

CLUSTERS EVOLUTION MODELS IN THE SCIENTIFIC LITERATURE: A TEXT MINING APPROACH

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Abstract

The existing literature related to the cluster concept has been based on solid research from A. Marshall's theory of industrial districts to M. Porter's cluster concept, with location being the main factor on which the two built their premises. Considering that the cluster model has evolved over time, this paper aims to study the dynamism of this model, taking into account geographic concentration as an essential element influencing the emergence of clusters. Then it moves on to novel aspects, such as the role of clusters in promoting new technologies or innovations and the cluster's contribution to increasing the competitiveness of companies or even regional competitiveness. The methodological approach of this research consists in systematically reviewing the literature on clusters, the evolution of the model, the importance of geographical proximity and clusters' impact on growth, the elevation of innovation processes and competitiveness of companies and regions, but also the involvement of clusters in the implementation of policies. The paper provides a general picture of the dynamics of the concept by summarizing and integrating several concepts treated by other researchers in an in-depth manner. Our findings reveal the importance of the proximity factor for industries that are part of clusters, along with the fact that over time, globalization has imposed a trend towards an approach that crosses regional and national borders.

Key words: competitiveness, cluster policy, evolution, innovative clusters, regional development

INTRODUCTION

Clusters have been studied over time by both academics and public authorities. However, they have gained importance at a global level among policy-makers and the economic community, being considered facilitators between the public and private environment, and potential contributors to large-scale policy implementation (Ketels, 2008)[22].

Evidence of an early cluster concept was also features in the article, showing that industries were collaborating long before the concept was even introduced by Porter.

To begin, the cluster concept will be described from the standpoints of "industrial districts- an area where a concentration of firms has settled down" and "localized industry- an industry concentrated in certain localities", which Marshall introduced in 1920 (Belussi et al., 2008, p. 2) [1]. As can be seen, the starting point was closely related to the location of the

companies and their tendency to cluster geographically, no matter the reason.

Building on the importance of the concentration of industries in a certain location, we introduce M. Porter's cluster concept 1998. "Clusters are geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998; Kuath, 2002) [40, 24]. Based on the idea of concentrating resources in a certain proximity, M. Porter considers that the boundaries of the cluster are defined by links and complementarities between industries and in-situations that are most significant for competition (Porter, 1998; p. 79) [40]. Also, within the clusters there should be relations of both cooperation and competition (Porter, 1998; p. 81) [40]. To stress out this idea we bring to light Porter's diamond model which defines four essential dimensions for the development of clusters, namely: i) the initial regional sources; ii) the co-operation and competitiveness strategies of the companies in

the cluster iii) market conditions but also iv) relations with other markets/ industries operating in the same base market as the cluster (Boja, 2011; Rugman et al., 1993) [2, 42].

To better understand this collaboration and competition it is necessary to also bring to attention a cluster's architecture. From Porter's theory we can identify a series of basic composing elements such as suppliers of specialized inputs, suppliers of specialized infrastructure, customers, companies from industries operating in training human resources/skills, technologies or common inputs, but also the component of specialized institutions (public government, research institutions, universities and others that provide services, distinct from the field of activity) (Motoyama, 2008; Porter, 2000; Oprime et al., 2011) [32, 39, 36]. Going beyond the initial conditions necessary for the development of clusters, it can be said that important steps must be taken for cooperation, exchange of information and furthering innovation. The capitalization and transfer of knowledge can be achieved through cooperative relations between the economic, educational and government environments, the collaboration also known as the triple helix model (Etzkowitz, 2013; Leydesdorff, 2000; Safiullin et al., 2014; Leydesdorff et al., 2016; Cai et al., 2022) [10, 27, 44, 28, 3].

Due to the development of the global economy to a triple helix model, other factors have been introduced to meet these trends. As an extension to the previous concept, the media and cultural audiences as well as the civil society were also included in quadruple helix concept. The quintuple helix innovation model entails a more comprehensive approach, and also incorporates the natural environment of society (Reis et al., 2022; Carayannis et al. 2012; Carayannis et al., 2018) [41, 4, 5]. In the existing literature on the cluster concept, it can be seen that clusters have adapted to changes over time and have integrated these changes into the evolutionary model.

A notable contribution to the theoretical perspective on industrial clusters is the paper published by Bekele & Jackson, 2006, entitled

"Theoretical perspectives on Industrial clusters," which analyzes the topic from the classic theories of agglomeration to dynamic externalities in a comprehensive way. According to their conclusions, there are a variety of theoretical concepts that attempt to explain the reasons for geo-graphical concentrations of economies. Among them is the fact that contemporary economies emphasize knowledge, especially the tacit exchange of information and knowledge within clustered industries (Gashawbeza et al., 2006) [16].

