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ESCOLA DE ADMINISTRAÇÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM ADMINISTRAÇÃO
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Orchestrating Networks:
three studies in different contexts and development stages.

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Dissertation submitted for the Doctoral degree in Administration at School of Administration at Federal University of Rio Grande do Sul.
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ABSTRACT

This thesis aims to analyze the orchestration of networks in different contexts and stages of development. The networks constitute an attractive environment in which different actors are connected to create and generate value. Regardless the type of network, their management is a challenge as a result of the complexity and dynamism of those structures. In this line, the orchestration approach is attracting academic and managerial attention because it is a management that seeks the capture and value generation without hierarchical character. However, there are still many gaps in the literature for the orchestration of networks to be better understood and applied. Three main gaps were identified: process of orchestration in the emergence of a network, influence of the orchestration activities over the lifecycle of the network and the role and the activities of the orchestrator. Three studies were developed to fill such gaps. The first paper "The orchestration process for emergence of innovation clusters" aims to analyze the orchestration process in the emergence of a Cluster of Innovation (CoI). This study is a qualitative exploratory research in Porto Alegre, in Southern Brazil, in the region known as 4th District. The results indicate the importance of alignment among network members, of coordination of actions and of joint agenda as facilitators for the emergence of a cluster. This study presents a framework to link orchestration process and the emergence of a CoI. The second paper "Multilevel orchestration: the unlock for innovation in clusters lifecycle?" seeks to analyze how does the orchestration influence on the clusters lifecycle. For that, an exploratory study was performed with longitudinal perspective in the wine cluster of Serra Gaúcha, Brazil. The study identified the key elements throughout the life cycle of the Serra Gaúcha cluster. From that, the study also identified the orchestrators, their key activities and their level of impact on the cluster. Then, the multilevel orchestration model with the key actions by level and stage of the life cycle was proposed. The results highlight the need of more than one orchestrator to articulate the innovation in the cluster and minimize the negative lock-in effect and the possible decline of the cluster. Besides that, the study presents the importance of the orchestration in the micro level (individuals), the meso level (organizations) and macro level (cluster). The third paper "Orchestrating an innovation ecosystem in the University: The case of a Brazilian University" aims to understand what the roles and activities of the orchestrator of the university innovation ecosystem are. For that, we conducted an action research in the innovation ecosystem of UFRGS, orchestrated by its Science and Technological Park, Zenit. The study identified critical factors for that process and we understood that the orchestrator of the university has as roles and activities: architect (map and compose the network, link complementary actors, construct a collective identity), knowledge broker (managing knowledge mobility, knowledge activation, facilitating transactions) and market translator (articulate demands, recognize and commercialize innovation, manage innovation appropriability). From that, toolbox with key actions to facilitate the orchestration of the University innovation ecosystem was proposed.

Keywords: orchestration, networks, stages of development, orchestrator.

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SUMMARY

1. INTRODUCTION

The importance of inter-organizational relationships and networks is widely acknowledged (Valkokari et al, 2017). In recent years, innovation has evolved beyond the boundaries of single firms towards a more network-based approach (Choi et al., 2010; Ramadani et al., 2013, Cinelli, Ferraro & Iovanella, 2019). Firms that invest in innovation outside their internal and business borders increase their opportunities to innovate (Lundvall, 2007). Accordingly, such networks have attracted a notable amount of managerial and academic interest (Hurmelinna-laukkanem & Natti, 2018). Networks constitute a valid structure within which to foster members' abilities to interact and cooperate, in order to reduce environmental uncertainty and face the challenges that derive from economic (but also from social and environment) change. Network members take advantage of their participation in the system by creating and extracting value when performing certain deliberate and purposeful activities (Ferraro & Iovanella, 2015).

The networks have been studied through different theoretical lenses (Suominen, Seppänen & Dedehayir, 2019). As Suominen, Seppänen and Dedehayir (2019) sustain, when we are concerned with the immediate business environment of a given organization, with an emphasis on the "geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998), we may profit from looking through the lens of "clusters." When the focal question is on the value that is co-created by a myriad of actors, irrespective of their geographical locations, we may alternatively opt to study innovation through the "value networks" framework (Maine et al., 2012; Overholm, 2015). Furthermore, when our intention is to underline the contribution of governance, universities and industry in creating innovation and economic development, we may view such networks as "innovation systems" (Carlsson and Stankiewicz, 1991; Cooke et al., 1997; Freeman, 2004; Malerba, 2002). The "business ecosystem" perspective is insightful when our intention is to examine the cooperative and competitive activities of multiple organizations that belong to different industries (Moore, 1993, 1996).

The extension of network management research to new application domains is a trend in the literature (Möller & Halinen, 2017). The network approach has been extended to study the construction and commercialization of innovations (Aarikka-Stenroos, Sandberg, & Lehtimäki, 2014; Dawson, Young, Tu, & Chongyi, 2014), sectors/ industries of economy activity (Kendrick, 1996), business ecosystems and new business fields (Adner & Kapoor, 2010; Möller & Svahn, 2009; Wilkinson & Young, 2013), and service

systems and various multi-actor platforms (Edvardsson, Kleinaltenkamp, Tronvoll, McHugh, & Windahl, 2014; Gawer & Cusumano, 2014)

The increase number of novel themes about networks is indicative of the vitality of the research field and accentuates the need for new openings and extensions to sustain the validity of network management research for the changing business landscape. In the last decade, the use of network-oriented collaborative forms for various kinds of value creation increased significantly (Möller & Halinen, 2017). Although these new forms are not necessarily called networks, they require management of collaborative efforts among firms and organizations, in other words, networks of relationships. The changing business landscape poses both new opportunities and new challenges for network management, and new issues for researchers to investigate (Möller & Halinen, 2017).

Networks are not an all-purpose category but exhibit great variety, thus, research in this broad domain is abundant (Möller & Halinen, 2017). The similar conceptual models provide stylized perspectives on the complex inter-organizational network phenomenon, each offering different advantages to the comprehension of real-world issues (Suominen, Seppänen & Dedehayir, 2019). Inevitably, these perspectives overlap and some may be considered as fully subsuming the other. By examining various collective forms of influencing, the approach offers promising managerial tools for orchestration of networks whether business fields, innovation ecosystems, industries or clusters.

The aim of this thesis is not to deep and discuss the concepts or the particularities of the different types of networks, but their orchestration. That way, in this thesis, we consider networks in a broader view, since they constitute an attractive environment in which different actors are connected to create and generate value. Members of such networks can be firms, organizations or research centers, located in different regions and specialized (or not) in particular sectors, linked by common interests, technologies and skills and networked by the decision to collaborate according to specific rules (Ferraro & Iovanella, 2013).

On the studies performed in this thesis, we used three types of networks: cluster of innovation (CoI), regional cluster and university innovation ecosystem. The first network - CoI - may be characterized as a concentration of different actors, with certain behaviors, connected and not being linked to a specific industry in a defined geographical space (Engel and del-Palacio, 2009; Engel, 2015). The second network - regional clusters - may be considered as “geographic concentrations of interconnected companies, specialized suppliers, services providers, firms in related industries, training institutions and support

organizations linked around technologies or end product within a local area or region" (Porter, 1990). Lastly, the third network - university innovation ecosystem - is about an innovation ecosystem which is typically defined to embrace the full set of agents, institutions, activities, and culture that support (or undermine) technological and business innovation that are assisted by a university's resources and behaviors (Heaton, Siegel & Teece, 2019).

Regardless the type of network, as a result of the complexity of those relations, it becomes necessary to understand which is the best model of management (Lumineau & Oliveira, 2018; Majchrzak et al., 2015). It is understood that managing and guaranteeing any process of innovation is a multifaceted and complex task (Pikkarainen *et al*, 2017), even more in environments where there is a great number and diversity of actors (Reypens, Lievens & Blazevic, 2019). The success of innovation networks therefore calls for careful direction and coordination; it calls for orchestration (Hurmelinna-laukkanem & Natti, 2018). Thus, the orchestration approach probably is the most suitable to describe the development, management and coordination activities of the networks (Ritala *et al.,* 2009).

Network orchestration denotes the act of performing a leadership role, without the benefit of hierarchical authority (Dhanaraj & Parkhe, 2006). Orchestration emerges as a set of activities aimed at the development, management and coordination of a set of actors that seek to create and extract value from the network (Dhanaraj & Parkhe, 2006). Fung, Fung and Wind (2008) support that definition bringing the orchestration as a capacity to unite several different expertise so that there is harmony capable of creating value. "It is about activities that allow and ease (but do not dictate) the coordination of the network for the performance of the results of innovation" (Ritala et al. 2012, p. 325).

Orchestrating (Dhanaraj & Parkhe, 2006) – innovation networks is not a new issue, but discussion on the phenomenon has been on the rise in recent years (McDermott, Mudambi, & Parente, 2013). Insights into various aspects of orchestration can be found in extant literature. Some studies have produced a broad general understanding of orchestration (Dhanaraj & Parkhe, 2006). Some studies have considered different types of networks from the point of view of management and orchestration (e.g., Hurmelinna-Laukkanen, Möller, & Nätti, 2011). Likewise, in the network literature there is some discussion on the different roles of orchestrators (Nilsen & Gausdal, 2017), the different types of orchestrators (Hurmelinna-laukkanem & Natti, 2018).

Although the literature on orchestrating networks is growing, it is still considered incipient and fragmented (Hurmelinna-laukkanem & Natti, 2018; Nilsen & Gausdal, 2017; Verhoeven & Maritz, 2012). Facing that, studies that explore the phenomenon in different contexts and by different perspectives become necessary. How does the process of orchestration in a network happen? And what is its influence at different stages of development of the network? What would be the key activities of the orchestration and the role of the orchestrator? Those are some questions that seek to better understand the management of the networks and must be answered by this thesis.

1.1. Objectives

This thesis aims to analyze the orchestration of networks in different contexts and stages of development.

The specific objetives are:

a. Understand how the orchestration process occurs in a network from different perspective.
b. Analyze the influence of orchestration at different stages of development of the network.
c. Compare orchestration in different contexts of networks.
d. Define the key elements of the orchestration of networks.
e. Identify the orchestrator (s), their roles and activities in a network.
f. Propose insights on network orchestration.

1.2. Potential Contributions

The orchestration of the networks is a theoretical approach that focuses on the manner of organization and the leadership in multi actors' relations (Young, 1982; Mintzberg, 1998; Dhanaraj & Parkhe, 2006). It is understood that such capacity may cover different processes according to its applicability, comprehending a set of actions conducted by one (or more) orchestrator (s) (Dhanaraj & Parkhe, 2006; Nambisan & Sawhney, 2011; Hurmelinna-Laukkanen et al. 2011). Dhanaraj and Parkhe (2006) chose to analyze networks, since present a framework for understanding the processes through which orchestrator perform their prime mover functions in network operations and because of the growing importance of innovation toward competitive success.

In the seminal paper, Dhanaraj and Parkhe (2006) developed three processes that are base for other more specific variations and for the descriptions of the orchestration of the innovation networks, they are: mobility of knowledge, appropriability of innovation and network stability. Nevertheless, the processes and the model proposed by Dhanaraj and Parkhe (2006) are being more and more questioned as a result of the emergence of the more complex and heterarchical networks (Cinelli, Ferraro & Iovanella; 2019). The growth and variety of innovation networks are demanding different views for their orchestration (Möller & Halinen, 2017). Thus, it is necessary to understand how the process of orchestrating innovation networks occurs in different contexts.

Another point that is not considered in many orchestration studies is the stage of development of the network. It is understood that according to the stage of its life-cycle, the network presents a set of characteristics that interfere on its innovation and its relations with the firms and with the region where it is inserted (Menzel & Fornahl, 2010). This way, recently, the greater interest and discussion in the literature have been dedicated to the network life-cycle (Fornahl, Hassink & Menzel; 2015). It was also identified that the orchestrator's role and activities change along the network life cycle (Nielsen & Gausdal, 2017).

Usually, the orchestration of a network was performed by a hub company (Dhanaraj & Parkhe, 2006), nevertheless it is been verified that, in some situations, the roles and the activities of network coordination for the performance of innovation results can go beyond the model based on the set of actions of a hub company when considering all the members of the network (Hurmelinna-laukkanem & Natti, 2018). The studies have been pointing out that multiple orchestrators with distinct roles are capable of generating more value for the organizations and networks (Hurmelinna-laukkanem & Natti, 2018), besides having identified that the orchestration influences differently the individual and organizational levels (Ritala, Armila & Blomqvist, 2009).

Based on the demand to analyze the orchestration of networks in different contexts and stages of development, we identified three specific gaps in the literature that the studies developed by that thesis seek to fill. The first gap is related to the orchestration in the context of emergence of a network. The network emergence process is complex and consists of a set of prerequisites coupled with local triggers (Brenner and Mühlig, 2007; Isaksen, 2016). The emergence phase is difficult to identify, but it is at this stage that the bases and the growth process are formed (Menzel & Fornahl, 2010). Therefore, it becomes necessary to verify how the orchestration may occur in this emergence process.

The second gap identified is related to the influence of the orchestration in the lifecycle of the network. It is understood that the orchestration varies according to the stage of network development (Nilsen & Gausdal, 2017). This way, several scholars (Heidenreich et al., 2014; Hoang and Antoncic, 2003; Landsperger and Spieth, 2011; Müller-Seitz, 2012; Nilsen & Gausdal, 2017) call for longitudinal, qualitative, process- and outcome-oriented research on networks in order to understand the key factors in each development stage.

The third gap is referred to the role and activities of the orchestrator in networks (Hurmelinna-laukkanem & Natti, 2018). The discussion about the role of the orchestration in the innovation networks is a black box (Nilsen & Gausdal, 2017). Since the initial proposition of hub company as orchestration (Dhanaraj & Parkhe, 2006), a lot has been discussed about who is and what the orchestrator does. This way, a study that attends the role of the orchestrator becomes appropriate.

With the purpose to fill the gaps identified in the literature, this thesis was developed in three papers that have the main goal to analyze the orchestration of innovation networks in different contexts and stages of development. Next, the three papers will be presented with their respective objectives and research methods.

1.3. Structure of Thesis

This thesis is organized in three parts besides this introduction and the conclusions. In the first part, the paper "The orchestration process for emergence of clusters of innovation". The second part is referred to the paper Multilevel orchestration: the unlock for innovation in clusters life cycle?". And in the third part there is the paper "Orchestrating an innovation ecosystem in the University: The case of a Brazilian University". The three papers seek to answer the general and specific objectives of this thesis and to fill the gaps identified in the literature. In the sequence, each paper will be presented.

The **first paper**, entitled "The orchestration process for emergence of clusters of innovation" had its initial version presented on the event "*VIII Encontro de Estudos em Estratégia (3Es)*" in 2017 and its final version published on the Journal of Science and Technology Policy Management in 2018. The paper aimed at filling the gap of the relation between the orchestration and network emergence from a case study of an innovation

cluster. As main contribution, there is the elaboration of a framework with network components, orchestration components and the drivers to emergence of an CoI.

Determining the origins of the cluster accurately is still a challenge (Menzel & Fornahl, 2010), as it is almost impossible to guess where a cluster will take root (Maskell & Malmberg, 2007). This situation gets even more complex when it comes to a network of multiple actors acting on different sectors in the same region, such as the case of the cluster of innovation (CoI). One alternative is the orchestration process. Considering the importance of business clusters for the creation of regional competitive advantages in a global environment, this paper aims at answering the following question: *how does the orchestration process happen in the emergence of a CoI?* The purpose of this research is to analyze the orchestration process in the emergence of a CoI.

In order to answer the research question, a single case study was used as a method, as it is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989). This approach is appropriate because more in depth understanding of orchestration itself – and understanding of multi-sided contextual influences – is needed (Yin, 2003). The research was carried out in Porto Alegre in Southern Brazil, in the region known as 4th District. This region is undergoing a transformation process to become a CoI. The revitalization of 4th District is part of the resilience strategies in Porto Alegre, for which both the city government and civil society are working together to encourage the emergence of an innovation cluster.

The **second paper**, with the title "Multilevel orchestration: the unlock for innovation in clusters life cycle?" had its initial version presented at *XLIII Encontro da Anpad (Enanpad)* in 2019, final version accepted in the event 20ª European Academy of Management (EURAM) in 2020. The paper has the intention to fill the gap regarding the influence of the orchestration in the lifecycle of the network from a study with longitudinal perspective in a regional sector cluster with a trajectory of around a hundred years. As main contribution there is the proposition of a model of multilevel orchestration.

Recently, the discussions about the decline are increasing, in function of the lock-in effect since many regional clusters in the world have significantly decreased in the last years (Hassink, 2005, 2010; Tödtling & Trippl, 2004). The tendency of "keep doing the same" is identified, since, over the years, competences and knowledge about the theme were developed, or because the organizations do not aspire to change (Dosi, 1997; Tomassini & Rocha, 2014). To avoid the decline, the answer is the stimulus to innovation,

which depending on the level will mean adaptation, renewal or transformation of the thematic limits of the cluster (Menzel & Fornahl, 2010). Thus, the present study seeks to answer the following question: *how does the orchestration influence on the regional clusters life cycle?* Therefore, this paper seeks to analyze how the orchestration can influence on the clusters life cycle.

For that, an exploratory study was performed with longitudinal perspective in the wine cluster of Serra Gaúcha, Brazil. The cluster was chosen because it has gone through and overcome several crises over its trajectory and because of its social and economic importance for the region. The longitudinal researches must be performed in more than one moment (Menard, 2002), therefore, visits were performed and data from interviews collected from 2009 to 2019 were used. A series of documents were analyzed – being some of them about since the beginning of the history of the winemaking in the region.

Lastly, the **third paper**, called "Orchestrating an innovation ecosystem in the University: The case of a Brazilian University" had its initial version presented at the *27ª Conferência Anprotec de Empreendedorismo e Ambientes de Inovação* in 2017 and its final version accepted at *R2IE - Revue Internationale d'Intelligence Economique* in 2020. The paper aims at filling a gap in the literature in relation to the role and actions of the orchestrator on the development of an innovation network from a research of participant action in an innovation ecosystem of the university. The main contributions are the identification of the roles and activities of the orchestrator and the definition of the actions to facilitate the orchestration of the university innovation ecosystem.

The role and demand of universities has been changing in recent years. In this context, the generating knowledge should be spill over for commercialization driving innovative activity and economic growth. The universities are seeking to build innovation ecosystems in their contexts in order to meet the demands of market claimed (Audretsch, 2014). A huge challenge is to understand who and how to design this ecosystem (Wright, Siegel & Mustar, 2017). The discussion about the role and the activities of the orchestrator is still incipient in the literature (Hurmelinna-laukkanem & Natti, 2018). Therefore, this paper sought to answer the following questions: *what are the roles of an orchestrator in a university innovation ecosystem?* The aim of this paper is to understand what the roles and activities of the orchestrator of the university innovation ecosystem are.

An action research was carried out in UFRGS – Federal University of Rio Grande do Sul, in the south of Brazil from April 2015 to March 2019. In this method there is no separation between subject and object, since the respondents are also part of object of this

research and they participate in its construction in a collaborative way (Kemmis & Mctaggart, 2007). The case was chosen since UFRGS is among the top five Brazilian universities, being a reference in teaching, research and extension. In recent years, the university has begun to focus on construction an innovation ecosystem from its Science Park, called Zenit. The Zenit Science Park can be considered the orchestrator of this movement, being in charge of the articulation and management of the university's internal and external actors.

1.4. Relation Among Papers

The three papers developed in the thesis seek to answer the objectives of this thesis and to fill the gaps identified in the literature, acting in innovation networks from different contexts and stages of development. The Table 1 shows a summarized presentation of each paper.

Table 1: Papers Presentation

	Paper 1	Paper 2	Paper 3
Title	The orchestration process for emergence of clusters of innovation.	Multilevel orchestration: the unlock for innovation in clusters life cycle?	Orchestrating an innovation ecosystem in the University: The case of a Brazilian University.
Purpose	Analyze the orchestration process in the emergence of a cluster of innovation (CoI).	Analyze how does the orchestration influence on the clusters life cycle.	Understand what the roles and activities of the orchestrator of the university innovation ecosystem are.
Context	Process for emergence of innovation network	Influence in network life cycle	Roles of an orchestrator in innovation network development
Type of Network	Cluster of Innovation	Regional Cluster	University Innovation Ecosystem
Method	Exploratory Study Case	Longitudinal Study	Action Research
Keywords	Cluster, Orchestration, Emergence of cluster, Life cycle of cluster.	Regional Clusters, Innovation Networks Orchestration, Cluster life cycles, Lock-in effect	Innovation Ecosystem, Universities, Network Orchestrator, Orchestration

Analyzing the papers developed in the thesis, we can verify three main features among them: context (type of network and coverage), stage of development of the network and the method of research adopted. Those different perspectives at the phenomenon of orchestration of networks reinforce the contributions generated by this thesis.

In respect to the context, it is worth to highlight the types of networks chosen cluster of innovation, regional sector cluster and university innovation ecosystem. In the first, there is a network of multi sector scope with the presence of distinct actors without

having common interests clearly established, which makes the orchestration even more complex. In the second, we notice a network with a sector and territorial focus well established, at the same time that it has a high quantity of actors involved, it is also more organized because of the long trajectory. The third paper brings the context of a network focused on a specific environment. Thus, it is possible to better understand who the actors are and what the relations they have.

The difference regarding the perspective of the stage of development also provides a broader approach at the orchestration of innovation networks. In the first paper, we focused on understanding the relation of the orchestration with a network that was in process of emergence. That phase of difficult detection brings important insights about how to mobilize the actors and generate value for all. In the second, we used the case of a well-established network in order to understand the influence of the orchestration along its lifecycle. During the trajectory, it is common that the network passes through different crises and advancements, therefore, we understand that this longitudinal approach allows a better understanding of how the orchestration occurs. In the third paper, we have a process of network development, which we could follow for four years. The participation on that construction allowed us to identify the roles and main activities of the orchestrator.

Lastly, another great contribution is the multiplicity of methods adopted in the papers, since, even all of them being performed under a qualitative approach, different lenses were used for each one of them. In the first paper, as it was about an exploratory moment (both for the case and for the researcher) an in-depth case study was used. Thus, it was possible to represent the moment of emergence and identify the essential points for that process. In the second paper, we would like to understand the influence of the orchestration over the life cycle of the cluster, this way, a longitudinal perspective was demanded. Such option allowed us to understand the changes of the orchestration over the network trajectory. In the third paper, the aim was to understand the role and the activities of the orchestrator, this way, we performed a participant action research. That method provided us to experience the routine of the orchestrator, promoting, this way, the understanding about their roles and activities.

There are many gaps in the literature for the orchestration of networks to be better understood and applied. In this thesis, we highlighted three main gaps: process of orchestration in the emergence of a network, influence of the orchestration along the life cycle of the network and the role and activities of the orchestrator. To fill such gaps,

studies that explore different types and coverage of innovation networks have become necessary, besides different perspectives in relation to their stage of development.

Thus, the composition of the three papers seeks to answer the objectives defined by this thesis. It is possible to verify that some article may not contribute directly to any objective, as shown in Table 2. However, the three papers allow an analysis on the orchestration of innovation networks in different contexts.

