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# BOLETIM DE CONJUNTURA

## BOCA

Ano VI | Volume 17 | Nº 51 | Boa Vista | 2024

http://www.ioles.com.br/boca

ISSN: 2675-1488

https://doi.org/10.5281/zenodo.10969167

BOLETIM DE CONJUNTURA

www.ioles.com.br/boca

# DEVELOPMENT STAGE AND DEGREE OF ORGANIZATION OF LOCAL PRODUCTIVE ARRANGEMENTS IN THE STATE OF PARANÁ, BRAZIL

*Maria Isabel Schierholt*[1]

*Marcelo Corrêa da Silva*[2]

*Rafael Todescato Cavalheiro*[3]

*Ricardo Guimarães de Queiroz*[4]

*Régio Marcio Toesca Gimenes*[5]

**Abstract**

The contingencies of a globalized market perfected that cooperation and collaboration through clusters makes companies gain staff to become more competitive. For the policies of the clusters to be efficient and effective, it is necessary to understand at which stage of the life cycle these arrangements are positioned. Thus, the objective of this study is to classify 24 clusters in the state of Paraná using an integrated model in order to identify the evolution cycle of each arrangement through its Development Stage (DS) and its Degree of Organization (DO). For this, with data collected through questionnaires in loco, the model was applied using a system of 58 indicators, subdivided into 9 dimensions. In view of the importance of Agribusiness in the state of Paraná, the study compared the evolution of the clusters linked to this sector with those of the others. The results revealed that there are four different hypotheses regarding the evolution cycle of the clusters in the state of Paraná. Two extremes were observed: the Maringá Software LPA was the only mature and innovative cluster; the LPA for Agricultural Equipment in the Cascavel region was the only informal and emerging one. In general terms, as partnership actions with teaching and research institutions were too discreet. Still, although agribusiness is the main economic matrix in the state of Paraná, clusters of other sectors have a similar evolutionary cycle. Finally, the results of the study serve as support for the development of strategic plans and decision return, with attention to the specificities and the evolutionary status of each cluster.

**Keywords**: Cluster; Life Cycle; Local Networks; Productive Clusters; Regional Development.



**Resumo**

As contingências de um mercado globalizado sugerem que a cooperação e a colaboração através de clusters faz com que as empresas ganhem forças para se tornarem mais competitivas. Para que as políticas dos clusters sejam eficientes e eficazes se faz necessário entender em qual fase do ciclo de vida esses arranjos estão posicionados. Assim, objetivou-se neste estudo classificar 24 clusters do estado do Paraná recorrendo a um modelo integrado com o intuito de identificar o ciclo de evolução de cada arranjo mediante seu Estágio de Desenvolvimento (ED) e seu Grau de Organização (GO). Para isso, com dados coletados através de questionários in loco, utilizou-se o modelo utilizando um sistema de 58 indicadores, subdivididos em 9 dimensões. Diante da importância do Agronegócio no estado do Paraná, o estudo comparou a evolução dos clusters ligados a este setor com os dos demais. Os resultados revelaram que existem quatro situações distintas em se tratando do ciclo de evolução dos clusters no estado do Paraná. Observou-se dois extremos: o APL de Software de Maringá foi o único cluster maduro e inovador; o APL de Equipamentos Agrícolas da região de Cascavel foi o único informal e emergente. Em termos gerais, as ações de parceria com instituições de ensino e pesquisa foram demasiadamente discretas. Ainda, embora o agronegócio seja a principal matriz econômica do estado do Paraná, clusters de outros setores apresentaram ciclo evolutivo similar. Por fim os resultados do estudo servem como subsídio para desenvolvimento de planos estratégicos e tomada de decisão, com atenção para as especificidades e o status evolutivo de cada cluster.

**Palavras-chave**: Aglomerados Produtivos; Cluster; Desenvolvimento Regional; Redes Locais; Vida Útil.

[1] Ph. D. candidate in Agribusiness at the Federal University of Grande Dourados (UFGD). E-mail: mariaisabelschierholt@gmail.com

[2] Ph. D in Animal Science at the Federal University of Goiás (UFG). E-mail: marcelo-correadasilva@gmail.com

[3] Ph. D. candidate in Controllership and Accounting at the University of São Paulo (USP). E-mail: rafaeltodescato@hotmail.com

[4] Professor of the at the State University of Mato Grosso do Sul (UEMS). Ph. D. in Agribusiness. E-mail: rgq7@yahoo.com.br

[5] Professor at the Federal University of Grande Dourados (UFGD). Ph.D. in Production Engineering. E-mail: regiogimenes@ufgd.edu.br

## INTRODUCTION

With the advent of globalization and a more competitive market, several types of organizational arrangements emerged that changed the traditional concept of a firm. In this significantly changed environment, the search for alternatives and opportunities to expand their creative and entrepreneurial potential has become a fundamental requirement for the survival of certain types of companies.

These alternatives are essential to obtain lasting competitive advantages in the long term, assuming that small companies that are not organized to compete in this scenario are doomed to decline. One of the alternatives for the survival of these companies is interorganizational cooperation. While competition is still a reality, this approach offers a new paradigm. Here, companies are challenged to operate synergistically, streamlining their activities with the aim of maximizing their performance. In this sense, collaborative practice translates into competitive advantages that would be considerably more complex to achieve in a context of individualized action. Therefore, this research focuses on the topic of inter-organizational cooperation through the analysis of the development stage of Local Productive Arrangements (LPAs) and also their degree of organization.



Cooperation between companies in the same industry can improve quality and productivity, reduce costs, manufacturing time and disseminate knowledge. This cooperation can occur in different ways, and can be called clusters, company networks, production clusters or Local Productive Arrangements (LPAs). In Brazil, the concept of cluster is close to the definition of LPA and is therefore treated as synonymous terms in this research. Thus, LPAs are an important form of productive organization, which can impact economic and social development at a local, regional or national level. Therefore, it has the ability to exert pressure on strategic relationships by investing in education and marketing, in addition to presenting strong local know-how, with a well-defined relationship between suppliers and customers.