Furthermore, the paper notes that an assumed relationship between economic development and cluster industries has not been investigated in depth due to a lack of rigorous empirical evidence to support it. The problem is mainly due to the lack of theoretical and methodological frameworks for cluster analysis (Gashawbeza et al., 2006) [16].

Currently, policy makers consider that the existence of clusters in a certain region is correlated with a high degree of innovation, performance and employment out-comes (Gashawbeza et al., 2006, p. 9) [16]. In light of this, clusters are considered to be essential enablers in the transition to a green and digital environment. This approach gives clusters a triple purpose: i) to be sources of market information; ii) to develop of broker stakeholder networks and iii) to offer business support (Franco et al., 2021, p. 83) [11].

By taking into account the current priorities, both the global ones and those coming from the European Commission, clusters could play an important role in guiding innovation through sustainable processes. The transversal use of resources, through collaboration and knowledge transfer could bring the industries closer to a unitary approach. In certain industries, such as agriculture, there are innovation gaps in the social and institutional field, which demonstrates the need for better informing and a knowledge system able to deal with economic pressure and its evolution (Jitea et al., 2021) [20]. This relationship between industries is also possible due to the fact that we can observe this clustering

tendency in each industry (Pohulak-Zoledowska, 2008, p. 90) [38].

What remains is the promotion of collaboration, not only between the members of a cluster, but also collaboration between clusters in the same region and beyond.

In a global and continuously evolving market, society and the economic environment must identify a competitive advantage. Global competitiveness is achieved through increased productivity and a more focused and clearer direction. An increased and sustained pace of innovation and growth must also be maintained (Dayasindhu, 2002) [9].

Clusters have also the advantage of creating a favorable framework for knowledge exchanges, much-needed for the innovation process. Dynamics of clusters offer companies the premise of increased competitiveness by:

- i) providing new companies with a framework of cooperation and stable connections;
- ii) stimulating the diffusion of the new product and process technologies;
- iii) guiding the updating and upgrading of companies through cooperation and competition;
- iv) getting clusters involved in collective interventions (policies, trainings, research);
- v) encouraging the directing of funds for the creation of collaboration networks (Simmie, 2004) [47].

The contributions analyzed above cover a series of different evolutionary stages in the history of clusters, and also offer a perspective on how they were able to adapt.

In terms of literature gap, it could also be observed that, as the cluster concept evolves and adapts to the changes occurring in society and the economy, the basic notions from which it started are no longer mentioned in the new published literature. This article counters this trend by reviewing what the core elements of the cluster concept mean and how it has taken on new tasks or acquired new roles in the economy.

Furthermore, the paper underlines the analysis of clusters as seen from the point of view of the academic environment and mainly examined according to three aspects: cluster concept evolution, the importance of spatial distribution and clusters' involvement in

complex concepts such as innovation, competitiveness and policies.

The aim of this paper is to identify key elements that shaped cluster model evolution, focusing mainly on aspects as the dynamics of cluster' model, how clusters have evolved over time, spatial distribution as a key factor in the cluster emerge and operation, and clusters' more complex roles as innovators, competitiveness boosters, or technology promoters.

The main contribution of this study to the existing literature is a comprehensive review on the cluster concept, its applications, and theories of cluster adoption over time based on a systematic literature review, with a focus on spatiality and phenomena such as innovation, competitiveness, or clusters as key spillovers of new technologies.

This evolutionary approach addresses three important aspects that were included in the research questions.

Research question 1: Is there a specific way to define how the cluster concept has evolved over time, and if so, was this evolution agreed upon?

The aim is to identify the common thread in the description of the cluster model from various perspectives based on the data collected from the specialized literature. Identifying possible common perspectives and ideas regarding the cluster concept throughout time could lead us to claim that the cluster model followed a certain trajectory determined by a series of factors, which in their turn should be identified.

Research question 2: The spatial distribution of companies in a particular area is considered to be a key factor in cluster emergence, but was it seen as a key determinant?

This research question aims to probe whether the emergence of clusters chiefly depends on the agglomeration of companies in a certain area and whether the connection between the spatial component of companies and the formation of clusters, forwarded by Porter and other authors, is valid.

Research question 3: Can clusters be considered promoters of technological, innovative, policy and financial evolution over time?

This research question aims to identify whether clusters are a tool that has contributed to the evolution of the industries in which they have been active over time. We are talking here about technological evolution, adopters of innovations and determining factors when it comes to the implementation of policies.

Regarding the new elements that the current work brings to the scientific environment, it can be mentioned that aspects that were treated separately by researchers in a more in-depth manner were included in the article by summarizing them. In this way the paper provides a general picture of the dynamics of the concept.

The current paper is organized as follows: a brief overview of the concept is provided, along with information about the purpose of the study and the research questions.

Then, it is presented the research methodology, followed by a thematic synthesis of the results is presented, followed by some discussion around the results. Conclusions and limitations are drawn in the end of the article.