Table 2: Relationship between specific objectives and papers

Specific Objectives	**Paper I**	**Paper II**	**Paper III**
Understand how the orchestration process occurs in a network from different perspective.	x	x	x
Analyze the influence of orchestration at different stages of development of the network.	x	x	
Compare orchestration in different contexts of networks.	x	x	x
Define the key elements of the orchestration of networks.	x	x	x
Identify the orchestrator (s), their roles and activities in an network.		x	x
Propose insights on network orchestration.	x	x	x

This thesis is justified, since interorganizational networks are considered an important structure for generating value for different organizations (Valkokari et al, 2017; Cinelli, Ferraro & Iovanella, 2019). Regardless of the type of network, its management is a challenge due to the complexity and dynamism of these structures (Pikkarainen *et al*, 2017; Reypens, Lievens & Blazevic, 2019). Therefore, orchestration is attracting academic and managerial attention, as it is a management that seeks to capture and generate value without hierarchical character, ideal for networks (Hurmelinna-laukkanem & Natti, 2018; Ritala *et al.,* 2009; Dhanaraj & Parkhe, 2006). The results of the thesis seek not only to bring theoretical contributions to make the literature on the theme more robust, but also managerial contributions, assisting public and private managers in the articulation of a network.

2.PAPER I:

THE ORCHESTRATION PROCESS FOR EMERGENCE OF CLUSTERS OF INNOVATION

Bittencourt, B. A.; Zen, A. C.; Wegner, D.; Schmidt, V. K. (2017) Orquestração para o processo de formação de clusters de inovação. In: VIII Encontro De Estudos Em Estratégia da Anpad - 3Es 2017. Curitiba.

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ABSTRACT

Clusters stand out as mechanisms of innovation for not only the clustered firms but also the territory in which they are located. However, the cluster emergence process is complex and still unknown. The purpose of this paper is to analyze the orchestration process in the emergence of a cluster of innovation (CoI). This study is a qualitative exploratory research in Porto Alegre, in Southern Brazil, in the region known as 4th District. The results indicate the importance of alignment among network members, of coordination of actions and of joint agenda as facilitators for the emergence of a cluster. Besides, results also highlight that the entrepreneurial process and the perspective of global strategy are essential to build competitive advantage to the region. This paper brings a theoretical and managerial contribution to the application of the concept of orchestration to emergence of a CoI. The framework presents network components, orchestration components and the drivers to emergence of a CoI.

Keywords: Cluster, Orchestration, Emergence of cluster, Life cycle of cluster.

1. Introduction

Several studies showed that clustered firms tend to be more innovative and achieve superior economic performance in comparison with isolated ones (Marshall, 1920; Saxenian, 1994; Audretsch & Feldman, 1996; Capello & Faggian, 2005; Bell, 2005; Giuliani, 2010). Business clusters stand out as innovation mechanisms, not only for the clustered firms, but also for the territory in which they are located (Porter 1998; Schmitz, 1999). The extant literature has focused mainly on the benefits of clusters, how they can be characterized, and what elements make them successful (Trippl *et al*., 2015). Nevertheless, the dynamic of clusters has been neglected in the literature and few scholars seek to understand the clusters life cycle and their mechanics (Hervas-Oliver & *Albors*-Garrigos, 2014).

The emergence is one of the most crucial phases of a cluster life cycle. The difficulty to identify a priori the emergence of a cluster is a reason of such importance (Menzel & Fornahl, 2010). Many agglomerations and projects, for different reasons, do not actually become a cluster (Martin & Sunley, 2011). Thus, the cluster emergence process is complex and still unknown, and consists of a set of prerequisites coupled with local triggers (Brenner & Mühlig, 2007). Hence, on starting a cluster, actors play a fundamental role since it is their responsibility to develop it (Henning, Stam & Wenting, 2013).

The concept of orchestration emerges as a set of activities aimed at the development, management and coordination of a network that seek to create and extract value for all members (Dhanaraj & Parkhe, 2006). Such capacity respects the specific identities of each actor involved and attempts to ensure that they continue to collaborate fruitfully (Parmentier & Mangematin, 2014). Considering clusters context, it is understood that orchestration arises as the possibility to guarantee the cluster survival and the generation of competitive advantage for the region.

Because of the success of these geographical agglomerations, several studies have been developed to propose public policies that support clusters development (Brenner & Schlump, 2011; Ingstrup & Damgaard, 2013; Yu et al., 2014). Although important, cluster development policies do not ensure regional development (Darchen & Tremblay, 2015). Case studies often point to inefficient development policies that do not consider local needs (Brenner & Schlump, 2011; Ingstrup & Damgaard, 2013). Each agglomeration can be understood as a complex regional system (Martin & Sunley, 2011),

which can offer benefits to a region if it is well managed (Yu et al., 2014). Therefore, this study emphasizes the need of including the orchestration approach to better understand the emergence of geographical agglomerations and to enhance the impact on the development of the region.

Engel (2015) introduces the concept of cluster of innovation (CoI) within the context above. Contrarily to sectorial and geographic delimitation, CoI is a concentration of different actors, with certain behaviors, connected and not being linked to a specific industry in a defined geographical space (Engel and del-Palacio, 2009; Engel, 2015). Considering the importance of business clusters for the creation of regional competitive advantages in a global environment, this paper aims to answer the following question: *how does the orchestration process happens in the emergence of a CoI?* The purpose of this research is to analyze the orchestration process in the emergence of a CoI.

To answer this question, a qualitative exploratory research was carried out in Porto Alegre, a State capital in Southern Brazil, in the region known as 4th District. This region is undergoing a transformation process to become a CoI. The revitalization of 4th District is part of the resilience strategies in Porto Alegre, for which both the city government and civil society are working together to encourage the emergence of an innovation cluster.

2. Theoretical Background

This section discusses the concepts of CoI, emergence of clusters and network orchestration and proposes a framework.

2.1. Cluster of Innovation (CoI)

CoI can be understood as a set of components, behaviors and linkages working to promote innovation in a given area (Engel, 2015). The components are actors (people and organizations) that interact in the locality. The main components are the government, universities, entrepreneurs, research institutions, investors, consolidated companies and local organizations (Engel, 2015). Behaviors are the actions responsible for creating cluster value. The critical behaviors of a CoI are defined as the mobility of resources (money, people and know-how/technology), entrepreneurial process (search for business opportunity, innovation and experimentation) and perspective of global strategy and alignment of objectives. This articulation among the actors is needed for developing a

collective strategy and enabling the emergence of a CoI. The linkages are relations of the cluster and its members, and may be weak ties, durable relations and covalent relations.

This research is based on definitions of CoI by Engel and del-Palacio (2009) and Engel (2015) and considers that clusters main positive externalities are derived from the interactions between firms and institutions; and that the cluster concept requires an update to explain the most recent agglomerations. Thus, cluster would be the agglomeration of different components (entrepreneurs, universities, government, etc.) with certain behaviors (mobility of resources, alignment of interests, incentives and objectives, perspective of global strategy and entrepreneurial process) connected by different links (weak ties, durable relations, covalent relations, etc.) in a delimited region.

Cluster has become an important topic of discussion in several areas, such as economy, geography and administration (Morosini,2004), but there are still few studies that seek to understand the life cycle of clusters and their operation (Hervas-Oliver & Albors-Garrigos, 2014). Thus, next session explores the phenomenon of cluster emergence.

2.2. Emergence of a Cluster

Determining the origins of the cluster accurately is still a challenge (Menzel & Fornahl, 2010), as it is almost impossible to guess where a cluster will take root (Maskell & Malmberg, 2007). The emergence phase is difficult to identify, but it is at this stage that the bases and the growth process are formed (Menzel & Fornahl, 2010). Cluster emergence can be triggered because of a series of endogenous and exogenous factors that lead to the co-location behavior of firms (Maskell & Malmberg, 2007). Cluster emergence is characterized by few companies and synergies (Menzel & Fornahl, 2010). In this way, there are two possible paths at this stage, the first is to lose strength and not become a cluster. The second line is to develop to the point of entering the growth stage (Martin & Sunley, 2011).

Two main approaches on cluster emergence can be distinguished (Isaksen, 2016). The first one suggests that new clusters often start in a certain place relatively by chance (Maskell & Malmberg, 2007). In the same view, Krugman (1991) brings to its cause, the seemingly trivial historical accidents. The second approach, however, advocates that clusters emergence is related to previously developed local capabilities, routines, and institutions (Boschma & Frenken, 2011).

In this context, some authors seek a middle ground between these two approaches to cluster emergence (Isaksen, 2016; Brenner & Mühlig, 2007). Isaksen (2016) recognizes the importance of preexisting regional conditions that allow the evolution of specific clusters in some places, while emphasizing triggers that bring up clusters in some specific places. In fact, for a successful experience of clustering, it takes a bit of luck in relation to the choices of agglomeration of firms and political actors that will fill the gaps of economic development (Siddivò & De Chiara, 2012). Thus, the actors involved in a cluster emergence play a vital role, given that they must be able to use favorable preconditions (Henning et al., 2013), local triggers and the policy framework, and should put into practice regional strategies for the cluster, promoting actions that improve collaboration between actors and the adjustment of national and regional policies (Yoon, 2017).

Cluster emergence is difficult to detect because there are few synergies among the actions performed and, often, if it loses force, it does not become a cluster. Thus, it is necessary to understand how to articulate all the movements to potentialize and guarantee the process of cluster emergence. Next section will discuss the capacity to orchestrate networks as an alternative to accomplish that.

2.3. Network Orchestration

Orchestration capacity emerges as a set of activities aimed at the development, management and coordination of a set of actors that seek to create and extract value from the network (Dhanaraj& Parkhe, 2006). Fung et al. (2008) consider orchestration as the capacity to unite several different expertises for a harmony capable of creating value. Silva (2016) compares the function of the orchestrator with the conductor in an orchestra, where there may be exceptional musicians, but someone is needed to connect them and make them share the same vision.

In environments in which there is a high diversity of partners, that is, in networks and clusters, an orchestrator is needed to secure valuable inputs and mitigate concerns from network actors. Different network roles – which refer to the orchestrator doing specific orchestration activities in a specific way – should be explored in the cluster emergence process.

Innovation networks orchestration involves three dimensions: knowledge mobility, innovation appropriability and network stability (Dhanaraj & Parkhe, 2006). Knowledge mobility refers to the sharing, acquisition and deployment of knowledge

within the network. Innovation appropriability ensures that innovators can capture the results generated by innovations, and network stability refers to the intentionality of maintaining collaboration among network members.

Based on Dhanaraj & Parkhe (2006), Hurmelinna-Laukkanen et al. (2011) add more dimensions and propose six of them as the basis for orchestration in innovation networks: agenda setting, mobilization, network stabilization, creation and transfer of knowledge, innovation ownership and coordination. Combining the dimensions proposed by Dhanaraj & Parkhe (2006) with the proposals by Hurmelinna-Laukkanen et al. (2011), six dimensions are recognizable (agenda definition, mobilization, knowledge mobility management, innovation appropriability management, network stability management and coordination).

2.4. Framework

Clusters stand out as mechanisms of innovation and development to firms and regions (Porter, 1998; Schmitz, 1999). However, their emerging process still generates discussion and uncertainty. In this sense, orchestration emerges as a capacity to capture, extract and generate value for the cluster, guaranteeing its existence and sustainable competitive advantage.

Facing a new social and economic scenario, Engel and del-Palacio (2009) and Engel (2015) update the concept of cluster for "CoI". Such a definition maintains the idea of agglomerations of organizations in a **geographical delimitation**, but it places a **multisectoral perspective** and reinforces the **heterogeneity of components** as factors of innovation generation.

The cluster emergence process is complex and still little explored; it is believed to encompass a set of local prerequisites coupled with triggering factors (Brenner and Mühlig, 2007; Isaksen, 2016). This study seeks to define **the drivers for emergence of innovation clusters**.

The first drive, **mobilization** (Hurmelinna-Laukkanen et al., 2011), is to search and select members to integrate the innovation cluster. Next, it is necessary to **define an agenda** (Hurmelinna-Laukkanen et al., 2011) to create and communicate a set of actions to provide direction and guidance to the innovation cluster members. Then it is possible to mobilize resources (Engel, 2015), share, acquire and implement physical, human and financial knowledge and resources within a cluster. **Entrepreneurial process** and **global**

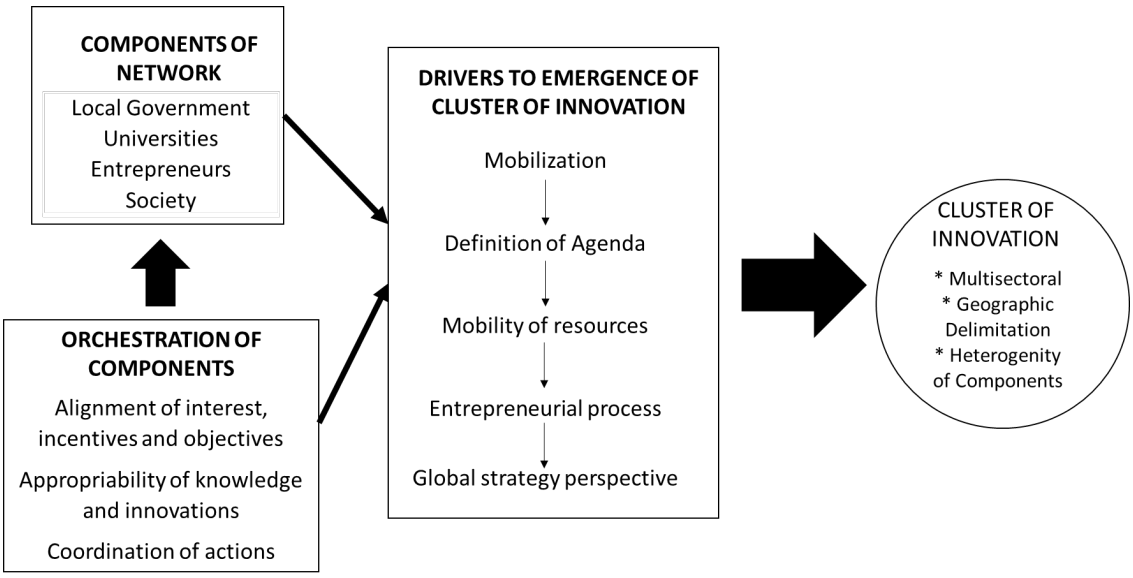
strategy perspective (Engel and del-Palacio, 2009; Engel, 2015) are fundamental drivers for guaranteeing the survival of the innovation cluster and its value generation.

How actors take part in the cluster is fundamental since it is their role to form the cluster (Henning et al., 2013). The need for **heterogeneity of network components** such as **local government, universities, entrepreneurs and society** to generate innovation is also highlighted in the literature (Porter, 1998; Engel, 2015). Orchestration emerges as the alternative to articulate these different actors in the emergence of an innovation cluster.

The following set of components for orchestration was defined based on the studies about emergence process of a CoI. First step is **the alignment of interest, incentives and objectives** (Engel, 2015), the capacity of stakeholders to ensure a collective strategy for the cluster. Next comes **the appropriability of knowledge and innovation** (Dhanaraj & Parkhe, 2006) that allows knowledge to be created and transferred and transformed into innovation. Finally, it is necessary to **coordinate** (Hurmelinna-Laukkanen et al., 2011), conduct planning and control the execution of actions.

The following framework (Figure 1) helps to understand how the orchestration of the emergence process occurs in a CoI. It summarizes articulation between orchestration components and network components. Then, they can leverage the emergence drivers for the formation of the innovation cluster.

Figure 1: Framework Orchestration of the Emergence Processs



3. Research Design

In order to answer the research question, a single case study was used as a method, as it is a research strategy which focuses on understanding the dynamics present within single settings (Eisenhardt, 1989). This approach is appropriate because more in depth understanding of orchestration itself – and understanding of multi-sided contextual influences – is needed (Yin, 2003).

Single-case studies can richly describe the existence of a phenomenon (Siggelkow, 2007), theoretical sampling of single cases is straight forward. They are chosen because they are unusually revelatory, extreme exemplars or opportunities for unusual research access (Yin, 1994).

The research strategy was a case study in 4th District, because of its trajectory as a CoI in emergency. In this way, the present case is suitable to analyze the orchestration process in the emergence of a CoI.

The 4th District, region located in Porto Alegre (in southern Brazil), is characterized by an old industrial zone profile that faced abandonment by large companies and the up surge of serious social problems. In recent years, an intersectoral and multidisciplinary movement arose, involving public bodies, universities, companies and various society actors, intending to develop the region and promote innovation. The formation of the multisectoral cluster has been occurring in an organic and decentralized way, which makes the case relevant to understand how it is orchestrated.

3.1. Data Collection

Data were collected through documentary research, non-participant observation in cluster meetings and organizations located in the cluster and face-to-face in-depth interviews with actors involved in the cluster formation. Documents, academic research, reports and action plans related to initiatives for 4th District were used as sources of information. The interviews and observations were based on the orchestration dimensions of innovation networks previously defined in the literature by Dhanaraj and Parkhe (2006) and Hurmelinna-Laukkanen et al. (2011).

The observations occurred from June to July 2016 in events promoted by ZISPOA, Vila Flores, Collaborative Houses, UFRGS. In addition, ten interviews were recorded for later transcription and analysis. Given the exploratory profile of this study and the lack of studies linking orchestration to cluster emergence, this research used a

limited number of interviews aiming to get stronger understanding on the subject and create hypothesis to guide future studies. This is not a new strategy in clusters studies. It has been used by Porter et al. (2013), Shin and Hassink (2011) and Martin and Coenen (2015). Interviews were about one hour long, and the profiles of interviewees are in Table 3.

Table 3: Profile of Interviewees

Code of Interviewee	**Component**	**Institution**
Interviewee 1	Government	City Hall
Interviewee 2	Government	City Hall
Interviewee 3	Government	City Hall
Interviewee 4	Entrepreneur	Vila Flores
Interviewee 5	Local Organization	ZISPOA/GUD
Interviewee 6	Entrepreneur	Nós Coworking
Interviewee 7	Government	State Government
Interviewee 8	University	UFRGS
Interviewee 9	University	PUCRS
Interviewee 10	Local Organization	Distrito C

Analysis of research data was made by paralleling the dimensions involved in the emergence of clusters of innovation described in literature (network and orchestration components and drivers to emergence of a CoI) with the development of the CoI in 4th District. Table 4 presents the three dimensions and their elements.

Table 4: Dimensions and elements of analysis

Dimensions	**Elements**	**Authors**
Network Components	Local Government Universities Entrepreneurs Society	Engel and Del-Palacio (2009); Engel (2015)
Orchestration components	Alignment of interest, incentives and objectives Appropriability of knowledge and innovations Coordination of actions	Dhanaraj and Parkhe (2006); Fung, Fung and Wind (2008); Batterink *et al*., 2010); Engel and del-Palacio (2009); Engel (2015).
Drivers to emergence of a Cluster of Innovation	Mobilization Definition of Agenda Mobility of resources Entrepreneurial process Global strategy perspective	Engel and del-Palacio (2009); Hurmelinna-Laukkanen *et al*. (2011); Engel (2015); Silva (2016)

In addition, transcriptions of interviews and data obtained from documents and through direct observations were also compared to the elements listed above. Thus, the data triangulation strategy was used to identify the data consistency and validate

evidences. Treatment of data was based on content analysis by Miles and Huberman (1994). The interviews were recorded under interviewees' previous consent.

4. Analysis and the Discussion of Results

In the early 2000s, several initiatives sought to structure an electronic industry cluster in the region. However, the movement was interrupted because of the election of a new mayor who did not support it anymore (Interviewee 7). Years later, around 2012, civil society initiatives reopened discussions about projects to develop 4th District. Interviewee 6 states about the group of entrepreneurs and creative economy enthusiasts he has organized to bring solutions to the region: "we were passionate about the 4th District and uneasy about the current situation, so we were working collaboratively to come up with strategies to revitalize the region".

Since then, residents and local entrepreneurs began to articulate in a collaborative way to recover this area. Besides the enterprises, the municipal government and local and international universities started to attend meetings. Taking the initiatives of civil society into consideration and having the Master Plan outlined, the city government began a mobilization in 2013 to transform 4th District into a CoI. The aim was to organize a network of multisectoral clusters: high technology, education, creative industries and health.

Working groups were organized encompassing several offices and public agencies, entrepreneurs, companies, organizations and universities. In early 2016, the city government signed a cooperation agreement with local and international universities. Then, the Master Plan for the region was better structured by researchers from a public local university and presented the strategic lines todevelop4th District. This project is still guiding actions for the CoI formation. According to Interviewee 1, "collaboration is a key element in this project that foresees the active participation of population since its conception".

4.1. Network Components

Engel and del-Palacio (2009) and Engel (2015) recognize CoI components as fundamental elements for geographic agglomeration. In 4th District, city government is an important component in this process. Within the **local government**, different departments and public agencies are involved in the project. The local government has

structured two working groups to guide the actions in the region: strategic group and executive group.

The Executive Group encompasses departments of Finance, Urban Planning, Security, Governance and Tourism, EPTC – Public Enterprise of Traffic Control and InovaPoa – governmental Innovation Office. This group produced a diagnosis that identifies the most relevant needs of the region. On the other hand, the Strategic Group includes the Finance and Governance Office, POA Digital, university, initiatives and entrepreneurs of the region, mobilized actors and established partnerships. “We are responsible for requesting the Master Plan, wich will guide future action” says Interviewee 3.

Universities are actively participating in this revitalization process. UFRGS – Federal University of Rio Grande do Sul, PUCRS – Pontifical Catholic University of Rio Grande do Sul and URL – Universitat Ramon Llull, Barcelona, Spain are contributing with knowledge generation supporting the entrepreneurs and implanting offices of their technological parks in the region. UFRGS is involving seven laboratories and research centers on the structuring of the Master Plan. In addition, the University's School of Engineering and its Zenit Science Park are committed to building the innovation zone in the region. PUCRS is also mobilizing various sectors and academic units to contribute to the project. Among the actions, the School of Architecture and Urbanism has a research group located in the region. According to Interviewee 9, the idea came from his experience in Barcelona, where public spaces were used as learning laboratories. Funitec La Salle in Barcelona –URL is also a strategic partner to provide ideas and experience. The university participated actively in the case 22@ in Barcelona, a reference as CoI and urban regeneration. Thus, universities have the role of building and disseminating knowledge, fundamental to the emergence of a CoI. “The phenomenon that is occurring in the 4th District is unique, and it is up to the university to provide support for the construction of this project,” said Interviewee 8.

One of the main actors of a CoI pointed out by Engel (2015) is the entrepreneur. In 4th District case, the **entrepreneurs** were responsible for mobilizing and reconfiguring the territory. In 2012, meetings of entrepreneurs started in a coworking space of the region. Since then, the region began to count on numerous collaborative spaces that cover dozens of entrepreneurs from different areas. By the end of 2013, District C, a social innovation project, started the operation, which mapped and brought together entrepreneurs from the creative, knowledge and experience economy. According to

Interviewee 10, a common objective was to join forces to transform the territory and consolidate a cluster of social innovation. At the same time, Vila Flores cultural center has been created. This center is an architectural complex with art and culture, education, entrepreneurship and urbanism as its guiding axes. Vila Flores involves about 20 entrepreneurs and hosts various events in the region. Interviewee 4 (Vila Flores founder) states that the initiative has a relevant social and economic role for the cluster formation: "we are a private, self-funded project that excels at sharing, aggregating collaborative work and diversity. There can be no urban revitalization with expulsion bias and social and cultural segregation".

