

RESILIENCE IN CLUSTERS: AN APPLICATION OF THE CLUSTER BRIDGE MODEL TO LIFE SCIENCE NORD (GERMANY)

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Abstract

Territorial capital, the innovative notion that reunites the productive assets found at the level of a territory, has been placed in the light of the current research given its potential in indicating economic growth and competitive advantage at the level of a territory. Being essentially an applied case study paper of cluster analysis in the Life Science Nord agglomeration, in Germany, this article extends the literature by offering a theoretical perspective on the terminology needed to understand economic resilience, to discover the possibilities of fostering resilience at the cluster level and to bring evidence from the cases of different industrial clusters reacting to various economic shocks during the process of resilience. Lastly, the Cluster Bridge Model is presented as an application to understand cluster dynamics.

Keywords: *resilience, clusters, COVID-19 Pandemic, Cluster Bridge Model, qualitative methods*

JEL classification: *B21, B55*

1. Introduction

At cluster level, “[...] perhaps the most discerning test of ‘true’ cluster dynamics is the one that assesses the alleged cluster’s resilience and robustness over time, in the face of severe shocks and dislocations. How has the region fared under such circumstances? How effectively have its firms and institutions adapted and evolved to such pressures for change?” (Wolfe & Gertler, 2004, pp. 1085-1086 cited in Behrens et al., 2018)

Our study centres on the economic unit of analysis *cluster*. Under the umbrella concept of “economic resilience”, recent studies have addressed the

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role of changing environmental conditions and regional clustering (Wrobel, 2013). Studies which have approached this topic of resilience in clusters are theoretically and empirically vague, according to Behrens et al. (2018). The same authors observe that resilience in clusters fosters a vicious circle because on one side clusters “can make firms more efficient and innovative, improving their ability to adapt and their resilience to shocks” (Behrens et al., 2018, p. 2) and on the other side this connectedness of firms might be the factor which makes the negative disturbances to propagate more easily.

Conz et al. (2017) suggest that there is a trade-off between connectedness and resilience: the relations between actors within the system are positive, but only to a certain point. According to this fact, Simmie and Martin (2010) have been able to outline an adaptive cycle model that involved four main stages. The first two stages, *exploitation* and *conservation*, relate to the emergence, development, growth and stabilisation of an economic system, while the second two, *release* and *reorganisation*, are concerned with the establishment, decline and exploitation of new developing paths.

Behrens et al. (2018) operate a study on plants in Canadian clusters of clothing and textiles to study how they resisted or adapted to the increase in Chinese imports between 2001 and 2013. The authors ask in their paper whether the companies in the clusters are more resilient than others. They find an answer in the literature in the work of Delgado and Porter (2017) who have studied the relationship between clusters of related industries in the United States during the global financial crisis and resilience, using aggregate data and their conclusion is that industries experience a higher employment growth when located in a region where other related industries are placed. However, Martin et al. (2013) does not find any evidence in France for the exporters to be more resilient in 2008 and 2009.

In the following sections, the review focuses on conceptual issues related to the

- (1) framework of four criteria forming a regional resilience framework;
- (2) addressing each criterion for practical evidence found in the literature of cluster resilience;
- (3) bringing the case of Life Science Nord GmbH Cluster throughout Coronavirus Pandemic;
- (4) introducing Cluster Bridge Model application.

2. Theoretical background

With various uses in the fields of materials science, the term [of *resilience*] has been also utilized to a great extent in engineering and construction, or computer networking. What is more, it has entered the vocabulary of macroeconomists as “a form of indicating *power*, mainly the power of a national state to counteract other economic, political, natural, socio-cultural, technological adversities and bounce back to the initial path as fast as possible” (Petre and Cojanu, 2017, p.12).

From its first definition, appeared in Encyclopedia Britannica in 1824 (Merriam-Webster dictionary, 2020), we find that resilience has two meanings:

- “The capability of a strained body to recover its size and shape after deformation caused especially by compressive stress.”
- “An ability to recover from and adjust easily to misfortune or change.”

Pettit et al. (2013) define resilience more broadly as the capacity for an enterprise to survive, adapt and grow in the face of change, so this might be a good definition for the multiple variants of resilience’ outcome.