Given the potential of LPAs as a form of business action and as a model of public policy focused on regional development, it is important to diagnose which phase the clusters are in, both for their management and progress, and for public managers who need make resource allocation decisions and institutional support. The evolution of LPAs is marked by different stages and the behavior of companies tends to change as the cluster develops. This observation is crucial to enhance your development. Furthermore, identifying the evolutionary stage and degree of organization of a cluster may direct public policies towards adopting more efficient actions for the moment, given that these policies are different, depending on whether the cluster is positioned in more or less advanced stages.

Given this brief context, the aim of this study was to classify the clusters based on their Development Stage (DS) and Degree of Organization (DO). To meet the proposed objectives, the method used in this research was the Indicator System (IS), which uses the integrated cluster classification model based on its Development Stage (DS) and Degree of Organization (DO) to provide a diagnostic of the process of evolution of these arrangements with the aim of guiding strategic decisions.

As the focus of the study, it was chosen to analyze the LPAs located in the state of Paraná, given their importance for the Brazilian economy and due to the previous mapping of the clusters located there. Furthermore, it was possible to ensure a network of local contacts that enabled the collection of primary data, through on-site semi-structured interviews, used in the research that used descriptive analysis and the IS methodology to calculate dimensions and indicators.

In this way, this research is justified by the importance of diagnosing the development stage of LPAs (life cycle) and to support comparative analyzes between the arrangements of the same economic sector, their market structures and level of articulation between the agents that compose them, thus being able to improve public policies. It is worth noting that public policies affect the development of the cluster and the premise that different measures vary in effectiveness throughout the cluster's life cycle encourages the study of the evolution of clusters. Furthermore, public policies depend on the historical, political and economic context in which the clusters are located. Furthermore, for them to be effective it is necessary to take into account the stages of their life cycle.



The contribution of the present study goes beyond the advances in academic literature on LPAs, considering that the results presented here have the potential to support public policies aimed at promoting arrangements that are still in the initial stages of development. Thus, by presenting the classification of clusters and highlighting which factors need to be improved, a robust diagnosis is offered so that the actors coordinating the arrangements can modify their form of management, focusing on less developed factors and skills, as well as being able to represent a guiding instrument for the agents involved in each arrangement, whether they are managers, researchers or public agents with a greater or lesser degree of decision-making power.

The structure of this research is composed of this brief Introduction that presents the theme, followed by the Theoretical Framework that supports this research, subsequently, the Methodology used is presented as well as the form of data analysis, after that, the Results obtained by this research, its Discussion and content analysis and finally the Final Considerations.

## LITERATURE REVIEW

The integration of national markets to world markets and the changes caused in territories by technological innovations have produced a multitude of studies on the inter-firm relationships immersed in the local production system. This growing literature around the world, in essence, deals with the search for competitive advantage and local development from the cooperation between companies in the form of clusters, networks of companies, local productive arrangements (LPAs) or many other concepts that identify groups of local companies working together (ALBUQUERQUE; LIMA, 2011; BORIN, 2006; HUMPHREY; SCHMITZ, 2000; UZZI, 1997).

Second Fuini (2013), LPAs are more flexible organization alternatives within the industrial space. In Brazil, their concept was systematized by researchers from the Research Network on Local Production and Innovation Systems of the Institute of Economics of the Federal University of Rio de Janeiro (REDESIST) as territorial agglomerations of economic, political and social agents, focusing on a specific set of economic activities, with links, even if incipient, with the participation and interaction in companies involved in the entire production chain (LASTRES; CASSIOLATO, 2004).



Sacomano Neto and Paulillo (2012) claim that LPAs are concentrations of companies that develop similar or interdependent activities in space, regardless of the economic sector of which they are part, operating in an artisanal way, with little dynamism, up to arrangements that are structured with great division of work between firms and products. They also emphasize that an LPA can encompass a locally structured production chain or concentrate on one or a few links in a chain of greater spatial scope, be it regional, national or even international.

It is worth noting that the term LPA was used as a synonym for cluster in this research, therefore it is essential to understand these concepts. According to Porter (1998), a cluster can be formed by interconnected and geographically concentrated companies and institutions, which can simultaneously promote cooperation and competition, as these occur in different dimensions and actors. In this way, clusters can be understood as supra-business systems with an evolutionary character and characteristics that promote competitive advantages (VIERA *et al*., 2023).

Cluster analysis has a broad research perspective, as it can be studied from different perspectives (CASSANEGO JÚNIOR; ARAÚJO, 2022). Thus, the theme provides a wide range of studies such as: investigation of cluster strategy, governance, competition, life cycle, local development, among others. Research in this area can also cover sectoral studies, such as furniture manufacturing (DELIBERAL *et al*., 2016), clothing (LACERDA *et al*., 2016), footwear (RIBEIRO; CHAUSCA, 2020), wines

(RODRIGUEZ *et al*., 2021), commercial agglomerations (GALANOS *et al*., 2022) in addition to the analysis of the life cycle phase of a cluster (MENZEL; FORNAHL, 2010).

Viera *et al*. (2023) carried out a systematic review of the literature on commercial clusters, highlighting the recent interest in the topic, due to the growth in publications from 2021 onwards. After an extensive review, the authors conclude that scientific production on commercial clusters is incipient, a topic which could form a promising research agenda.

Schierholt *et al*. (2022) carried out a state-of-the-art survey on the life cycle of clusters, through a systematic review. The results show that the topic is not new, but over the years there have been variations in the volume of publications. However, it is possible to observe a low number of authors (26) who evaluated the phase of the life cycle in which the clusters were found, with several authors approaching the life cycle in 4 phases: emerging, growth, maturity and decline (MENZEL; FORNAHL, 2010).

To understand the importance of these clusters, studies have focused on analyzing the spatial distribution to identify patterns of industrial specialization and concentration (OLIVEIRA; LIMA, 2017; DE LIMA *et al*., 2014; DE LIMA; ANSCHAU, 2013; WILLERS *et al*., 2011). Other studies have also contributed to the understanding of the evolution stages of clusters, whose dynamics are influenced by endogenous and exogenous conditions such as: historical regional development, pre-existing market structure, local demand, expertise and innovation, in addition to public support policies articulated with the actors of cooperation networks (BERNELA *et al*., 2019; GRILLITSCH *et al*., 2019; VANTHILLO *et al*., 2018; ELOLA *et al*., 2017; INGSTRUP; DAMGAARD, 2013; ELOLA *et al*., 2012; SHIN; HASSINK, 2011; MENZEL; FORNAHL, 2010; PROPRIS; LAZZERETTI, 2009; SADLER, 2004).