The **society** was also involved in the project of 4th District. ZISPOA – Sustainable Innovation Zone of Porto Alegre, which was founded by an American researcher, is formed by two hundred people. According to Interviewee 5, their aim is to make Porto Alegre the reference city for sustainable innovation in Latin America by 2020. They are divided into six groups to work that objective: innovation and technology, sustainability and resource efficiency, community participation management, entrepreneurship and startups, creativity and collaboration and business-friendly environment.

The Government of Porto Alegre created an office to attract resources for the city and to 4th District: Invest Poa. In 2015, Airbus and Medical Valley (Germany) were surveyed on a mission by the state government and the city hall. The French aircraft companies developing a proposal of a technology center and Medical Valley intend to install a technological and industrial complex dedicated to health research, in association with universities and research centers. The heterogeneity of components is fundamental for the construction of a multisectoral cluster. More than 20 operations in the health sector have already been counted in the region, including hospitals, clinics, laboratories, pharmacies and health insurance. In information technology and communication area, the efforts involve Softsul-South-Riograndense Association for Software Development Support, Assespro- Association of Brazilian Information Technology Companies and Brazilian Electrical and Electronic Industry Association (ABINEE). Regarding education, actions are based on cooperation with universities in the region and contact with schools and educational institutions. Finally, the creativity area rests on the hands of the pioneers of whole process, District C, Vila Flores and other spaces linked to creative economy, art and culture. These evidences lead to the following research proposition:

> *P1. The emergence of a CoI in the urban regeneration context depends on the engagement of actors that contribute with different resources.*

4.2. Orchestration of Actors and Resources

Because of heterogeneity of actors and the broad scope of this CoI, **alignment of interest, incentives and objectives** are becoming more complex. If heterogeneity is too high, the cluster can die because of lack of cohesion (Menzel & Fornahl, 2010). Interviewee 6 points out that different audiences impede an alignment of interests. “The government does not know what the investor wants, the university does not understand the needs of the local community and so on.” Interviewee 4 warns of the risk that region's valorization may cause the local community to be expelled because of increase in the cost of living. Interviewee 3 reports that one solution was the creation of working groups of different publics, however, it is noticeable that each working group is homogeneous and that there is no intergroup exchange. By aligning the interests of the actors involved, public policies could reduce the risk of cluster fragmentation (Tödtling &Trippl, 2005), which occurs when the high cluster heterogeneity makes it difficult to achieve the same critical mass (Menzel & Fornahl, 2010). In the case of the 4th District, the alignment of interests, incentives and objectives is still very incipient and the components do not perceive a single identity of the agglomeration.

The **appropriability of knowledge and innovations** is related to identification, assimilation and exploitation of knowledge from the construction of weak ties, durable relations or even, covalent relations. This collective interaction and construction require network stability to ensure that these links remain active and fortified. Ter Wal and Boschma (2011) argue that cluster links evolve with cluster capabilities. In the cluster initial stages, knowledge and technologies are tacit (Giuliani, 2005) and are strongly related to the human capital. Thus, this technological regime results in instability and volatility in the cluster networks (Ter Wal & Boschma, 2011). For emergence of a CoI in 4th District, it is essential to encourage knowledge exchange among the actors to disseminate best practices, allowing the emergence of a dominant design and cluster externalities (Tödtling and Trippl, 2005; Menzel and Fornahl, 2010).

Actors in 4th District do not know the other CoI components’ potentialities and limitations. This context reduces the **appropriability of knowledge and innovations** in the region. One of the possible causes of this situation may be the low level of network stability. It is perceivable that though there are pride and willingness to participate in the formation of the CoI, the 4th District agglomeration has no single identity. Various initiatives generate knowledge and experience, but one does not see them in totality. As

solution, Interviewee 5 is organizing a survey about all the actions developed in the region. The results will be published and shared with all actors involved in the project.

Concerning **coordination of actions**, there is also a strong decentralization in 4th District. The initiative to create the Strategic and Executive Working Group has a strong political influence and a limited result in terms of practical actions. When questioned about this issue, Interviewee 1 states that the cluster is too immature for governance, which he believes that may emerge over time. Interviewee 4 says: "that lack of local leadership can be a risk to the emergence of this cluster". Based on these evidences the second research proposition is:

> *P2. Coordination of actions fosters the alignment among the actors and stimulates the emergence of CoI.*

4.3. Drivers to Emergence of Cluster of Innovation

Besides to identifying the network components in a CoI, it is necessary to analyze the roles that drivers play in the emergence of a CoI. Related to **mobilization**, exchanges and interactions among actors occur in more informal and organic way. **Mobilization** can be even more potentiated if there is greater interaction among the different actors. However, some activities in 4th District are happening in an isolated component or only between peers. So, a solution could be to share the **definition of agenda** and propose collective actions. The importance of this driver can be observed in meetings organized by either the city hall, or the collaborative spaces or ZISPOA. However, Interviewee 4 understands that actions in 4th District are still disjointed because there is no joint agenda aligned with specific goals. For example, on the District C website, one can find academic papers and reports, but only involving that initiative. Coordination of components could conduct planning and control the execution of actions by components, while the joint agenda creates routines to provide direction and guidance to cluster members.

The **mobility of resources** is easily verified in 4th District, because of the number of actors and initiatives that provide for exchanges and interactions among then. Such mobility is enhanced by the creation and dissemination of knowledge mainly by universities and entrepreneurs from academic research, networking meetings and training. However, these actions occur organically and in a disorganized way, which could be related to the lack of alignment of objectives and collective strategy. In addition, the links among the actors are still evolving, which directly affects the network stability.

There are evidences that the cluster emergence is a consequence of the mobility of resources, such as intellectual capital, which has been increasing the participation of different actors. “The number of people attending our meetings has been increasing exponentially,” says Interviewee 1. The role of entrepreneurs and society is fundamental to community engagement. In addition, the city government is protagonist in the search for strategic partners and financial resources. Finally, the universities and the collaborative spaces have been disseminating knowledge.

Another driver is the **entrepreneurial process.** The area of 4th District, abandoned by the industries, started a slow movement of urban regeneration from large empty areas to creation of new companies. On supporting these initiatives, it is important to highlight the role of the collaborative spaces and the coworking offices installed in the region. “Many companies have emerged from exchanges and interactions here at Vila Flores,” says Interviewee 4. The mobility of resources and entrepreneurial process are quite remarkable in 4th District. Coworking spaces, collaborative houses and technological parks linked to the agglomeration promote the generation of innovations and new business.

Although the initiative is local, 4th District is already structured with a **global strategy perspective**. Besides URL, from Barcelona, contacts with French and German companies reinforce the intention to internationalize the region. Also, the participation of an American scholar and his global organization shows that the cluster already has visibility in other countries. “We believe that 4th District of Porto Alegre will serve as an example not only for other spaces in the city, but also for different countries”, says Interviewee 2. Interviewee 5 also complements that the space is already a reference since the initiative was awarded in Sweden as an international case of innovative local development. In addition, the health cluster that will be structured in the region is the result of a partnership with Medical Valley.

As presented, there are evidences that there is a global strategy perspective, that is, 4th District presents interaction at local, national and global levels. This interaction can happen when the orchestration ensures mobilization, hence seeks and attracts new partners to enhance the cluster competitive advantage. The area has three strong international partners: an American scholar, a Spanish University and the German Government. In sum, the global strategy perspective enables a wide mobilization to capture partners and knowledge. These evidences lead to the third research proposition:

P3. The joint definition and communication of common agenda enable the development of an identity as CoI.

5. Conclusions

In current dynamic and competitive scenario, networks and agglomerations appear as the main alternative to innovate and stand out in the market. There is a shift from enterprise-centered innovation to network-centric innovation (Nambisan and Sawhney, 2011). Clusters are revealed to be an efficient form of economic organization (Lorenzen, 2005), however the advantages found within clusters come from the collective action and not from the individual action of a particular firm (Schmitz, 1999). Yet, the ways in which these agglomerations are emerged is still generating a lot of discussion and questioning (Isaksen, 2016; Brenner & Mühlig, 2007). Therefore, the orchestration of networks appears as an alternative to articulate the preexisting characteristics of the region with factors that trigger agglomeration and innovation. To answer the research question, a qualitative exploratory research was carried out in Porto Alegre (Brazil), in a region known as 4th District.

The first contribution herein is the proposal of an analytical framework to understand how orchestration occurs in the emergence process of a CoI. Based on the literature review, this study presents the set of orchestration components (alignment of interest, incentives and objectives, coordination of actions) and the actors of a CoI (local government, universities, entrepreneurs and society). These actors can generate the drivers for the emergence of a CoI (mobilization, mobility of resources, entrepreneurial process and global strategy perspective) and the necessary elements for the emergence of a CoI (geographical delimitation and component heterogeneity).

Based on the research framework, this paper analyzes the case of 4th District, which becomes especially interesting because of its complexity and trajectory. The historical analysis revealed that after the exit of large industries that have been installed in the region, it started a long period of declining and abandonment. However, 4th District drew attention of political authorities, entrepreneurs and social scientists because of the emergence of new sectors working collaboratively. In this sense, 4thDistrict is an example of a region that, after a period of crisis, has been able to develop new trajectories of growth. It has been increasing its resilience by exploring new niches and emerging economic sectors (Martin & Sunley, 2011; Porter et al., 2013). P1 shows that the

emergence of CoI in the urban regeneration depends on the interaction of different components. It was identified that the first step towards the emergence of an innovation cluster is the engagement of different actors. Each actor has a given knowledge that, together with others, enables to generate innovation in an agglomeration. P2 argues that coordination of actions is easier when it is aligned among the components and stimulates the emergence of a CoI. The actors need guiding points; thus, the coordination of actions facilitates an alignment among them and, consequently, greater interaction and generation of innovation. P3 shows that joint definition and communication of common agenda enable the development of an identity as a CoI. In the same line as the P2, it was verified the need for an identity for the CoI that begins to be constructed from a joint definition and communication of common agenda.

In sum, P1 brings points in relation to the cluster actors, the importance of an alignment among them, the possible difficulty related to heterogeneity and the need to disseminate information and interaction for appropriability of knowledge and innovation. P2 and P3 place the coordination of actions and joint actions as facilitators for the construction of a cluster identity.

Finally, this study brings a theoretical and managerial contribution to the application of the orchestration concept to create a CoI, thus promoting a discussion about the emergence of this type of cluster and ways of maximizing the positive externalities that it generates. One limitation was the use of a single case. Therefore, it would be important that future studies analyze more cases and gather more data from different sources. The theme would be greatly benefited by researches using quantitative tools to consolidate the findings.

3.PAPER II:

MULTILEVEL ORCHESTRATION: THE *UNLOCK* FOR INNOVATION IN CLUSTERS LIFE CYCLE?

Bittencourt, B. A.; Zen, A. C. Shmidt, V. K. (2019). Orquestração Multinível: o u*nlock* para inovação em cluster? In: XLIII Encontro da ANPAD - EnANPAD 2019, São Paulo.

Bittencourt, B. A.; Zen, A. C. Shmidt, V. K. (2020). Multilevel orchestration: the unlock for innovation in clusters life cycle? In: 20ª European Academy of Management - EURAM 2020. Dublin.

ABSTRACT

The clusters are recognized for their social and economic impact for their firms and for the regions where they are inserted. However, recently, the discussions about the decline are increasing, in function of the lock-in effect since many clusters in the world have significantly decreased in the last years. The orchestration emerges as an alternative for the management in those clusters. Therefore, the present paper seeks analyze how does the orchestration influence on the clusters life cycle. For that, an exploratory study was performed with longitudinal perspective in the wine cluster of Serra Gaúcha, Brazil. The cluster was chosen because it has gone through and overcome several crises over its trajectory and because of its social and economic importance for the region. As main result of the research, a proposition of a model of multilevel orchestration was developed, where a shared role in the orchestration is defended and an operation in the individual, organizational and cluster level in order to avoid the lock-in effect.

Keywords: regional clusters, innovation networks orchestration, cluster life clycle, lock-in effect

1. Introduction

The focus of the study of regional clusters for many years was the reason why the clusters exist, the main characteristics of the clusters and how the clusters may be supported by political initiatives (Isaksen, 2016). However, more recently, greater interest have been dedicated to the clusters lifecycle: how clusters emerge, change and develop over time (Fornahl, Hassink, & Menzel, 2015).

The decline of several traditional clusters around the world during the last years encouraged the debate about the decline and renewal of the clusters (Hassink, 2005, 2010; Tödtling & Trippl, 2004). It was showed that, with time, the high specialization of a cluster, the limitations of the connections among the firms and the strong support of the institutions end up making the cluster inflexible, which hinders actions oriented to the innovation, taking the cluster to the imprisonment and decline through lock-in (Menzel & Fornahl, 2010; Cho & Hassink, 2009; Grabher, 1993; Hassink, 2005). The lock-in effect is the resulting process of the trajectory dependence (Tomassini & Rocha, 2014). The lock-in is characterized as an equilibrium state where there is a low potential of endogenous change, showing itself a difficult effect to escape internally, needing, most of the times, action of some exogenous strength on the actors (Vergne & Durand, 2010).

The tendency of "keep doing the same" is identified, since, over the years, competences and knowledge about the theme were developed, or because the organizations do not aspire to change (Dosi, 1997; Tomassini & Rocha, 2014). Therefore, in case there is not the insertion of new knowledge and/or external changes, the imprisonment may take an industry firm or cluster to the decline.

In this paper, we argue that the answer to avoid the decline is the stimulus to innovation, which depending on the level will mean adaptation, renewal or transformation of the thematic limits of the cluster (Menzel & Fornahl, 2010). However, it is understood that managing and guaranteeing any process of innovation is a multifaceted and complex task (Pikkarainen *et al*, 2017), even more in environments where there is a great number and diversity of actors (Reypens, Lievens & Blazevic, 2019), such as the case of the clusters and innovation networks. Facing that, an alternative is the capacity of orchestration to guarantee inputs, minimize conflicts inside the cluster, encourage the existence of equity and stability of a network and generate more innovation (Dhanaraj & Parkhe, 2006).

We define orchestration as a set of activities oriented to the development, management and coordination of cluster of actors that is destined to creating and extracting value from the network (Dhanaraj & Parkhe, 2006). Such capacity respects the specific identities of each one involved and tries to guarantee that they keep collaborating fruitfully (Parmentier & Mangematin, 2014) generating innovations for themselves and for the cluster, without the benefit of hierarchical authority (Dhanaraj & Parkhe, 2006).

Although it is not a recent theme, the orchestration has been attracting more and more interest of scholars and managers (Hurmelinna-laukkanem & Natti, 2018). Among the most recent discussions, we highlight the role and the functions of the orchestrators for the greater articulation of the complex networks in dynamic environments (Pikkarainen *et al*, 2017; Hurmelinna-laukkanem & Natti, 2018). The literature points that the orchestrator's role changes along the cluster or network trajectory (Nielsen & Gausdal, 2017). The studies have also been pointing out that multiple orchestrators with distinct functions are capable of generating more innovations for the organizations and networks (Hurmelinna-laukkanem & Natti, 2018), besides having identified that the orchestration influences differently the levels individual and organizational (Ritala, Armila & Blomqvist, 2009).

In this line, we identify a gap in the literature: the relationship between orchestration and clusters life cycle. Considering the economic and social importance of the regional clusters and the impact that may cause its decline for the region, organizations and people around them (Avila, 2018) allied to the emergence of the orchestration capacity such as potential of incremental and radical innovation and new business opportunities (Ritala, Armila & Blomqvist, 2009), the present study seeks to answer the following question: *how does the orchestration influence on the regional clusters life cycle?*

This paper will push the emerging discussion on regional clusters in a new direction, exploring the orchestration on the stages of the life cycle. For that, an exploratory research was performed in the wine cluster of Serra Gaúcha. The cluster was chosen, not only by its long trajectory of more than a century of activity and by its social and economic impact in the region and in the country, but mainly, for having passed through several crisis in the last years and having presented stable productive and market indexes (Mello, 2018). Even during the economic crisis, which severely affected the Brazilian transformation industry (Carneiro, 2017; Lacerda, 2017; Mendonça & Morini,

2016), the cluster has being innovating and avoiding its lock-in effect and decline. The regional cluster is recognized by its product, process and market innovations.

This paper is divided in five more parts besides the introduction. Following, there is the theoretical background with the topics of life-cycle of cluster and orchestration of innovation networks, followed by the methodological procedure adopted by the research. From that, the data are presented and discussed, then, the propositions of the study are performed. Lastly, there are the conclusions of the research.

2. Theoretical Background

The cluster life cycle began to be researched due to the fact that cluster approaches failed to explain how the cluster emerged (Brenner & Muhlig, 2007; Bresnahan et al, 2001; Ter Wal & Boschma, 2011), how and why that mature clusters died (Bergman, 2008) and why they transformed their areas of activity (Lorenzen, 2005). Thus, clusters began to be seen as dynamic agents that, like industries, also have life cycle stages (Klepper, 2007).

Network orchestration, on the other hand, refers to the ability to influence the evolution of a new business network, in which new technologies, products or business models can be commercialized, capturing and generating value for all participants (Möller & Svahn, 2003; Dhanaraj & Parkhe, 2006). It is understood that it is possible to link the approach of orchestrating innovation networks to the context of clusters, since their definition with Porter (1990) and their origins with Marshall (1922), clusters are always related to positive externalities from a network of actors. In addition, clusters are increasingly being linked to networks that promote innovation (Eraydin & Armatli-Köroğlu, 2005). Therefore, in this paper, as already discussed in the literature, clusters are considered an innovation network (Lazzeretti & Capone, 2016; Desmarchelier & Zhang, 2018; Pan et al, 2019).

Thus, we understand that the orchestration can influence the clusters life cycle, avoiding its decline. In the sequence, the theoretical background that deepens this discussion, will be presented.

2.1. Life cycle of Clusters and the Lock-in Effect

Clusters become an important structure for the current economic scenario marked by transformations (Porter, 1998; Menzel & Fornahl, 2010), promoting the regional

economic development and increasing the probability of survival of the firms (Morosini, 2004), according to its potential of innovation generation (Lai *et al.* 2014). However, it is understood that according to the stage of its life-cycle, the cluster presents a set of characteristics that interfere on its innovation and its relations with the firms and with the region where it is inserted (Menzel & Fornahl, 2010). This way, recently, the greater interest and the greater discussion in the literature have been dedicated to the clusters life-cycle: how clusters emerge, change and develop over time (Fornahl, Hassink & Menzel; 2015).

The studies about clusters life-cycle have become very popular among the scholars (Martin & Sunley, 2011; Trippl *et al.*, 2015). Despite the differences among the approaches, most part of the theories about the cluster life-cycle involve from three to five phases of development in which the cluster may be present, being, in a generic form: emergence, growth, maturity, decline and renewal (Bergman, 2008; Enright, 2003; Hervas-Holiver; Albors-Garrigos, 2014; Menzel & Fornahl, 2010; Pressuti *et al.,* 2013; Shin & Hassink, 2011). The most widely used approach in the literature is the one developed by Menzel & Fornahl (2010) that described the cluster life-cycle as having four stages, which are: emergence, growth, sustainment and decline.

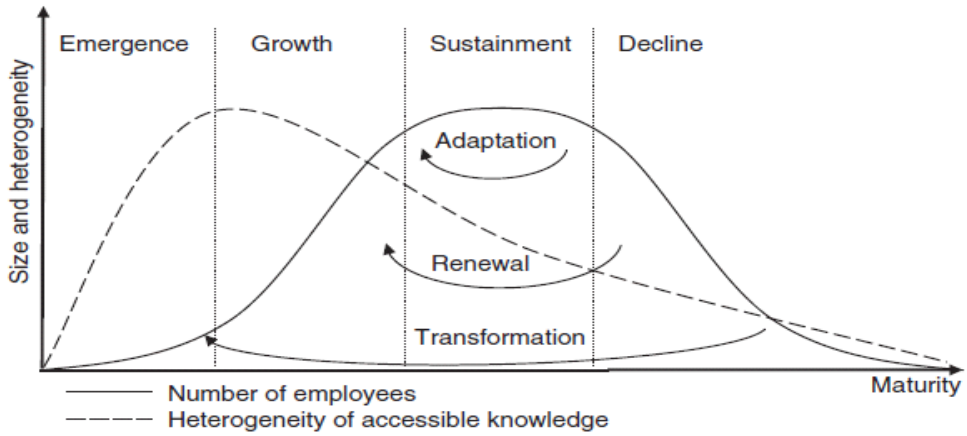
It is difficult to precisely define the phase in which a cluster first arises. The main reason for this is that the emerging cluster is not actually a cluster. Emerging clusters only contain a few, often quite small companies with few employees that are scattered over wide areas technologically. The emerging cluster either becomes a growing cluster when it is able to reach a critical mass and the growth rate of the companies exceeds the growth rate of non-clustered companies. The crucial factor for this is to first create synergies around a focal point.

Unlike the emerging cluster, the boundaries are now definable. Both the existing companies and the start-ups orient themselves toward the growth centers of the cluster. The shakeout of companies at the edge of the cluster additionally decreases the heterogeneity. This convergence further narrows the boundaries of the cluster, the cluster becomes more focused and a “dominant cluster design” forms. The growing stage ends when the growth of a cluster adjusts to the industry average and the cluster arrives at the sustaining stage (Pouder & St. John, 1996), albeit at higher productivity. The sustaining cluster describes a state of equilibrium. Fluctuations are more of a cyclical than of a structural nature. The various competencies of the companies are made accessible by dense and established networks (Menzel & Fornahl, 2010).

A declining cluster is defined by a decrease in the number of companies and especially of employees due to failures, mergers, and rationalizations. A region with a shrinking cluster is marked by a strong cluster-oriented bias of economic activities. This bias is caused by a specific knowledge base, highly qualified and specialized employees and companies strongly focused on specific markets and technologies. The competencies of such a cluster are contained in only a few companies (Menzel & Fornahl, 2010).

In case the value generation increases again, the cluster can "move back" in the cycle and start in a new stage of growth. This way, the cluster may start in the renewal stage through the insertion of a new product, incorporating new technologies or completely transforming the cluster for new scope of work (Menzel & Fornalh, 2010; Trippl & Todtling, 2008). Thus, we realize that the generation (or absence) of innovation is a trigger for changing stages in the cluster life cycle. In Figure 2 it is possible to see the model defended by Menzel and Fornalh (2010). It is important to highlight that the clusters will not necessarily follow a linear path of emergence, growth, support and decline during its development (Martin & Sunley, 2011) and they may present long periods of growth, or not, depending on its capacity of keeping a high diversity and value generation (Menzel & Fornahl, 2010).

Figure 2: Cluster Life Cycle Model



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

The approaches about life-cycle highlight the importance of the heterogeneity of knowledge of the firms and its related variety, the evolution of the value chain and the dependence on the trajectory of the industrial regions (Trippl *et al*, 2015). The approach about the cluster life-cycle focus on the dynamics related to actors, networks and institutions. These dynamics that are strongly different among the stages of life-cycle and

affect the transmission from one stage to another, since they are interconnected (Fornahl *et al.*, 2015). From the optics of the life-cycle, the clusters are not seen as agents that act of isolated, preset and pre-established manners anymore, becoming almost guaranteed structures of success (Bresnahan *et al*, 2001; Crespo, 2011; Martin & Sunley, 2003), responsible for the increase on the competitive performance, innovation (Baptista, 2000; Baptista & Swann, 1998; Porter, 1998) and the growth and regional development of the firms (Molina-Morales, 2001).