Having so many meanings is beneficial on one side because it encourages interdisciplinary research. On the other side, the drawback of it, is that the concept continues to be vague in understanding (Martin and Sunley, 2015; Bristow, 2010; Hassink, 2010). There are three main arguments worth mentioning in this respect: regional or local economic resilience has “*no universally agreed definition*”, [...] “*no generally accepted methodology*” for its operationalization and measurement [and] “*no theory* of regional economic resilience as such and relatively little discussion of how the concept relates with other concepts such as uneven regional development, regional competitiveness, regional path dependence and the like” (Martin and Sunley, 2015, p. 3).

Both qualitative and quantitative methods have been used in various attempts of measuring the regional economic resilience (interviews, surveys or econometric models and factor analysis). Martin and Sunley (2015) propose a methodological approach based on four questions for resilience conceptualisation: resilience of *what*, *to what*, *by what means* and with *what outcome*. Therefore, we organize the methodological section as of these four research targets, correspondingly.

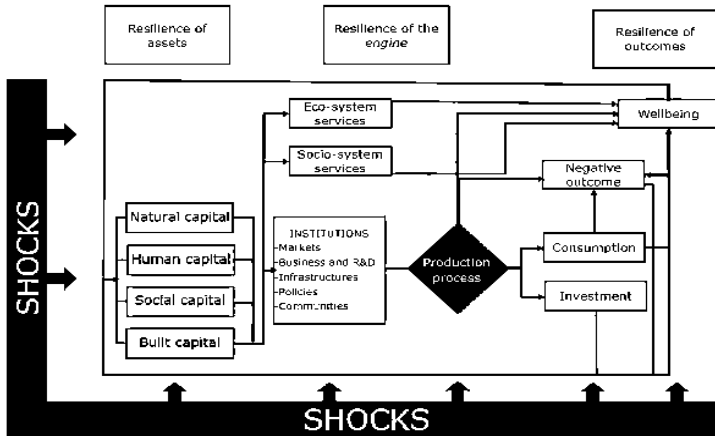
2.1. Systemic resilience in times of COVID-19 Pandemic

The current COVID-19 pandemic has seriously affected all the sectors of the economy in the case of the majority of countries worldwide. The crisis came in waves, it started at the end of 2019 in China, Wuhan region and spread in a domino effect in all countries around the world. Compared to the 2008-2009 recession this pandemic is even more dangerous for human life and for the economic situation of the countries involved. International Monetary Fund projects in World Economic Outlook (2020) a global growth drop of -3 percent, compared to only -0.1 percent in 2009. This is a downgrade of 6.3 percentage points since January 2020 and a major change over a very short period of time.

In Giovannini et al. (2020), European Commission through Joint Research Centre releases a report on the transformative resilience-building process in times of this COVID-19 emergency, which means preparing the society to develop sustainable general capacities, not only for coping with the current crisis, but with future ones. Unfortunately, the national systems were vulnerable in the face of this virus and especially the health systems were unprepared for the effects of such a pandemic. Coronavirus has affected the society at various levels and with different intensity, and by this involving „the human and social capitals, the socio-system services, institutions, communities, the production process, consumption, and investment” (Giovannini et al., 2020, p. 3).

In Figure 1 below there is a resilience framework which shows the societal system composed of three elements: assets, engine and outcomes, in other words, a multidisciplinary, 360-degrees system approach. First, the assets include different forms of natural, human, social, and built capital. Then, the engine turns the assets into outcomes through intermediaries like governments, markets, enterprises and communities and the processes they generate. Lastly, the outcomes are determinants of the well-being of individuals and of the society in general, like health, “employment, trust and happiness”, consumption and investment and also adverse fallouts of the system like “social exclusion, poverty, inequality and waste in general” (Giovannini et al., 2020, p. 5).