MATERIALS AND METHODS

To answer the research questions presented above, a systematic literature review (SLR) was conducted.

The SLR is characterized by an in-depth literature search, as well as clear and easily understood searched terms and selection criteria (Ruhlandt, 2004) [43]. With the SLR methodology, relevant research can be identified and critically evaluated (Chifor et al., 2022) [6].

The existing literature on a certain topic can be reviewed for various reasons: from providing a foundation or evidence about a certain subject to finding out how reliable or possibly efficient a typology is (White et al., 2005) [52].

As an SLR is a thorough and rigorous research approach, this study began by screening the literature on the cluster concept and its evolution as a preliminary and exploratory step.

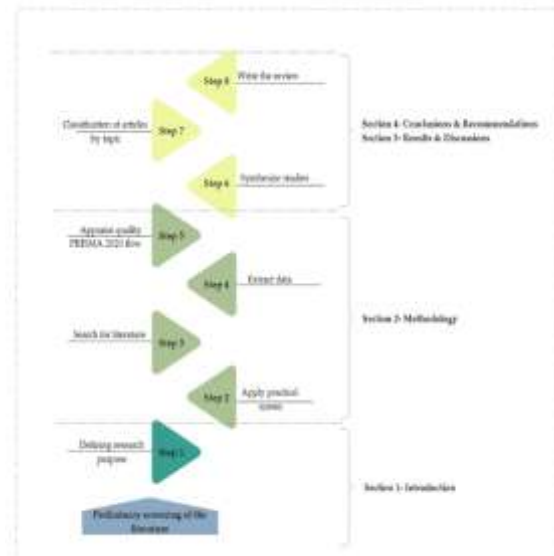


Fig. 1. Adapted systematic literature review steps by the authors

Source: Elaborated based from the steps proposed by Okoli (2015) [34].

SLR adopted the steps proposed by Chitu Okoli (2015) [34] with some personal adjustments by the authors.

The first step after examining the initial data was to:

- 1) define the purpose and the research questions (section 1- Introduction);
- 2) apply practical screen;
- 3) search for literature;
- 4) extract data;
- 5) appraise quality (section 2- Methodology);
- 6) synthesize studies;
- 7) classify the articles by topic;
- 8) write the review (section 3- Results & Discussions and section 4- Conclusions & Recommendations) (Okoli, 2015) [34].

Literature screening was performed by querying three prestigious academic literature databases, namely Web of Science, Science Direct and Scopus.

In step two of the practical screen, the categories related to the previously mentioned databases were defined in order to be included in the search (Table 1).

During step three, literature was searched by querying the database in two stages: in the first one a set of words was used and in the second one a novel combination of words was employed.

Table 1. Categories included in the databases search

Web of Science	Scopus	Science Direct
Economics	Business, Management and Accounting	Business, Management and Accounting
Management	Economics, Econometrics and Finance	Economics, Econometrics and Finance
Business	Agricultural and Biological Sciences	Agricultural and Biological Sciences
Business Finance		
Agriculture Multidisciplinary		
Agricultural Economics Policy		
Agricultural Engineering		

Source: authors own interpretation.

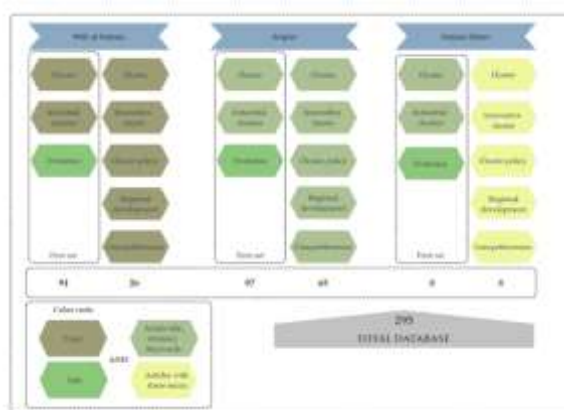


Fig. 2. Description of the inclusion criteria in the three databases

Source: authors own interpretation.

All literature was restricted to papers written in English. The results of the two sets of searches were put together in a common database (step four extract data). To adhere to the standards of systematic literature review, the implementation of a five step - appraise quality followed the process outlined in the PRISMA 2020 flow diagram.

PRISMA consisted of a four-phase flow diagram and a 27-item checklist. This describes the criteria for identification, screening, eligibility, and inclusion of publications within the scope of a certain evaluated topic (Selçuk, 2019) [46]. This way, the selection process is a transparent one and the decisions taken at the different stages of the flow are reported, including the reasons

why certain exclusions were made (Onofre et al., 2021) [35].

