

Cluster Life Cycle: A Study in the Vale dos Sinos Footwear Cluster

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ABSTRACT

This paper aims at analyzing the stages of the lifecycle of clusters, based on four dimensions: diffusion of knowledge in the cluster, competitive advantage, structure of cluster and policies for clusters. For that, the Footwear Cluster of Vale dos Sinos-Paranhana in Rio Grande do Sul was chosen as a study object. The results point out that the cluster is little collaborative and little innovative. The cluster is still recognized as a great footwear producer, but the own identity of the people with the cluster is being lost. The local culture does not promote the diffusion of knowledge due the companies are closed. This research contributes with the comprehension of how the clusters develop, for this purpose, the flow of knowledge will have a central role in the renewal of the cluster. As a practical implication, the awareness of the difficulties and the necessary mechanisms to renovate a cluster are important so that it is possible to work on sectoral policies and of cluster. As theoretical contribution, the study reinforces that the lack of new knowledge influences the imprisonment, resulting from its dependent trajectory, leading it to the decline.

PALAVRAS-CHAVE

Cluster, ciclo de vida, estágios de desenvolvimento, declínio e renovação de cluster.

RESUMO

Esta pesquisa tem como objetivo analisar a relação entre fluxo de conhecimento, o lock-in e o estágio do ciclo de vida de um cluster. Para tanto, o Cluster Calçadista do Vale dos Sinos-Paranhana no Rio Grande do Sul foi escolhido como objeto de estudo. Os resultados apontam que o cluster é pouco colaborativo e inovativo. O cluster ainda é reconhecido como um grande produtor de calçados, mas a própria identidade das pessoas com o cluster está se perdendo. A cultura local não promove a difusão do conhecimento, uma vez que as empresas são fechadas. Esta pesquisa contribui com a compreensão de como os clusters se desenvolvem, para tanto, o fluxo de conhecimento terá um papel central na renovação do cluster. Como implicação prática, a consciência das dificuldades e dos mecanismos necessários para renovar um cluster são importantes para que seja possível trabalhar as políticas setoriais e de cluster. Como contribuição teórica, o estudo reforça que a falta de novos conhecimentos influencia o aprisionamento, o qual é decorrente da dependência de trajetória, levando-o ao declínio.

1 Introduction

Despite globalization, many scholars argue that the location can explain the competitive advantage of firms and regions (Giuliani, 2005; Porter, 1998). Several studies show that the agglomeration of firms of the same sector strengthens the chances of survival and growth, besides increasing the potential of innovation of the firms (Baptista, 2000; Schmitz, 1999).

The cluster may be composed of several institutions, such as universities, research, and development centers and firms, creating a complex system of production and innovation, which holds several interconnections that influence themselves mutually (Menzel & Fornahl, 2010). In the past decades, the studies about the clusters were limited trying to explain the main characteristics of the clusters, their operation, and main advantages, giving little attention to issues related to their emergence, development and (Harris, 2020; Trippel, Grillitsch, & Isaksen, 2015).

The clusters are dynamic agents, having stages of development with their characteristics that changing over time (Crespo, 2011; Martin & Sunley, 2011; Menzel & Fornahl, 2010). It is crucial to determine the stage of the life cycle so that the decision-makers can manage the cluster according to the specific needs of each stage (Brenner and Schlump, 2011). It is also possible to investigate how knowledge flow and lock-in can influence the activity of innovation in clustered companies. This paper explores that gap in the literature of clusters concerning the relationship between the flow of knowledge and lock-in along the stages of development of clusters, especially in the context of the industries of low technological intensity in Latin America.

In this context, this paper aims at analyzing the stages of the life-cycle of clusters, based on four dimensions: diffusion of knowledge, competitive advantage, structure, and public policies. To do so, we conducted a case study of Footwear Cluster of Vale dos Sinos-Paranhana, it was one of the most important of the sector in the world and has passed through several transformations during its trajectory.

This paper is organized in six sections, besides this first introductory part, being them: the theoretical part will discuss the concepts of cluster and life cycle of cluster. The third section describes the methodological procedures. The fourth section

will show the historical context of the footwear cluster and the data of this research. We will discuss the main findings in the fifth section. In the last, we present the final considerations, limitations, and further research.

2 Theoretical Framework

2.1 Clusters

According to Porter (1998), the clusters are geographical concentrations of interconnected companies and institutions of a particular field; the clusters embrace a grid of industries linked to the support institutions to improve the competitive performance of the firms. The primary purpose of the cluster is to offer resources for the companies, which they could not have access to acting in an isolated form (Schmitz, 1999). The superior development of the clustered firms arises from the reduction of transaction costs due to the presence of local suppliers, sharing of infrastructure, access to the labor, access to information, technologies, and institutions (Holm & Østergaard, 2015).

The clustered firms have a lower cost to identify, access, and change information (Presutti, Boari, & Majocchi, 2013), considering that diffusion of technological knowledge works better inside the geographical borders (Baptista, 2000). In this way, the location and the proximity are shown as key factors for the diffusion and exploration of knowledge (Vicente, 2018), making the clusters to prove themselves as environments favorable to innovation (Giuliani, 2005).

Although the evidence shows that the cluster increases the propensity and the diffusion of innovations, only the argument of geographical approximation does not apply the acquisition of new knowledge by the firms (Balland, Boschma, & Frenken, 2015; Presutti et al., 2013). The transference of knowledge among firms depends, among other factors, on the absorptive capacity of the firms (Cohen & Levinthal, 1990), and also, on the cluster strategies, corporative culture and actions of the firms (Isaksen, 2018).