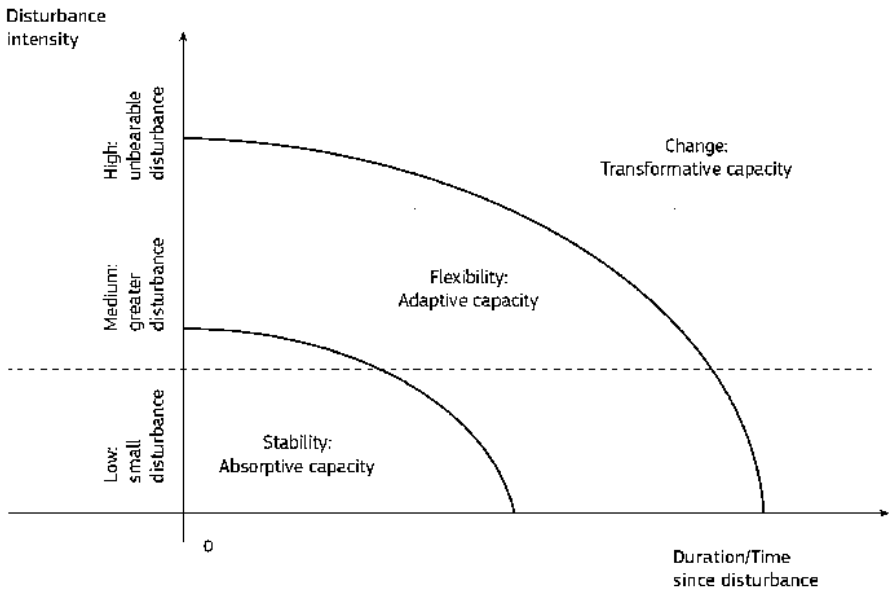
Figure 1: Transformative resilience in a 360 degrees system approach



Source: Giovannini et al. (2020, p. 6)

COVID-19 has caused damage in all the areas shown in the diagram, and the resilience of assets, engine and outcomes are under pressure. In a very short period of time, the economies worldwide had to exclude the absorptive capacity of the resilience, which generally enters into action when the shock is not that intense and the time of exposure to the shock is limited. In this case the adaptive and the transformative capacities of the resilience are needed because the intensity of the shock surpasses the bearable limit and the extent in time of the shock is forecasted to be measured in years. Transformation will include not only technical and technological changes, but also cultural ones, behavioural shifts and institutional reforms. Apart from this framework, three types of resilience capacity are represented in the graph in Figure 2, together with two coordinates, intensity of the disturbance and duration of the disturbance.

Figure 2: Types of resilience capacity



Source: Giovannini et al. (2020, p. 7)

2.2. The Cluster Bridge Model

This method provides a model for evaluating cluster dynamism. The model regards the cluster as an ensemble of various institutions, which are wired through networks. Apart from firms, there are research institutes, educational institutions, capital providers and government organisations (Sölvell and Mordulis-Yakushev, 2016). Firms and other organizations in clusters are connected on the organizational level in many different ways, for instance through resource and information mobility and sharing, and they are often involved in common projects.

The authors of the model consider cluster organizations as being the “bridge-building” institutions inside a cluster because they glue together the institutions in a cluster. The cluster organization operates through three different pillars: 1) overall networking and cluster identity, 2) supporting innovation projects across cluster actors and 3) supporting business development projects across cluster actors (Sölvell, 2015 cited in Sölvell and Mordulis-Yakushev, 2016).

A way to evaluate the performance of a cluster organization during a certain period is to match the scale of the efforts (initiatives and actions) that the respective organization has made in (a) building bridges across cluster actors, and (b) in deepening the links and networks between these various actors, leading to real improvements in the financial and non-financial performance of member firms (Foley, 1992; Turok, 1990 cited in Sölvell and Mordulis-Yakushev, 2016).

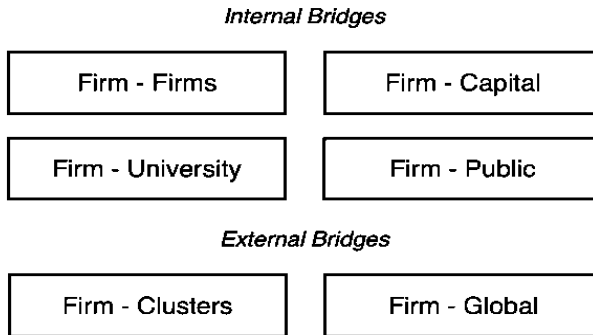
The Bridge model studies the dynamism of a cluster through two processes: bridge-building and traffic. Bridge-building refers to the institutional and physical structures that allow for interaction between actors and traffic refers to the measured activities on the bridges (Sölvell and Mordulis-Yakushev, 2016). In addition to formal projects, bridges are built through incubators, accelerators, training programs and other institutional structures.

The cluster bridge model (Sölvell and Mordulis-Yakushev, 2016) offers a way to observe the gaps between different actors in a cluster and provides solutions to close those gaps. There are five actors that generally make part of a cluster: the firms, the research organizations, universities, the capital providers and the government and the public bodies.