Despite the strong argument in relation to the social interactions for the development of the cluster, the present relations of the networks have a tendency to co-evolve with the cluster over the life-cycle, passing through periods of greater cooperation in the early stages of the cluster to a greater competition and rivalry in the final stages (Wal & Boschma, 2011), due to the reduction of technological heterogeneity (Menzel &Fornahl, 2010) and the increase of cognitive proximity (Boschma, 2005). Besides that, the resistance to change is one of the main causes of decline of the clusters, being this phenomenon traditionally explained through the negative lock-in effect (Grabher, 1993; Hassink, 2007; Martin & Sunley, 2006; Menzel & Fornahl, 2010; Underthun *et al*., 2014).

The lock-in effect is occurs in a regional level and emerges from the trajectory dependence (Boschma & Lambooy, 1999; Grabher, 1993), which hampers the regional economy breaks its historical legacy (Hassink, 2005, 2010), taking to a tendency of reproduction of the same structures and technologies over time, due to the generation of growing returns and externalities that marked initially the success of the region (Martin & Sunley, 2006). For that matter, the cluster is imprisoned on its own success history, or as stated by Grabher (1993): to the initial strengths of a district – its industrial atmosphere, highly developed and the specialized infrastructure, the close relations inter firms and the strong political support become an obstacle for innovation (Grabher, 1993, p. 256).

Despite the advantages of a dominant pattern (Teece, Pisano & Shuen, 1997), in case the cluster cannot break that pattern, there will be a decrease of the heterogeneity of knowledge and consequently, a decrease of innovations, taking the cluster to the imprisonment and decline through lock-in (Menzel & Fornahl, 2010). The inertia generated by the lock-in effect imprisons the cluster in a trajectory, which jeopardizes the capacity of the cluster to adapt and renew (Grabher, 1993; Hassink, 2010; Martin & Sunley, 2011). The drop on the innovative performance, increase of the costs of management and trade, dissolution of networks (Martin & Sunley, 2011; Tomassini & Rocha, 2014), are examples of negative externalities that take the cluster to the decline.

Yet, the geographical proximity eases the diffusion of knowledge, social and institutional norms, being possible to make the agents inserted in the cluster to have a narrow view (Boschma, 2005) as long as the cluster becomes a closed system and that self reproduces (Hassink, 2010). For that matter, there is a fast radical change in the technological field of the cluster, it tends to have difficulties to adapt, taking its agents to a state of technological obsolescence (Tomassini & Rocha, 2014).

In front of the innovation potential confirmed that the clusters have and the possibility of decline that they encounter over the life-cycle as a result of the lock-in effect, the need to understand how such clusters can continue innovating and surviving the market emerges. As alternative is to develop capacity of orchestration of innovation networks, theme that will be addressed as it follows.

2.2. Orchestration of Innovation Networks

The innovation activities happen more and more in the interaction among organizations in different networks (Dhanaraj & Parkhe, 2006; Reypens, Lievens & Blazevic, 2016). Consequently, those networks have attracted a considerable quantity of management and academic interest. However, one of the key points that remain inconclusive is the orchestration of networks, especially considering the variety among the actors that search the creation of value and its capture (Hurmelinna-laukkanem & Natti, 2018).

The networks theory focus on the multi-actors relations, being them individuals, sectors and/or organizations (Powell, 1990). Therefore, Powell (1990) indicated that industrial districts are a specific form of network. The industrial district is similar to other forms of regional cluster, mainly with respect to cooperation, competition and motivation of the companies that are part of it (e.g., Giuliani, 2005; Schmitz, 1995; Porter, 2009; Goedert, 2009). Considering that, it is relevant to understand that Powell could be considering clusters with a specific type of network and not only industrial districts. Years later, Owen-Smith and Powell (2007) stated that a network structure and co-location are characteristics of a cluster. That way, in this paper, clusters are considered as an innovation network (Lazzeretti & Capone, 2016; Desmarchelier & Zhang, 2018; Pan et al, 2019),

The complexity of interconnected businesses and the dynamism of the modern environment highlight how the innovation is the result of interactive processes among

multiple actors. The networks can be seen as a consequence of combining the existent and new knowledge of several companies and their limits, in order to create exclusive products, services and processes, depending on the current needs of the market (Cinelli, Ferraro & Iovanella, 2019). Innovation is fundamental for the long-term success of a company or a network, and even big organizations sometimes are not capable of sustaining the innovation in an independent way (Cinelli, Ferraro & Iovanella, 2019). Therefore, the orchestration of networks can influence the cluster life-cycle from the innovation – in other words, coordinating and introducing updates that generate the perceived value (Tidd, Bessant & Pavitt, 2008).

The networks orchestration appears as a set of activities oriented to the development, management and coordination of actors that are destined to create and extract value from the network (Dhanaraj & Parkhe, 2006; Ritala *et al.,* 2009). Fung, Fung and Wind (2008) support that definition bringing the orchestration as a capacity to unite several different expertises so that there is harmony capable of creating value. "It is about activities that allow and ease (but do not dictate) the coordination of the network for the performance of the results of innovation" (Ritala et al. 2012, p. 325).

Dhanaraj and Parkhe (2006) compose such capacity from three dimensions: **knowledge mobility, appropriability of innovation and stability of the network.** The mobility of the knowledge is referred to the sharing, the acquisition and implantation of knowledge inside the network. The appropriability of innovation involves ensuring that the innovators are capable of capturing the results generated by the innovations; and the stability of network is referred to the intent in keeping the collaboration among the members of the network.

Orchestration of innovation networks is not a new subject in the literature, but the discussion about that phenomenon has increased a lot in the last years (Hurmelinna-laukkanem & Natti, 2018). It is understood that there is a gap in the literature mainly about the roles, functions and influence of the orchestrator in the networks (Heidenreich, Landsperger & Spieth, 2016; Paquin & Howard-Grenville, 2013). Usually, the orchestration of an innovation network was performed by a hub company (Dhanaraj & Parkhe, 2006), nevertheless it is been verified that, in some situations, the roles and the functions of network coordination for the performance of innovation results extrapolate the model based on the set of actions of a hub company when considering all the members of the network (Hurmelinna-laukkanem & Natti, 2018).

We argue that a complex network may contain several orchestrators assuming a range of functions (Pikkarainen et al, 2017) and that the orchestrator and its role change over the life-cycle of an innovation network/cluster (Nielsen & Gausdal, 2017). Recent studies point out that the leadership may be shared and the different members may be organized without a defined hierarchy, spontaneously combining their resources and capacities to create and extract value from the network (Cinelli, Ferraro & Iovanella; 2019; Ferraro & Iovanella, 2015).

Besides that, Ritala et al (2009) already alerted that the skills and capacities of individual and organizational level interact and affect one another in several manners in the orchestration of innovation networks, and, thus, the authors identified some processes from top to bottom and vice versa where the macro level (the organization) influences the micro levels (groups of individuals) and vice versa. Therefore, the present paper indicates the possibility of multiple actors in distinct levels influence the generation of innovation, the lock-in effect and, consequently, in the clusters life-cycle. In the next section the method used to perform the present research will be presented and, next the discussions that support such statement.

3. Research Design

The study was developed under a qualitative approach. We chose as research strategy the single case study from a longitudinal perspective. It was opted to use the methodology of case study, due to the depth that this method provides to the researched object. The study case allows that the element time is covered, highlighting organizational and, mostly, relational behaviors in moments distinct from the current. Another characteristic of the method is to perform a multifaceted investigation, with data from different sources (Yin, 2010).

The case of the wine cluster of Serra Gaúcha was selected based on its long trajectory, its social and economic importance and on its acknowledgement as a geographical cluster from certifications as indication of origin and designation of origin. The cluster is the main responsible for the wine industry in Brazil, representing 85% of the national production of fine wine (Ibravin, 2017) and concentrating the main references of the Brazilian wine sector, with more than 60 wineries (linked to associations) and around 18 institutions connected to education, research, production associations, professional consultancy, sector representation among others.

The cluster with more than one century of activities has gone through several crisis and advancements in the last years, having to innovate to survive and to be highlighted in the market. Therefore, the case allows the understanding of how the orchestration can influences on the cluster life-cycle. To understand this phenomenon, a longitudinal study is necessary (Nilsen & Gausdal, 2017; Heidenreich et al., 2014; Sydow et al., 2011).

This research was longitudinal, bearing in mind that it analyzed the Wine Cluster of Serra Gaúcha since its origins until the present moment, which corresponds more than 100 years of history. Menard (2002) suggests that the longitudinal researches must be performed in more than one moment of time, therefore, visits were performed and data from interviews collected in the years of 2009 to 2019 were used; however, a series of documents were analyzed – being some of them about since the beginning of the history of the winemaking in the region. The data were collected in partnership with the authors' Research Group, which already has numerous researches in the areas of strategy and innovation on the Serra Gaúcha cluster since 2008.

The data were collected through documental research (academic surveys, reports of the sector, websites of institutions and vineyards, strategic planning and market data), non-participant observation (in events of the sector, visits in the companies and meetings of organizations located in the cluster) and thirty-five face-to-face in depth interviews with actors involved in the cluster dynamic (with representative of the Brazilian Institute of Wine, government, research centers, institutions of education and formation, professional consultancy, association of producers, entrepreneurs and associates of vineyards, managers of correlative areas among others). The list of the interviewees can be seen on Table 5. The semi structured interview script sought to explore the background of the cluster and the organizations and the interactions and the articulations performed over that trajectory. The interviews lasted the average of thirty-five minutes from June 2009 to March 2019.

Table 5: Profile of the Interviewees

Code of Interviewee	Type of Organization	Interviewee Position	Year of Interview	Interview duration
INT1	Cooperative Winery A	Director	2018	44min
INT2	Cooperative Winery B	Technician	2018	52min
INT3	Winery C	Technician	2009	58min
INT4	Winery D	Manager	2018	26min

INT5	Winery E	Manager	2018	12min
INT6	Winery F	Manager	2018	42min
INT7	Winery G	Director	2018	16min
INT8	Winery H	Enologist	2018	19min
INT9	Winery I	Enologist	2018	28min
INT10	Winery J	Director	2018	16min
INT11	Winery K	Director	2019	38min
INT12	Association A	Director	2009	43min
INT13	Association B	Director	2018	16min
INT14	Association C	Director	2018	1h36min
INT15	Association D	Director	2018	38min
INT16	Association E	Associate	2018	57min
INT17	Association F	Administrative	2018	22min
INT18	Association G	Associate	2019	33min
INT19	Representive Organization	Director	2018	42min
INT20	Representive Organization	Director	2019	28min
INT21	Turrism Institution	Administrative	2018	9min
INT22	Educational Institution	Professor	2018	13min
INT23	Oenology Institution	Director	2018	25min
INT24	Research Institution	Researcher	2009	33min
INT25	Research Institution	Researcher	2018	18min
INT26	Profissional Representation	Manager	2018	9min
INT27	Business Suport Institution	Consultant	2018	12min
INT28	Syndicate	Director	2018	42min
INT29	Governament	Administrative	2018	14min
INT30	Association B	Director	2009	1h25min
INT31	Winery G	Director	2009	25min
INT32	Winery J	Manager	2009	48min
INT33	Oenology Institution	Director	2009	1h11min
INT34	Representive Organization	Manager	2009	32min
INT35	Resentive Organization	Director	2009	58min

The data analysis of the research was based on the integral transcription of the interviews, the documents analyzed and the observations performed from a historical analysis about the trajectory of the cluster based on the stages of the life-cycle of the cluster pointed out by Menzel & Fornahl (2010): emergence, growth, sustainment and decline and the orchestration from the dimensions defended by Dhanaraj & Parkhe (2006): mobility of the knowledge, appropriability of the innovation and stability of the

network. Almost two hundred thousand words were transcribed after approximating one thousand two hundred minutes of interviews. From that, the strategy of data triangulation was used in order to identify the consistency of the data and, thus, implement the validation of the results found (Bardin, 2011).

The research was performed in three steps. The first one was dwelt on the historical construction of the cluster trajectory in order to identify the key elements that impacted on the cluster life-cycle. The second stage aimed at understanding how the orchestration happens in the Serra Gaucha cluster. The third step sought to cross the previous steps and analyze how the process of orchestration influences in the cluster life-cycle.

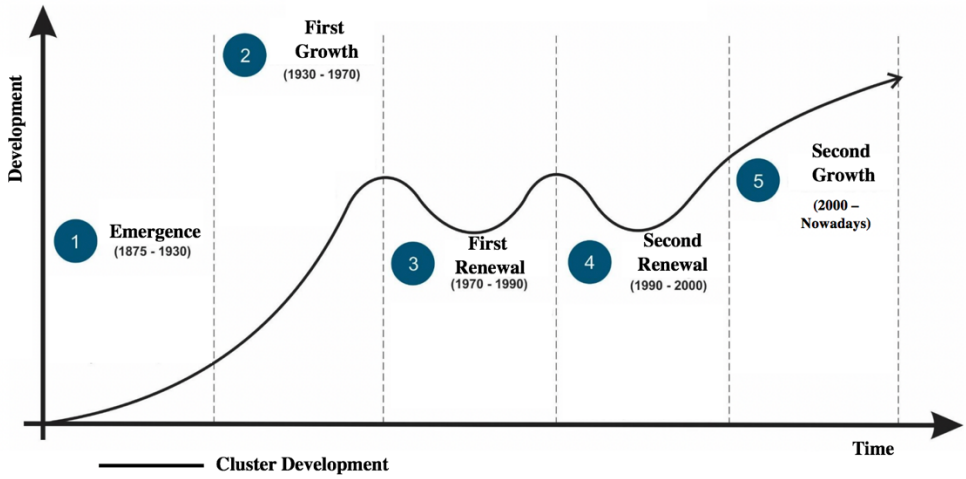
4. Analysis and the Discution of Results

In this section, we will discuss the trajectory and orchestration of the Cluster of Serra Gaúcha.

4.1. Trajectory of the Cluster of Serra Gaúcha

The Cluster of Serra Gaucha includes fifteen cities in the south of Brazil, more specifically, in the state of Rio Grande do Sul. The cluster is responsible for more than 85% of the wine production in the country (Ibravin, 2017), counting on the presence of the main institutions of the sector. Since its formation, the cluster that has passed through many changes in its life cycle. It is important to highlight that moments of decline and renewals are not the decline of the sector (number of employees / companies), but the decline of established routines and how the cluster has managed to increase its heterogeneity through the insertion of new knowledge, which led to the economic exploration of new products and business models. In this paper, we will use the life cycle analysis of the Serra Gaucha Cluster by Fernandes et al (2019) in which the author identified five moments: emergence, first growth, first renewal, second renewal and second growth as we can visualize in Figure 3.

Figure 3: Serra Gaucha Cluster Life Cycle



Source: Adapted of Fernandes *et al* (2019)

4.1.1. Emergence (1875–1930)

The viticulture activity of Serra Gaúcha started after 1875 as a result of the Italian immigration, which brought with them seeding of vine and the expertise of the grape cultivation for the region of Serra Gaúcha (Vieira, Albert & Bagolin, 2007). From the arrival of the Italian immigrants in the region of Serra, the trade of wine has begun; however, such activity was kept in small-scale until 1920. It was only after the years 1920 that big traders started to emerge, which were responsible for the construction of a production chain that was expanded to several regions of the south of Brazil, expansion that was simplified by the arrival of the rail transportation in the region of Serra Gaúcha in 1910 (Niederle, 2009).

In this moment it was possible to realize the potential for the cooperation (INT5, INT18) and that there was, effectively, a lot of change among the producers (INT11). It is highlighted that the stipulation of that initial moment as the stage of emergence is according to the conception of Aziz and Norhashim (2008) that define that the stage of emergence is started when the cluster starts to present the potential for cooperation. In its emergence, the cluster was composed mainly of individual producers of grape, not formalized, family (Flores, 2007; Souza, 2001; Tonietto, 2003). The main problem of the producers was the survival (INT32, INT17, INT19). This situation can be identified in the speech of the winery director: “when the immigrants arrived here, the high and first priority was to end hunger, produce food and that was the first priority. They planted

corn, they made paçoca; the wine was a food, a fuel, and it was also exchange currency" (INT11).

The emergence stage is referred to a previous stage of the real beginning of the cluster, without presenting obvious competitive advantages in relation to other regions, which was the condition of the wine region of Serra Gaúcha until near the years of 1930, when the region sees cooperatives of local producers appear (Dal Pizzol & De Sousa, 2014; Tonietto, 2003); it is in this moment that the region starts to really show results related to the existent competitive advantages.

4.1.2. First Growth (1930-1970)

The second stage of development started after 1929, with the implementation of several cooperatives, movement that evolved in the years 1930. The production increased to assist a market that reached other states of the country (Tonietto, 2003). Due to the growing pressures practiced by union and by the sanitary legal demands, the craft production of wine and grape-related products became more complicated. This way, after the decade of 1930, the first cooperatives of wine with capacity of competing with the private vineyards were constituted (Niederle, 2009). The cooperatives showed themselves important economic agents, since with the growing association of local producers, the cooperative could produce in large volume and practice prices low enough to control the market. The cooperatives also served as an alternative to small local producers to market their grapes at fairer prices, encouraging the production of the small grape farmer. After 1940, the agricultural activity starts being replaced by the industrial, as part of a national politics. The industrialization attracts new workers and diverges the production.

That was a period also marked by the technological development in the sector (Vieira, Albert & Bagolin, 2007) and investments on the part of the Federal Government (Nierdele, 2009). The Federal Government started to show a greater interest in developing a more modern wine industry and started a process of great technical e economic transformations in the sector, which caused the emergence of an industrial-business segment of a larger size (Niederle, 2009). Yet, during that time, the Brazilian winemaking sector starts to direct their efforts to join the market of fine wines. That way, a series of technical changes happened in that period, in order to improve the quality of production of the wines and the organizational structure of the vineyards (Niederle, 2009)

That long period was really important in the history of the cluster, in that period the emergence of representative organizations that still exist like Sindivinho, in 1948,

Fecovinho in 1952 and UVIBRA in 1967 happened. Those entities work and have worked seeking goals of categories, such as vineyards and cooperatives, and they had strong relevance in the development for the region (Dal Pizzol & De Sousa, 2014). O INT4 indicated that currently Fecovinho refers to the idea of non competition and the regulation of minimum sales price. Another important actor that emerges in this moment is the School of Viticulture and Winemaking (Dal Pizzol & De Sousa, 2014), that for a long time was the only one in the country and increased a lot the level of knowledge spread in the region, increasing a lot the number of qualified professionals, that previously, were scarce and mostly foreigners (INT23, INT33). Because of the increase of the number of actors, production and technological advancements, that phase can be characterized as growing stage (Menzel & Fornahl, 2010)

4.1.3. First Renewal (1970-1990)

After the years 1970, there is a new moment in the cluster trajectory, with the arrival of multinational companies in the region, altering the scenario from the point of view of the leader actors of the market in the time, taking to a greater weakening of the local vineyards, especially the cooperatives, which were facing difficulties at the time (Niederle, 2009). “When the multinationals arrived, they started the production of new cultivars and presented a higher focus on trading” (INT16).

That way, their arrival clearly meant a new dynamic of production and sales of wine for the region. The beginning of the multinational activities caused, mainly, two impacts for the producers that were already in the region: fear and excitement. Some producers and companies were fearful about their future and some abandoned, effectively the production activities (INT16). In contrast, many of them declared that multinationals as an opportunity to learn how to add value to the product and as potential disseminators of knowledge (INT11, INT26, INT20). Besides those points, the arrival of companies with greater capital also mean an increase of confidence of demand by productions – “the companies that came, many of them also implemented some vineyards, but they, in practice, relied a lot on many producers” (INT28).

The arrival of multinationals means a need of productive, technological and market update, for the producers that were already here. The sector that before sold wines with low quality, had new players that focused in cultivars traded at a higher price, with more advanced productive and industrial practices and better technology that guaranteed

higher quality and efficiency (INT9, INT15, INT26, INT20). This moment is also marked by the formation of the first technicians formed by the Winemaking School (INT23).

In 1975, Embrapa/CNPUV, was created, as a National Center of Research of Grape and Wine, organ linked to the Agriculture Ministry, it was the first institution of research oriented solely and exclusively for the technological demands of the sector (Vargas, 2013). Such institution helped a lot on the development of the region, at a technological level (INT12, INT24) allied to Uvibra that acted especially in tax and government matters (INT16).

The increase of the production was a characteristic of that stage on the life-cycle of the cluster (Dal Pizzol & De Sousa, 2014), it is understood that that behavior is a characteristic related to such industry, which will seek to increase the production regardless the conditions of the market (INT26). That stage was characterized as renewal especially because of the inclusion of new cultivars, which greatly impacted the sector since the beginning of the stage until the current days. Those points that are compatible with the concept of renewal stage of Menzel and Fornahl (2010), are characterized by strong technological and production alterations in the cluster.

4.1.4. Second Renewal (1990 – 2000)

Following, the cluster faced great challenges signaling clues of a possible decline (INT35). The end of the years 1980 were marked by the Brazilian trade closing to importations, action that guaranteed a false competitiveness inside the national sector to the vineyards. Besides that, great part of the wine production of the time was destined to the production of vinegar or distillation for the production of cognac (Niederle, 2009). That scenario ended up being damaging to the progress of the sector, since the national industry had a great and stable demand for wines of low quality and the vineyards did not fight any competition that made them invest in innovations and production improvement (Niederle, 2009). The stagnation that market the years 1980 ended after the years 1990 when the sector of table wine realized its demand, that was stable by then, collapse due to the changes of the cognac production. The crisis also followed for the segment of fine wines due to the loss of space in the internal market for the international wines that started to arrive with the international trade opening which the country was going through at the time (Niederle, 2009). The international trade opening made the vineyards to compete with products with more attractive prices and with better quality, forcing the sector and the cluster to reinvent themselves.

After the economic crisis in 1989, a critical moment started for the Brazilian wine industry. With a new economic plan, called Color Plan, which main goal was to open the market reducing the import tariffs and the creation of Mercosul in 1991, new competitors of the sector joined the Brazilian wine market, first Germany, then Argentina and Chile. Most of the multinationals, including the ones located in Serra Gaúcha, left Brazil to countries with lower cost of production. It was in that period that some local producers of grapes decided to be integrated and became producers of wine to provide a market for their crop. As a consequence of that decision, many new local vineyards were created (INT34).

Due to repeated crisis faced in the beginning of the decade of 1990, the subsequent years were marked by a restructuration of the winemaking. That time is characterized by strong alterations, such as: the opening of the market and the French paradox. The opening of the market, in 1990, strongly impacted the cluster with high ease of entrance of international wines, especially coming from other countries of Mercosul. The French paradox, on the other hand, brought a cultural change that encouraged the consumption and the production of red wine and the migration to sparkling wine of great part of the grape production for white wines.

INT9, INT14, INT28 and INT19 indicated that the market opening brought negative impacts for the region; INT26 stated that this factor was the one that caused the greater negative impact for the sector until now. The competition that happened until this moment was only of similar products, and the market opening brought wines of different varieties, special, from other nationalities and at a lower cost (INT13, INT8 INT26). The competition until now was almost intern; “the focus was production and industrialization, there was not a concern about the market” (INT8). As well as in the arrival of the multinationals, this new fact brought a series of discomfort for the producer, provoked the lack of trading ease, payment of suppliers, and promoted the closing of companies and the loss of properties (INT16). “The companies did not have easiness to trade anymore, to pay the suppliers, some companies closed. It happened here, it was not planned, then, there is the matter of imitation, copy. […] Some of them lost their properties” (INT16).

