



Evaluation Methods Review of the Innovation Capacity of Companies Based on Knowledge Management

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Abstract. The knowledge economy and the improvement of efficiency in the dissemination and promotion of the achievements of innovation from the knowledge generated in the organization is relevant. The value chain of knowledge allows absorbing and making the most of new knowledge useful to improve competitiveness opportunities for business competitiveness. The relevant elements that evaluate the innovation of organizations based on knowledge management are delimiting through the bibliographic review in the Scopus and Google Scholar databases, using Boolean search formulas. About evaluation methods nearly to 40% work in organizational strategy, in approx. 25% include in region cluster and industry for the optimization. Hence the preponderance of topics related to knowledge optimization and innovation, decision making, value generation and knowledge supply chains. Finally, all models have limitations that must be considered, in relation to the cultural context where they are applied and the human-organizational phenomenon present. They should also consider the limitations in the use of quantitative techniques, leaving aside the richness of qualitative constructs in the analysis and strategic decision-making for a technological evolution of organizations.

Keywords: Knowledge-management · Making decisions · Innovation

1 Introduction

The knowledge economy and the improvement of efficiency in the dissemination and promotion of innovation achievements from the knowledge generated in the activities defined in the organization in the virtual and real value chain supported by Big Data [1], make knowledge management become increasingly important in the development

of business and industry. The integration of knowledge acquires greater relevance in research, in the field of knowledge management, for its effects on the improvement of the levels of knowledge management (acquisition, storage, application and innovation of knowledge) according to Cong, [2], the improvement in the capacity for methodological and technological innovation, in the formation of competitive advantages in organizations [3], in the configuration of an organizational knowledge value chain [4] and of a knowledge supply chain [5].

Therefore, knowledge management improves the effectiveness and efficiency of knowledge, while at the same time it can improve the decision, application and production capacity of technological innovation [6]. The ability to innovate and to acquire knowledge necessary to support the innovation process determine the success of an organization [7]. The knowledge value chain is important for the company, to the extent that it allows absorbing and making the most of new knowledge, taking advantage of useful knowledge to improve competitiveness [8]. The integration of technology to information management includes the implementation of methodologies such as AHP, as well as clustering assisted by the development of neural network architecture or genetic algorithms, through which knowledge sharing in the organization can be evaluated [9].

For the development of the information architecture, on which the exchange of knowledge generated from each of the links in the value chain in organizations is based, there are evaluation methods for the development of knowledge management and innovation generated in organizations. The analysis of the bibliographic review will allow to answer in an exploratory way which methods are frequently used to improve the performance of knowledge management in organizations in relation to innovation processes and capabilities?

2 Method

In the period of 2018–2022, through the bibliographic review of 20 articles from the Scopus databases, and Google Scholar, also through the Publish or Perish and Dimensions application. To better filter the information, Boolean search formulas are used (knowledge management, innovation, evaluation methods), the information is systematized to identify articles related to knowledge management in terms of innovation capacity in the organization to determine the relevant variables of the methods that evaluate the innovation of organizations based on knowledge management, which delimit the opportunities for business development and competitiveness that constitute value co-creation systems and dynamism the value chains of organizations.

3 Results

This evaluation helps the management departments of organizations to dimension the capacity of the research and development (R&D) area in relation to the exploration and exploitation of knowledge, as well as the expansion of the company in the market, against its own development potential to integrate innovation as a catalyst for knowledge management. Under this scenario, knowledge management becomes a fundamental element for the generation of innovation processes and the articulation of work and knowledge

Table 1. Elements of analysis of the selected papers on knowledge management and innovation in organizations (Source: Authors)

n°	Author (year) [nn]	Elements			
		Evaluation methods	Ecosystems building	N° helices	Innovation Impact
1	Tang (2020) [1]	Big data analysis	Enterprise ocean informatization	3	Creation and appreciation of the value of information
2	Cong, Liu, Zhang, Zhao y Wang (2020) [2]	Comprehensive assessment using AHP and cloud modeling	Power Design Engineering Team - Case Study	2	Optimizing the knowledge base
3	Guang (2018) [6]	Shared organizational mental model	Paper industry	4	Added value of knowledge
4	Lin, Yu, Wu y Cheng (2018) [10]	Intellectual capital valuation model	Construction industry	4	Improving decision making in intellectual capital management
5	Yu & Yang (2018) [11]	Bibliometric	Knowledge-intensive construction industry	4	Evolution of knowledge management in the construction industry
6	Robescu, Fatol, Baesu, Draghici (2020) [12]	ROI, NWW analytics	Big multinational production company NWW	3	Identification of critical capabilities for innovation
7	Xiaoping (2020) [13]	BIM and Bayesian network	Safety in construction projects	4	Improving the safety of construction projects
8	Wang (2022) [14]	BPNN enhanced BPNN with PSO (PSO algorithm and BP neural network)	Industry-University-Research Alliance	4	Valuation of shared knowledge