In the model there are six types of gaps that limit the performances of firms in a cluster (See Figure 3 below) and the cluster organization has the purpose to build six Bridges, four of which are internal (firm-firm/s, firm-university, firm-capital firm/s, firm-public bodies) and the other two, external (firm-cluster/s, firm-global value chains). These gaps exist because sometimes between the members weak links can be formed, which isolate the members, create gaps between them and this situation translates in limited mobility, dissemination of knowledge and cooperation.

The model was built with the purpose to help the cluster organizations to evaluate the results of their work and improve the performance of the cluster members through efficient cluster initiatives (Sölvell and Mordulis-Yakushev, 2016).

Figure 3: The Cluster Bridge Model



Source: Sölvell and Mordulis-Yakushev, 2016, Handbook on Evaluation of Cluster Organizations, Part II, The Cluster Bridge Model, p. 9.

3. Resilience in Life Science Nord

3.1. Methodological approach

The methodology of the article will analyse what are the limits of the four conceptual issues in the literature - of what, to what, by what means and with what outcome- questions that apart from Martin and Sunley (2015), no other authors have placed together in the same methodological framework. Here comes the novelty of this article, as we focus on this framework and try to find evidence in the literature referring to resilience in clusters. Carpenter et al. (2001, p. 767) mention how in literature the concept of resilience has been understood in most of the cases as a metaphor and not as an operational, measurable concept in the form of a model. Most of the articles dedicated to the issue of resilience seem to follow non-deliberately at least two out of the four criteria because their authors want to talk alternatively about the unit of economic analysis, in our case, the cluster; the nature of the shock, its intensity, duration and effects; the mechanism and processes of shock adjustment and last, but not least, the result of the process of resilience.

Additionally, we bring our contribution to this four-step methodological framework by adding the Cluster Bridge Model, designed by Sölvell and Mordulis-Yakushev (2016) to signal the existing gaps that form between the actors of a cluster. This model provides a solution to fill in these gaps through bridge building. The application of the Cluster Bridge Model consists of a set of eight questions which were the object of preliminary

interviews during the fieldwork the author has undergone during 2017-2018 Erasmus+ Traineeship in Kiel, Germany and also during an online survey run from July until September 2020, both addressed to the members of the Life Science Nord cluster: companies, research institutes and cluster organization representatives. From the interviewed and surveyed members the author selected the opinions of Werner Lanthaler (CEO of Evotec SE), Siegfried Bialojan (Head of the European Life Science Center, Ernst and Young GmbH) and Sarah Niemann, the Manager of International Affairs at Life Science Nord GmbH.

The methodological frameworks combine harmoniously at the level of the cluster because this phenomenon of resilience is multifaceted and should be observed through various qualitative methods, especially with the imminence of the COVID-19 crisis. It will be interesting to discuss in a future study whether the firms in clusters tend to be more resilient than the firms which are not cluster members. The limitation of the research consists of the unavailability of more respondents to take part in the survey.

Of what?

Our analysis targets the cluster level, however this cannot be understood without its interacting with the other levels of economic analysis, as Kahl and Hundt (2015, p.383) clear out that “the examination of the resilience of regional clusters may thus be significantly enhanced by disentangling effects at the firm, network and regional (i.e. context) levels.”

At macro-level analysis, Delgado and Porter (2017) write about the role of clusters for the resilience of regional industries during the Great Recession in the U.S. and discover that industries had a higher employment growth when they were located in a region with other related industries, therefore regional industries in clusters experienced a lower vulnerability and a faster recovery.

At micro-level analysis, Martin et al. (2013) analyse how exporters located near other exporters had cluster advantages and performed better than other firms under business as usual as long as the economic turmoil did not happen. The weaker resilience of the competitiveness cluster is determined by the fact that firms in clusters are more dependent on the evolution of the leader (the largest exporter in the cluster).

Another study is made by Kahl and Hundt (2015) on the German biotechnology industry before and during the global financial crisis. The study focuses on micro and context level effects on economic resilience and the

authors use a multilevel linear regression analysis and an egocentric network analysis.

To what?

In the literature of cluster resilience there are two important variables worth mentioning, connectedness (mentioned already above) and diversity. As far as diversity is concerned, it can be the case of a regional or local system or the diversity of the industry in which the cluster is active in. Sedita et al. (2014) use a statistical multivariate approach to show how diversity is positively related to system resilience and plays a key role both during recessions and in the on-going support of innovation activities. If the local economy is more diverse, inevitably it has a wider range of options during the recession, so the system has a lower vulnerability, is less affected by external shocks and more flexible.