For Shin and Hassink (2011), it is possible to analyze the evolution of clusters in 4 distinct phases: development, expansion, maturation and transition. This last phase is characterized by a reorientation of the companies' roles in the chain, through the emergence of new, very valuable local know-how and the ability to reorganize it within the cluster.

Menzel and Fornhal (2010) also identify 4 different stages in the development of clusters, however, they name the fourth phase as a phase of decline or renewal, that is, there are two ways in which the maturation stage can end. The first follows the cluster cycle: a decreasing diversity on a one-way trajectory that causes the cluster to decline. The second is a setback in its life cycle through the generation of new heterogeneity and a parallel change of the thematic boundary through innovation, which results in a new phase of growth (renewal).

Therefore, innovation and knowledge constitute essential elements for the renewal and success of some clusters. In the context of the relationship between clusters and technological learning, two

concepts emerge: that of innovative means, which are constituted as spaces equipped with innovation networks that develop through learning and absorb the externalities of innovation; and productive and innovative systems that are arrangements capable of increasing endogenous technological innovation and local competitiveness through cooperation and learning from interactions and links between companies participating in the network (CASSIOLATO; LASTRES, 2003).

When analyzing the manufacturing and service industries in China, Yang and Dunford (2016) verified the importance of technological innovation and the development of new products as fundamental to avoiding the regional lock-in of the cluster. However, Jia *et al*. (2015) state that although the impact of the industrial cluster and the internal innovation network has a positive effect on improving regional innovation capacity, they are clearly less important than labor, capital and other factors. Industrial clusters are not formed for technical innovation, but for resource location and market environment advantages. Therefore, according to these authors, it is the Government's role to undertake actions to establish more relevant policies by increasing innovation networks.

In this way, these policies can take different forms such as investments in research, professional training and infrastructure, commercial policies and means to encourage demand. However, for them to be effective, it is important to consider the stage of the cluster's life cycle (ELOLA *et al*., 2017).



To establish a systematic approach to how cluster policies can affect the emergence and evolution of clusters, the model by Brenner and Schlump (2011) suggests six categories of policies aimed at each phase of a cluster's life cycle: education (present at the throughout the life cycle phase of agreements), public research (basic in the early stages, but also vital to avoid lock-in and decline), support for research and development and culture (important in the early stages to improve innovation processes, but essential to avoid the decline of existing systems), support for start-ups (present throughout the entire life cycle of agreements), support for networks and regional cooperation (most relevant policy in the initial and expansion phases) and infrastructure and local conditions (larger investments will be made when the cluster is mature and consolidated, thus reducing uncertainties related to this capital investment).

In this way, the exchange of information and knowledge supports organizations in the search for alternatives and the development of innovations during a possible crisis. Strategic planning can be useful for cluster orchestrators and government organizations, even in the sense of carrying out regional development planning (SCHIMIDT *et al*., 2023). Public policy decision makers play an active role in promoting the resilience of regions, focusing resources and efforts on the right policy areas, without waiting for possible crises, serving as individual guidance to the companies in the cluster regarding what they should seek to promote in their partner networks (DI CARO; FRATESI, 2018). Harris (2021) and

Mackinnon *et al*. (2019) also pointed out that a number of actors in clusters can leverage and combine intra-regional and extra-regional assets to support their economic development.

However, knowledge transfer in the cluster is influenced by several factors, such as: cooperation, relationships with institutions, workforce mobility and geographic proximity. Some act as facilitators (when their action creates or expands the transfer of knowledge), others as inhibitors (when their absence or greater action inhibits the emergence or restricts the transfer of knowledge in the cluster), preventing the emergence of knowledge transfer or restricting its results (FIORAVANTI *et al*., 2023).

For Wu and Coe (2023), local governments could first investigate who the most influential and well-connected individual actors are in the sector in question and generate a directory of them, and then they could devise favorable policies to encourage these key individuals to become involved in the cluster, providing them with incentives such as financial and reputational rewards. Bittencourt *et al*. (2020) state that in the initial stages, the cluster presents greater volatility and instability, since the actors have not yet defined their roles within the cluster. As the cluster grows, the preferential connection mechanism tends to make it more stable, solidifying the relationships and positions of agents within the network (SUIRE; VICENTE, 2014; TER WAL; BOSCHMA, 2011).



For Galanos *et al*. (2022) a cluster is competitive, but to obtain more advantages it must improve collaboration between public and private agents. In this way, it becomes possible to develop strategies to increase the competitive dynamism of the cluster, intensifying interaction between interested parties. The group's increased competitiveness affects the region's socioeconomic development, in addition to providing a broad mix of products to meet customer demand.

Therefore, over time, and after the end of the initial phase of a cluster and as it grows and develops becoming more stable, there is a better relationship between the parties involved, making the activity more solidified, resulting in benefits for those involved.

## MATERIAL AND METHOD

The method used to carry out this study was the Indicator System (IS) proposed by Amato Neto (2009). This system uses the integrated cluster classification model based on their Development Stage (DS) and Degree of Organization (DO), aiming to classify the clusters located in the State of Paraná by comparing their evolution over time. This system provides a diagnosis of the evolution process of these arrangements with the aim of guiding strategic decisions.

This study used an exploratory qualitative methodology, based on a bibliographic survey on the proposed topic and the collection of primary data. The Paranaense Institute for Economic and Social

Development (IPARDES) database was used to map and select existing LPAs in the State, with 22 clusters previously selected.