Giuliani (2005) adopted the concept of absorptive capacity for the cluster level, showing that the absorptive capacity of the cluster is the capacity of the cluster to absorb, disseminate, and explore knowledge extra-cluster. The absorptive capacity impacts the capacity of the firm to acquire new knowledge and, consequently, to innovate,

which makes it a crucial factor for the growth and development of the clusters (Crespo, Suire, & Vicente, 2015). During the learning, the firms do not keep static; they combine the already existent knowledge and the knowledge of external sources, adjusting their technological bases (Menzel & Fornahl, 2010). Due to that movement, the localized learning changes the heterogeneity of the cluster, and the clustered firms tend to imitate the technological patterns of the well-succeeded firms, which generates behavior and technological pattern inside the cluster (Essletzbichler & Rigby, 2007). The common focus and the same technological patterns promote the learning of clustered firms (Martin & Sunley, 2006). However, the decrease of the heterogeneity inside the cluster may lead to a process of lock-in and the decline of the cluster (Grabher, 1993; Harris, 2020; Schmidt, Alex, Zen, Bittencourt, & Belussi, 2020). In this way, the dynamic of knowledge of cluster is related to the heterogeneity of knowledge and the cluster structure.

2.2 Path Dependence and lock-in effect

Path dependence is a historical process in which the results of a system are direct consequences of the own history of the system in question (Martin & Sunley, 2006). Some key events in the cluster's trajectory affect its constitution (Martin, 2010). These events also influence its historical path, routines, possibilities for action, and economic development (Grillitsch, Asheim, & Trippel, 2018; Scherrer & Vasconcellos, 2019; Vasconcellos, Calixto, Garrido, & De Souza, 2012) permanently. However, the emphasis on specific patterns can cause the trapped in its trajectory (Yang, Fu, & Li, 2017). The lock-in makes the developed technologies and the organizations to be driven to determined paths, even though there are more efficient alternatives possible (Martin & Sunley, 2006).

Path dependence tends to be connected to regional institutions since the process of learning usually is local (Martin & Sunley, 2006). The importance of path dependence increases where there are conditions of growing returns due to the adoption of a pattern, which makes the incorporated technologies and products more attractive (Menzel & Fornahl, 2010). Despite the advantages of a dominant pattern (Crespo, 2011),

in case the cluster cannot break this pattern, there will be a decrease of its heterogeneity and, consequently, reduction of innovations, leading the cluster to decline through the process of lock-in (Grillitsch et al., 2018; Isaksen, 2018; Menzel & Fornahl, 2010).

The effect of lock-in is the process resulting from path dependence (Grabher, 1993; Isaksen, 2018; Menzel & Fornahl, 2010; Schmidt et al., 2020). The lock-in is characterized by a state of balance, in which there is a low potential for endogenous change. Then, it's needed the action of some exogenous strength on the actors for the inertia to be broken (Martin & Sunley, 2006). In this context, the actors' cluster must seek new sources of knowledge outside its organization to absorb extra-cluster knowledge, not immersed inside the dependent trajectory (Giuliani, Pietrobelli, & Rabellotti, 2005; Harris, 2020; Trippel & Otto, 2009).

The lock-in must not be seen only as a negative influence; the growth of a regional economy derives from a positive lock-in (Martin, 2010; Martin & Sunley, 2006). The cluster is composed of several firms that, initially, present high levels of heterogeneity (Menzel & Fornahl, 2010). Due to that distance of knowledge, the companies have different economic performances (Balland et al., 2015). Thus, as far as some firms get high performance, other firms tend to copy the patterns that present better results (Maskell & Malmberg, 2007). That movement makes firms increase their gains of range and efficiency, which creates an effect of path dependence around the dominant model (Martin & Sunley, 2006). In this way, the lock-in may be understood not only as an effect responsible for the decline of the clusters (Cho & Hassink, 2009) but also, it explains the dynamics of the regional development. Yet, despite the strong appeal for the argument that clusters decline due to the inertia promoted by the lock-in effect, the concept also helps to explain the process of adaptation and transformation of clusters, since new trajectories emerge from the trajectories already existing (Grillitsch et al., 2018; Isaksen, 2018; Trippel & Otto, 2009).

Based on path dependence and lock-in effect, the performance of clustered' firms will be affected differently, according to the stage of development of the cluster (Bergman, 2008). Moreover, competitive advantages that guaranteed the strength of the cluster in the past may become

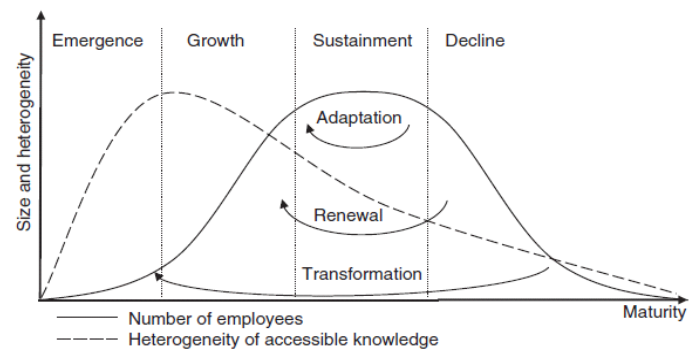
the main factors that lead it to the decline (Grabher, 1993; Martin & Sunley, 2006). This way, no economic advantage belonging to the cluster is permanent, which leads to treating the clusters as heterogeneous clusters and prone to changes (Harris, 2020; Martínez-Marín, Puello-Pereira, & Ovallos-Gazabon, 2020).