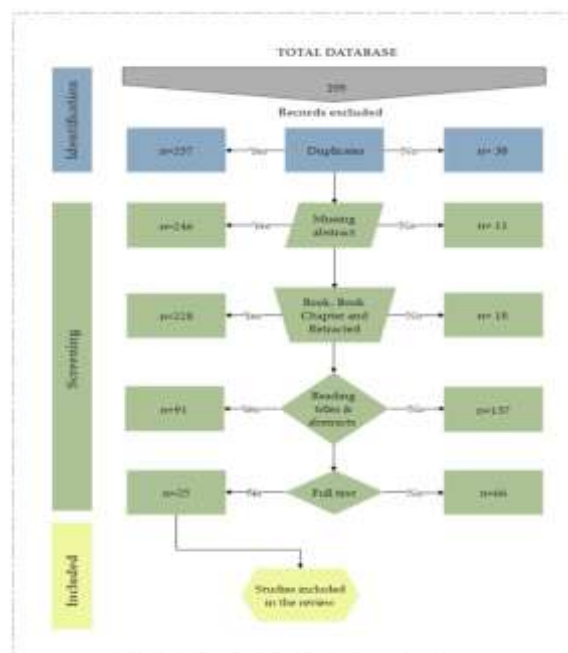


Fig. 3. PRISMA flow diagram

Source: Adapted by the authors based on the paper A Guide for Systematic Reviews: PRISMA by Selçuk (2019) [46].

After going through the filtering process presented in Figure 3, 25 relevant papers were included in the final sample. After reading the titles, abstracts and full papers, some literature was excluded on the following grounds:

- 1) it has only pre-print version;
- 2) the topic addressed does not fall within the scope of the current research;
- 3) the content was approached too widely and could not be included in one of the selected topics.

In the subsequent steps of study synthesis and articles classification by topic, all eligible publications were thoroughly examined, a synthesis of the content was carried out, and lastly the final articles were classified according to the categories presented in Table 2. A two-stage qualitative analysis was performed after reading the 25 full texts in order to better understand the subject: in the first stage a classification of the publications was made in chronological order, and at the same time, a classification was assigned to the abovementioned papers among those presented in Table 3.

Table 2. Classification by topic and coding

Category	Coding	Description
Life cycle Approach	01	It covers the topic related to the evolution of the cluster concept from the life cycle perspective.
Location	02	Details on the agglomeration of SMEs, external economies, concentration (in space), proximity of cluster members, local economies, and local accumulation
Innovation	03	It includes all issues related to innovation within the clusters and the companies in their component, as well as the regional innovation impact.
Policy	04	Notions of the policy through which clusters and policies related to the implementation of certain priorities have formed and evolved; clusters as determinants in the implementation of large-scale policies.
Network	05	All data related to the cooperation inside and outside the cluster is included, the way in which these connections have evolved and an overview of their impact.
Knowledge sharing	06	Clusters as knowledge spillovers; the way this knowledge flow is achieved.
Competitiveness	07	Evidence related to strengthening competitiveness at both company and regional level.

Source: authors own interpretation.

The second stage consisted in synthesizing the information according to the classification that it was assigned. It is important to mention that a publication could have been assigned to more than one coding due to the diversity of the topic addressed and the results it contained. All the above processes allowed the authors a better understanding of the concept, along with a classification of the evolution and also provided answers for the research questions. After completing the steps described above, the results were disseminated in the following sections.

RESULTS AND DISCUSSIONS

After completing all the steps presented in the previously explained methodology, a number of 25 articles remained relevant for the evolutionary analysis of the clusters.

The analysis of the results was divided into two parts. In the first one, the papers were analyzed from a chronological perspective and at the same time, based on the central ideas on which the work was built, they were framed in a codification. The second part focused on the analysis of the main ideas addressed. We begin by looking at clusters from a classification perspective as it is represented in Table 3.

Table 3. Studies included in the systematic literature review ordered chronologically and coded according to the focal points

Authors	Title	Year	Classification						
			01	02	03	04	05	06	07
D. Keeble; Wilkinson, F. (Keeble et al., 2021)[21]	Collective Learning and Knowledge Development in the Evolution of Regional Clusters of High Technology SMEs in Europe	1999		X	X				X
Yamawaki, H. (Yamawaki, 2002) [53]	The Evolution and Structure of Industrial Clusters in Japan	2002			X		X	X	
Guerrieri, P.; Pietrobelli, C. (Guerrieri et al., 2004) [17]	Industrial districts' evolution and technological regimes: Italy and Taiwan	2004		X			X	X	
Fromhold-Eisebith, M.; Günter, E. (Fromhold-Eisebith et al., 2005) [12]	How to institutionalize innovative clusters? Comparing explicit top-down and implicit bottom-up approaches	2005	X			X			
Iammarino, S.; McCann, P. (Iammarino et al., 2006) [19]	The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers	2006		X					X
Su, Y.S.; Hung, L.C. (Su et al., 2008) [48]	Spontaneous vs. policy-driven: The origin and evolution of the biotechnology cluster	2008	X			X	X		
Cruz, S.C.S.; Teixeira, A.A.C. (Criuz et al, 2010) [7]	The Evolution of the Cluster Literature: Shedding Light on the Regional Studies-Regional Science Debate	2010							X
Menzel, M.P.; Fornahl, D. (menzel et al., 2010) [31]	Cluster life cycles-dimensions and rationales of cluster evolution	2010	X	X					X
Martin, R.; Sunley, P. (Martin et al., 2011) [30]	Conceptualizing Cluster Evolution: Beyond the Life Cycle Model?	2011	X		X		X		
Wang, T. (Wang, 2011) [51]	Does geographical proximity matter in evolution of industrial clusters?	2011		X					