The application of the IS (9 dimensions and 58 indicators) was carried out through semi-structured interviews, on site, with agents in each of the clusters, following the procedure adopted in the literature (MOBEDI; TANYERI, 2019; VANTHILLO *et al*., 2018; FELZENSZTEIN *et al*., 2018; HERVAS-OLIVER *et al*., 2017; TOMLINSON; BRANSTON, 2014; ELOLA *et al*., 2012). In each of the arrangements, an agent was contacted, who could be the manager of this arrangement when clearly identified and otherwise, the leader or entrepreneur representing the main company in the cluster. Initially, the interviews were carried out in the 22 previously selected clusters, however, throughout this phase, 2 more clusters were identified, thus totalizing 24 clusters analysed by this research.

At the end of the data collection stage, they were tabulated using Microsoft Excel software, version 2017. A descriptive statistical analysis was used to understand the information collected and the calculations referring to the IS (dimensions and indicators) followed the methodology applied by Amato Neto (2009). Finally, to better visualize the results, graphs and tables were created containing the main results of the research.



To carry out the literature review, it was chosen to search international databases: Web of Science, Scopus, Science Direct. This choice was made due to their importance, as they encompass the most influential journals, with relevance and breadth in the international academic community. In order to cover an abundant scope of articles in the area in question, a temporal delimitation was not established. The key words used in the search descriptors were: “cluster* life cycle” and “cluster* lifecycle”. Furthermore, filters were defined to delimit the articles: type of publication (research articles only), category in each database and language (English and Portuguese). Initially, the Title, Summary and Keywords of the selected articles were viewed to check whether they fit the scope of this research.

The segment clusters that make up this study are: (1) Aluminium from Francisco Beltrão; (2) Apucarana Caps; (3) Southwest Clothing; (4) Cyanorte Clothing; (5) Maringá Confectionery; (6) Terra Roxa Children's Clothing; (7) Agricultural Equipment of Cascavel and Toledo; (8) Campo Mourão Medical and Dental Equipment; (9) Campo Largo Crockery and Porcelain; (10) Timbers and Frames of União da Vitória; (11) Ponta Grossa knitwear; (12) Cassava and Starch from Paranavaí; (13) Furniture from Arapongas; (14) Ponta Grossa Metallic Furniture; (15) Southwest Furniture; (16) Furniture and Wood from Rio Negro; (17) Curitiba Software; (18) Londrina Software; (19) Maringá Software; (20) Lime and Limestone in the Metropolitan Region of Curitiba; (21) Imbituva Knitwear; (22) London Clothes; (23) Loanda Sanitary Metals and (24) Pato Branco Software.

According to Amato Neto (2009), the construction of an IS allows diagnosing a cluster, in addition to classifying it. Thus, managers and public agents can develop dimensions that are not so mature with due support to raise the levels of the clusters. The IS here proposed to diagnose the stage of evolution of Paraná clusters includes 58 indicators for the nine dimensions of analysis, which are:

1) **Geographical Dimension (IG):** It has 8 indicators that assess the cluster's gains derived from the positive externalities that occur due to the concentration of companies in each location.
2) **Economic Dimension (IE):** It has 8 indicators to determine the importance and representativeness of the cluster in generating income and employment in the region where it operates as well as in the national context.
3) **Institutional Dimension (II):** It has 7 indicators and refers to the relevant role of sharing infrastructure and transmitting knowledge and information in the interaction and cooperation between companies.
4) **Social Dimension (ISD):** It has 7 indicators and considers the innovative, entrepreneurial, participative, and associative character of the community and its importance in the sustainability of the cluster. It also assesses the impact of the cluster's actions in attracting new investments and the impact of professional training in meeting the demand of the units participating in the cluster.
5) **Technological Dimension (IT):** It has 6 indicators that identify the cluster's capacity for innovation and technological diffusion through research and development institutions. This dimension indicates the level of knowledge generation and communication between the cluster's productive units.
6) **Environmental Dimension (IA):** It has 11 indicators that measure how the cluster is positioned in relation to environmental responsibility practices, that is, how much the cluster's business units are engaged with the preservation of the environment in the region where they are located.
7) **Internationalization Dimension (IDI):** It has 4 indicators that measure the competitive capacity of companies in each cluster in the international market. This dimension measures export operations individually or collectively, which take place through export consortia.
8) **Governance Dimension (IGov):** It has 3 indicators that assess how productive activities are coordinated in the cluster, that is, which public or private agent, local, regional, or global, has decision-making power and intervenes in the way the companies in the cluster operate in relation to its input suppliers and consumer markets.
9) **Management Capacity Dimension (ICG):** It has 4 indicators that measure the performance of the management of companies participating in the cluster in their different specialties, such as production, finance, marketing and human resources.



The indicators were prepared for any type of industry or activity, regardless of size or level of revenue. From the application of the IS and the scores in each of the dimensions of analysis, the clusters were classified according to two criteria: Stage of Development (SD) and Degree of Organization (DO).

**Stage of Development (SD)**

The Development Stage allows the evaluation of the cluster's performance and comparison with other clusters that operate in the same sector of activity (BORTOLOTTI, 2005; AMATO NETO, 2009). To classify the cluster according to DS, the indicators of dimensions proposed by Bortolotti (2005) and Amato Neto (2009) were used, namely: geographic, economic, institutional, social and internationalization. According to the SD the cluster can be classified into one of the following stages:

a) **Embryo (0 < SD ≤ 1):** is the grouping initial stage, when the preconditions for the emergence of the cluster are presented.

b) **Emerging (1 < SD ≤ 2):** in this phase, the cluster has already passed the embryo phase and is in the process of consolidation, acting in public policies, stimulating the region's natural and social potential, and strengthening itself in its primordial needs.

c) **Expanding (2 <SD ≤ 3):** at this stage, the cluster already operates efficiently, but still supported by institutions and community. The productive units are already of great importance to the local economy and are growing in efforts towards a position in the national and international economies, identifying themselves with a specific industry.

d) **Mature (3 <SD ≤ 4):** Support institutions work fully and are accessible to all units participating in the cluster. Information sharing mechanisms, inter-company cooperation and the processes of diffusion of technological innovations characterize this stage. The cluster is a reference in its sector of activity and easily attracts public policy actions as its sustainability has relevant economic and social impacts for the entire community.