2.3 Life cycle of clusters

The approach of the life-cycle of cluster has been used to characterize the evolution of the clusters along the time (Bergman, 2008; Harris, 2020; Martin & Sunley, 2011). Most of the research about the life cycle of cluster involve three or five phases of development in which the cluster may be present (Ingstrup & Damgaard, 2013; Menzel & Fornahl, 2010; Presutti et al., 2013). The approaches about the life cycle highlight the importance of the heterogeneity of knowledge of the firms, the evolution of the value chain, and the path dependence of the industrial regions (Trippel et al., 2015). This new approach focuses on matters related to the actors, the networks, and the institutions. These dynamics are strongly different among the stages of the life cycle and affect the transmission from one stage to another (Fornahl, Hassink, & Menzel, 2015). The clusters aren't isolated actors, pre-defined, and pre-established, as guaranteed structures of success (Martin & Sunley, 2011).

The models of life cycle usually are characterized as an S-shaped curve, in which the cluster cross through periods of growth, stagnation, and decline (Bergman, 2008). Menzel and Fornahl (2010) developed a model that explains the dynamics and development of clusters. Besides that, they argue that the life cycle of clusters has a different pattern from the life cycle of industrial sectors (Menzel & Fornahl, 2010). This fact allows each cluster to have its trajectory that will impact on its performance (Martin & Sunley, 2006). The model of Menzel and Fornahl (2010) also brings the idea that key drivers through the stages of the life cycle are diversity and heterogeneity of knowledge. Then, the stages of the cluster will be defined based on quantitative and qualitative dimensions. Figure 1 presents the model of Menzel and Fornahl (2010).

Figure 1–Life cycle of the cluster



Source: Menzel and Fornahl (2010), p. 218.

Menzel and Fornahl (2010) show the relation of the development of the cluster and the absorptive capacity of the clustered firms. During the initial phases, the cluster shows itself disperse, with little possibilities of interaction, and the knowledge is diffuse. During the stage of growth, the firms start to interact more and absorb the knowledge from one another. In the sustainment phase, dense knowledge networks arise intra- and extra-cluster, the knowledge starts being widely widespread, emerging the possibility of a lock-in effect. In the decline phase, there is a weakening of networks due to the exit of many firms.

2.4 Development of the model of analysis of the cluster life cycle

The present article explores different dimensions of analysis to determine the stage of development of the cluster. This way, this section has the aim to present the main theoretical precepts that compose the model of analysis of the life cycle of the cluster, besides the *knowledge heterogeneity* (Menzel & Fornahl, 2010) and the *diffusion of knowledge* (Giuliani, 2005). Based on the literature review, we developed an analytical framework for presenting critical factors found next to the characteristics of each stage of the life cycle. The Table 1 shows four dimensions of analysis which involve: (i) diffusion of knowledge in the cluster; (ii) the competitive advantages; (iii) the structure of the cluster; (iv) the role of the support institutions and the development policies.

The idea that the firms in cluster have superior innovative activities (Baptista, 2000) gains more strength in moments where the tacit knowledge has greater relevance for the generation of innovative activities (Audretsch, Falck, &

Feldman, 2008). Audretsch and Feldman (1996) reviewed the influence of the life cycle in the industry on the propensity to innovative activities in clustered companies. They found out that the clustered companies presented a higher rate of innovations during the initial stages of the industrial sector and that firms outside the cluster presented higher rates of innovation after the growth of the sector. Thus, the authors conclude that the innovative activity happens especially during the initial stages of the life cycle of the industry, period where the tacit knowledge is more relevant (Presutti et al., 2013).

Van Klink and De Langen (2001) analyzed the dynamism of the *value chain* along the development of the cluster. During the initial stages, the networks of actors are established, and the value chain starts to be created with the strategic relations. During the phase of expansion of the cluster, the firms seek new opportunities to expand, the collective actions focus on refining the process of production and increasing the extent of the market. In the maturity phase, the cluster stabilizes the mix of products, the patterns of production, and sales. The final stage is achieved due to a change of market, and there is a big exit of firms which destabilized the value chain and may culminate with the end of the cluster (Van Klink & De Langen, 2001).

Wal and Boschma (2011) analyzed the *network's stability* of the cluster on the perspective of the theory of the life cycle. In the initial stages, knowledge and technologies are tacit, and they are fixed to the human capital factor. Thus, this regime results in instability and volatility in the cluster networks (Wal & Boschma, 2011). In the stage of growth of the cluster, a dominant technological design starts to emerge; the cluster begins to gain the market share, resulting in fast growth and increment of the cluster stability (Martin & Sunley, 2011). During the stage of maturity, we can see a decrease of market, the number of new inbound clients declines, and the innovative potential decreases. In this stage, the cluster faced a process of shakeout; that is, a significant number of firms exits the cluster because the industry becomes more and more competitive (Wal & Boschma, 2011). Thus, the final stages of the life cycle occur an increase of *rivalry and competition* to the detriment of *cooperation* (Malakauskaitė & Navickas, 2011). There is also a decrease in a variety of firms, and a disruption of networks (Wal

& Boschma, 2011).

Malakauskaitė and Navickas (2011) related the life cycle of the cluster and the *degree of productivity*. During the emergence of the cluster, the productivity tends to be low, but with growth perspective. In the growth stage, the productivity of the cluster increases significantly. In the maturity phase, the emergence and adaptation of a dominant design make the productivity of the cluster to be high. In the decline stage, as the firms leave the cluster, productivity tends to decrease (Malakauskaitė & Navickas, 2011).