The French Paradox started after 1991, that “even with a diet full of fat, the French people suffered less coronary problems and showed themselves comparatively less fat than their neighbors and, especially, the Americans” (Clemente, 2009). Such view was promoted after the performance of a survey published in the British Medical Journal,

performed with 34.000 people; that study concluded that the consumption of wine was related to that paradoxical situation; consequently, there was, briefly, a great growth of demand of red wine (Clemente, 2009). In that time, there was also the exit of the multinational companies, which encouraged the growth of small vineyards (INT8). INT16 indicated as favorable factor of that situation, that: "the production is made in the pot, with a small investment. That helped the verticalization. There was a transformation of a primary material that was underpaid in a product that is better paid."

It is understood that the restructuration also happened in relation to the redefinition of the regulatory instruments (Niederle, 2009). Among the actions that marked that period, the creation of the Program of Restructuration and Development of the Winemaking of Rio Grande do Sul (PROVITS) in 1993, the creation of the Joint Subcommittee of Winemaking at Legislative Assembly of the State in 1995 and the creation of the Brazilian Institute of Wine (Ibravin) in 1997 are highlighted. In front of that new reconfiguration, representative of the sector understood that the existent alternative for the wine sector to leave an unfavorable position in the global chain of value would be through investments and innovations, in order to enable a production of quality wines and competitive costs (Niederle, 2009). During the decade of 1990, those new vineyards invested on the development of process of winemaking and improvement of the wine quality. The process continues and involves gradually a greater number of established companies. Facing that, it is understood that period as the second renewal of the Cluster of Serra Gaúcha.

4.1.5. Second Growth (2000 – Nowadays)

In the initial moments of the stage of the Second Growth, the difference is the act of IBRAVIN and the associations of vineyards seeking seals of Geographical Indications, as well as the emergence of new associations. With that there is a scenario where the cluster develops its organizational structure of strategic level, having more actors, support institutions and orchestrators in the associations' level, making such strategic structure more and more complex, which is a characteristic of clusters that are in growth phase according to Menzel and Fornahl (2010).

Many collective initiatives and innovations to improve the quality of wine and the reputation of the region started after the years 2000. Among them, Gollo (2006) highlights the production of sets of wines and the substitution of the bombardment conduction system for the gravity system and for the systems of automatic control of temperature and

reassembly. The innovations in the distribution cover the expansion of the internal and external markets. In 2002, the program Wines from Brazil (nowadays “Wines of Brazil”) was created to promote the presence of Brazilian wine in the international market. That program is a network of vineyards which goals are to promote the Brazilian wine in the international market and prepare the Brazilian producers to export (INT35). Besides that, the representative entities obtained the possibility of inclusion in the tax system called “Simples Nacional” that simplifies the charge of taxes for the sector. Another important innovation of marketing was the name “Vale dos Vinhedos” in 2002, the first one to be given in Brazil. Since 2012, the vineyards of Vale dos Vinhedos have Designation of Origin (DO), with restrict rules to produce grapes and wines.

Through the perception of local entrepreneurs about the growth potential of the internal market for products with international standard, such as fine wines and grape juices, ways to trade products with more added value were sought. This way, in 2002, through the request of Association of Producers of Fine Wines of Vale dos Vinhedos (APROVALE), the Registration of Geographical Indication was granted which created the first Indication of Origin of Brazil. The geographical indication aims at promoting qualitative improvement of the image of the Brazilian fine wine and ended up taking a role of reference for the other producer centers, irradiating a movement of the same sense in other producer regions, such as Pinto Bandeira in 2010 (Protas & Camargo, 2010).

Farias (2012) indicates that the main innovations are related to the system of soil and vine management, which is reducing the malformation of the bunch of grapes and increasing the quality. Another innovation highlighted by the author consists in the replacement of the system of conduction of the vineyards from trellised to espalier, in order to obtain a greater productivity. In relation to the processes, Farias (2012) highlights that the machining process of the production stages. The author also highlights the acquisition of stainless-steel tanks and automatic control of temperature, which makes the fermentation stage more precise. Still about the innovations in the processes, Farias (2012) highlights the process of storage and ageing of fine wines, which happens in oak barrels. Lastly, the author highlights the management innovations, which involves the implementation of changes on the structures, alterations in the concepts and practices of marketing and trading.

The wine production of Rio Grande do Sul, that is mostly performed in Serra Gaúcha, in the period of 2000 until 2017, presented high index of growth, specifically, around 15% per year when compared to the annual average of wine production in the

previous stage (Uvibra, 2018). Such characteristic favors the understanding that the cluster is on a growth stage. That growth is given both due to the increase of wine and grape juice trading, and also due to the expansion of the called "wine business", which consists on the increment of accessory business related to the wine production, such as restaurants, inns, hotels and enotourism (Flores & Flores, 2012). Through those activities, the vineyards can add value to their brand and increase their trading (Farias, 2012). Among the most important recent happenings, some projects developed by IBRAVIN are highlighted, such as *Programa Visão* 2025, the project Wines of Brazil, the program of Promotion and Communication of Grape Juice 100% and the Wine Register. Those programs aim at establishing guidelines, goals, actions and data survey, with the intention to develop the wine sector.

From a historic analysis about the trajectory of the Wine Cluster of Serra Gaúcha, it is noticed that the regional cluster has gone through several crisis and advancements since its emergence. Therefore, it is possible to identify the existence of key elements that influenced the life-cycle and, also, the lock-in effect and the generation of innovation in the cluster. Table 6 summarizes those main happenings over the trajectory of the cluster.

Table 6: Key Elements of Life cycle of the Cluster of Serra Gaucha

Emergence (1875–1930)	**First Growth** (1930-1970)	**First Renewal** (1970-1990)	**Second Renewal** (1990 – 2000)	**Second Growth** (2000 – Nowadays)
Italian Immigration	Consolidation and first activities of the cooperatives	Entrance of Multinationals	Market Opening	Creation of Associations
First cultivations of vine	Foundation of Sindivinho, Fecovinho and Uvibra	Learning of new techniques of development	Exit of Multinationals	Possibility of acting on the Simples Nacional
The cooperation among the producers started	Creation of Winemaking School	Creation of Embrapa and Development or researches	French Paradox	Innovation on the system of soil and vine management
Arrival of rail transportation	Public investment in technological development	Tax discussion and government representation	Renewal of the operation and trading	Growth on the production and trading
	Legal demands of production		PROVITS and IBRAVIN	Obtainment of geographical indications and designation of origin
	Beginning of the production of fine wines		Participation of the government	Actions of marketing and development of enotourism
			Drop on the production of table wines	Creation of Programa Visão 2025 and Project Wines of Brazil

Source: Adapted of Fernandes *et al* (2019)

4.2. Orchestrators of the Cluster of Serra Gaúcha

The Cluster of Serra Gaúcha concentrates the main companies and institutions of the Brazilian wine industry, including public and private organizations, training and

research institutions, category representations and organizations related to tourism. Those institutions act on the promotion, regulation, supervision and coordination of the Brazilian wine sector.

A relevant actor on the articulation of the cluster over its trajectory is the government, in the municipal, state and federal scope. The government influenced how the infrastructure, arrival of the rail transportation, creation of public policies, investments in technological development and incentives and tax collections. According to INT29, the growth of close cities is directly connected to the development of the cluster. The interviewee even highlights the impact of enotourism in the local economy.

Besides the government, it is worth to highlight the influence of several representative organizations in the cluster scope, being the main ones: Ibravin and Uvibra. Such organizations are responsible for representing the cluster beside the government, seeking financial incentives, creating brands and collective strategies, developing programs of encouragement among others. The Brazilian Institute of Wine (IBRAVIN) is an organization responsible for the promotion and the strengthening of the productive chain of winemaking in all its chains. Ibravin emerges "with the purpose to be an entity that can represent the sector, but above all that can search for resources" (INT19). INT20 expressed that Ibravin emerges in the search for resources with legitimacy that Uvibra did not have, in the sense of having that function on its bylaws.

Uvibra, Brazilian Union of Winemaking, emerged with a small group, but in 2007 counted on 27 companies, that corresponded to 60,8% of the Brazilian production of wines and derived (GOVERNMENT OF THE STATE OF RIO GRANDE DO SUL, 2007). According to the website, the organization was created with the purpose to foster the production and the winemaking trading of the region, being composed by vineyards and other representative organizations and institutions of the sector.

Another factor that had impact over the trajectory of the cluster was the institution of research, represented by Embrapa, it was one of the main responsible for the first renewal of the cluster. Embrapa Grape and Wine has extreme relevance for the development of the region. The research institution is responsible for several technological advancements such as improvement on the processes and production quality and, also, for contributing in sector achievements such as the geographical indications and appellation of origin. It is observed that the acting of the institution has direct influences for the sector, with the development of technologies, and for the companies, with the transfer of knowledge and practices.

A movement that produced impact on the first stage of growth of the cluster is the cooperatives of producers. Those organizations gather and represent small producers through a common brand, helping them since the production until the trade (INT1). The cooperatives are yet represented by their Federation: Fecovinho. Fecovinho, the Federation of Wine Cooperatives of Rio Grande do Sul, emerged in 1952, "from the union of three cooperatives: Garibaldi Vineyard, Aurora Vineyard and Forqueta Vineyard". INT2 reports that the cooperative that he is part of had its beginning especially oriented to trade activities, but nowadays it does not act exclusively with such subjects.

In the same line of the cooperatives, however a little more recent in the cluster trajectory, there are the associations of producers. Such organizations had great influence on the stage of the second growth of the cluster. Nowadays they are around six associations divided in micro regions. As main actions developed for the companies, it is worth to highlight the creation of the brand Vale dos Vinhedos, the search for Origin Seal, the inspection of the legal demands for the seal, the connection among producers, providing collective purchases and machinery exchange. "The association is composed by producers and partner companies. Since our foundation, many benefits were generated for the vineyards and for the region since changes on the production to programs of encouragement of trading" (INT13).

As influence in the scope of the organizations and also of professionals and individuals, there is the business support institution, represented by SEBRAE. SEBRAE, Service of Support to Micro and Small Enterprises, acts on the qualification and foster of small entrepreneurs as of business consultancy, management courses, technical trips and visits and promotion of interactions and exchange of knowledge among entrepreneurs. "I'll tell you that the one that helps the most is SEBRAE, thanks to them I learned more about marketing, went to Italy to know more about innovations on the sector and I am starting to export" (INT3).

Continuing in the level of the individuals, one important articulator of the cluster are the educational institutions, among them, the main ones are ABE and IFSul. The Brazilian Association of Winemaking (ABE) was the first Brazilian institution of enologist training and until now it is one of the main references in the world. In the last years the region also received the head office of the Federal Institute of Rio Grande do Sul (IFSul) that also started to contribute with the training of professionals that work in the cluster. The institutions besides contributing with the qualification of the professionals, also promotes approaches among the collaborators of the different

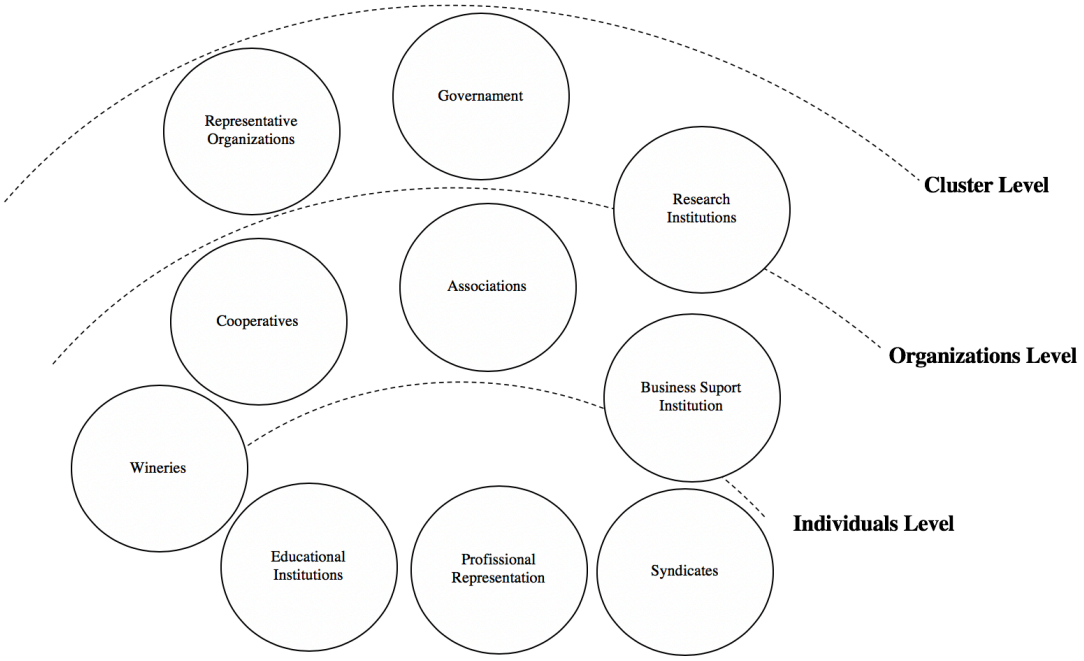
vineyards, factor that also supports the interactions and knowledge exchange. “Everybody knows everybody because of ABE and/or IFSul, that makes us keep in touch and exchange knowledge even if we are working at different places” (INT8). We have the enologists’ brotherhood once a month, then we are always aware of the news (INT9).

Still in the individual level, the professional representations also have influence on the cluster, being the main ones: CRQ – V, Regional Chemical Council, and ASARVI, Association of the agricultural engineer of the Wine Region. Such organizations qualify, inspect and interact with the professionals of the area. “We help the formation of professionals and the legislation enforcement” (INT26).

In the field of professional representations, there are the unions, being the main ones the Union of the Rural Workers of Serra Gaúcha and the Union of the Wine Industry (Sindivinho). The unions are responsible for representing and defending the rights of the professionals. The union has been also acting on the qualification of the workers and on the promotion of courses and technical visits (INT28). According to the statute of Sindivinho, the goal of the organization is “to study, coordinate, protect and represent legally the economic category of the wine and derived industries”.

Based on the identification of the cluster's trajectory and the actors responsible for its orchestration, Figure 4 was elaborated. On the illustration, the actors according to the level of greater (and direct) influence on the actions were organized, it is worth to highlight that some organizations impact more than one level, like research institutions and business support institutions.

Figure 4: Main Actors of Serra Gaucha Cluster



Besides those organizations identified it is possible to realize the existence of a chain of correlative industries that help on the development and innovation of the cluster, for example, enotourism that covers areas of gastronomy, hosting and leisure. All those organizations adding the more than a hundred wineries of the region and respectively suppliers compose the Cluster of Serra Gaúcha. From those relations, it was sought to understand how the orchestration of the cluster happens, taking into consideration the dimensions defended by Dhanaraj and Parkhe (2006): mobility of knowledge, appropriability of the innovation and network stability.

The **mobility of knowledge** is referred to the sharing, acquisition and implantation of knowledge inside the network (Dhanaraj & Parkhe, 2006). In this line, it was observed that the performance of researches and tendency surveys commanded by Embrapa and IBRAVIN are actions that deserve focus on that dimension. Besides them, the participation in fairs, trips and events provided by producers' associations, unions and SEBRAE enable the organizations to take access to new knowledge and technologies. The professional courses offered by IFSul, ABE and Professional Representations are also very important for the exchanges and interactions among the professionals.

The **appropriability of innovation** is related to the transformation of knowledge in innovation, guaranteeing positive results for the organizations and region (Dhanaraj & Parkhe, 2006). A great milestone pointed on the interviews performed and, on the

documents, consulted is the obtainment of the Geographical Indication (GI) and the Designation of Origin (DO) of the region. With that, the cluster starts to be recognized and valued by its production. “It was a long process, but today we can say that it was worth it, because it brought several benefits for the region” (INT12). Innovation on the soil and vine management system as well as the improvement on the wine production and the development of new products such as juices and sparkling wine are pointed as activities that contributed for the generation of value for the cluster and for the organizations. “Over the years, we were always implementing improvements on the production according to the opportunities and demands of the market” (INT25). Lastly, it is still highlighted the collective purchases and the joint use of new technologies. According to (INT28), the companies after exchanging knowledge started to perform joint actions such as purchase and use of new technologies. “This way, the people share the risk and the benefits of innovating” (INT15).

The **network stability** concerns the intentionality of keeping the collaboration among the members of the network (Dhanaraj & Parkhe, 2006). A point that deserves focus is the public policies and the tax and tributary benefits earned by IBRAVIN with the governments. According to (INT20), having obtained the tax exemption was essential for the sector to keep united. INT20 still points out that challenges like reducing the tributes is a motive of considerable connection among the actors of the region. Besides that, the strategies and the collective brands of appreciation of the local product are another point that encourages the sense of belonging among the vineyards and organizations. “The people know that we can go further” states INT 14. Lastly, another action that deserves attention is the meetings provided by the Education Institutes and the informal gatherings resulting from them. “We are friends with everybody that works here, we studied together and grew up together after all” states INT8.

It is worth to highlight that many actions pointed end up fitting in more than one dimension and being performed by different actors. Nevertheless, in order to guarantee a better view of the dimensions of orchestration in the cluster of Serra Gaúcha, Table 7 was elaborated.

Table 7: Dimensions of Orchestration of Serra Gaucha Cluster

Dimension of Orchestration	Key-Activities	Evidence	Responsible Actors	Impact Level
Knowledge Mobility	Performance of Researches and Development of Technology	"We are reference in research and technology for the sector" (INT24)	Representative Organizations (IBRAVIN), Research Institute (Embrapa).	Cluster
	Participation in Fairs and Events	"We organize courses, technical visits and trips for the people to know the news" (INT27, INT28)	Associations of Producers, Unions, Business Suport Institution	Organizational; Individual
	Professional Formations and Technical Demonstrations	"In the past we imported enologists, now we export them." (INT23)	Education Institutions, Business Suport Institution	Individual
Appropriability of Knowledge	Obtainment of Geographical Indication (IG) and Designation of Origin (DO)	"The legal demands for the obtainment of the seal made the vineyards to improve a lot their production" (INT12)	Representative Organizations (IBRAVIN), Research Institute (Embrapa), Producers Associations	Cluster; Organizational
	Innovation on the system of soil and vine management; Improvement on the production of wine and development of new products such as juices and sparkling wine	"Lately the grape juice and the sparkling wine is what is saving the sector, we make the best of the world" (INT 25)	Research Institute (Embrapa), Business Suport Institution	Cluster; Organizational
	Collective purchases of machinery and technology	"They can share the machines and the risks" (INT15)	Associations of Producers,	Organizational

Network Stability	Development of Public Polici and Achievement of Tax and Tributary Benefits	"We achieved the benefit of joining the Simples Nacional" (INT20) "PROVITS was launched to promote the region" (INT20)	Representative Organizations (IBRAVIN), Government	Cluster
	Construction of Collective Strategies	"We created the brand Vale dos Vinhedos to value the local product" (INT12) "The program Wines of Brazil was created to stimulate the internationalization" (INT20)	Representative Organizations (IBRAVIN), Associations of Producers, Business Suport Institution	Cluster; Organizational
	Gatherings and Formal and Informal Meetings	"We promoted interactions among the enologists" (INT23) "We gather monthly to know the news" (INT8)	Education Institutes (ABE and IFSUL), Unions and Professional Representations	Individual

From that analysis, we verified that the orchestration in the Cluster of Serra Gaúcha is decentralized, that is, the cluster does not have an only hub company as orchestrator, as Dhanaraj and Parkhe (2006) defended. That happens since the activities aligned to the dimensions of the orchestration are performed by multiple actors. Such finding responds to the last findings in the literature (Hurmelinna-laukkanem & Natti, 2018; Pikkarainen *et al*, 2017; Nielsen & Gausdal, 2017). Besides that, we confirmed that the role of the orchestrators keeps changing over the cluster life-cycle, as Nielsen and Gausdal (2017) already indicated.

As main contribution, we realized that the actions performed related to the orchestration with greater focus of action in the macro level (cluster), others in the meso

level (organizations) and others, yet, in the micro level (individual). As far as we analyzed the key elements over the cluster life-cycle, we realized that in all stages there impact in the three levels. When we analyze the dimensions of the orchestration, we also verified activities with impact on the three levels. Among the dimensions, only appropriability of innovation does not have an activity directly related to the individual level. However, we understand that this happens since the objective of such dimension is to transform innovation for the organizations and the cluster.

Valkokari et al. (2017) stated, recently, that the innovation networks, as well as the clusters, are multilevel phenomena, which makes the challenge of orchestration complex. Ritala, Armila and Blomqvist (2009) had already identified that the capacity of orchestration is also a multilevel construct, pointing the individual and organizational levels. Over time the relationship between the phenomena at different levels may be unidirectional, bidirectional or reciprocal (Kozlowski & Klein, 2000) as time and temporal scope create the boundary for multi-level theorizing (Rousseau, 2000).

From the case of the cluster of Serra Gaúcha, we defend that it is important to take into consideration more one level, the cluster one. We believe that there are activities of orchestration that capture and generate value with focus on the network, such as the case of development researches, creation of public policies, financial and tax incentives, creation of brands and collective strategies, origin seals among others. Most previous researches on innovation networks have focused on firm-level strategies to operate in a network rather than the composition or orchestration of a network as a whole (Valkokari et al, 2017). Therefore, a more macro vision will contribute to the literature.

This way, it is inferred that the multilevel acting may be one of the differentials of the Cluster of Serra Gaúcha, which contributes for its survival and generation of innovation throughout its life cycle, avoiding the lock-in effect and decline. In the next section, the proposition of a model of multilevel orchestration will be exposed.

5. Proposition of a Model of Multilevel Orchestration

The definition about the role and the activities of the orchestration inside a network/cluster is a black box (Nielsen & Gausdal, 2017). The main roles identified and, also superimposed, of the network orchestrator are knowledge broker, innovation broker, network entrepreneur and network leader. However, we argued that those roles need

crucial activities and, therefore, we state that the role of the network leader must be more researched and explored (Nielsen & Gausdal, 2017).

The first ones to discuss that role are Dhanaraj and Parkhe (2006) on their seminal paper. The authors unite the orchestrator and the concept of hub company, which may be understood as the one that has prominence and power acquired through individual attributes and a leadership role to gather the disperse resources and the capacities of the network members to generate value.

Years later, Batternik *et al* (2010) brought the innovation correctors as orchestrators since they are responsible for identifying the needs of innovation, articulate the demands of knowledge, establish partnerships and generate processes of inter organizational cooperation inside the network. Yet, the literature compares the orchestrator to the concepts of innovation brokers postulated in the open innovation defended by Chesbrough (2006) and to the technological *gatekeepers* pointed in the study of absorptive capacity in clusters by Giuliani (2005). However, both definitions as more focused on the external search for technologies and their intermediation of the relations among the members of the network (also important) and not so much as responsible for the articulation of the relations and innovation extraction (essential to guarantee the orchestration of a cluster).

The literature indicates that the orchestrator needs to have a systemic view, share the activities among the members and, next, make them to the things (Möller *et al.,* 2005). The orchestrator can be a company (Nambisan & Sawhney, 2011), a university (Gastaldi & Corso, 2016), a government (Levéna, Holmströma & Mathiassen, 2014) or a partnership with the community (Parmentier & Mangematin, 2014), depending on its context and stage of life cycle of the cluster.