**Degree of Organization (DO)**

The Degree of Organization (DO) allows knowing the degree of technological development and the level of articulation between the cluster agents (BORTOLOTTI, 2005; AMATO NETO, 2009). The dimensions analysed according to the classification of the cluster according to DO are: technological, economic, institutional, governance and management capacity. According to this classification, clusters can be in the following categories:

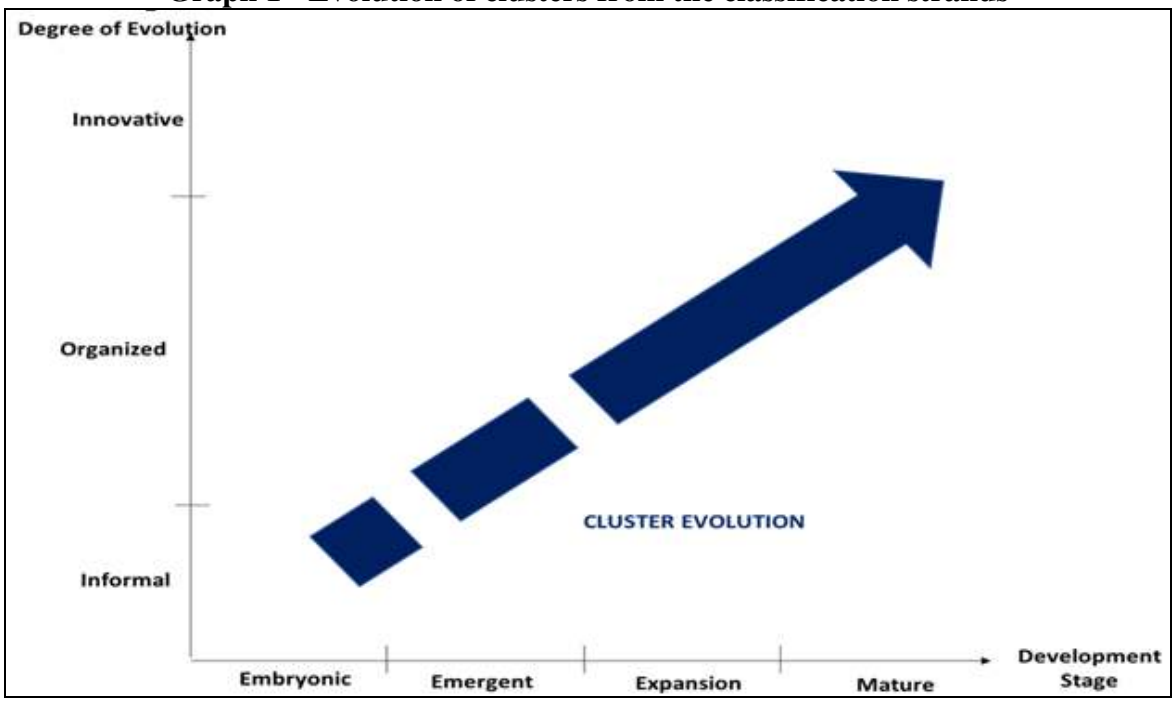
a) **Informal (0 <DO ≤ 1):** in this category, the cluster products are not differentiated, and its competition strategy is based on price, since its production processes and technologies are simple and well known in the market. Cooperation between companies in the cluster, customers, suppliers, and support institutions is practically non-existent. Clusters in their initial stage generally fall into this category, that is, the starting point for a development towards more structured categories.

b) **Organized (1 <DO ≤ 3):** it includes clusters that present greater differentiation in their products and brands, because of professional management and entry barriers for the competition. There is also a large volume of investments in equipment and technologies in the production process. In this category, there is greater cooperation between the companies in the cluster and greater intra-regional coordination between the institutions that exercise governance. It helps vertical specialization between the links in the production chain.

c) **Innovative (3 <DO ≤ 4):** the companies in this cluster have a flexible technology park, capable of quickly meeting the changing demands of their consumer market. They are capable of innovating and influencing the market in which they operate, including the foreign market, where a significant part of their production is destined. In this category, large companies exercise governance, inducing small and medium-sized companies to become specialized suppliers of products and services in the process of unbundling. The regional economy receives the impacts of the innovative cluster through the political-technical articulation of support institutions, enabling gains in scale and greater coverage for individual and collective companies, generating income and employment for the community in which they operate.

In summary, the methodology proposed by the IS application classifies clusters based on the relationships between Stage of Development (SD) x Degree of Organization (DO), as illustrated in Graph 1.

**Graph 1 - Evolution of clusters from the classification strands**




Source: Self elaboration. Adapted from Amato Neto (2009).

All questions had 5 (five) well-defined answer options, equivalent to points on a scale from 0 (zero) to 4 (four). Performance was measured so that, in each dimension evaluated, a score of 0 (zero) indicates the greatest weakness and a score of 4 (four) corresponds to the most advanced stage of development of the clusters.

Weights were assigned to indicators of the same dimension, using a value of 1 for the few important ones, 2 for the important ones and 3 for the very important ones, following the methodology of Amato Neto (2009). Thus, an indicator for each dimension was obtained by the weighted average of the responses obtained from the indicators representing the dimensions.

## RESULTS

Table 1 shows the evaluation of the clusters with averaged scores for Stage of Development (SD) and Degree of Organization (DO).