Staber and Sautter (2011) studied the relations between the *identity of the cluster* and its stage of the life cycle. The identity of the cluster is the shared understanding of the industrial, technological, social bases, and institutional characteristics of the cluster (Staber & Sautter, 2011). This identity considers cultural aspects and local conditions (Staber & Sautter, 2011). The authors conducted studies in two distinct clusters, revealing that the cluster can develop a closed identity or more flexible one driven to meet the new demands coming from new technologies and markets (Staber & Sautter, 2011).

According to Vahl (2009) and Menzel and Fornahl (2010), there is a relationship between the stage of the life-cycle of the cluster and the number of employees. During the initial stages, we will see a few companies and few employees in the cluster. However, as the cluster is developing, the number of employees and firms increases. During the maturity stage, the number of companies and employees is stable and starts to decline during the final stages of the life cycle.

The public agents also demonstrate an interest in the industrial clusters to promoting the development of a region (Ingstrup & Damgaard, 2013). In this way, the support institutions, as well as the cluster-oriented public policies and the facilitating agents, have great importance for the development of the cluster (Brenner & Schlump, 2011; Eraydin, 2016; Fornahl et al., 2015; Ingstrup & Damgaard, 2013). Brenner and Schlump (2011) argue that these public policies must consider the characteristics of each cluster and their current stage of life-cycle. Different stages of life require different strategies driven to the growth of the cluster (Brenner & Schlump, 2011; Ingstrup & Damgaard, 2013). Brenner and Schlump (2011) asked themselves if different types of measures should be used according to stages of the life cycle

of the cluster. Thus, the authors examined the effects of several policies driven to the development of the cluster and its effectiveness in the different stages of life cycle of the cluster, showing which policies have a positive effect in each stage of the life cycle and which do not.

Ingstrup and Damgaard (2013) showed that, in the initial stages of the cluster, the facilitators create networks focusing on developing and improving the local conditions, building safety loops, identifying new actors to join the cluster, and creating bonds among them (Ingstrup & Damgaard, 2013). Thus, the focus of the facilitators aims at creating critical mass and cohesion. In the second stage, the facilitators focus on the cooperation and the expansion of the trust (Ingstrup & Damgaard, 2013). Lastly, they will be integrators of the activities and seek new business opportunities.

Table 1 describes our framework and presents four dimensions to explain each stage: emergent, growth, sustainment, and decline. The low diffusion of external knowledge, the disruption of the networks, and the technological lock-in are signs of the decline of a cluster.

Table 1–Framework of analysis of the stage of life cycle of the cluster

Indicator		Stages of Life cycle of the cluster			
		Emergent	Growth	Sustainment	Decline
Diffusion of knowledge in the cluster	Diffusion of Knowledge	Few and weak knowledge networks	Increase of the connections, but there are still isolated firms	Dense networks of knowledge intra and extra cluster	Weakening of the networks
	Diversity of knowledge	Diffuse knowledge	Convergence for a dominant design of the cluster	Widespread – possibility of lock-in	Highly widespread – need of renewal
	Propensity to innovative activities in the firms	Low, but growing	High	High, but decreasing	Low
Competitive advantages	Strength of the networks in the firms of the cluster (networking)	Unstable	Growth of the stability	Peak of stability followed by the shake out	Disruption of the networks
	Level of Coopetition	Low	Firms cooperate more than compete, growth of trust	Firms compete more than cooperate, high trust	Low

Indicator	Stages of Life cycle of the cluster				
	Emergent	Growth	Sustainment	Decline	
Value Chain	Development of the value chain with different firms	Specialization of the firms in the chain	Stable roles of the firms in the chain	Reorientation of the roles of the firms in the chain	
Structure of cluster	Growth in the number of companies in the cluster	Low	Low, but growing	Stable	Great exit of the number of companies
	Growth in the number of employees in the cluster	Low	Low, but growing	Stable	Great exit of the number of employees
	Production of the firms	Low, but growing	Productivity higher or equals to the average of the industry	High	Productivity lower or equals to the average
	Technological heterogeneity of the firms	High and growing	High and decreasing	Moderate and decreasing	Low and decreasing
	Identity of the cluster	Heterogeneous identity	Development of a common identity	Homogeneous identity	Decrease of the homogeneity
	Qualification and specialized training	Non-existent	Low, but growing	High and growing	Decrease of the search for training centers
Policies for clusters	Role of the institutions	Development of networking	Development of the trade relations	Integration of the members of the cluster	Stimulate the diversification
	Focus of the institutions	Provide favorable conditions to the emergence of the cluster	Stimulate the cooperation	Creation of business activities	Search for new opportunities

3 Methodology

The methodological strategy adopted in this paper was a single case study. We chose the footwear cluster of Vale dos Sinos and Paranhana because its one of the most relevant in the Brazilian economy and having gone past different phases of growth and decline during its trajectory. Besides that, the footwear sector has great economic and social importance for the region.

The data collection happened in the years of 2016 and 2017, using three main sources:

interviews, databases of the government, and documental analysis. For the interviews, a semi structures script was created based on the proposed dimensions in Table 1. The interviews took place in person or by web. In total, fifteen interviews were conducted with different organizations that belong to the cluster. Table 2 presents information about the interviews. The duration of the interviews ranged from 40 minutes to 1 hour and 15 minutes.