More recently, the studies are indicating the possibility to exist more than one orchestrator in a cluster, however the understanding about the acting or function is still very limited (Pikkarainen *et al*, 2017). We understand that the complexity and the dynamism of the cluster demands activities of value generation that cannot be performed only by one actor; therefore, we defend the existence of multi orchestrators for a geographical cluster.

Besides that, which had already been discussed in the literature is that the orchestration consists in both organizational decisive levels and individuals (Ritala, Armila & Blomqvist, 2009). For Ritala, Armila and Blomqvist (2009), skills and capacities of individual and organization level interact and affect themselves in several

ways in the orchestration of a cluster, thus, it is possible to identify some processes from bottom to top and from top to bottom where the organizational level influences the levels of the groups or individuals and vice-versa.

We argue the existence of a third level, the cluster one. We identified that the capture and generation of value are different for the individual, organization and cluster. Activities oriented to the innovation in a network level that will influence directly or indirectly on the organizations and individuals become necessary, however, theirs focus is for the cluster. We understand that the activities developed for each level are interconnected and are interdependent, guaranteeing this way that one will influence the other on the renewal and growth of the cluster.

Lastly, recently, it was also identified that the role and the activities of the orchestrator change over the cluster life-cycle (Nielsen & Gausdal, 2017). From the longitudinal study that we performed on the Serra Gaúcha Cluster; we can support such statement. We noticed that the actions developed, and the actors were different according to the reality that the cluster was going through.

In the emergence, actions developed on the three levels of impact were focused for the structuring of the cluster, starting with activities of cooperation for the production and commercialization that will demand a greater infrastructure of the region. In the growth stage, the professionals are in a moment that demands greater exchange of knowledge; therefore, the context becomes favorable for the creation of associations of companies and for the participation in events. As a consequence, in the cluster level, the network is ready for the creation of collective strategies and programs. The renewal period is when the cluster goes through great changes that demand new formations, new processes, new technologies and more representativeness with the public policies. On Table 8, we present a synthesis of the Key Actions of the Orchestration over the cluster life cycle. It is worth to highlight that such actions can be present in more than one level and their relations with the others can be of cause or consequence. And, it is also important to highlight that they receive direct and indirect influence of the external and contextual happenings.

Table 8: Key-Actions of the Multilevel Orchestration in the Cluster Life-cycle

	Emergence	**Growth**	**Renewal**
Individual Level	Cooperation Actions;	Knowledge Exchanges;	Technical and Management Formations;

Organizational Level	Actions of production and commercialization;	Creation of associations, Participations in events and fairs;	Development of collective actions;
Network Level	Infrastructure action;	Creation of collective strategies and sector program;	Investment in research and technological development; Greater participation in the public policies;

Based on the analysis of the Serra Gaúcha Cluster, it is identifying that the cluster has gone through several crisis and challenges in the last years, however, it had the capacity to reinvent, innovate and avoid the negative lock-in effect and, consequently, its decline. In front of that, we sought to understand, from the orchestration lens, which were the mechanisms by the cluster. Initially, it is noticed that, the existence of multiple orchestrators in this innovation process in the cluster, emerging the first proposition of study:

Proposition 1: The complexity of a regional cluster requires a multiplicity of orchestrators. From the objectivel and the flexibility of the orchestration concept, allied to the complexity and dynamism of the cluster, it is identified that, to guarantee the survival and generation of value of the cluster, multi orchestrators are necessary. The orchestrators' monopoly inhibits new technologies, institutions, and firms from emerging in the cluster, as new combinations can threaten power from their central position in the cluster. As a result, these orchestrators can push the network to greater inertia to preserve their position (Pinkse, Vernay & D'ippolito, 2018). It is assumed that the cluster is a result of the interaction of different variables, dynamics and social economic conditions of a region (Menzel & Fornahl, 2010). This way, several actors are necessary, so the cluster does not become homogeneous and with low innovative capacity. That proposition corroborates with Menzel and Fornahl (2010); the greater the diversity is, greater the possibility of innovation is.

The multiplicity of orchestrators of the Serra Gaúcha Cluster can be seen as different actors were in charge of the orchestration processes and activities along its trajectory. However, from the study performed, it is not enough to have multiple orchestrators in the cluster, it is necessary that they act in different levels. Thus, there is the second proposition.

Proposition 2: Multilevel orchestration (individual, organization, cluster) minimized the negative lock-in effect over the cluster life-cycle. It was identified that in the Serra Gaúcha Cluster there were activities related to the orchestration in three

different levels: individual, organization and cluster. From the interviews, observations and documents, it was noticed that each orchestrator realized innovation in different level (one or more), however, it is noticed that they were correlated and interdependent, generating a chain reaction of innovation and influence in cluster life-cycle. Assuming that the clusters are a multilevel phenomenon (Valkokari et al, 2017), as well as the orchestration capacity acts in a multilevel manner (Ritala, Armila & Blomqvist, 2009), it becomes important to bring the discussion of multilevel orchestration to the literature and for the management of regional clusters in this context. We understand that it is necessary to have different orchestrators role in order to meet the different demands. The multilevel perspective presented supports the proposition of Isaksen (2016) that defends a similar need for the emergence of a cluster, with three levels of acting.

This proposition can be seen from some practices of the Serra Gaúcha Cluster. For example, when Embrapa researchers developed projects to obtain geographical identification and designation of origin, they brought market and product innovations to the cluster level. Just like when Ibravin developed the "Wines of Brazil" brand, promoting the region as a whole. At the organization level, we highlight the actions of Sebrae, which promotes courses, events and technical trips in order to generate improvements for wineries. These actions facilitated the exchange of practices between organizations inserted and external to the cluster. It is also possible to perceive the collective actions linked to wine tourism promoted by the Producers Associations. These actions impacted the way wineries manage their business, advertise and sell their products. At the individual level, we highlight the teaching and training institutions ABE and IFSUL that started to train professionals specialized in vitiviniculture. These institutions are responsible for the technical improvement of local labor. In addition, the fraternities of winemakers and professionals in the cluster aim to exchange experiences and improve the operation.

The propositions suggested are aligned with the recent findings of the literature where they indicate the possibility of the cluster to have even function of parallel orchestrators in an innovation context, and even there is the possibility to exist three types of activities of orchestration performed and roles taken by different actors in different stages of development of the cluster (Hurmelinna-laukkanem & Natti, 2018; Pikkarainen *et al*, 2017; Nielsen & Gausdal, 2017). This way, the present paper presents a concept of **Multilevel Orchestration** as influencer in the generation of innovation on the cluster's life cycle.

6. Conclusions

The clusters represent a potential of innovation for their firms and for the regions where they are inserted (Bittencourt, Zen & Prevot, 2019). However, recently, the discussions in relation to the decline of clusters are increasing in function of the lock-in effect since many clusters in the world have significantly decreased over the last years. A possible alternative for that reality is the orchestration capacity, defined as a set of activities oriented to the development, management and coordination of a cluster that is destined to create and extract value of the network. In front of that, the present paper sought to analyze how does the orchestration influence on the clusters life cycle. An exploratory qualitative research was performed with longitudinal perspective in the Serra Gaúcha Cluster, since the regional cluster has gone through several crisis and modifications over its trajectory.

We analyzed the trajectory of the case and its orchestration process and we proposed that an influence on the cluster life cycle would be the Multilevel Orchestration. We identified the key elements throughout the life cycle of the Serra Gaúcha cluster. From this, we identify the orchestrators, their key activities and their level of impact on the cluster. Then, we proposed the multilevel orchestration model with the key actions by level and stage of the life cycle. We understand that the proposed model shows how orchestration can influence the life cycle of the clusters, generating innovations and avoiding the lock-in effect. We defend the need of more than one orchestrator to articulate the innovation in the cluster and to minimize the negative lock-in effect and the possible decline of the cluster (Pinkse, Vernay & D'ippolito, 2018). Besides that, we reinforced the importance of the operation of the orchestration in the micro level (individuals), the meso level (organizations) and macro level (cluster).

We realized that discussions of literature on cluster management / orchestration are restricted to a hub firm or the possibility of more actors (still little explored). We go further. We believe that in addition to the cluster requiring multiple orchestrators with different expertise, it is necessary to have an impact at different levels: individual, organization and cluster. So, one level of performance can influence the other and avoid the major cause of cluster decline: imprisonment and a lack of innovation due to the lock-in effect. In this way, we bring that a multi-level orchestration can influence the life cycle of the cluster and change this reality.

Thus, this paper aims to contribute on the discussion of the life-cycle and renewal of the cluster and the networks orchestration in a longitudinal perspective. We would like to highlight the theoretical contributions from (1) the case and the research method used, (2) the analysis and discussion of the cluster life cycle and (3) the role and actions of the orchestrators. We believe that the use of a case with more than one hundred years of trajectory, in which changes in the stages of development are demonstrated, through longitudinal research, has brought important insights to the literature. From this, we were able to identify the critical points in the life cycle of the clusters and verify how and by whom the management / orchestration was carried out in each stage. Finally, we brought discussions and reflections on the orchestrators and their performances.

In the management field, this paper aims to contribute with professionals and managers of organizations inserted in clusters and public managers to understand orchestration throughout the cluster's life cycle. We believe that the study can help them identify the stages of development of the cluster. In addition, we understand that the study can also help them with innovative insights to avoid the negative lock-in effect and, consequently, its decline. Furthermore, we understand that different professionals and managers can better understand their role and the role of other actors throughout the cluster's trajectory.

The present research has a limitation of data related to the past. We believe that studies involving social network analyzes and action research may bring new insights into the relationships of orchestrators. It is suggested as future studies a greater deepening in the comprehension of the roles of orchestrators and the understanding of their activities. We also suggest studies in other contexts of networks, such as, for example, clusters or smaller innovation networks in order to map and understand the strategic roles of orchestrator(s).

4.PAPER III:

ORCHESTRATING UNIVERSITY INNOVATION ECOSYSTEM: THE CASE OF A BRAZILIAN UNIVERSITY

Bittencourt, B. A.; Cervo, J.; Zen, A. C. (2017). Orquestração de atores na emergência de um parque tecnológico o caso do Zenit. In: 27ª Conferência ANPROTEC, 2017, Rio de Janeiro.

Bittencourt, B. A.; Zen, A. C.; Santos, D, G. (2020), Orchestrating University Innovation Ecosystem: The case of a Brazilian University. R2IE - Revue Internationale d'Intelligence Economique. (accept)

ABSTRACT

Universities are changing their roles and becoming innovation ecosystems, responsible for the promotion of innovation and development for people, companies and regions. Although this theme has been expanding in the literature, there is a gap about the management/orchestration of those environments. Therefore, this paper aims to understand the roles and activities of the orchestrator of the university innovation ecosystem. For that, we conducted an action research in the innovation ecosystem of UFRGS, orchestrated by its Science and Technological Park, Zenit. We identified critical factors for innovation ecosystem orchestration and we understood that the orchestrator has the following roles and activities: architect (map and compose the network, link complementary actors, construct a collective identity), knowledge broker (managing knowledge mobility, knowledge activation, facilitate transactions) and market translator (articulate demands, recognize and commercialize innovation, manage innovation appropriability). From that, we proposed a toolbox with actions to facilitate the orchestration of the University innovation ecosystem.

Keywords: innovation ecosystem, universities, network orchestrator, orchestration

1. Introduction

Innovation ecosystems have been recognized as an important structure for the local and regional socioeconomic development, given their potential to generate jobs, income and social well-being through innovation. Despite its focus on a city level (Schaeffer, Fischer and Queiroz, 2018), lower levels of innovation ecosystems, as the case of universities, are also transforming their environments. Universities serves as catalysts for the entrepreneurial mindset and comprise a bundle of actors and resources that can be connected for the purpose of transforming knowledge into innovation (Spigel, 2017).

The role and demand of universities is changing in recent years, just generating knowledge did not ensure that knowledge would spill over for commercialization driving innovative activity and economic growth. The emergence of the concept of entrepreneurial university gave universities a dual mandate—to produce new knowledge but also to alter its activities and values in such a way as to facilitate the transfer of technology and knowledge spillovers (Audretsch, 2014).

Such differences have implications for how universities are able to reach-out to the local and regional community in order to participate in the building of the entrepreneurship and innovation ecosystem (Wright, Siegel & Mustar, 2017). There has been a strong growth of the movement of universities and the recognition of its role as inducer of technological development and of innovations. Universities are considered important infrastructures that sustain innovation ecosystems and, at the same time, institutional mechanisms that stimulate local and regional development.

An ecosystem is a result of various mechanisms and actors, in different contexts and evolves over time. Innovation ecosystem are co-created rather than one group or sector being at the centre of the process and managing it. Many stakeholders are engaged as co-creators: students, professors, university managers, research groups, laboratories, science parks, incubators, investors, angel networks, local authorities, start-ups and corporations. Each of these stakeholders has different objectives, norms, standards, and values. Thus, many dimensions of the ecosystem go beyond actions by universities management. The complexity and variety of ecosystems suggest the need to develop mechanisms for bringing together the range of different stakeholders (Wright, Siegel & Mustar, 2017).

Ecosystem include broad sets of actors and the relationships and interactions are not always governed with contracts (Valkokari et al, 2017). This lack of formal structure increases the role of relational governance mechanisms (Poppo & Zenger, 2002). A key challenge concerns the question of who designs the ecosystem (Wright, Siegel & Mustar, 2017). We understand that there is also a gap in the literature on how orchestration of innovation ecosystems occurs, especially in the context of universities.

The concept of orchestration emerged in the literature as a set of activities aimed at the development, management and coordination of actors that are intended to create and extract value from the network or ecosystem (Dhanaraj & Parkhe, 2006). Orchestration is thus a fundamentally dynamic and uncertain activity, where participation is voluntary and coordination resembles enabling leadership rather than strict management (Ritala et al, 2009). Such capacity respects the specific identities of each actor and tries to ensure that they continue to collaborate fruitfully (Parmentier & Mangematin, 2014).

Thus, we propose the follow research question*: what are the roles of an orchestrator in a university innovation ecosystem?* Orchestrating innovation ecosystems or networks by firms in a business context is already common in the literature (Dhanaraj & Parkhe, 2006). The aim of this paper is to understand what roles and activities are required for the functioning of an innovation ecosystem in a university, orchestrated by its Science Park. Thus, an action research was carried out in UFRGS – Federal University of Rio Grande do Sul, in the south of Brazil from April 2015 until March 2019.

UFRGS is among the top five Brazilian universities, being a reference in teaching, research and extension. In recent years, the university has begun to focus on construction an innovation ecosystem from its Science Park, called Zenit. The Zenit Science Park can be considered the orchestrator of this movement, being in charge of the articulation and management of the university's internal and external actors. Thus, it is understood that this is an important and relevant case to answer the research question.

The paper is divided into four more sections besides this introductory one. In the theoretical background, the fundamentals of the research will be presented: university as an innovation ecosystem and orchestration of innovation ecosystems. In the method, the explanation of the action research and the research steps are presented. Then the results of the paper are analyzed and discussed. Finally, the conclusions and suggestions for continuity are exposed.

2. Theoretical Background

The management literature presents a wide range of concepts related to interorganizational arrangements, such as clusters, innovation networks and ecosystem. Innovation ecosystems include different of stakeholders and are perhaps the broadest of the different strategic network-based constructs (Autio & Thomas, 2014), and consider the ability of a territory to create a system of actors and infrastructures, and the mere construction of a network structure between companies (Nicotra et al., 2017).

In the same line of Autio and Thomas (2014), we consider innovation ecosystems as a unique and specific type of networks encompassing a diverse community of actors with multilateral and multisectoral ties, spanning the boundaries of a single industry and emphasizing increased interdependence as well as symbiotic potential among the actors (Adner, 2017). However, we decided to explore to innovation ecosystem in the context of university and the relation among the different actors in university community to foster innovation. Based on this delimitation, this section the key conceptual elements of this research: (i) university innovation ecosystem and (ii) orchestrating innovation ecosystems.

2.1. University as an Innovation Ecosystem

The innovation ecosystem approach emphasizes precepts of natural systems that resemble what happens in business environments, such as the connections and dynamics of evolution, competition, predation and mutualism among their actors (Shaw & Allen, 2016). The term "ecosystem", originating from biology, was first associated with business by Moore (1993), but only started to be used more frequently from the 2010 decade, being mainly linked to entrepreneurship (Isenberg, 2010; Stam, 2015) and to innovation (Autio and Thomas, 2014). Since then, the term has gained ground in academic discussions.

The innovation ecosystem is understood as a dynamic system whose objective is economic and technological development (Wang, 2010). Recent studies of such innovation practices underline a variety of differences forms, such as interorganizational alliances and collaborations with and within communities, crowds, or networks of individuals – including user, citizens, scientists and others (Valkokari et al, 2017).

In this context, universities are moving from a traditional role of promoting research, teaching and dissemination of knowledge to a more advanced one, of technology transfer and promotion of academic entrepreneurship, resulting in the creation of academic spinoffs and, consequently, in the provision of new technologies and solutions to the market (Pattnaik & Pandey, 2014). They can be viewed as innovation ecosystems, as they bring together a number of internal and external actors with the purpose of fostering innovation. The science parks emerge as a strategy and a core structure to make these activities viable, by concentrating a series of specialized services and establishing the connection between the knowledge generated in the academic environment and the demands of the community in general (Guadix et al., 2016).

Drawing on recent research on contextual factors influencing innovation ecosystems we conjecture that the ecosystem is influenced by the university's external environment, including the nature of the local, state, regional and national government policy stances towards university entrepreneurship, government objectives concerning the role of universities in society, and the ownership of intellectual property (IP) between universities and faculty/students (Wright, Siegel & Mustar, 2017). Country, regional and industrial contexts provide variety in their access to customers, suppliers, finance, human capital and other resources (Wright et al., 2006, 2008).

Likewise, an important dimension of the ecosystem is the historical trajectory and culture of a university. Some universities have a teaching focus, while others are focused on research. Public universities, especially land-grant universities, also have a strong economic development mission, which complements any efforts to enhance innovation and entrepreneurship (Wright, Siegel & Mustar, 2017). One element of the framework concerns the variety of university contexts, in terms of scale, scope, research quality, history and culture, location and local networks, resources and capabilities. Heterogeneity among universities has important implications for the extent and nature of spin-offs by academics (Clarysse et al., 2005).

The main mechanisms created by universities to facilitate the spillover of knowledge by innovation undertaken at the universities are the science parks, incubators, and proof of concept centers, Technology Transfer Office (TTO) (Audretsch, 2014). The Science Parks facilitate the acceleration of business through the agglomeration of knowledge, resource sharing and collaboration among firms and institutions, thereby helping to transform a business idea into an economic organization (Phan, Siegel & Wright, 2005; Guadix et al., 2016). Thus, firms located in parks tend to be more effective

in terms of generation of new products, services and patents (Siegel et al., 2003). Academic spinoffs, specifically, may play an even more relevant role in generating financial returns for the inventor and university, as well as employment and economic development for the region (Pattnaik & Pandey, 2014).

The International Association of Science Parks (IASP), defines science park as "an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions" (IASP, 2019). Thus, science parks play an important role in regional development. In addition to the generation of jobs provided by the creation of new technology-based businesses, they promote the articulation between developed research and its transformation into innovations through technology transfer, resulting in benefits not only economic but also cultural and social (Guadix et al., 2016).

Given the science park's responsibility and complexity in articulating and managing the university innovation ecosystem, we sought to understand more about orchestrating innovation ecosystem, the theme of the next subsection.

2.2. Orchestrating Innovation Ecossystem

There is an ongoing debate in the literature about the best collaboration models and their management in network and ecosystem contexts (Hurmelinna-laukkanem & Natti, 2018). Managing – or orchestrating (Dhanaraj & Parkhe, 2006) – innovation ecossystem is not a new issue, but discussion on the phenomenon has been on the rise in recent years (McDermott, Mudambi, & Parente, 2013; Hurmelinna-laukkanem & Natti, 2018).

Innovation ecosystem orchestration can be characterized as a purposeful action or practice by an orchestrator (an actor such as a hub firm) to initiate and manage knowledge in the innovation process in networks and ecosystems (Nambisan & Sawhney, 2011). Orchestration comprises a set of activities, and when an orchestrator conducts (some of) these activities in a specific manner (e.g., by exerting more or less power on other network or ecosystem members), it can be considered that the orchestrator takes a specific role (Pikkarainen et al, 2017).

The expected behaviour, or role, of the orchestrator is connected to various crucial network activities and processes. These activities and processes are used in the following

to build a framework of the roles needed to perform them (Nielsen & Gausdal, 2017). The orchestrator generally influences the network design and how the process are established (Laukkanen & Natti, 2012). The orchestrator also monitors and controls the knowledge flow and has a huge number of connections tha are willing and able to provide it with important opportunities and resources (Cinelli, Ferraro &Iovanella, 2019)

The orchestration model was originally defined by Dhanaraj and Parkhe as the set of deliberate, purposeful actions undertaken by a central actor to create and extract value from a network (Dhanaraj & Parkhe, 2006). Dhanaraj and Parkhe (2006) begin this discussion by composing such capacity from three dimensions: knowledge mobility, appropriability of innovation and network stability. Knowledge mobility refers to the sharing, acquisition and deployment of knowledge within the ecosystem. The appropriability of innovation involves ensuring that innovators are able to capture the results generated by innovations; and the stability of the ecosystem refers to the intentionality of maintaining collaboration among ecosystem members.

Batternik et al. (2010) have shown that orchestration is composed of three functions: the beginning of innovation, the composition of the network and the process of innovation. The fundamental aspect of the beginning of innovation is articulation and the direction of the project. The ecosystem composition would be the mapping and selection of complementary actors, as well as the definition of procedures and tasks for the partnership. The innovation process includes conflict management, project management and interaction stimulation.

In a complementary way, Nambisan and Sawhney (2011) list six processes for orchestration, including managing innovation leverage, managing innovation coherence, managing knowledge flows, managing network adherence, managing stability management of the appropriability of innovation. However, the authors focus on managing innovation leverage, managing innovation coherence, and managing the appropriability of innovation. Innovation leverage refers to optimizing opportunities and facilitating relationships to take advantage of value creation. The coherence of innovation is related to the coordination of the internal and external activities to the network and aligning it with the output generated. Finally, the appropriability of innovation seeks mechanisms to appropriate the proposed value generations.

Hurmelinna-Laukkanen et al. (2011) add more dimensions to the Dhanaraj and Parkhe (2006) proposition and also place six dimensions as the basis for the orchestration of innovation networks: setting agenda, mobilizing, stabilizing the network, creating and

transferring knowledge, coordination. By combining the dimensions proposed by Dhanaraj and Parkhe (2006) with the proposals by Hurmelinna-Laukkanen et al. (2011), six grouped dimensions are generated (agenda definition, mobilization, knowledge mobility management, knowledge appropriability management, network stability management and coordination).

We understand that these dimensions and activities are valid for business-orchestrated innovation ecosystems in the business context. Assuming that the role and function of the orchestrator changes according to the network/ecosystem, our purpose in this paper is to understand the orchestrator's roles and activities in a university innovation ecosystem. In the next section, we present the methodological procedures adopted in the research.