Authors	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lin, H.M. (Lin, 2012) [29]	The dynamic evolution and technological diffusion in Taiwan's TFT-LCD industrial cluster: a network perspective		X	X									
Cui, X.; Wu, B. (Cui et al., 2013) [8]	Regional Innovation System Based on Industrial Clusters		X						X				
Fundeanu, D.D.; Badele, C.S. (Fundeanu et al, 2014) [13]	The impact of regional innovative clusters on competitiveness					X	X	X					
Gafurov, I.R.; Platonova, O.U.; Pratchenko, O.V. (Gafurov et al, 2014) [15]	New state economic policy - Cluster policy cluster policy as the factor of innovative development of Europe					X	X						
Păuna, C.B. (Pauna, 2015) [37]	Cross-sectoral Cooperation vs. Cluster Development at European Level				X								
Fundeanu, D.D. (Fundeanu, 2013) [14]	Innovative Regional Cluster, Model of Tourism Development							X					
Valdaliso, J.M.; Elola, A.; Franco, S. (Valdaliso et al, 2016) [50]	Do clusters follow the industry life cycle?: Diversity of cluster evolution in old industrial regions		X					X	X				
Yang, Z.S.; Dunford, M. (Yang et al, 2017) [54]	Cluster evolution and urban industrial dynamics in the transition from a planned to a socialist market economy: the case of Beijing			X									
Halse, L.L. (Halse, 2017) [18]	The evolution and transformation of industrial clusters: A conceptual model					X							
Zedgenizova, I.; Ignatyeva, I. (Zedgenizova et al, 2017) [55]	The Problems of Creation and the Prospects for Development of Regional Clusters									X			
Lehmann, E.E.; Menter, M. (Lehmann et al, 2018) [26]	Public cluster policy and performance							X	X				
Nikonova, T.V.; Yusupova, L.M.; Kodolova, I.A.; Kalimullina, R.R. (Nikonova et al, 2018) [33]	Cluster Approach as a Factor of Increasing the Investment Attractiveness of the Region											X	
Konstantynova, A. (Konstantynova, 2019) [23]	Cluster policy change and evolution: facilitating regional smart specialisation and economic development							X					
Scutaru, L.; Prelipcean, G.; Cozoric, A.-N. (Scutaru et al., 2019) [45]	Smart Specialization in Supporting SMES in the Tourism Sector Through							X					
Laiko, O.; Kovalenko, S.; Bilousov, O. (Laiko et al., 2020) [25]	Innovative Clusters Prospects for the Development of Cluster Forms of Entrepreneurship In Euroregions									X		X	X

Source: Authors' synthesis based on [21, 53, 17, 12, 19, 48, 7, 31, 30, 51, 29, 8, 13, 15, 37, 14, 50, 54, 18, 55, 26, 33, 23, 45, 25].

Taking a closer look at the main area of interest, the most widespread topic related to the cluster is the network, more precisely the relationship between the members of the cluster followed by policy and innovation. Looking more in-depth, Table 4 highlights the works included in the research with the description of the main ideas approached in a classified manner.

Table 4. The main ideas classified according to the coding presented in Table 2

Authors	Code	Main ideas
Keeble, D.; Wilkinso n, F. (Keeble et al., 1999) [21]	02	Companies located in close proximity to one other can benefit much more easily from the technological and organizational developments generated on a large scale (p. 4).
	03	There is a direct relationship between the labor turnover and the radical product integration given by the idea of collective learning. There is also a relationship between incremental product innovation and proximity to the workforce (p. 8).
	06	The ability to share and use diverse knowledge was seen as an important precondition for the success of high-tech regions- collective learning perspective (p. 7).
Yamaw aki, H. (Yamaw aki, 2002) [53]	02	The existence of specialized support in a local industry is considered the most important element in creating agglomeration economies (p. 19).
	05	The knowledge flow is realized in a natural way within a strengthened network (p. 19).
	06	The complementarity of the capabilities (skills, knowledge, labor) of the entities in the cluster and the exchange of knowledge between them constitute an asset in the evolution of clusters (p. 19).
Guerrieri, P.; Pietrob el li, C. (Guerrier i et al., 2004) [17]	02	Globalization has changed the paradigm for both the concept of proximity, quality and scope of competition (p. 13).
	05	For survival, local and global visibility are needed, along with global networks that allow the accumulation of knowledge (p. 13).
	06	The knowledge transfer crosses the cluster borders and it is important for it to be achieved globally (p. 13).
Fromhol d- Eisebith, M.; Günter, E. (Fromho ld-	01	Regarding the phases of the cluster life cycle strategic public efforts can be a way to help the cluster in the early stages when there is a need to increase the degree of awareness within included organizations (p. 17).
	04	There is not enough evidence to support either the top-down or bottom-up approach as having superior advantages (p. 16).