Table 2 - Interview information

Type of organization	Interviewee's position	Number of pages transcribed
Footwear manufacturer	Entrepreneur	10
Footwear manufacturer	Supply manager	13
Footwear manufacturer	Exportation manager	13
Footwear manufacturer	Exportation manager	11
Footwear manufacturer	Marketing manager	13
Footwear manufacturer	Factory director	25
Footwear manufacturer	Entrepreneur	12
Footwear manufacturer	Director of Operations	8
Footwear manufacturer	Marketing and Communication Director	14
Tannery	Product development	10
Footwear components	CEO	15
Outsourcing service provider	Vice president	2
Design service provider	Entrepreneur	14
Supporting institution	Project Manager	15
Supporting institution	Director	9

Besides that, we used data bases of the government, such as RAIS – Annual Relation of Social Information, to collect information about the number of employees, firms, and production of the cluster. Lastly, the documental analysis explored sectoral reports, dissertations, and thesis about the cluster to analyze the historical context.

The data analysis of this research was performed based on the full transcripts of the interviews, the analyzed documents, and the observation. The analytical categories defined in this study were the cluster life cycle indicators identified in the literature. Thus, we used the strategy of triangulation of data to determine the consistency of data and validity of the results. The technique of data treatment was content analysis. We considered the Analytical Framework (Table 1)

to conduct this analysis and compare data from different sources,

4 Analysis

The cluster Vale dos Sinos-Paranhana is one of the oldest industrial clusters in Brazil, which includes footwear manufacturers, leather goods, and institutional agents in the value chain (Calandro & Campos, 2016). The footwear industry in the Rio Grande do Sul is considered a very traditional industry, generating an impressive quantity of jobs. The shoes production in the region of Vale dos Sinos and Vale do Paranhana began through a leather-footwear tradition in which the German immigrants brought with them when they populated the region.

Brazil is the fourth biggest producer of shoes in the world (Abicalçados, 2018), having a footwear park constituted of 7.1 thousand companies and generates more than 279 thousand working places (Abicalçados, 2018) directly. Because it is an extensive industry concerning labor, the displacement of the footwear industry for regions that present lower costs of production is widespread, characteristic that makes the shoe manufacturing to be a "nomad" industry (Costa, 2009).

Despite being a very traditional industrial sector, the footwear cluster of Vale dos Sinhos-Paranhana has been going past difficulties (Abicalçados, 2018; Costa, 2009). According to Abicalçados (2018), from 2015 to 2017, the footwear sector presented a decline in all the performance indicators. The results emphasize the loss of more than 4,1 thousand of working places all over Brazil and a decline of 1271 establishments that manufacture footwear. The industry had also been reducing shoes production from 1.036 million pairs in 2013 to 908 million in 2017.

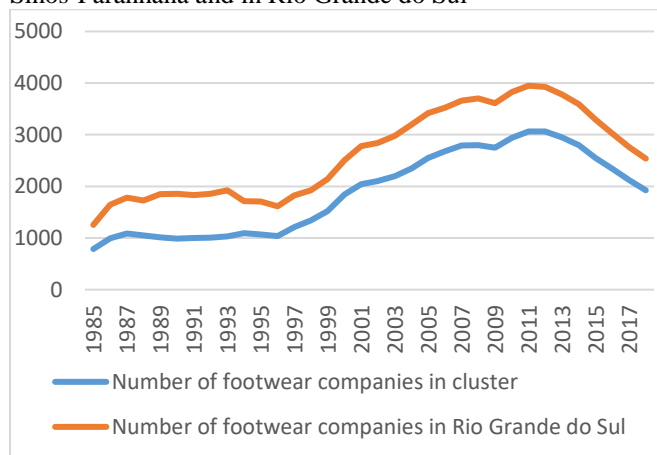
4.1 Stage of Development of the Cluster

The cluster of Vale dos Sinos-Paranhana has gone past several phases over the years. In each one of those phases, the cluster changed its technological orientations, going past renewal processes followed by new stability. We can identify the movement in a historical analysis of the number of firms and employees that belong to the cluster. The data withdrew from RAIS/TEM record

the formal relationships of the working places. The period 1985 to 2018 was used due to the availability of the data in RAIS.

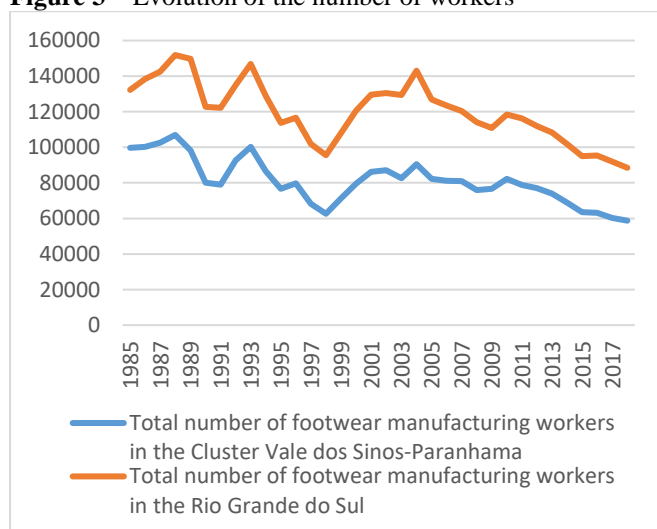
Figure 2 presents the evolution of the number of footwear manufacturers in the Cluster Vale dos Sinos-Paranhana and the State of Rio Grande do Sul. We also observed that the number of companies remained constant between the years of 1987 and 1995. After this period, the number starts to grow considerably until the years of 2011 and 2012, where it comes to its maximum number of 3063 companies. From 2012 on, the number of companies starts to decrease, coming to 1924 companies in 2018.