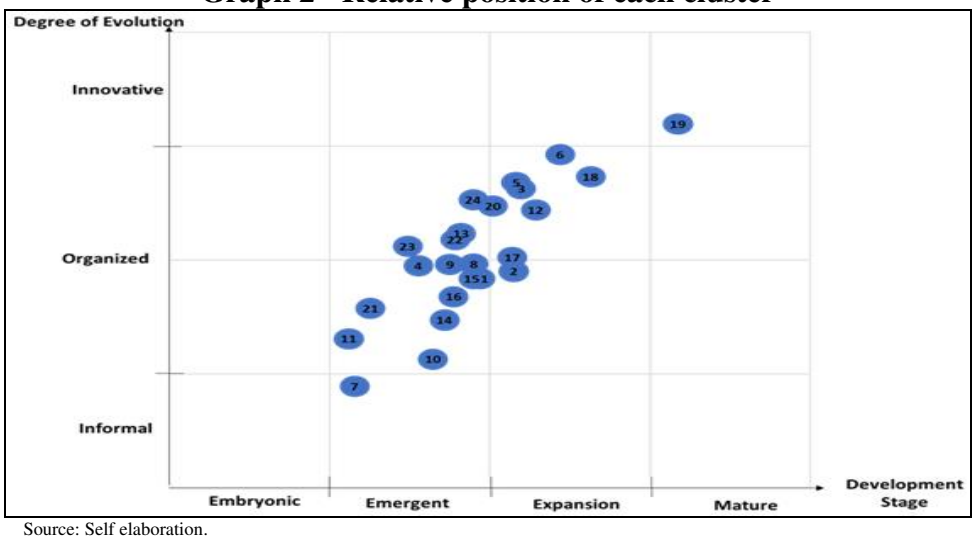
**Table 1 - Stage of Development (SD) and Degree of Organization (DO) of the clusters in the state of Paraná (2019)**

| Cluster | Identification | Development Stage | Degree of Organization |
|---|---|---|---|
| Software – Maringá | LPA 19 | 3,2 | 3,2 |
| Software – Londrina | LPA 18 | 2,6 | 2,7 |
| Baby Fashion Clothes - Terra Roxa | LPA 6 | 2,4 | 2,9 |
| Cassava and Starch - Paranavaí | LPA 12 | 2,3 | 2,4 |
| Clothing – Maringá | LPA 5 | 2,2 | 2,7 |
| Men's clothing - Francisco Beltrão | LPA 3 | 2,2 | 2,6 |
| Software – Curitiba | LPA 17 | 2,1 | 2 |
| Caps – Apucarana | LPA 2 | 2,1 | 1,9 |
| Lime and Limestone - Colombo | LPA 20 | 2 | 2,5 |
| Software - Pato Branco | LPA 24 | 1,9 | 2,5 |
| Medical and Dental Equipment - Campo Mourão | LPA 8 | 1,9 | 2 |
| Aluminium - Francisco Beltrão | LPA 1 | 1,9 | 1,8 |
| Furniture - Francisco Beltrão | LPA 15 | 1,9 | 1,8 |
| Furniture – Arapongas | LPA 13 | 1,8 | 2,2 |
| Clothing – Londrina | LPA 22 | 1,8 | 2,2 |
| Furniture - Rio Negro | LPA 16 | 1,8 | 1,7 |
| Crockery and Porcelain - Campo Largo | LPA 9 | 1,7 | 2 |
| Metallic Furniture - Ponta Grossa | LPA 14 | 1,7 | 1,5 |
| Clothing – Cianorte | LPA 4 | 1,6 | 1,9 |
| Timbers and Frames- União de Vitória | LPA 10 | 1,6 | 1,1 |
| Sanitary Metals- Loanda | LPA 23 | 1,5 | 2,1 |
| Knitwear – Imbituva | LPA 21 | 1,3 | 1,6 |
| Agricultural Equipment - Cascavel/Toledo | LPA 7 | 1,2 | 0,9 |
| Knitwear - Ponta Grossa | LPA 11 | 1,1 | 1,3 |

Source: Self elaboration.

The positions of each cluster are plotted in Graph 2, relative to the degree of evolution and stage of development.

**Graph 2 - Relative position of each cluster**



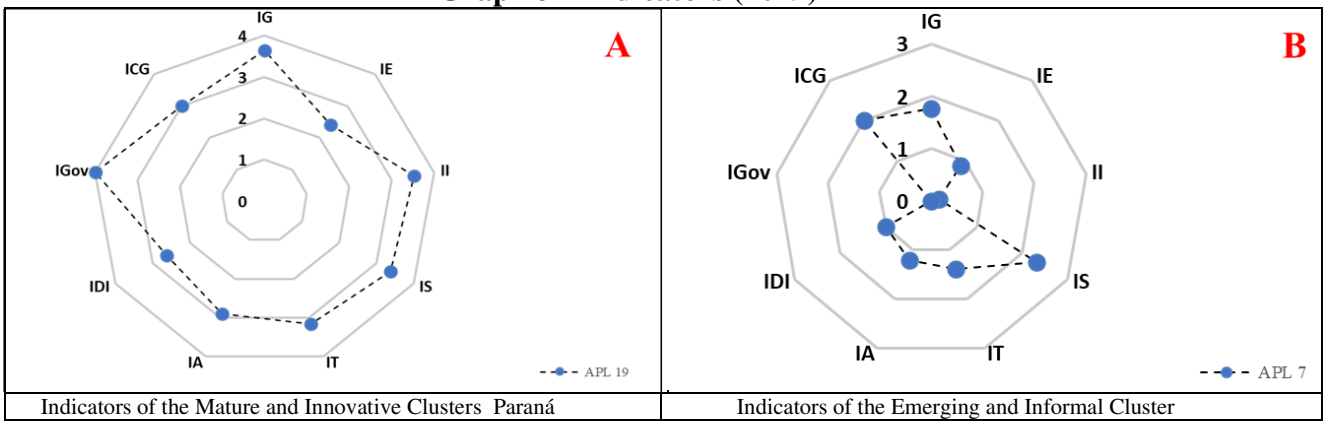

Source: Self elaboration.

The positions of the clusters according to Degree of Organization and Stage of Development, presented in Table 1 and Figure 2, reveal four distinct categories in the state of Paraná among the 12 possibilities for combining levels. Most LPAs were characterized as organized and emerging (58.33%) and then 8 clusters were classified as organized and expanding.

Only one cluster (Software of Maringá - LPA 19) was characterized as mature and innovative in the state of Paraná. This differs from other clusters by geographic, institutional, technological and governance advantages, as shown in Graph 3A.

Finally, the study identified a single emerging and informal cluster. This cluster, located in the Cascavel region, presents inefficient management techniques, scoring low on the indicators, except for the social dimension (Graph 3B). It lacks an agent to coordinate actions between companies for greater strengthening. More than that, it is a cluster with a low capacity for innovation, both in production processes and in the organizational sphere.