Eisebith et al., 2005) [12]		[51]	4).
Iammari no, S.; McCann, P. (Iammari no et al., 2006) [19]	02	03	When innovation is a priority, one could observe the tendency of companies to imitate other companies with which they compete and also look for their cooperative behavior (p. 11).
	07	05	Technology transfer occurs mostly among connected firms because they share knowledge and tacit learning (p. 11).
	01	03	The advantages of an industrial cluster include its innovative effect, given that it in itself is actually a special innovation system (p. 7).
	01	06	Clusters help and promote innovation by creating the necessary innovation framework, cultivating enterprise learning and promoting the transfer of knowledge, thus being a facilitator of innovation (p. 3).
Su, Y.S.; Hung, L.C. (Su et al., 2009) [48]	04	05	By joining a network whose purpose is to gather expertise and to stimulate the competitiveness of its component entities, companies will be able to follow the effects that this fact generates by evaluating their own resources (p. 10).
	05	06	Clusters can have an impact on the economy, competitiveness and innovation as being considered links between the economic environment, research and public authorities and policy makers (p. 10).
	05	07	When we talk about the impact of clusters at a regional level, it can be said that they influence competitiveness by creating new jobs, attracting investments, implementing public policies and stimulating entrepreneurship (p. 8).
Cruz, S.C.S.; Teixeira, A.A.C. (Cruz et al., 2010) [7]	06	04	Practice has shown that innovation policy is impossible without stable links between industrial groups, higher education institutions and scientific institutions, economic institutions. It could also be observed from practice that, innovative activity unites them (p. 3).
	01	05	Based on good practical examples of the countries and territories that are the global epicenters of the generation of innovations, it can be observed that the transition of economic systems to the new growth model begins with the creation of a cluster network environment (p. 3).
Menzel, M.P.; Fornahl, D. (Menzel et al., 2010) [31]	02	04	Research on cluster policies indicates that there are basically two types of policies, namely i) emergent policies which support existing clusters in the development phase or clusters in formation and ii) policies that use information about how industrial development is evolving to develop new policies (p. 3).
	06	05	In order to obtain individual benefits, the members of the cluster are in a symbiotic relationship of cooperation but also in competition (p. 3- p. 5).
	01	01	Technology and industry play a significant role in the evolution of clusters as it tend to co-evolve with their dominant industry. If the industry stalls, it either follows the course of the industry, or it transforms radically. If the industry changes at a fast pace, it either evolves with the industry at the same pace, or remains stuck, and in the end, decline will occur (p. 16).
Martin, R.; Sunley, P. (Martin et al., 2011) [30]	03	05	The larger the cluster, knowledge base and region, the greater the cluster's ability to adapt to changes in the industry (p. 17).
	05	06	The knowledge base of the cluster depends on
Wang, T. (Wang, 2011)	02		

		the capabilities (and strategies) of member companies, the absorptive capacity of the clusters, the ability to create networks plus the adding capabilities of the region (p. 14).	al., 2020) [29]	market infrastructure and spheres of activities (p. 5). The cluster framework also generates an additional economic effect with impact on improving competitiveness advantages the region (p. 4).
Yang, Z.S.; Dunford, M. (Yang et al., 2017) [54]	01	The evolution of the cluster can be affected both by internal factors related to the links between companies, but also by external factors such as globalization, which offer the opportunity of upgrading and generating a significant structural adjustment (p. 16).	07	
Halse, L.L. (Halse, 2017) [18]	01	The proposed cluster model shows that the macroculture of the clusters, over time, will be influenced by changes at the transactional level and that the new relationships between companies will prevail and the exchange of knowledge will be done explicitly not tacitly (p. 13).		
Zedgenizova, I.; Ignatyeva, I. (Zedgenizova et al. 2017) [55]	07	Through clusters, regions can be offered numerous advantages, the beneficiaries mainly being manufacturing enterprises, businesses, the government and educational institutions and other actors that will have the opportunity to work together to increase and strengthen competitiveness and the production potential of the region (p. 17).		
Lehman, E.E.; Menter, M. (Lehman et al., 2018) [26]	04 05	The creation of industrial clusters constitutes an effective and appropriate political tool for regional promotion, especially for structurally weak regions. They can profit from industrial agglomerations that focus on future markets to compensate regional disadvantages (p. 28). The public policies of clusters could promote increased collaboration between university-industry-government and could also have an impact on new companies, thus resulting in a vibrant business environment with economic impact at the regional level (p. 28).		
Nikonova, T.V.; Yusupova, L.M.; Kodolova, I.A.; Kalimullina, R.R. (Nikonova et al., 2018) [33]	05	Clustering is also important for regional management, clusters being among the most progressive and modern industrial policy models, an effective enabler for building business networks, including business-to-government networks (p. 4).		
Konstantynova, A. (Konstantynova, 2019) [23]	04	The best practice examples have shown that cluster policies must be flexible and adaptable to truly generate positive change to a certain region (p. 9).		
Scutaru, L.; Prelipcean, G.; Cozorici, A.-N. (Scutaru et al., 2019) [45]	04	The idea of clustering and cooperation between clusters is promoted for the implementation of policies related to smart specialization regions (p. 12).		
Laiko, O.; Kovalenko, S.; Bilousov, O. (Laiko et	03 05	On a global level, it can be observed that clustering of cross-border economies influences competitiveness, also boosting and improving innovative activities (p. 4). Enterprises that are part of a cluster earn extra synergistic effect due to the use of shared resources as technologies, infrastructure and		