Figure 2—Footwear manufacturers in the Cluster of Vale do Sinos-Paranhana and in Rio Grande do Sul



Source: RAIS/MTE. 2018. Own elaboration.

Figure 3 – Evolution of the number of workers



Source: RAIS/MTE. 2018. Own elaboration

Concerning the labor, Figure 3 presents the evolution of the number of employees in the footwear manufacturing in the cities that are part of

the cluster and in Rio Grande do Sul. The peak of workers in the cluster happened in 1988, coming to 106.947 workers. From 2004 on, the number of workers starts to decline, reaching 58.731 workers in 2018.

From the decade of 1960, the cluster received a high demand on the part of foreign companies that decided to outsourcing production the Brazilian companies. From the years 1990, Asian countries started to join the world scenario of production, practicing an intense competition due to its low costs, which forced the Brazilian companies to change their strategies, since they could not compete about price with the Asian companies. This way, the companies started to invest more and more in the creation, formation, and insertion of their own brand in the international market. Despite the changes oriented to the value-adding, the footwear sector is still going past difficulties, according to our data.

Concerning the **diffusion of knowledge** inside the cluster, the cluster is structuring its knowledge networks just now and that the local culture of closed companies still prevails. However, some initiatives have already been built to reunite groups and companies to discuss new technologies and tendencies. The production of shoes is an ancient activity, and the knowledge has passed through generations, coming to the point where the knowledge in the manufacturing was no longer tacit and could be expanded to other places, as it was the case of the migration of the industry to the Northeast.

In terms of **knowledge networks**, the interviewees pointed out that recently the cluster started to host events and workshops to connect the sector and disseminate knowledge. The interviewees also pointed out that there is a significant deficiency about researches and search for new technologies for materials, innovations in products, and services. Recently, Abicalçados started to promote programs, such as Moda Cor and Maratona Mude to increase the relations between the several links of the chain.

About the **innovation**, the cluster did not show itself innovative. Otherwise, few are the companies that indeed invest in research, and besides, the innovations are incremental and easily copied. In general, the industry stopped in the time, where there are very few changes in the industry blueprints in the last years. In the cluster, the closed culture of non-collaboration and copy still prevails.

The innovations are characterized by being incremental and derived specially from the material industry.

Concerning the **knowledge diversity**, the footwear cluster presents a low variety and for a long time there has been a dominant design in the cluster. The manner of production is very similar inside de companies, and the way that they try to distinguish themselves is through design or material, however, as the inspirations for new products are the same. There is a robust culture of copy, and the products end up being very similar.

Regarding **networking**, the cluster presents a very developed network and even stable. If, on the one hand, there is little cooperation among the producer industries; on the other hand, the networks created showed themselves better developed for the companies in the cluster. Moreover, the interviewees highlighted the role of the fairs as an important means to increase the networking and range of clients, as well as the incentive of meeting among entrepreneurs, suppliers, and clients, seeking the strengthening of the relations inside the cluster.

All of the interviewees pointed out that the companies present a low level of **cooperation**. They **compete** much more among them, due to the excess of products for an already saturated demand. The interviewees also pointed out that the attempts to create collective strategies even crash into the closed mindset of the entrepreneurs of the sector and that many companies are still managed by families, which do not seek partnerships. The interviewees also pointed out that, in the last years, the proximity between the support entities had improved.

Concerning the **value chain**, the footwear cluster of Vale dos Sinos-Paranhana presents a complete and very stable value chain. The interviewees argued that the gaucho cluster has a better value chain related to shoes in Brazil, being this an advantage in other producer regions. Another highlighting factor is a good logistic infrastructure, both for the intern market and exportation.

One of the changes in **heterogeneity** in the footwear sector occurred through the business model of the companies, reducing the production of **private label shoes**. The innovations also included design, the increment of new tendencies, and technologies in the shoe production. However, no great innovation has emerged in Brazil. The

footwear industry waits to see what becomes a tendency in the European market and adapts to the Brazilian reality. The traditional model of footwear production and trade is ceasing to exist. Less and less, it is expected the companies to keep the model B2B, where the companies manufacture significant quantities of shoes and deliver them to distributing companies that are responsible for the sales in retail. The number of small companies selling directly to the consumer on the internet is increasing. This model does not count on stock and produces only on demand, and products with more added value characterize it.

The cluster is presenting difficulties in capturing and maintenance of its workforce. One of the causes of the scarcity is that the young people of the region do not realize the job inside a footwear factory as something positive, primarily because of the physical conditions and low salaries. Despite the lack of workforce, the interviewees highlighted that there are several training centers and organizations related to the footwear inside the territory of a cluster. Despite the existence of several graduation courses, Senai issued an alert to Abicalçados, showing that there were fewer people interested in a technical formation.

The footwear cluster presents a collective *identity* and a strong cultural identification of the society with the footwear. The manufacture of footwear is a family business and cross different generations over the years. In this sense, it is said that the footwear business is "inside the DNA" of the people. However, the interviewees also argued that the German culture also hinders the development of new innovations, since the people are very suspicious and closed, hindering the flow of information and knowledge.

Concerning the **support institutions**, the interviewees highlight that, recently, the institutions have been creating projects and helping the companies more and more. One of the main efforts made was the integration of the members of the cluster. To stimulate cooperation among the firms, Abicalçados has been developing projects, such as Future Group, Future of Footwear, and Brazilian Footwear. Abicalçados aims at stimulating the relations through fairs and market research, offering opportunities of business to the companies. About the *focus of the activities of the support institutions*, we noticed a search for increasing cooperation. Still, mainly, it is sought to create new business activities through the

promotion of Brazilian brands in the national and international markets.