(continued)

Table 1. (continued)

n°	Author (year) [nn]	Elements			Innovation Impact
		Evaluation methods	Ecosystems building	N° heli- ces	
9	Yu, Hu, Li & Xiao (2022) [15]	Enhanced entropy- TOPSIS method	Case study Chongqing Uni- versity, China	3	Decision making
10	Zhang (2022) [16]	Neural net- work (NN) model	Technology Enterprise case study	3	Virtual team knowledge transfer value chain
11	Jun & Kim (2022) [17]	Corporate Open Innova- tion Attitude Assessment (COIAA) scales and Test for Delphi Survey	SMEs and large local and foreign firms (Ko- rean Management Association)	4	Organiza- tional attitude evaluation scale
12	Silverstein, Benson, Gates y Nguyen (2022) [18]	Logic Model and the Kirk- patrick Model	Baylor College of Medicine Inter- national Pediatric AIDS Initiative (BIPAI)	4	Reducing professional iso- lation, strength- ening peer rela- tionships and improving the knowledge and practices of health profes- sionals.
13	Liu, Yang, Zheng, Xiao, Gao y Lu (2022) [19]	PVAR model and Monte Carlo method	Provinces of China	4	Improving the GTIE of de- veloping coun- tries
14	Trstenjak, Opetuk, Cajner y Hegedic (2022) [20]	Analytic hi- erarchy process (AHP method)	Case study of a metal machining company	3	Making deci- sions support
15	Durand, Ri- cardo, Beaudet, Fortin- Pellerin, Mo- rales y Trem- blay (2022) [21]	General Es- timating Equa- tions	Health care practice (Canada)	4	Collabora- tion, psycholog- ical safety and engagement in the community of practice

(continued)

Table 1. (continued)

n°	Author (year) [nn]	Elements			Innovation Impact
		Evaluation methods	Ecosystems building	N° heli- ces	
16	Liu y Zhang (2022) [22]	Intelligence- based knowledge management fuzzy evalua- tion algorithm (intelligent al- gorithm and neural network algorithm)	16 universities	3	Making deci- sions and knowledge management in- novator
17	Pei (2022) [23]	Entropy weighting method and fuzzy integral evaluation method	Four provinces in China	4	Innovation performance in companies
18	Han & Gu (2022) [5]	Analytic hi- erarchy process (AHP) and data envelopment analysis (DEA algorithm)	Yangtze River Delta region (in- cludes four prov- inces in China)	4	Efficiency in the knowledge supply chain
19	Szczekala y Stadnicka (2022) [24]	Bibliometric	Bibliometric analysis in data- bases	-	Effective im- plementation of knowledge management in manufacturing areas
20	Bao y Wang (2022) [25]	Neural net- work and infor- mation trans- mission model	Business clus- ters in various re- gions of China	4	Transfor- mation of inno- vative knowledge flow

networks that facilitate the generation of value and the construction of differentiating factors that allow the sustainability and growth of the organization. The following Table 1 gives a summary of all elements.

The following Table 2 gives a summary of the color legend indicators for the interpretation of the Table 1.

Table 2. Color legend indicator (Source: Authors)

n°	Elements					
	Evaluation methods		Ecosystems building		Innovation Impact	
1	Organizational and strategy	40%	Enterprises	20%	Value generation	15%
2	Big data	10%	Building industry	15%	Optimization	35%
3	Neuronal network	25%	Education sector	15%	Making decision	20%
4	Hierarchical	15%	Regions, Clusters, Industry	25%	Personal value	15%
5	Bibliometric	10%	Health	10%	Knowledge supply chain	15%

It is interesting the combination of methods and their enrichment to design and evaluate QA and innovation assessment models, as well as to ensure that the results not only meet the conditions of methodological validity and reliability, but also respond to the needs and requirements of organizations and different industry sectors. This can be seen in the breadth of use of the models, whether in small and medium-sized companies, or large companies in various industries, in different sectors of the economy, manufacturing, construction, engineering, health. In this sense, ecosystems are being worked on in some research from two/three helixes, when they are case studies, which develop models within organizations in relation to governmental impositions and the market, including competition. In other studies, usually focused on regions, provinces, industries and clusters, it is possible to identify the presence of the four helixes of the ecosystem, the business environment, the governmental environment, the competitive environment and the civil society.