Source: Authors' synthesis based on [21, 53, 17, 12, 19, 48, 7, 31, 30, 51, 29, 8, 13, 15, 37, 14, 50, 54, 18, 55, 26, 33, 23, 45, 25].

Going into further detail on the characteristics of the various papers, from the SLR carried out within the present research we can highlight seven focal areas:

1. Life cycle

With respect to the cluster life cycle, the idea that seems to be accepted and pro-moted is that there is no unanimously valid model of how clusters evolve from the life cycle perspective. Rather, it is about how they adopt the changes that occur both internally and externally (Fromhold-Eisebith, 2005; Su et al., 2009; Menzel et al., 2010; Martin et al., 2011; Valdaliso et al., 2016; Yang et al., 2017; Halse, 2017) [12, 48, 31, 30, 50, 54, 18].

Opposing ideas can be observed regarding the relationship between the cluster life cycle and the industry life cycle in which it operates.

In the work published by Valdaliso, J.M.; Elola, A.; Franco, S. (Valdaliso, 2016) [50], it is mentioned that technology and industry play a significant role in how clusters evolve and tend to co-evolve with the industry. Authors Menzel, M.P.; Fornahl, D. (Menzel et al., 2010) [31] argue that there are essential components that have an impact on the growth or decline of a cluster. Those are independent of the industry life cycle. Future studies need to be done to address this exhaustive idea.

2. Location

The location or proximity of a cluster is considered by many (Keeble et al., 1999; Fromhold-Eisebith et al., 2005; Yamawaki, 2002; Menzel et al., 2010; Tao, 2011) [21, 12, 53, 31, 49], an influential factor in its functioning. Being concentrated in an area generates benefits such as the adoption of new technologies, innovation, specialized support, and the ability to absorb new knowledge or innovations.

A trend could be observed in opposition to those previously mentioned in the publication by Guerrieri, P.; Pietrobelli, C. (2004) (Guerrieri, et al., 2004) [17] who argue that globalization has changed the paradigm and localization may not be a decisive factor for firms that want to expand beyond regional clusters.

3. Innovation

In the case of innovation, clusters positively influence companies by guiding them towards innovation, whether it is collective learning or innovation forced by competition (Keeble et al., 1999; Martin et al., 2011; Lin 2012; Cui et al., 2021; Laiko et al., 2020) [21, 30, 29, 8, 25].

4. Policy

Concerning the policies, the papers consulted focused more on clusters' policies, from emergence to operation (Fromhold-Eisebith et al., 2005; Su et al., 2009; Pauna, 2015; Konstantynova, 2019) [12, 48, 37, 23].

As facilitators or promoters of the implementation of certain policies, clusters could be involved in the completion of innovative policies and those related to smart specialization regions (Fundeanu, 2014; Lehmann et al., 2018; Scutaru et al., 2016) [13, 26, 45].

5. Network

It can be said that the creation of complex networks is encouraged both within the cluster and outside of it, including at global level. In addition to building networks, network flow is also promoted (Yamawaki, 2002; Guerrieri 17, 2009; Martin et al., 2011; Lin, 2012; Fundeanu et al., 2013, Gafurov et al., 2014; Fundeanu, 2014; Valdaliso et al., 2016; Lehmann et al., 2018; Nikonova et al., 2018; Laiko et al., 2020) [53, 17, 30, 29, 14, 15, 13, 50, 26, 33, 25].