3. Research Design

In this research, we conducted action research, because it foresees the accomplishment of an action of transforming character (Kemmis and Mctaggart, 2007). In this method there is no separation between subject and object, since the respondents are also part of object of this research and they participate in its construction in a collaborative way. Moreover, it unites theory and practice, since it takes the theory to the field and there it performs an action together with the researched ones (Brandão, 1984; Kemmis & Mctaggart, 2007; Thiollent, 2003). There is also an educational and social transformation character, since all those involved in the research learn together, in addition to being emancipatory, since, in becoming aware of their situation, the respondents can proceed to act more critically in relation to the environment in that are inserted (Kemmis & Mctaggart, 2007).

In addition, the participatory action research has a strong social commitment on the part of the researcher, who feels connected to the researched subject and acts according to values shared by the respondents (Brandão, 1984). This makes the researcher concerned on making his research accessible to the public researched and put his scientific curiosity in the service of a social benefit to the community (Brandão, 1982). All the steps proposed by Kemmis and McTaggart (2007) were followed:

1) **Plan** - collect all necessary data and jointly plan the action to be performed;

2) **Acting and Observing** - is the moment of action itself, which must be carefully observed in order to generate a wealth of data that will feed the reflection;

3) **Reflect** - together with the respondents, reflect on the action taken, to understand what emerged from the action and, if necessary, provide inputs for a new planning of a new action.

The researchers are also members of the Zenit Science Park, since they acted in the planning, implementation and monitoring of the process of construction of the innovation ecosystem. Thus, the data collection took place through participant observation, individual interviews with actors of the sectors correlated of University (Department of Technological Development, Entrepreneurship Center, Business Incubators, Academic Units, Junior Companies, Incubated Startups) and data access (management reports, strategic planning, University plan, site). The research was from April 2015 to March 2019. Our research recognizes the importance of time in this process of develop resources and capabilities to enable innovation ecosystem to exist (Siegel et al, 2017).

3.1. UFRGS and Zenit Science Park

The Federal University of Rio Grande do Sul (UFRGS) is one of the most important universities in Brazil. UFRGS ranked second in the ranking of the Ministry of Education of Brazil of the best universities in the country (BRASIL, 2018). The university has 93 graduation courses, 80 masters and 90 doctorates. In addition to teaching, the university also encourages research and development, extension projects, international mobility of students and interaction with society. UFRGS strategy increasingly emphasizes its purpose in promoting sustainable socio-economic development through innovation and entrepreneurship in articulation with society, thus translating the knowledge produced in academia into new technologies and market solutions, and becoming an international reference (UFRGS, 2019). In 2019, UFRGS received the award for the fourth most entrepreneur university in Brazil and the most entrepreneur university in the south of the country.

In that context, the Science Park of the Federal University of Rio Grande do Sul (Zenit) was created with the purpose of "promoting research, development and technological innovation activities of organizations that present a cooperation plan with Units and Interdisciplinary Centers of UFRGS" (Zenit, 2012, p.1). In the UFRGS innovation ecosystem, Zenit Science Park links incubators, startups, junior companies, technological laboratories and researchers of the University, also connecting them with

external actors such as companies, research and development centers, public and private spaces of entrepreneurship, governments and society. Its actions include education and entrepreneurship training, business incubation support (primarily the technology-based ones), and services to promote open innovation and the consequent connection of university startups with established partner companies (Zenit, 2018).

The Science Park, therefore, stands as a multisectoral activities. The official regiment of the park does not specify or exclude any area of knowledge, but defines that the park prioritizes, according to its Article 12, initiatives that comply with the following principles:

I - the enterprises will be anchored in the knowledge generated in the UFRGS, transferred to the enterprises according to the norms regarding the preservation of the intellectual property of the university;

II - the projects should be guided by sustainable development, understood by all its social, economic, scientific, technological and environmental dimensions;

III - the enterprises should prioritize the social, human and economic development of the State of Rio Grande do Sul and of the Country (ZENIT – Strategic Plan, 2012, page 4).

In 2015, the board of the Science Park of UFRGS presented in a public event open to the community the new name and the new visual identity of the park. From this moment, the park was renamed Zenit. According to the director of the Park, the definition of the name had two main motivators: the need to create a specific brand for the park and to adapt it to the new portfolio of services and projects of the park, presented at the same event.

The structuring of the Park and its portfolio of services has as main objective the capture of associated companies and the engagement of the different stakeholders inside and outside the UFRGS. This process of orchestrating the university's innovation ecosystem will be presented in the next section.

4. Analysis and the Discussion of Results

4.1. Planning

In this stage, we initially sought to understand the university in which the Park is installed and to identify the actors that comprehends its innovation ecosystem. As a result,

the essential points for the Zenit service portfolio and the areas for its orchestration were defined.

UFRGS has its decentralized infrastructure composed of three campus in the city of Porto Alegre, south of Brazil. The academic units are distributed in these three spaces. In this way, the spaces of teaching, research and extension of the University were built in time in a grouped manner by areas, making it difficult to exchange and coexist different segments in a common space.

The UFRGS incubators followed this pattern, as previously specified. Its activities take place in the physical spaces of the academic units with which the theme is closely related. The positive point for incubators, in this regard, is the possibility of communication and direct relationship with the research and teaching source of the area to which it is connected. The critical point to be considered is that incubated companies lose in interdisciplinary relationships with other areas, which could result in promising partnerships.

The innovation ecosystem of UFRGS itself is decentralized and, in addition to Zenit, the following actors are found in different units. The main actors involved in entrepreneurship and innovation at the University are:

- **Sedetec:** The Department of Technological Development of UFRGS is the NIT (Nucleus of Technological Innovation) responsible for patents and intellectual property developed at the University.
- **Junior Companies:** UFRGS has seventeen initiatives of junior companies formalized. Companies are formally linked to undergraduate courses such as design, administration, engineering (s), chemistry among other University courses.
- **Incubators:** UFRGS has 4 active technology incubators: CEI (Information Technology), Héstia (Engineering, Chemistry and Physics areas), IE-CBiot (Biotechnology) and Germina (Multi-sector).
- **Center of Entrepreneurship:** The Center of Innovative Entrepreneurship aims to disseminate the culture of entrepreneurship in UFRGS among students, technicians and teachers in a transversal way. They are responsible for innovation and entrepreneurship courses and disciplines.
- **Technology Labs:** UFRGS has around 200 multidisciplinary laboratories that offer services for academic research and market demands.

- **Academic Units:** there are 27 academic units with 98 undergraduate programs and 90 postgraduate programs. In them, more than 900 research groups are linked.
- **Incubated or Associated Businesses:** There are about 35 incubated or associated businesses in the university in the areas of technology, health, biotechnology, energy, food, education, creative economy and others.

From this mapping, we conducted individual conversations with representatives of each actor in the ecosystem to understand what and how Zenit could act. It was identified, from the interviews, that although the UFRGS is one of the most traditional and well-respected Brazilian universities of the present time, it has a still incipient performance regarding technology transfer and generation of innovation. In this way, it becomes necessary to articulate in order to maximize all the research potential that the University possesses, and also to build an image focused on the area of innovation.

Another point raised was the absence of headquarters building for shelter of associated companies and research centers. This question is one of the main generators of Zenit's uncertainty regarding the academic community. With this, it was up to the Park to seek services and a position that would overcome this lack.

In addition to these considerations, it was possible to identify from the visits and conversations with university actors the need to connect the different initiatives of entrepreneurship and innovation once they end up acting in isolation and often overlapping. We realized that there was no innovation ecosystem identity at the university. Allied to this, it was realized that the action of the Park should be interdisciplinary since the University has research actions and extension of excellence in different areas of knowledge.

From the points raised, we sought to define the scope of action of Zenit. It was understood that the Park should act not only as a **connector** between the internal actors to the UFRGS but also external, involving the city as a whole in order to build an image linked to innovation. Along these lines, it became necessary for Zenit to offer **innovation**-related services to this public. In addition, by the incubators already incorporated to the Park and, also, by the desire to attend more companies, the **incubation** service would be essential. Finally, due to the University's teaching tradition and the identification of the need to prepare the entrepreneurs and the students, it was understood that the **training** would be another performance of Zenit. Thus, the Park's service portfolio was organized

from four pillars: Incubation, Connection, Training and Innovation. Their development and implementation are presented in the next section.

4.2. Action and Observation

In this section the development of Zenit services will be presented from the orchestration of the ecosystem actors. Initially, the services related to activities of **Incubation** were focused on the support to Incubators and Incubated Companies and Companies Associated with Zenit. The scope of these services is to offer of support in the management of the business, the stimulation of exchanges and interactions and the training and development of the entrepreneurs.

Therefore, Zenit incorporated the Network of Technological Incubators of UFRGS (Reintec) in order to offer support to the incubators regarding the follow-up of essential processes such as selection of incubated, processing and analysis of contracts and support in the certifications. In addition, Reintec seeks to integrate into the incubators, through meetings or being present at the internal meetings of the incubators.

We observed that the great challenge of that articulation was the incubators to acknowledge the Park as an orchestrator since they emerged previously and had total autonomy. According to an interviewee, “the incubators […] are very old, preceding the idea of a park that emerged from the initiative of informatics, engineering and biotechnology professors […] each one created their own incubator”.

Another service is the association of non-resident companies. Due to the lack of physical space to house companies and a physical area for the implementation of new buildings with their own resources, this modality was developed. It started from the premise that an organic environment of exchange and interaction does not depend exclusively on a physical space. Therefore, the purpose of this service is to promote interaction from the services offered by the Park and partners, generating and applying new knowledge and developing the skills of companies in the area of innovation.

In relation to the ventures planned in Statute, the Park can host research and development laboratories, incubated companies, companies, sector and business, technological or scientific representation entities or even other organizations that serve the principles and goals of Zenit. We observed that the program is oriented especially to the organizations that have as a goal the increment of activities of R&D&I. We observed

that the first companies to participate of the program sought innovation and access to the infrastructure, network and reputation of the university.

The services related to the **Connection** area seek to make interactions between Zenit and agents internal or external to UFRGS, both to promote technological skills of the university and to offer services and opportunities. These processes are established through third parties, with advantages for the academic community and, also, for companies associated with Zenit.

The network of internal and external partners was created as a service that seeks to establish connections with internal actors (junior companies, research groups) and external (entrepreneurs, startups, associations) to offer services related to the support of entrepreneurship and innovation, such as funding, investment, networking and consulting. Thus, Zenit partners would offer exclusive advantages to incubated companies and associated companies. The main objective of this service is to connect the actors of the entrepreneurship and innovation ecosystem of UFRGS and Porto Alegre with the companies associated and incubated in Zenit.

We also noticed three main benefits with that service (1) bring the internal actors of the university closer to clients, (2) bring companies closer to the university environment and (3) offer cheaper consultancy and qualification services to incubated companies or companies associated with the park. According to a partner entrepreneur, “it is an opportunity to link our brand with the university”.

Furthermore, the Network of Laboratories was developed, a virtual environment, available on the Zenit website, to facilitate access to information from UFRGS technological laboratories that have a partnership with the Park. The objective of this service is to provide a platform for dissemination of the technological competencies of UFRGS laboratories. The information on services, equipment and certifications are provided by the laboratories that meet the accreditation criteria and later standardized and published by Zenit. Following this process, the park provides an accredited laboratory seal.

We noticed that it is also about an activity to bring the actors of the University closer to the market. This way, Zenit mapped, trained and announced the services of the laboratories. Thus, “when the companies get in touch, we already have the laboratories that are ready to serve companies”.

The services related to the **Training** aim to enable the internal and external communities of UFRGS to access events that involve the themes of innovation and

entrepreneurship, promoting a space of interaction among the most diverse actors of the community. In addition, training is also offered focused on topics relevant to new enterprises already established and seeking to innovate.

An example would be the *Quartas de Inovação*, meetings in the form of panels on emerging themes and cases of success related to entrepreneurship and innovation. Each meeting addresses a different theme, just as there are different speakers and / or moderators, invited by the team executing the project. The meetings are of monthly periodicity with the objective of training entrepreneurs, stimulating networking and exchanging experiences.

In addition, the Project Workshop would be a Project Development Workshop for Resource Prospecting aimed at training entrepreneurs who have an innovative project with market potential, but do not have enough capital to make it viable. Thinking about the different possibilities of fundraising, this program was conceived in four modules, which contemplate the main possibilities of raising funds for entrepreneurs and entrepreneurs with different levels of knowledge, both for public and private resources being designed in partnership with incubators.

We observed that the training activities, besides transferring knowledge to the entrepreneurs, promote disclosure of different services of the University both to external and internal actors. “We had a very diverse public: entrepreneurs, company employees, students, professors… many people that did not even know UFRGS came”.

Finally, in the services of the area of **Innovation** we have those who seek to foster both the development of an innovative culture in organizations and support the development of innovative projects. The aim is to guide companies towards the implementation of an innovation management system and also to support the development of innovative products through prototyping practices.

The AcelerEA is a business accelerator project, designed by Zenit and the School of Management. It aims to stimulate the interaction between students, teachers and pre-incubated startups. The accelerator will offer face-to-face and online weekly activities in the theoretical/ practical model, which will help the startup on better defining and validating its hypotheses and business model as well as its operations. By the end of the program, startups can pitch their business to potential investors.

> It was a demand that came up from the managers of university’s incubators [...] the coordination of REINTEC said that they had difficulties in having a common training program for the incubated companies. And in the end, each

> incubator made their training program differently […] we thought: why not offer an Extension Program linked to the Administration School? Who coordinates is Zenit, but it is operated by the Administration School. The students and former students of the Administration School offer mentorship and support for the development of an acceleration plan for the incubated companies.

We observed that the activity of AceleraEA, besides training the businesses in innovation, also influenced the construction of a collective agenda among the incubators that unify their selection processes from the program. "We could show the reason to make a unified calendar […] it is not a calendar to please to Park […] that is because it will enable joint actions like that".

On the other hand, the NAGI is a project that aims at supporting startups, small and medium enterprises into the development and implementation of an Innovation Management Plan. The methodology used is the *Innovation Route*, which was created by a team of researchers and students from UFRGS and it is divided into four main stages: (1) Initial diagnosis; (2) Training; (3) In-company consulting, with elaboration of an Innovation Management Plan (IMP); and (4) New diagnosis.

We identified that the initiative had already been initiated in 2013 with the Informatics Institute and the Administration School from a public promotion public notice. From that, Zenit Science Park started to integrate the activity and connect more actors in its execution.

The Rapid Prototyping Multiuser Center (CMPR) is a laboratory linked to the Zenit Park, in partnership with the Hestia Incubator, which aims at providing rapid 3D prototyping infrastructure to its users for the development and development of their own and / or collaborative projects. The CMPR is multiuser, that is, it serves both the internal community of UFRGS (teachers, students, research groups and incubated companies) and the external public to the University (associated companies, entrepreneurs and research institutes). The Center has the following equipment: 3D printer and milling machine, which allow the rapid development of concrete prototypes coming from 3D virtual projects. We noticed that this activity is a way the University can share technology with its ecosystem.

In the next section we have the reflections about the process of implementation of these services.

4.3. Reflection

In this section we reflected on the process of implementation of the activities developed by Zenit Science Park and the critical factors for the orchestration of the university innovation ecosystem. Regarding the Incubation services, we noticed that because of the technological incubators of UFRGS have arisen prior to the existence of Zenit (except Germina, which came later) one of the major difficulties is the mutual integration of these with the Park.

As for Reintec services, it is understood that incubators are increasingly involved with Zenit, with more and more open communication flows. The biggest challenge, therefore, was to generate incubators' sense of belonging to the university's innovation ecosystem. According to one interviewee, "the incubators have their own life, they follow their guidelines, and the Park makes a great effort to see if they can work in a more articulate manner". However,

> "the mapping of the processes of work of the incubators of network and the offer of exclusive services to them, enabled the improvement of that relation […] The incubators are already feeling part of the Park as well as liked to it […] it is not only a feeling, we are working for the documents to be unified, standardized."

The network of the associated companies depends as much of the operationalization of the conceived services as of the bureaucratic procedures of viabilization the establishment of the contract. In this way, after the other services of the Park are fully executable, it will be possible to offer such an association. We understand that there was a prior need to structure and operationalize the other services in order to be able to offer the proposed benefits to the business association.

Regarding connection services, it was identified that there is interest and willingness to be part of a network of both partners and laboratories. Despite this, there is a lack of knowledge and preparation to offer services to the external community of the University.

For example, the network of laboratories counts on 12 accredited laboratories, being these mainly composed of laboratories of the School of Engineering and the ones that already have a trajectory of interaction with companies/transfer of technology being easier to deal with. It has been difficult to find laboratories able to participate in the Network according to the accreditation criteria since technology transfer and the interaction of companies with the university is still incipient. In spite of the estimate of the existence of 200 technological laboratories in the University, we noticed that the laboratories, for the most part, do not fulfill the requirements agreed as necessary to be

part of the Network. Finally, we identified the need to make the online platform more intuitive to the user in the search of information about the laboratories.

Besides the lack of knowledge and train of actors in relation to the innovation generation, we also noticed the superposition of activities and resistance to change as critical factors of the ecosystem orchestration of the university. According to one of the interviewees "the Park faced some competence conflicts with other instances in the university when it started to position as a proactive actor in the promotion of innovation". We identified that some actors were afraid to lose their space.

"We worked with the concept that the Park has the role to connect actors. Then, that was our keyword, let's say, that it is a matter of connection […] we don't want to replace any existent actor in the ecosystem […] we don't want to be in conflict with activities that are already established, but we do want to give more synergy to that system of entrepreneurship and innovation, science and technology, in the sense of connecting companies with laboratories, with public agencies". Another interviewee adds "the Park has the fundamental role to connect actors allowing the scientific knowledge to come to the society". In his opinion, that was always a "neck of the university".

From that, Zenit Science Park, in partnership with SEDETEC, created the campaign #UFRGSInnovation aiming at acknowledging, valuing and disclosing the actors and services of the university ecosystem. According to the campaign website, the development of #UFRGSInnovation starts with the understanding that UFRGS is nationally and internationally recognized for its excellence in teaching, research and extension, however, there is still space to expand and consolidate its actions and image of innovative and entrepreneurial University. We noticed that as far as the roles of each actor were cleared, the resistance and the superposition of actions reduced.

In the network of internal and external partners, we verified it becomes necessary to continually evaluate the partner's reputation with feedback from associated and incubated companies to not undermine the reputation of the Park. In addition, the Park must continuously seek new partnerships to meet the most diverse demands of associated and incubated companies – not to overburden companies and the public with the presence of the same speakers and consultants.

We noticed that in the last years, that connection with external actors increased. Zenit established partnership in 2018 with City Hall of Porto Alegre and with the Ministry of Science, Technology, Innovation and Communication (MCTIC) for the creation of a Center of Computer Reconditioning (CCR). The program promotes the professional

training for young people and transforms technological garbage in products. “That initiative interests the municipal public government and the university with all that generates electronic garbage” said one interviewee. Another example of interaction and expansion that Park Zenit is working is the Office of Innovation in partnership with the City Hall of Farroupilha, in Serra Gaúcha. Representing UFRGS, Zenit “will promote the training in entrepreneurial education and innovation management of that region”. In the same year, Park Zenit, with UFRGS, founded a partnership with the municipal government, local entrepreneurs and two more universities of the city (PUCRS and UNISINOS) with their Science Parks: The Alliance for Innovation. The initiative aims at connecting and exchanging expertise in order to promote greater innovation for the city.

When it comes to training services, it was found that the *Quartas de Inovação* events worked well for Zenit’s relationships and image building both internally and externally to the University – bringing different partners to attend these meetings as speakers, it was possible to give visibility to the Park and to the partnerships. In addition, it is a means to stimulate entrepreneurship and innovation, presenting and applying techniques related to the topics addressed and stimulating networking and the exchange of experience. In addition, it became possible to reach out to the public: students and future entrepreneurs – who may in the future contact Zenit via incubation or via a business association.

The Project Workshop has not yet been validated since the service was in the phase of market analysis and validation with the public. However, according to an incubated entrepreneur, only by being on the ecosystem of the University it is possible to have access to many sources of funding, being them public or private. The access to knowledge of professors and researches was also pointed out as a benefit by the startups. Moreover, an entrepreneur created a consulting council for the company with actors of the ecosystem. “One is from the stock market, another of interaction university-company, another from the corporative part and another from the academic part. To conclude, “everything we decide – contract, price, client, strategy – everything the council directs us”.

In the innovation services, NAGI UFRGS brings a lot of potential to Zenit since the businesses served have great chances of becoming companies associated with the Park. We noticed that the NAGI activity is an alternative to make to services of the internal actors tangible for the market and a faster way for the organizations to know and

be linked to the ecosystem of the university. The “UFRGS seal is very important because it is a reference institution in research and knowledge” states one of the participants.

The CMPR involved the involvement of university actors, the design of the business model, and it is currently in the validation phase of the value proposition and the market. With the center it will be possible to attend different actors (researchers, companies) because it is multiuser. It is possible that Zenit is also a provider of technological services to its own stakeholders, thus strengthening the idea of the park being a connector of its peers.

However, we noticed that a blocking for the operation of the center is the bureaucracy and lack of agility and autonomy of the university. The processes are restricted and limited to the demands of a Public University. With that, they end up being slower and, many times, inefficient. Besides that, we observed complaints of entrepreneurs and internal actors in relation to the limitations of infrastructure of the university such as the internet service, reception service and physical space. With that, inadequate infrastructure may be considered a limiting factor for the innovation process.

After that thought, we can imply some critical factors for the orchestration process of the university innovation ecosystem. Bittencourt et al (2018) had already listed the engagement of actors; the alignment among the actors and the joint definition and communication of common agenda as key points for the orchestration of an emergent innovation cluster. With the case of the innovation ecosystem of UFRGS we validated those three factors and added two more for the university context: the internal flows and infrastructure of the university and the heterogeneity of knowledge of the actors in relation to the innovation.

The engagement of the actors on the innovation ecosystem of the university may be realized with the resistance of some actors in the activities proposed by Zenit and with the lack of initial sense of belonging showed by the incubators. The alignment among the actors, we could observe the moment when there was superposition of similar activities in the ecosystem such as lectures and courses of entrepreneurship. The joint definition and communication of common agenda was identified since the processes were individualized and the actions isolated, for instance, the incubation public notices.

The internal flows and infrastructure were realized with difficulty to buy supplies for CMPR and with the complaints and structural limitations of the university. Lastly, we identified the heterogeneity of knowledge from a lack of knowledge and unpreparedness of the laboratories and other actors in achieving to generate innovation for the market. On

Table 9 we compiled the critical factors and their evidences for the orchestration of the innovation ecosystem in the university.

Table 9: Critical Factors for the Orchestration of University Innovation Ecosystem

Critical Factors	Evidence
Engagement of actors	Resistance and lack of belonging sense
Alignment among the actors	Superposition of similar activities
The joint definition and communication of common agenda	Individualized processes and isolated actions
Internal Flow and Infrastructure of the University	Not adequate infrastructure for innovation
Heterogeneity of knowledge	Unpreparedness and knowledge to innovate

According to observed activities of Zenit Sciente Park as orchestrator of the innovation ecosystem of UFRGS, in the next section, we present a model for the role of the orchestration in that context.

5. The role of the orchestrator of a university innovation ecosystem

There is a vast and rapidly growing literature on the use of innovation ecosystem as policy instruments to enhance innovation and to explain how regional cooperation and innovative networks work (Sydow et al., 2016). Broad discussions on how to orchestrate appropriate forms of cooperation are, however, relatively recent (Nielsen & Gausdal, 2017). Hurmelinna-Laukkanen *&* Natti (2018) likewise argue that there is a lack of research on the orchestrator's roles and activities in innovation ecosystem (Heidenreich, Landsperger & Spieth, 2014; Paquin & Howard-Grenville, 2013).