Second, Nooteboom (2004) cited in Conz et al. (2017, p.190) illustrates how factors like learning and innovation, and governance; policies and relational risk work hand in hand to “drive the connectedness of the system and, thus, enhance the resilience of both the cluster as a whole and the firms that operate within it.”

Thirdly, Bhamra et al. (2011) cited in (Conz et al., 2017, p. 191) synthesize “two groups of factors that affect the resilience of firms: human (e.g. flexibility, motivation, perseverance and optimism) and organisational (e.g. capabilities and resource availability). The analysis of these aspects results in the definition of three resilience dimensions: readiness and preparedness, response and adaptation and recovery or adjustment.”

By what means?

In some cases, external shocks may erode the competitive positions of the companies, therefore in the event of changing circumstances firms must learn to adapt. “Moreover, firms are not isolated from their regional environment. That is, economic resilience may be supported (or inhibited) by different context-level features concerning, for instance, location within a cluster as well as the economic structure of regional clusters”. (Kahl and Hundt, 2015, p.372)

In other cases, a great inhibitor for the resilience of the cluster can be the lock-in, as Østergaard and Park (2013) admit.

Moreover, the interaction of the cluster with the small and medium enterprises is another factor. “A better understanding of the interplay between the SME and the cluster may provide useful insights into how managers can

boost the firm-specific resilience of their organisations and, at the same time, mitigate any negative influence of the cluster in which they are embedded". (Conz et al., 2017, p. 187)

Extending the idea of resilience for small and medium enterprises, Reinmoeller and Van Baardwijk (2005) propose a framework which includes four strategies: organisational, innovative, cooperative and entrepreneurial (see Figure 4). Time (t) represents the actions that are currently in use, so they are in the exploitation phase, and time (t+1) indicates the innovative resources and capabilities that will be utilized to create something that will be used in the future, so this is the exploration phase.

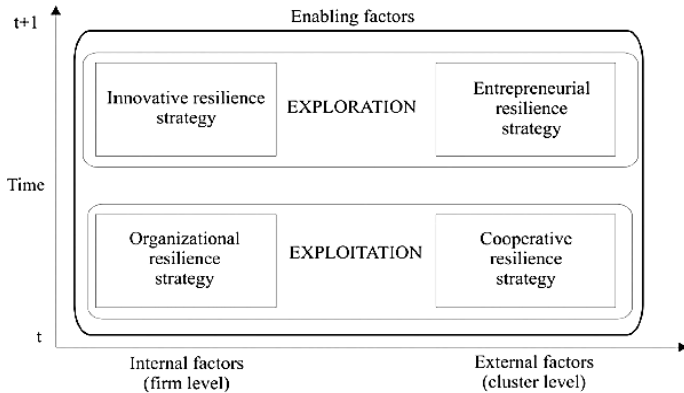
The *organizational resilience strategy* outlines that top-level skills, as acquired through comprehensive training and education programs are key elements for the resilience and competitiveness of the company.

The *innovative resilience strategy* performed in time (t+1) refers to creating new ideas and resources and is fostered in the supply and value chains.

The *cooperative resilience strategy* is actuated at time (t), increasing cooperation both internally and externally by sharing internal knowledge and competencies with external partners within the same industry. During this phase, horizontal and vertical ties are created, incrementing the level of connectedness of the cluster.

The *entrepreneurial resilience strategy* is based on entrepreneurial activities happening at time (t+1). The creation of new businesses and the search for new opportunities are central to this phase. Although this strategy starts within the firm, it easily goes beyond its boundaries, sharing an entrepreneurial mentality among cluster stakeholders and exploring new opportunities.

Figure 4: Framework for resilience strategies



Source: In Conz et al. (2015, p. 193), adaptation from Reinmoeller and Van Baardwijk (2005).

With what outcome?

Not so many studies on resilience make the subject of their analysis the outcome of the respective resilience process because they do not focus on the empirical aspect and are more theoretical or conceptual in nature. However, Behrens et al. (2018) have noticed since 2005 a surge in imports from China for goods in industries that were beforehand protected by an active quota until the end of 2004. The effect is that “plants inside clusters die and exit less than others in the following two years”. (Behrens et al., 2018, p.1)

In Kahl and Hundt (2015), as results of the study suggest, on one side, specialization at the network and context level is an important factor of growth prior to the crisis and, on the other side, diversity at the levels of the region and of the network is associated with economic resilience during the crisis.