6. Knowledge sharing

As a result of knowledge sharing, clusters can be viewed as having spillover effects on the spreading of information (Keeble et al. 1999; Cruz et al., 2010; Cui et al., 2012; Fundeanu et al., 2013; Valdaliso et al., 2016) [21, 7, 8, 14, 50]. Additionally, information regarding the diversity of knowledge could be extracted. In order to keep the cluster and the region on a

dynamic development path, it is essential to foster complementary learning and information exchange outside of territorial boundaries (Yamawaki, 2002; Guerrieri et al., 2004; Menzel et al., 2010) [53, 17, 31].

7. Competitiveness

A functional framework of competitiveness can be attributed to clusters. Moreover, they have a significant impact on the competitiveness of a company on a national, regional, and global level (Fundeanu et al., 2013; Zedgenizova et al., 2029; Laiko et al., 2020) [14, 55, 25]. In addition, companies may find that sharing knowledge, interacting with other companies in the cluster, which are usually direct competitors, removes their competitive advantage (Iammarino et al., 2006) [19].

Creating a collaborative and competitive environment built on trust could help companies feel safe as part of such a complex structure.

Summarizing all the main ideas mentioned above, it is necessary to emphasize the fact that clusters have been studied in a complex manner, from their life cycle evolution to broader concepts such as innovation, knowledge, relationships and competitiveness, being associated credits in those directions.

With reference to the research questions, there is no single recipe to show how the clusters evolve (RQ1), but there are certain factors that determine the trajectory as the emergent policies, connections formed in the cluster, internal and external (regional) capacities.

Proximity gives obvious advantages to form networks, and it is important for the exchange of knowledge between them (RQ2). The fact that they operate in a free market determines the need to have a global approach such as internationalization, cross-border cooperation and relations with other entities outside the cluster (Guerrieri et al., 2004) [17].

Clusters have been and are considered key drivers in the adoption of new technologies and promotion among members. They have been involved in large-scale policy implementation and are an essential promoter of innovation (RQ3).

Having considered the sources interrogated for this study, it can be said that in addition to the information that is required to answer the research questions, other common findings were identified. There is an impact regarding competitiveness and additional economic effect of both clustered-companies and the regions where they are formed (Laiko et al., 2020) [25]. This impact of clusters on regional development can be observed in more current research. If in the works of Bekele & Jackson, 2006 we could observe that industrial agglomerations could not be attributed the premise that they contribute to the development of a region, in more recent studies we can observe the tendency to link regional competitiveness and regional development with the functioning of a cluster in that area (Gashawbeza et al., 2006)[16].

CONCLUSIONS

Briefly, clusters have an impact on the increase of competitiveness of both companies and regions. The more mature and cooperation-oriented the transfer of knowledge from inside and outside the cluster is, the more this informational and knowledge flow has a significant impact. In the current economic context, which is no longer a closed and regionally blocked system, clusters can be a strong link between regional economies and similar global economies in terms of adopters of new innovations, transfer of knowledge in both directions inside and outside the cluster. Clusters can also be used as the main entities responsible for the implementation of policies applied on a large scale, an advantage given by the connections and networks they include.

A suitable approach might involve defining a cluster model that takes into account the cluster's life cycle. This will enable us to determine the cluster's operating direction based on the cluster's components at a particular time. It is important to note that if the members who initially directed the action in the component of a cluster have either withdrawn or are technologically outdone, or if the new companies in the cluster are innovative or making technological advances, then the cluster itself must adapt its strategy in

accordance with the directions given by that group of active and relevant companies in the cluster. The current work, based on the data obtained and analyzed, contributes to the specialized literature by offering some perspectives on how clusters and their attributes have evolved in the economy.

This study has several limitations that should be considered when evaluating its results. As a starting point, papers were gathered from only three databases: Scopus, Science Direct, and Web of Science. Furthermore, it was observed that varieties often used to describe clusters, such as geographical agglomerations, economic concentrations, and special economic zones were not included in the combinations of words chosen to gather the specialized literature. Thirdly, because of the search criteria, papers published in other languages were excluded.

In terms of exhaustiveness, this review could have been more comprehensive if other databases had been queried or if other sets of words and languages had been included.

The current paper was based on a synthesis of the literature covering a complex concept, it is clear that the current paper does not delve deeper into the concepts, but provides an overview of the dynamics of the cluster concept being evaluated in an evolutionary perspective. On the other hand, what was found could also be applicable in other fields. Further research could also focus on studying the interconnectivity between clusters operating in the same region, even if the industries they operate in are different, to see if geographic proximity is indeed an impact factor.

To deepen, a study on the relationship between the theory of industrial organization and the impact that clusters have on the strategic decisions that companies make could constitute another future research direction.

The data related to the influence of clusters on increasing competitiveness are empirical and a more in-depth analysis based on a quantitative analysis that includes various criteria, from economic performance to visibility or even customer loyalty, would be recommended. Also, a study that is based on a wider evolution over time.

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