4.2 Discussion of the Results

Based on the taxonomy of Giuliani (2005), the evidence indicates that the footwear cluster has absorptive capacity at the intermediate level since the companies have forms to generate internal knowledge. However, this knowledge is still adapted from the one existing, making radical innovations a rare event in the cluster. Moreover, there are few and weak knowledge networks. The cluster is in the early stages of its network of **knowledge diffusion**, because the region still has a very closed culture to share knowledge. Institutional and cultural aspects can be a significant limitation for the dissemination of knowledge diffusion since they define how the agents exchange knowledge (Holm & Østergaard, 2015; Isaksen, 2018; Staber & Sautter, 2011). In this sense, the culture of mistrust limits the knowledge to be recombined and transformed into innovations that encourage the renewal of the cluster (Grillitsch et al., 2018; Tripl & Otto, 2009).

About the **innovative capacity**, the cluster presents incremental innovations and easily copied. The literature about the life cycle of cluster shows that the clusters decline due to the cognitive isomorphism, which leads to a decrease of innovations (Martin & Sunley, 2011), a process that reinforces the lock-in effect (Harris, 2020; Schmidt et al., 2020). This way, the low innovative activity of the footwear cluster is a strong clue that the cluster is heading to a decline stage (Audretsch & Feldman, 1996; Martin & Sunley, 2011; Tripl et al., 2015).

Regarding **knowledge diversity**, the cluster presents a low level. The interviews identified a dominant design in the cluster, and the production model of footwear is very similar. According to Menzel and Fornahl (2010), the existence of a dominant model is characteristic of a mature cluster, and its continuity leads to a decrease of heterogeneity, being possible to cause a lock-in and, consequently the decline of the cluster (Grabher, 1993; Isaksen, 2018; Schmidt et al., 2020). The patterns that marked the success of the cluster become obsolete, and the existent model is going to face several difficulties, mainly due to the lack of competitiveness and innovations. This way,

the footwear cluster is stuck in a dominant trajectory and needs increments on its heterogeneity to free itself from its current state (Tripl & Otto, 2009).

Wal and Boschma (2011) argued that networking develops with the capacities of the cluster along its life cycle. In this footwear cluster, we observed the existence of stable networking, but such stability may have led the cluster to a shakeout process. We can see the movement of the reduction of the number of companies based on secondary data (Figure 3). Moreover, the interviewees also mentioned the competitive worsening on the footwear prices. According to Wal and Boschma (2011), the process of shakeout and the worsening of competition for prices are characteristics of a mature network.

One of the main characteristics of a cluster is the relation of **competition, cooperation, and the trust relations** of the companies (Porter, 1998). The analysis showed that the companies of the cluster present a low level of cooperation, starting to compete much more among them. There is strong confidence among the clustered firms, in particular, in the context of the relationship between producers and suppliers. The lack of competition and trust and the little collaboration among the actors are characteristics of clusters in the final stage of the life cycle (Malakauskaitė & Navickas, 2011).

The low diversity of knowledge can also be one of the aspects responsible for the low cooperation activity and the high mistrust within the cluster. This aspect can be related to the distance between agents is very low (Boschma, 2005; Neffke, Henning, & Boschma, 2011; Nooteboom, 2000). In environments where cognitive distance is low, firms tend to have more homogeneous routines, making knowledge a redundant asset and unproductive cooperation activities (Boschma, 2005), since there are less gains through collaboration.

The cluster presented a complete and stable **value chain**. The cluster also has a dominant model in the patterns of production and sales, which indicates a value chain of a mature cluster (Van Klink & De Langen, 2001). Even after the exit of companies, the cluster is not yet undergoing a restructuring of the value chain. However, this may be the next stage of the cluster, in case it cannot reorient and renew itself.

Concerning the **number of manufacturers**

of footwear in the Cluster Vale dos Sinos-Paranhana, it was observed a strong decrease from the year of 2011. The same happened in the **number of employees** which has also been decreasing over the years. Another factor is the production of the number of shoes in the most recent years. The decrease in the number of companies, firms, and production are characteristics of a cluster in decline (Menzel & Fornahl, 2010; Vahl, 2009).

The model of Menzel & Fornahl (2010) points out that the strength that moves the cluster through the stages of life cycle is **diversity** and **heterogeneity**. No radical innovation happened in the last years, and all the companies follow the same model of production. The low heterogeneity is evidence of decline (Harris, 2020; Isaksen, 2018; Schmidt et al., 2020). However, producers are investing in new business models and different products, which may be an increase in heterogeneity. In that case, in case the cluster can increase its heterogeneity, it can go past a process of renewal (Grillitsch et al., 2018; Menzel & Fornahl, 2010; Trippel & Otto, 2009).

The footwear cluster presents a collective identity and cultural identification with society. The rooting and the cultural identification with the segment are characteristics of a mature cluster. Even with the existence of a strong collective identity, the clustered firms are finding difficulties in renewing their **workforce**. The lack of interest of new generations is a great challenge that the cluster will have to face in the future.

Staber & Sautter (2011) showed that a cluster has a central **identity**. The cultural characteristics of the region have developed the identity (Staber & Sautter, 2011). The identity of the cluster influences the trajectory of the cluster, possibly following two different paths: one of the paths leads the cluster to greater flexibility and the second path privileges a state of inertia and stability, that on the other hand, prevents the cluster from innovation and adapting, leading the cluster to the decline (Staber & Sautter, 2011).