3.2. Case Study

Life Science Nord cluster was legally formed in 2004, together with Norgenta North German Life Science Agency GmbH, as a central part of the cluster, having the objectives to combine, network and coordinate the regional life science activities and to develop an internationally competitive cluster (<https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/support-measure/cluster-life-science-nord-management-gmbh>).

Life Science Nord is based on an equal 40% membership contribution

of Schleswig-Holstein Government and of European Union Commission to the cluster agency Life Science Nord Management GmbH and on 20% sponsorship of industry association Life Science Nord eV. The stated purpose of the cluster's strategy is to create added value in the fields of biotechnology, medical technology and pharmaceutical by consolidating the entire value creation chain in Hamburg and Schleswig-Holstein and to become a leading life science international network (EU Cluster Collaboration Platform). It has a membership of over 260 members grouped in the Life Science Nord e.V. agency and the entire cluster network consists of 500 members, such as companies, research institutes and universities, according to their official website(<https://lifesciencenord.de/de/%C3%BCber-uns/unsere-organisation.html>). The cluster has repeatedly won the Gold Excellence Label in 2016 and in 2018, award granted by the European Secretariat for Cluster Analysis.

The cluster management has announced on the official website (<https://lifesciencenord.de/de/covid-19.html>) that they offer all the required support for member companies to find solutions to cope with production bottlenecks, interrupted supply chains, export restrictions or funding gaps by turning to the support of their vast network and of the state governments during the COVID-19 Crisis.

Occasioned by the Coronavirus Pandemic, Life Science Nord has coordinated a survey with 163 companies (including 92 members of Life Science Nord eV) across Schleswig-Holstein and Hamburg between the period 07-21 April 2020 and the results show the following: around 80% of the companies surveyed felt medium to very intense effects of the Corona pandemic; the revenue fell for 80% of the companies surveyed and one-third of them had a revenue loss of more than 50%; the liquidity and security of the supply chains were the main challenges of the companies surveyed; almost half of the companies offered or planned to offer products or services that can be used to combat the Corona pandemic and for around 20% of the companies this already lead to an increase in sales.

Coming back to the resilience framework, the resilience of the assets and of the engine, shown in Figure 2, were severely affected in the case of the surveyed cluster members. Only the time of recovery and the intensity of this recession will decide whether the cluster requires adaptive or transformative capacity building.

3.3. Results and discussion

Moving back to the applicative part of the Cluster Bridge Model, the set of questions proposed to the interviewees and to the surveyed collaborators are designed to identify the Life Science Nord clustering evolution steps and also the implementation of Cluster Bridge Model. One question is also seizing the development of the cluster activities during COVID-19 Pandemic.

1. Did you notice a clustering tendency before the formal setting-up of your cluster? If yes, could you estimate since when?

The Cluster Bridge Model has been applied on a mature cluster, which has been founded in 2004. However, its critical mass has started to take shape since 1996 and has been contouring a representative name in the industry of Life Sciences in the region ever since.

“The first idea of fostering a Life Science cluster in Northern Germany came [in] 1996 with the participation [in] the BioRegio competition. There were also other organizations in the region, [the] predecessors Bay to Bio Förderverein Life Science Nord e.V. and Arbeitsgemeinschaft Medizintechnik e.V. (AGMT)[which] fused to Life Science Nord e.V” (Online survey with Sarah Niemann - Manager of International Affairs at Life Science Nord GmbH).

“In 2000s the companies started to merge, but their expectations to succeed were too high so they failed. Afterwards they bounced back and formed the cluster in 2004. In Hamburg and Kiel, Biotech was more developed and in Hamburg and Lubeck, the Medtech” (Interview with Siegfried Bialojan - Head of the European Life Science Center, Ernst and Young GmbH).

2. Applying the cluster bridge model to your cluster, what do you think are the inter-institutional gaps that currently limit the performance of your cluster members?

3. What efforts is the cluster organization doing in order to limit the gaps in the cluster?

As the surveyed collaborator mentions, the biggest limit of the cluster as an entity is in managing the inter-institutional gaps (“firm-university and firms-investors”). Being so varied in the existing types of members, the gaps are not so easily to identify at the cluster level. Nevertheless, the cluster organization makes efforts to bridge these gaps by “maintain[ing] and

strengthen[ing] relations to relevant players (Such as HTGF, IFB, the region fund Innostarter etc.)”