4 Discussion

The literature review allows us to identify three elements of analysis related to culture, (infra)structure and strategic direction or business model. In relation to culture, it is possible to talk about management styles, communication processes, values related to trust, recognition, and valuation of personnel dedicated to R&D, all of them different depending on the region, the sector of the economy and the industry in which the analysis is made. In terms of strategy, the role of the leader or manager to promote and facilitate the flow of knowledge in a value chain and permanent supply in the organization, as well as the policies and incentives related to R&D results and products, the capabilities and knowledge of personnel, researchers and managers, as well as the focus of the business and the area of the economy in which it operates, which makes the processes more or less stable and change (innovation) becomes a constant or not of survival. It also

includes bets on sustainability and green economies, which, in the current economic scenario, are differentiating elements that the market rewards. In relation to infrastructure, access to technology, the relationship between financing, technology and knowledge, as well as leverage and the potential for generating profits and value from knowledge and innovation.

On the other hand, it is important to recognize that organizations have elements that condition their capacity for innovation based on knowledge management, which establish conditions for evolution in the field of technological integration in the value chain of organizations, factors such as human talent, research, infrastructure, market exploration and development, as well as sustainable and sustainable business development are part of the relevant factors to have triggers for processes that promote innovation. Knowledge transfer barriers are also identified in relation to economic, legal and cultural perspectives. Cultural issues are the most complex to overcome, although they have been identified. The evaluation models used provide us with an image of organizational complexity, in which the development relationship of organizations depends on the ecosystemic relationship and social integration for the development of collective dimensions of knowledge that relates the design, creation and networks for knowledge and technology transfer, with the use of capabilities and their development in organizations internally and externally. It can be noted that most evaluations are based on perception through strategic analysis of databases in the cloud, as well as resorting to simulation in the systems for their optimization and the generation of information that allows you to make decisions in real time, assertively.

Evaluating the innovation capacity of organizations in a particular sector, in relation to knowledge management, involves making use of statistical approaches that make it possible to assess which variables interact with others and what the results of these interactions are. Neural networks, factorial analysis, fuzzy logic, among others, are statistical approaches/analyses that allow finding which elements interact with others and which ones influence more in one process than in another. Statistical methods allow understanding phenomena that are governed by multiple endogenous and exogenous factors, which can find correlations between the different factors being analyzed and their perturbations, in a multivariate phenomenon. Deciding which model (statistical or non-statistical) is the most appropriate for organizations is complex, and the literature reviewed reports various models that can be applied to the phenomenon under study: entropic models, cloud models, big data, value chain, organizational shared mind model, organizational knowledge acquisition assessment (OKA) model, algorithms and fuzzy models, particle swarm optimization method; fuzzy border number analytical method, catastrophe progression method, Fuzzy neural network, fuzzy comprehensive evaluation, Fuzzy clustering analysis, neural network, among others.

Expanding the indicators and analysis variables, as well as using evaluation methods that combine qualitative and quantitative methods, is recommended to overcome the limitations of the models, variables and indicators selected. Complementing the information from questionnaires or surveys with in-depth interviews, focus groups, meetings with experts, as well as the review of relevant literature on the subject, is an element to be taken into account to improve the evaluation models of the relationship between knowledge management and technological innovation in organizations, especially if it

is desired to evaluate this relationship in terms of value generation, decision making, strategic positioning and sustainability over time.

5 Conclusions

This article, through the literature review, identifies the most significant articles on the subject of study in the period 2018–2022 and reviews both their analysis models, as well as the relationship of their variables and categories, the most important conclusions reached in relation to the use of each method and their possible uses in organizations. This information will allow decision makers to select the tool and model (or even build a hybrid model) that best meets their objectives and particularities. In innovation in the articles reviewed, the optimization of both knowledge management and innovation itself have the greatest coverage, followed by the contribution to organizational decision making, in third place are the generation of value from knowledge and innovation, the generation of value from subjects and teams, and the knowledge value chain. The models present us with a path of evolution and maturation of the construction of information for decision making in real time, by building with bibliometric a knowledge base and indicators for the strategy and the collection of quality data that allow, in a hierarchical way, the construction of neural networks for decision and assistance for decision making at the executive level. In the construction of ecosystems, the focus on regions, clusters and industry in general is very relevant, followed by case studies in companies, also relevant is the focus on the construction industry and the education sector, ending with the health sector. This leads to the conclusion that the evaluation of knowledge management as a fundamental support for organizational innovation is a highly relevant topic in all sectors of the economy, from companies to industry, from clusters to regions, and in different countries. The limitations of the studies reviewed in general are associated with cultural elements, in relation to their application and validity in cultural contexts in other regions of the world, outside the countries analyzed, particularly China, Korea, Canada and India.

Finally, organizations and businesses engaged in different activities in the market scenario can select the model that best suits their needs, understanding the uses of each of them and their results, as well as their limitations. The articles reviewed maintain the semantic line on the subject and are the most current in the discussion proposed here, in such a way that it is possible to have an approximation to the way in which the models of evaluation of the innovation capacity of organizations have been changing from knowledge management.

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