Another factor to be analyzed is the **facilitation policies** of the cluster promoted by the support institutions (Eraydin, 2016). Policies driven to regional development have extreme importance for cluster development (Ingstrup & Damgaard, 2013). The interviewees highlight that, in the last years, institutions such as Abicalçados, Assintecal, and IBTEC have been creating new

projects and helping the companies in several areas. For that matter, one of the main roles highlighted was the role of integrator agent of the members of the cluster, seeking to organize the companies to work more collectively.

Abicalçados aims at stimulating those relations through fairs and researches of target markets, offering the new companies' opportunities of business. Among the main tasks performed by the institutions, there are the actions of branding, meetings for idea sharing, funding in fairs, market research, and events of networking. Based on this, we noticed that the facilitator role of the footwear cluster is slightly dissonant from the current needs of the cluster. A facilitator that aims at the development of the relations is a characteristic of a mature cluster. However, the footwear cluster needs to increase its heterogeneity to renew itself (Menzel & Fornahl, 2010). This way, the actions of the institutions should be more driven to increase the diversity of the region through projects that aim at the innovation.

Based on the analysis framework of the life cycle of the cluster, Table 3 presents the application in the Footwear Cluster of Vale dos Sinos. It is observed that 9 of the 14 indications catalogued are found in the decline stage. The decline stage does not necessarily indicate the complete death, there are still a lot of renewal possibilities, as several authors (Bergman, 2008; Grillitsch et al., 2018; Martin & Sunley, 2011; Menzel & Fornahl, 2010; Trippel & Otto, 2009). However, to renew itself, a cluster needs a greater flow of external knowledge, fostering larger interactions with the extra-cluster agents and reducing the negative effect of the lock-in.

Table 3 –Stage of life cycle of the Footwear Cluster of Vale dos Sinos-Paranhana

Indicators		Stage of life cycle			
		Emergence	Growth	Sustainability	Decline
Diffusion of knowledge in the cluster	Diffusion of knowledge		Few networks of knowledge		
	Diversity of knowledge				Low diversity of knowledge
	Propensity to innovative activities in the firms				Low

Collective advantages	Strength of the firm networks of the cluster (networking)			Developed and stable networks	
	Levels of cooperation, trust and competition among the firms of the cluster				Low level of cooperation and high level of competition
	Value chain			Stable and complete	
Structure of the cluster	Evolution of the number of companies in the cluster				Decline of the number of companies
	Evolution of the number of employees in the cluster				Decline of the number of employees in the past years
	Production of the firms				Declining
	Technological heterogeneity				Low heterogeneity
	Identity of the cluster				Existence of a strong identity, but it is being lost
	Formation and specialized training				The cluster presents difficulties in renewing the workforce
Policies for cluster	Role of the institutions			Integrator agent of the members	
	Focus of the institutions			Goal to create new business activities	

5 Conclusions

The emergence and the evolution of clusters can be a research avenue to explain the difference of innovation capacity in the firm and cluster levels. The understanding of the specific needs that each stage of the life cycle demands is vital to keep the cluster competitive and innovative (Brenner & Schlump, 2011). Considering these needs, our paper aimed at analyzing the stages of the life-cycle of clusters, proposing an analytical framework.

As a theoretical contribution, we proposed a framework to analyze the stages of the life-cycle of the cluster, based on four dimensions: diffusion

of knowledge, competitive advantage, the structure of the cluster, and policies for clusters. These dimensions are aligning with Fornahl et al. (2015) and Trippl et al. (2015).

The results point out that the footwear cluster of Vale dos Sinos-Paranhana presents a low level of cooperation and innovation. The cluster is still considering as the most significant producer of footwear, but new generations don't recognize this cultural and collective identity. The decline of the footwear cluster is related to the path dependence and the trapping effect that emerges from it (Schmidt et al., 2020; Vasconcellos, Garrido, Vieira, & Schneider, 2015). We identified the difficulty of renewing the technological basis of the cluster. This difficulty can be related to a lack of new knowledge (Menzel & Fornahl, 2010), inertia generated by outdated production models (Cho & Hassink, 2009) and local culture, which does not encourage knowledge diffusion (Staber & Sautter, 2011).

This context indicates that the footwear cluster needs to break with the current trajectory (Vasconcellos et al., 2012). An alternative is to invest in the acquisition and diffusion of new knowledge and offer higher value-added products on the market (Trippl & Otto, 2009). In fact, since the 2000s, the cluster has invested in acquiring new knowledge, producing its own brand, and adding value (Vasconcellos et al., 2012; Vasconcellos et al., 2015) and, more recently, new sustainable business models have emerged in the cluster. However, these changes do not seem to have been sufficient to completely renew the cluster (Trippl & Otto, 2009).

The capacity of assimilation of superior practices makes the clustered firms to grow over the average of the sector. However, the superior practices end up disseminating and generating a dependent trajectory of a mental model, hindering new methods and innovations to happen. The lack of changes will impact competitiveness and start to compete for costs. In this way, the companies that did not have privileged positions in the value chain, or that were not so competitive, tend to disappear (Wal & Boschma, 2011).

6 Implications and Further Research

This research contributed to the understanding of the evolution of clusters, considering that the flow of knowledge will have a

central role in the renewal of the cluster. As a practical implication, the awareness of the difficulties and the necessary mechanisms to renew a cluster are essential to developing policies for clusters and the footwear industry in Brazil.

As a theoretical contribution, the study reinforces that the lack of new knowledge influences the negative lock-in, leading to the decline. Further research can validate the framework in empirical tests in the same cluster or different ones. Empirical studies will also clarify how the dissemination of patterns and the increasing heterogeneity in mature clusters.

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