In that scenario, the present paper contributes to the discussion with the proposition of the roles and the activities of the orchestrator of an ecosystem of innovation in the university. The emerging in the definition of innovation ecosystem orchestration addresses what orchestrators do (Hurmelinna-Laukkanen *&* Natti, 2018). Nyström et al. (2014, 484) define roles as "behaviors expected of parties in particular positions." Role is here defined as a set of actions and responsibilities (Mintzberg, 1973).

Orchestration comprises different activities for formulating the network and directing and managing the practices and processes so as to enable value creation and capture (Batterink et al., 2010). It is about "a set of evolving actions, not a static structural position" (Paquin & Howard-Grenville, 2013, 1624). From the Case of UFRGS, we could identify three main roles performed by Zenit that helps us understand the acting of the orchestrators in that context: architect, knowledge broker and market translator.

The first role is the **Architect** (Hinterhuber, 2002. Hurmelinna-Laukkanen *&* Natti, 2018). This role involves mapping and composing the network (identify and recruit the actors), linking complementary actors (promote connection among them) and constructing a collective identity (develop common agenda and processes) (Nambisan & Sawhney, 201; Laukkanen & Natti, 2012). In this role, a lot of responsibility and initiative comes from the orchestrator (Hurmelinna-Laukkanen *&* Natti (2018). We noticed such activities developed by Zenit with the initial mapping of actors, draw of the ecosystem, connection among the projects, construction of the unified processes with the incubators, definition of joint events calendar and the development of the campaign #UFRGSInnovation.

Another role identified was **Knowledge Broker** (Dhanaraj & Parkhe, 2006; Nilsen & Gausdal, 2017), that is, the orchestration as sensor, disseminator and manager of knowledge. For that, the activities involved on that role are knowledge activation (hold and search for knowledge), facilitate transactions (articulate and stimulate the exchange of knowledge) and managing knowledge mobility (guarantee the dissemination of knowledge). Managing knowledge mobility is at the core of an innovative network, since knowledge is the key resource, while knowledge sharing and knowledge creation are the key processes (Dhanaraj & Parkhe, 2006; Gausdal &Nilsen, 2011). Knowledge Broker involves sharing, acquiring and deploying knowledge, and includes facilitating common meeting places for learning (Nilsen & Gausdal, 2017). We observe that external partnerships, the training programs and the unified processes are examples of actions of that role performed by Zenit.

The last role identified was **Market Translator**, that seeks to approximate, translate and trade the knowledge generated by the university for the market (Dhanaraj & Parkhe, 2006; Gausdal & Nilsen, 2011). That role encompasses the activities of articulate demand (identify the needs of the market), recognize and commercialize innovation (identify the value of the innovations of the university) and manage innovation appropriability (transform the knowledge in innovation). Translation is likely to be a challenge in an innovation network; additionally, the lack of a common knowledge and terminology constitute barriers for the network's survival — as well as for its innovativeness and success (Clegg et al., 2004).

Even when knowledge mobility is managed, networks frequently face the challenge of capturing the profits generated by innovation (Dhanaraj & Parkhe, 2006), where the ability to recognize innovative ideas and commercialize these are prerequisites. This is

taking knowledge brokering one step further, to innovation brokering. Managing innovation appropriability — which consists of recognizing and developing innovative ideas, securing patents and copyrights, and governing the ability to capture the profits generated by innovation — it is a crucial process within innovation brokering (Dhanaraj & Parkhe, 2006; Gausdal & Nilsen, 2011). We noticed that the network of laboratories and the connection among the services of the junior companies and other actors of the ecosystem are examples of that acting.

We believe that the roles of the orchestrator of the innovation ecosystem of the university are different from the ones performed in an ecosystem/network of business. The acting of the universities as innovation ecosystems is still recent, therefore, the function to draw the ecosystem and translate and transform their knowledge in innovation is fundamental for their success. We understand that the roles identified do not respect, necessarily, a linear sequence, being possible to exist alteration of agreement with the stage of development of the ecosystem. Besides that, it is also understood that the roles are not restrict to the activities listed here. However, in order to synthesize the roles and the activities of the orchestrator of the innovation ecosystem in the university, we created Table 10.

Table 10: Orchestrator's Roles and Activities

Orchestrator Roles	Activities	References
Architect	Map and compose the network	Hinterhuber (2002); Nambisan and Sawhney (2011); Laukkanen and Natti (2012) Hurmelinna-Laukkanen and Natti (2018)
	Link complementary actors	
	Construct a colletive identity	
Knowledge Broker	Knowledge activation	Dhanaraj and Parkhe (2006); Nambisan and Sawhney (2011); Nilsen and Gausdal (2017);
	Facilitate transactions	
	Managing knowledge mobility	
Market Translater	Articulate demands	Clegg et al. (2004). Dhanaraj and Parkhe (2006); Gausdal and Nilsen (2011); Batternik et al (2010)
	Reconise and comercialize innovation	
	Manage innovation appropriability	

From the analysis of the UFRGS case and the proposition of roles and activities of the orchestrator for that context, we suggested a **toolbox** with facilitating actions to orchestrate a university innovation ecosystem. As first point, we believe that the creation

of a collective campaign, such as #UFRGSInnovation is important to touch the actors of the ecosystem and develop a joint purpose.

In the sequence, we understand that the definition of roles and the creation of a common agenda collaborate for the engagement and alignment of the actors and avoid the superposition of similar activities and the isolated processes. About the training programs, we noticed that they can be important allies to level the innovation knowledge of the internal actors and attract new external actors for the ecosystem, enjoying this way, the reputation of the universities in teaching and research. Lastly, we bet on the creation of platforms to spread the services and the projects developed as mechanism to bring the university closer to the market and generate more innovations. The toolbox with facilitating actions for university ecosystem orchestration can be viewed in Table 11 below.

Table 11: Toolbox – Facilitating actions for Orchestration of University Innovation Ecosystem

Actions
Collective Campaign
Definition of the roles of the actors
Common Agenda
Training Programs
Platform for communication of projects

6. Conclusions

Innovation ecosystems have been calling attention of the researchers and private and public managers because of their potential of innovation generation and development. Thus, the universities are seeking to build innovation ecosystems in their contexts in order to meet the demands of market claimed. However, there is a gap in the literature about the orchestration of those ecosystems, especially in the university context. Therefore, this paper sought to answer the following questions: *what are the roles of an orchestrator in a university innovation ecosystem?* For that, we performed an action research in the innovation ecosystem of UFRGS orchestrated by its Science Park, Zenit.

We note that the innovation ecosystem is an important mechanism for universities to connect their internal actors, bring them closer to the market and promote greater innovation and development for society. In the literature, innovation ecosystems and their management are being increasingly discussed, however, always focusing on the business

environment. Thus, we realized that became essential to understand the particularities of innovation ecosystem orchestration in the university context.

The first difference we have identified is that the main objective of the university's innovation ecosystem is not only economic gains, but to building and exchanging knowledge in order to generate innovation. Thus, managing knowledge mobility is an important activity of the orchestrator. The second difference refers to the articulation of actors of the same institution. We have identified challenges of this context as belonging and overlapping activities. Also, we realize the need for the orchestrator to construct a colletive identity. Finally, the third difference identified is the challenge of bringing the knowledge and innovations generated by the university closer to the market. Generating and comercializing innovation is not the university's main activity, so being a translator for the market is one of the orchestrator's roles of university innovation ecosystem.

Theoretical contributions, we opened the black box of the roles of the orchestrator proposing a model for innovation ecosystems in universities. Besides that, we brought empirical evidences about the relation of the university with the construction of an innovation ecosystem from a method that connects researcher and object and, thus, we could bring perceptions that are not identified in case studies.

From the Case of UFRGS, we could identify three main roles performed by Zenit: architect (map and compose the network, link complementary actors, construct a collective identity), knowledge broker (managing knowledge mobility, knowledge activation, facilitate transactions) and market translator (articulate demands, recognize and commercialize innovation, manage innovation appropriability).

Management contributions, we identified the critical factors of the orchestration of the ecosystem and innovation in universities and we suggested a toolbox with facilitating actions of the process. As critical factors, we identified the engagement of actors, alignment among the actors, the joint definition and communication of the common agenda, internal flow and infrastructure of the university, heterogeneity of knowledge. As facilitating actions, we suggest: collective campaign, definition of the roles of the actors, common agenda, training programs, platform for communication of projects. We believe we can help managers of universities and science parks to identify their roles and activities for the construction of an innovation ecosystem.

We had as limitation of the study the unique case, which hinders the generalization of the findings proposed. We understand that a historical analysis, expanding the time of the research could have brought even more insights. We know, however, that the action

research at the same time that brings important contributions as result of the involvement of the researcher with the object may have left some short-sighted analysis.

We suggest as future studies to expand the research to other universities as well as compare roles and the activities of the orchestrator with other ecosystems of innovation. We also believe that longitudinal studies can bring new elements, such as a possible alteration of roles or of orchestrators throughout the process.

5. CONCLUSIONS

Recurrent innovation is crucial for organization to survive and stand out in the market. In this context, networks are acknowledged as main source of value generation. However, independently of its type, the management model of the networks still needs to be debated and developed. It is understood that managing and guaranteeing any process of innovation is a multifaceted and complex task (Pikkarainen et al, 2017), even more in environments where there is a great number and diversity of actors (Reypens, Lievens & Blazevic, 2019), such as the case of networks. Networks orchestration arises as a more adequate alternative (Ritala *et al.,* 2009), although its literature is still fragmented and little explored (Hurmelinna-laukkanem & Natti, 2018).

The present thesis aimed to analyze the orchestration of networks in different contexts and development stages. We have identified three main theoretical gaps that relate orchestration to networks in their different contexts and stages of development. The first is related to the process of orchestration in the emergence of the network. The second refers to the influence of orchestration throughout the network's life cycle. And the third is related to the orchestrator's roles and activities. Therefore, three papers were developed to fill in these gaps, answer the thesis objectives and contribute to the literature and network's management practice. Next, the main results acquired in these studies will be presented and discussed.

In the **first paper**, the objective was to analyze the orchestration in the emergence of a cluster of innovation. (CoI). As a contribution, we developed an analytical framework in order to better understand this process. Based on the literature review, the framework presents the set of orchestration components (alignment of interest, incentives and objectives, coordination of actions) and the actors of a CoI (local government, universities, entrepreneurs and society). These actors can generate the drivers for the emergence of a CoI (mobilization, mobility of resources, entrepreneurial process and global strategy perspective) and the necessary elements for the emergence of a CoI (geographical delimitation and component heterogeneity). We also have suggested three propositions to help in the understanding of the orchestration process in the emergence of an innovation network. The first proposition shows that the emergence of CoI in the urban regeneration depends on the interaction of different components. It was identified that the first step towards the emergence of a cluster of innovation is the engagement of different actors. Each actor has a given knowledge that, along with others, enables the

generation of innovation in an agglomeration. The second proposition argues that coordination of actions is easier when it is aligned among the components and stimulates the emergence of a CoI. The actors need guiding points; thus, the coordination of actions facilitates an alignment among them and, consequently, greater interaction and generation of innovation. Finally, the third proposition shows that joint definition and communication of common agenda enable the development of an identity as a CoI. In the same line as the second proposition, it was verified the need of an identity for the CoI that begins to be constructed from a joint definition and communication of common agenda.

In the **second paper,** we aimed to analyze the influence of orchestration in the network's life cycle. As a result, it was possible to identify the existence of key elements that influenced the life cycle and, also, the lock-in effect and the generation of innovation in the cluster. From this, we identified the orchestrators, their key activities and their level of impact on the cluster. We verified that the orchestration in the Cluster of Serra Gaúcha is decentralized, i.e. the cluster does not have a hub company as orchestrator, as Dhanaraj and Parkhe (2006) defended. That happens because the activities aligned to the dimensions of the orchestration are performed by multiple actors. Such finding responds to the last findings in the literature (Pikkarainen *et al*, 2017; Hurmelinna-laukkanem & Natti, 2018; Nielsen & Gausdal, 2017). Besides, we have confirmed that the role of the orchestrators keeps changing over the cluster's life cycle, as Nielsen and Gausdal (2017) had already indicated. Then, we proposed the multilevel orchestration model with the key actions by level and stage of the life cycle. We defend the need of more than one orchestrator to articulate the innovation in the cluster and minimize the negative lock-in effect and the possible decline of the cluster (Pinkse, Vernay & D'ippolito, 2018). We reinforced the importance of the orchestration's operation in the micro level (individuals), meso level (organizations) and macro level (cluster). Therefore, one level of performance can influence the other and avoid the major cause of cluster decline: imprisonment and lack of innovation due to the lock-in effect. In this way, we bring that a multi-level orchestration can influence the life cycle of the cluster and change this reality.

In the **third paper**, we had the objective of understanding the roles and activities of the orchestrator of a university's innovation ecosystem. We believe that this research brings three relevant contributions, besides the found results. The first one would be the research context: the university's innovation ecosystem. Currently, universities are going through changes in their practice field, therefore, the development of innovation ecosystems in this environment becomes extremely necessary and relevant (Wright,

Siegel & Mustar, 2017). The second is directly related to the papers's objective: the orchestrator's role and activities Broad discussions on how to orchestrate appropriate forms of cooperation are, however, relatively recent (Nielsen & Gausdal, 2017). In these scenarios, Hurmelinna-Laukkanen *&* Natti (2018) likewise argue that there is a lack of research on the orchestrator's roles and activities in innovation networks. The third contribution concerns the adopted method: participatory action research. This method has an educational and social transformation character, since all those involved in the research learn together. In addition to being emancipatory, since, in becoming aware of their situation, the respondents can proceed to act more critically in relation to the environment in that are inserted (Kemmis & Mctaggart, 2007). As results, based on UFRGS's case we were able to identify three main roles performed by the orchestrator (Zenit) that help us understand the acting of the orchestrators in that context: architect (maps and composes the network, links complementary actors, constructs a collective identity), knowledge broker (managing knowledge mobility, knowledge activation, facilitating transactions) and market translator (articulates demands, recognizes and commercializes innovation, manages innovation appropriability). We understand that the roles identified do not respect, necessarily, a linear sequence, being possible to exist alteration of agreement with the stage of development of the ecosystem. Besides, it is also understood that the roles are not restrict to the activities listed here. We also identified the critical factors of the ecosystem's orchestration and innovation in universities and we suggested a toolbox with facilitating actions of the process. As critical factors, we identified the engagement of actors, alignment among them, joint definition and communication of the common agenda, internal flow and infrastructure of the university, and heterogeneity of knowledge. As facilitating actions, we suggest collective campaign, definition of the actors' roles, common agenda, training programs, and platform for communication of projects.

After the papers' results presentation, it is possible to verify that they were able to fill the theoretical gaps previously identified and succeed in the thesis's aim to analyze the orchestration of networks in different contexts and development stages. With the aims to facilitate the visualization of the contributions and results generated by the studies and north this thesis' reflections, Table 12 was elaborated.

Table 12: Papers' contributions and results

Paper	Objective	Contributions	Key Results
The orchestration process for emergence of clusters of innovation.	Analyze the orchestration process in the emergence of a cluster of innovation (CoI).	Analytical framework to understand how orchestration occurs in the emergence process of a CoI.	The understanding and the structure of the orchestration process for the emergence of the innovation network.
		Three propositions: actors' engagement, actions' coordination and agenda, and common communication.	
Multilevel orchestration: the unlock for innovation in clusters life cycle?	Analyze how does the orchestration influence on the clusters' life cycle.	Key elements of the cluster's life cycle.	Longitudinal view on the influence of orchestration in the cluster's life cycle and the proposition of multilevel orchestration.
		Multilevel orchestration model and orchestrators' key actions.	
		Two propositions: multiplicity of orchestrators and multilevel acting.	
Orchestrating an innovation ecosystem in the University: The case of a Brazilian University.	Understand what the roles and activities of the university innovation ecosystem's orchestrator are.	Critical factors of the process of innovation ecosystem orchestration in universities.	Participation in the development of an university innovation ecosystem and identification of the orchestrator's roles and activities.
		Orchestrator's role and activities.	
		Toolbox with facilitating actions	

5.1. Theorical and Managerial Contributions

Based on those studies, we were able to notice that the process of orchestration in the emergence of a network happens based on certain actors in the network, allied to components in the orchestration through some drivers: mobilization, agenda definition, resources mobility, entrepreneurial process and global strategy perspective. In terms of CoI, we propose that the engagement of actors with different resources, the coordination of actions and the definition of an agenda, and common communication are actions that facilitate this process.

In terms of influence of the orchestration in the network's life cycle, we have identified that in each stage there are distinct key elements (influencers) It occurs either due to changes in the network's market/external environment or to internal alterations. Moreover, we have verified that the influence occurs and impacts on multilevel: network,

organizations, or individuals. Therefore, we understand the complexity and dynamism of the network orchestration, which, in this context of regional sectorial cluster, demands multiple orchestrators in different levels of impact in order to generate innovation and avoid its decline.

In regard to the orchestrator's role and activities, we participate in the development of a network and understand the orchestration's key success factors. From that it was possible to identify three of the orchestrator's roles and their activities. It is worth emphasizing that such contribution is related to the context of the university's innovation ecosystem, i.e. taking into consideration the particularities of this environment. Furthermore, it is understood that the study brought contribution to the theme.

The diversity of contexts explored in this thesis both validates the applicability of the orchestration to different types of networks and incites reflection on the particularities of each one of them. We have conducted studies on a large multisectoral network, a sectorial regional network and a small network in connection with an institution. In all of them, practices to capture and generate value among members (orchestration) were necessary. We have noticed that activities to engage and align the actors were punctuated as key elements in different contexts, independently of the size or scope of the network. We have realized that in the largest and most diverse network (Paper I), the approximation among actors became even more necessary. In the sectorial and most consolidated network (Paper II), the research development and representation activities that assisted from production to sales of products were the most demanded ones. Lastly, in the smallest and closest network (Paper III), flow organization, external and internal communication, and members training were the main requirements for the network's management.

Another point that made it possible for a better understanding of the networks orchestration is the multiplicity of development stages of the network's life cycle. We had a network in the emergence process (Paper I), one network with a 100-year path (Paper II), and one that was recently developed (Paper III). Based on the conducted studies, we have inferred that in the early stages the orchestration must focus more on the construction of a collective identity, common agenda and actors approximation (network stability). As the actors are connected and exchanging knowledge (mobility of knowledge), the challenge is the maintenance and renovation of value generation (appropriability of innovation).

This thesis brings important contributions to the literature on orchestration and networks also in regard to methods and researched cases. The networks' emergence process is sparsely explored due to the difficulty of detection; when conducted, they tend to be made in a retrospective way, which inevitably entails the loss of important information. In the first paper, we conducted research during the emergence of a network, which made it possible to even detect the difficulties of this process. The relation between orchestration and life cycle reinforces the dynamism of a network's management, since the orchestration cannot be the same throughout the path and changes in context. In the second paper, due to a partnership with a research group, it was possible to conduct a study with a longitudinal perspective in an almost 100-year-old network, in which we gathered data over a 10-year period. Based on this gathering, we were able to identify the differences and subtleties of an innovation network's orchestration over time. Finally, the participation in the formation of an innovation ecosystem in the university and the possibility of experiencing the roles and actions (with facilities and difficulties) of an orchestrator, in the third study, brought elements that facilitated and added to the understanding of networks management.

We realize that it is difficult to generalize the orchestration process since it varies according to the context and stage of development of the network, as already defended by Cinelli, Ferraro & Iovanella (2019). From this, we proposed some insights in each paper in order to highlight the particularity of each case. We developed a framework and made some propositions regarding orchestration in the emergence of a CoI. We have also found that, over the lifecycle of the innovation network, the demands are different and multiple actors are needed to orchestrate it. Finally, we found that even on smaller networks, the orchestration process is complex, requiring the orchestrator to play different roles. With that, we proposed some facilitating action in order to assist this performance. Thus, we understand that the three studies carried out answered the proposed objectives of this thesis.

All these contributions support not only the academic literature, but also provide important managerial knowledge. A public manager, by understanding the main drivers to the emergence of a cluster of innovation, is able to think and perform more assertive public policies. We believe that an organization by identifying the components of the orchestration and the network will make more and better use of benefits generated by agglomeration and contribute to their development. When individuals, organizations, entities and government realize that the management of the sectorial network is performed

by all and impacts on all (multilevel) and that the key actions vary according to the stage of development, certainly they will be able to have a more systemic view, more appropriability of their roles, flexibility to their actions and proactivity in moments of change. In the same way, students, entrepreneurs, researchers, incubators, technological parks, investors and other actors involved in the university's ecosystem will understand more clearly the roles and activities needed for the institution's environment to generate more value to all of them.

In general, we believe that this thesis contributes to managers to identify the particularities of the context and the stage of development of the innovation network that they are insert (or will be), in order to seek the most appropriate orchestration process for their reality. Whether for small or large networks, for emerging or declining networks, the present study brings critical factors, activities and roles to be performed in each of these cases. We know the complexity of network management, however, we understand that the propositions, models and toolbox carried out by this study bring important contributions for orchestrators and network participants to maximize the innovations generated.

Finally, for individuals and organizations that do not integrate or do not know innovation networks, this study seeks to present the benefits and challenges of these collaborative actions, bringing alternatives for their management and operation. Therefore, we understand that this thesis can also contribute to the formation of new networks, the stimulation of new collaborative structures and the reformulation of interorganizational relations. Thus, individuals, organizations and regions can create and extract more value from the contributions of this thesis.

5.2. Limitations and Futher Research

We know every study is made of choices, therefore, as we make these choices, we move forward to understand the phenomenon better through one point of view than another. Thus, this thesis presents limitations due to the choices made throughout the research process. We understand the first paper's data gathering to have been conducted in a restricted amount of time with a reduced number of interviewees (mainly when in comparison to paper 2). In the second paper, there was access limitation to data referring to the beginning of the cluster's formation and analysis limitation, in terms of being only qualitative. In the third paper, the data gathering and analysis could have been conducted

on better-defined time frames, which was not the case due to the great approximation of the researchers to the objective, regarding the adopted methodology. In general, it is also possible to notice that this thesis's studies were limited to Brazilian cases and qualitative methods.

We understand that the networks orchestration theme still lacks more studies in order to fill the identified gaps, fill other theoretical gaps and contribute to the management of these agglomerations that have been increasing both in quantity and in types of formation. It is suggested to deepen studies on networks orchestration, validating the propositions made and comparing the framework developed to clusters of innovation from other regions and countries. It is also suggested to keep track of the Serra Gaúcha cluster in order to check how the orchestration will perform in the following years. Besides, the development of research in the social network analysis format may generate new insights to understand the multilevel orchestration. We suggest a follow-up on UFRGS's innovation ecosystem and checking to see if other actors will take on these (or new) roles/functions throughout the network's path. It would be interesting to conduct a comparative study with other university innovation ecosystems. Would there be a difference in the orchestrator's roles of a public university? How about a foreign university? In regard to new themes, we also suggest three studies 1) on the differences of orchestration according to the type of network, 2) on the orchestration of strategic resources in innovation networks, 3) on the influence of orchestration in the local development of regions in which the networks are inserted. Certainly, orchestration of networks is a theme of great relevance and interest.

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