**Graph 3 – Indicators (2019)**




Indicators of the Mature and Innovative Clusters Paraná | Indicators of the Emerging and Informal Cluster

Source: Prepared by the authors (2023).
Note: IE = Economic Dimension; IG = Geographical Dimension; II = Institutional Dimension; IS = Social Dimension; IT = Technological Dimension; IA = Environmental Dimension; IDI = Internationalization Dimension; IGov = Governance Dimension e ICG = Management Capacity Dimension

This cluster, unlike the other twenty-three from Paraná, has a degree of organization considered informal due to the low indicators of Governance (Igov = 0) and Institutional (II = 0.2). In the governance structure of the Agricultural Equipment cluster, no agent was identified (no legitimacy), as well as any form of governance.

## DISCUSSION

The first classification found in the state of Paraná was the Maringá Software Cluster (LPA 19), the only mature and innovative one. Directly linked to innovation, it has highly qualified human capital

and robust structural capital. That is, a set of administrative systems, routines, processes that support Information Technology (IT) activities.

Geographical indicators show that this cluster has a strategic location, thus providing competitive advantages that reach the national consumer market. Except for industrial concentration, the indicators in this dimension had the highest score. Therefore, it is noteworthy that geographic concentration was not only influential in the initial phase but mainly in the development of the cluster (LAZZERETTI; CAPONE, 2016).

In addition, this cluster stands out in a peculiar way in governance, institutional and internationalization assessments. The indicators of the institutional dimension reveal the presence of specific credit lines for the companies in the cluster, in addition to support actions by entities such as the Federation of Industries of the State of Paraná (FIEP), the Brazilian Support Service for Micro and Small Enterprises (SEBRAE) and the National Service for Industrial Learning (SENAI) and the presence of employers' unions. These findings are in line with the results of Täube, Karna and Sonderegger (2019). When analysing the arrangements of the IT sector in India, the authors verified that the interaction of local and non-local networks was fundamental for the continuous evolution of the clusters.



In addition, the presence of these networks and public policy actions that go beyond the municipal sphere, plus the cluster's insertion in the international market through participation in international fairs, are characteristics of mature clusters that operate in well-established regional cooperation networks (MENZEL; FORNHL, 2010). These characteristics were decisive to differentiate the Maringá cluster from the other two arrangements, located in Curitiba (LPA 17) and in Londrina (LPA 18), which were classified as expanding and organized.

The second classification, that of organized and expanding clusters, represented 33.33% of the sample (LPA 2, LPA 3, LPA 5, LPA 6, LPA 12, LPA 17, LPA 18, and LPA 20). This expansion phase of the development stage was characterized by the alignment of local conditions, such as qualified labor, training, suppliers, and institutions (BERGMAN, 2008). A notorious asymmetry was observed between the arrangements characterized as organized and expanding. This shows that, despite receiving the same classification, there is great intra-group variability, with specific demands and situations for each cluster.

The Londrina Software Cluster (LPA 18) came close to becoming an innovative cluster (ED = 2.7) due to good indicators of governance (Igov = 4.0) and management capacity (ICG = 3.0). To improve the degree of organization of this cluster, an improvement in the technological dimension is necessary. Although Londrina has a nationally recognized State University (Londrina State University), there are no partnerships between educational institutions and companies that make up the cluster.

Like the Londrina Software Cluster (LPA 18), the Terra Roxa Baby Fashion Cluster (LPA 6), also came close to becoming Innovative (G.O = 2.9). The innovation process identified in the Terra Roxa cluster is probably the result of representative entities that defend the interests of the cluster, the practices of sharing services between companies, the presence of expressive employer unions, access to credit lines directed to their needs, and the presence of quality certificates and products sold with identification. In addition, LPA 6, as well as LPA 18, had the highest scores in the governance dimension, demonstrating a coordination process between cluster actors that contributes to achieving common goals, which justifies a transition to a more innovative level.

However, the internationalization indicators (IDI), with inexpressive performance, are an obstacle for the clusters to become more mature. These arrangements will be developed focusing on the possibility of insertion in the international market. Internationalization can influence product and service innovation and be a successful strategy (CHENG; BOLON, 1993; KAFOUROS *et al*., 2008; HITT *et al*., 1994), despite being one of the most difficult challenges (BELUSSI; SEDITA, 2009).

In the textile industry, innovation follows world fashion trends for the launch of collections. The manufacturing clusters of Maringá (LPA 5) and Francisco Beltrão (LPA 3) need to pay attention to this dynamic. The Maringá cluster (LPA 5) presents a better performance than Francisco Beltrão (LPA 3) when the technological indicators are analysed. However, they are similar in terms of governance and management capacity of companies. Studies involving clusters in the textile industry found that the development of arrangements is neither linear nor predictable. Adaptation to changes in the external environment and internal challenges is necessary. Furthermore, to deal with uncertainty, a risk-averse profile for financial security is important (CARLI; MORRISON, 2018; SCHIELE *et al*., 2012).



Differently from the other clothing clusters, the Cianorte (LPA 4) and Londrina (LPA 22) clothing clusters and the Ponta Grossa (LPA 11) and Imbituva (LPA 21) knitwear clusters are classified as emerging and organized, this being the third classification found in this study, more frequent and common to 14 clusters.

These arrangements, as they are emerging, are characterized by business consolidation, local infrastructure, and some level of business cooperation that favour the cluster. Of these arrangements, Francisco Beltrão's Aluminum cluster is close to surpassing the emergent stage (DE = 1.9) to the expansion stage. For this, it needs to focus on joint business actions and partnerships with educational and research institutions to meet the demands of the cluster.

The knitwear production clusters (LPA 11 and LPA 21) are similar in that they are geographically distant from both raw material suppliers and other inputs. The lack of partner industries that make up the same production chain makes it difficult to take advantage of the externalities that are

so characteristic of clusters. The low interaction of local businesses reflects on the companies' gross revenue, demonstrating a poorly consolidated production chain, which hinders the development of these two arrangements. The Cianorte (LPA 04) and Londrina (LPA 22) Clothing clusters also have this limitation. Furthermore, they do not have public policies to drive business and cluster development.

