other highlighted information.

This research was based on the search for scientific articles in English; articles available for free on the CAPES journals portal; articles published in national and international journals; articles published between the years 1986 to 2020.

Among the analyzes referring to the initial bank of articles with a generic theme aligned with this research, the considerable increase in productivity during the covered period stands out, with emphasis on the years after 2010, with maximum amplitudes in the last three years.

The results demonstrated the relevance of knowing the barriers that can prevent or hinder the processes involving knowledge in an organization, as well as highlighting the connection between efficiency and decision in the knowledge management sector

Regarding the criteria defined as the most relevant, it is possible to state that the work directly contributes to managers, providing a clear tool for organizations seeking to start their knowledge management sector. As well as it systematizes an evaluation model for knowledge management systems already implemented.

5.1 SUGGESTIONS FOR FUTURE STUDIES

The model proposed in this work achieved promising results, however, it is necessary to carry out further studies on the subject, especially regarding the selection criteria of the knowledge management system.

Additional research can be conducted to validate the model, as well as suggest adaptations for different contexts depending on the particularity of each organization.

Although the representativeness of the criteria is a way to validate the effectiveness of the knowledge management tool, future studies can be carried out in order to verify their sensitivity.

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