Three other arrangements are also in the emerging phase: Medical and Dental Equipment of Campo Mourão (LPA 8), Crockery and Porcelain of Campo Largo (LPA 9) and Sanitary Metals of Loanda (LPA 23). The Campo Mourão Medical and Dental Equipment cluster (LPA 8) is geographically distant from both raw material and other input suppliers. Although it receives support from institutions representing the sector, such as FIEP, SEBRAE and SENAI, there are no public sector actions specifically aimed at the needs of these local entrepreneurs.As in the medical technology clusters of Sweden and Vienna (Austria), programs and support policies coordinated between regional, national and international actors are fundamental and must play a continuous role in the development of the arrangement (GRILLITSCH *et al*., 2019).

The strengths of the Crockery and Porcelain Cluster of Campo Largo (LPA 9) are the geographic indicators. The proximity to suppliers and the abundance of raw materials become a competitive advantage. The strong interaction and learning with suppliers shape the companies' capabilities and increase their competitiveness, similarly to what was observed in a pottery cluster in Santa Gertrudes/SP (GEROLAMO *et al*., 2008; SCUR; GARCIA., 2019).



The three furniture arrangements (Arapongas – LPA 13, Francisco Beltrão – LPA 15 and Rio Negro – LPA 16) and metal furniture from Ponta Grossa (LPA 14) are also in the emerging stage. The latter (LPA 14) has practically no innovative characteristics (IT = 0.5) and, according to the managers consulted, there was no evidence of actions aimed at internationalization. Furthermore, although the coordinating agent of the cluster activities is identified, he does not belong to the cluster and, therefore, has low representation among the companies. Finally, this arrangement shows a low flow of knowledge given the lack of partnerships between teaching and research institutions and the companies that make up the cluster. Even so, there is no predisposition of actors to interact outside the cluster, which was also observed by Abbasiharofteh and Dyba (2018) in Polish clusters in the furniture sector.É recomendável o forte investimento na estrutura de gerenciamento, qualificando seus gestores para aprimorar os processos de gestão internos da empresa, e o incentivo a uma liderança participativa e aberta a novas ideias fortalecendo os interesses do cluster.

This communication between actors can generate new procedures that will possibly transform the organizational climate towards more trust and cooperation (GUIMARÃES *et al*., 2016). The furniture clusters in the state of Paraná follow this pattern and are aligned to promote product launches

annually, thus improving their competitiveness in the domestic market. Both have a governance structure according to the analysed IGov indicators and are geographically close. However, it is a low-technology sector with a high concentration of labour. For these arrangements, it is suggested the adoption of measures to facilitate communication and exchange of knowledge between companies, enhancing sustained competitiveness and the dissemination of best practices between them (SALA; CASTELLANI, 2009).

Finally, the study identified the Equipment and Implements cluster (LPA 7) as the last with emergent and informal characteristics. Low levels of governance and management capacity are the main indicators of informality in this arrangement. Governance shows the role of local and external actors in coordinating production systems and developing the productive and innovative capacity of companies (STALLIVIERI, 2012). Seen as a structure of power distribution among agents, governance is also important for the elaboration of business strategies and public policies (AMARAL FILHO, 2011).

This lack of cooperation weakens the cluster as local agents do not collaborate with LPA companies, thus not establishing cooperative relationships between customers, suppliers, and support institutions (BORTOLLOTI, 2005). Institutional indicators confirm this deficiency, demonstrating a low degree of cooperation between cluster companies and professional associations, credit and development institutions, marketing & promotion services, among others.



The indicators show that, given the agricultural potential of the state of Paraná, policies to encourage the most diverse forms of learning, creation and dissemination of knowledge are essential for the evolution of the cluster. Consequently, innovative processes can increase their productive capacity and competitiveness (TATSCH, *et al*., 2015).

## FINAL REMARKS

This study aimed to identify the characteristics of clusters in the state of Paraná - BR and classify them through their stage of development and degree of organization. For this, the integrated cluster classification model proposed by Amato Neto (2009) was applied, whose quantitative data were collected by applying structured questionnaires to an agent in each cluster.

The analysis allowed us to group 24 arrangements into four clusters: mature and innovative, organized and expanding, organized and emerging, and emerging and informal. It was observed that clusters have very similar characteristics even when in different classifications. On the other hand, the intragroup diversity is notorious, with arrangements already turned to a more advanced stage, while others still present characteristics of the previous stage of development.

It is worth noting that despite some arrangements having similar initial conditions, being in geographically close cities and belonging to the same economic activity, their development was not linear. Thus, the importance of the capacity for transformation and adaptation of each of them is evident when faced with internal changes and external shocks.

This article has illustrated the current status of each of the arrangements. The characterization of the stages of development is essential to guide public policies that avoid wasting resources, as the sectorial needs differ according to the stage of development of each cluster. The proposed diagnosis of the arrangement life cycles is relevant to guide not only public agents but also business managers in their decision making.

Early-stage clusters, immature or organized, need to strengthen their networks, as cooperation is essential at all stages of the life cycle. This can be done with meetings and lectures offered by the participating companies, training in professional qualification, investments in marketing, etc. These joint business actions can increase the cluster's regional and national visibility. Self-promoting clusters can rise credibility with the public sector to attract investments in infrastructure, access credit and receive tax incentives for business development.



In arrangements already developed, investments in human capital must be continued with a focus on specialization and renewal of local and non-local networks. At this stage of development, policies must be effectively oriented towards positioning clusters in a global network. Cooperation for joint activities should not be limited and there should be no risk of decline or entrapment.

The study has some limitations. For example, in some cases, governance indicators were not very comprehensive, focusing on only one of the governance pillars. Another limitation was the analysis of the arrangements at a given time, making the diagnosis look like a photograph of their characteristics. In future studies, it is recommended to include a time series component that allows evaluating the development of clusters within a predetermined period. This assessment is also relevant to monitor the effectiveness of policies applied to clusters.

The identification of the development stages of a cluster requires a complex approach, with dynamic variables and characteristics that complement each other, requiring continuous follow-up to carry out support actions and policies, aiming at greater collective efficiency.

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Ano VI | Volume 17 | Nº 51 | Boa Vista |2024

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