4. Name maximum three advantages and three disadvantages of collaborating with other cluster members (firms, universities, public bodies, investors, associations etc).

5. Please give two to three most important examples of local or national public support to facilitate cluster emergence and development.

6. Mention up to three international networks that your organization is part of.

Therefore, a good way to bridge the gaps and strengthen the bridges is given by strong collaboration within the cluster (which has these advantages: “Fostering of innovation and being able to develop a product faster due to external but trusted competences, sound decisions due to sharing of experiences, strength in numbers (i.e. voicing concerns for the MDR [Medical Device Regulation] timeline)”, between the cluster and the state (“there is a strong, on-going support and re-assurance from both the states of Hamburg and Schleswig-Holstein of the importance of Life Science Nord's work and contribution to the region. On a political level, we are frequently regularly involved in political delegations, such as last year with Hamburg's first mayor to China and Japan or with representatives of Hamburg and Schleswig-Holstein to Israel, to present the Life Science capabilities of the region”) and between networks, “Scanbalt, Baltic Fracture Competence Centre (BFCC), MAGIA (EU-network with the aim of internationalizing MedTech SMEs)”.

7. What is your main line of business? How is it primarily carried out now, offline or online? But at the start of your business?

“Cluster management, fostering innovation and connecting players in the region. It is predominantly carried out through online seminars, online working groups, and individual conversations with actors, mainly via phone or web conference. Before, our activities were strongly intertwining one-on-one activities via phone or personal exchange, as well as gatherings, networking events, lectures, and trade show participation. [Also], maintaining a communication line between authorities, politics and cluster actors to reflect the overall needs (particularly during the COVID-pandemic) [is the key of the

cluster's policy action]" (Online survey with Sarah Niemann - Manager of International Affairs at Life Science Nord GmbH).

8. How much is the context relevant for the success of a bridge as a competitive tool and how is the mentality influencing the actual implementation of this BRIDGE project?

The great achievement of Evotec SE company, gold member in Life Science Nord e.V., is in creating in 2016 a new paradigm for translating early-stage academic research into pharmaceutical research and development called "BRIDGE" (Biomedical Research, Innovation & Development Generation Efficiency). It follows the role model and the mindset of the Biotechnology Cluster in Boston.

BRIDGEs are an integrated framework consisting of a fund and an award system to open up pioneering academic sciences, create new spin-out companies and build partnerships with pharmaceuticals and biotech. Through these efforts, Evotec has defined a new formula for the rapid discovery of early-stage medicines. This project can be translated in a great way to foster inter-institutional gaps between firm-university and firm-investors, exactly the current overall problem which the cluster faces. Below is an extract from the speech offered by the CEO of Evotec SE, Werner Lanthaler, regarding BRIDGEs' logic of functioning at the Ernst and Young Biotechnology Reading Report, in 2018, in Hamburg.

"Plug and play. You need to bring the members in alignment and time before you start the project to accommodate them. There is a platform made out of academia, a funding source and the Evotec company. The context is defined by the scientist. You get the scientist and take him by the hand, explain him the whole process and assist him along the way as well. The scale of the project can be defined by him and this freedom is actually confusing at first but then empowering".

At the same event, Siegfried Bialojan (Head of the European Life Science Center, Ernst and Young GmbH) comments on German mentality towards the biotechnology industry: "The failure of the companies back in 2000s, combined with the risk-adverse mentality caused them not to reduce the 20 years gap in evolution and finances with the US. It is all about the mentality and about the fact that lots of people which are consuming the products and services and are risk-adverse are making the rule and not the exception in Germany.

The Cluster Bridge Model application for the case of Life Science Nord Cluster has revealed that there are two bridges to be reinforced, firm-university and firm-investors. The cluster has already started to take the right measures to combat these limitations, even if the COVID-Pandemic has doubled their efforts.

4. Conclusions

The present paper has its fundamentals in four conceptual issues, which are also the basis for its methodological framework.

The current Coronavirus Pandemic which makes the case study of this article represents the worst shock the global economy has faced since the Global Financial Crisis in 2008-2009. This is the reason why we have chosen it as an example for the application of the above expressed resilience framework.

First of all, regarding the “of what” element, we have approached the Life Science Nord Cluster in Germany. The power of the well-built network makes cluster firms resilient, but there is still no proof whether they might be more resilient than the non-clustered firms. The “vicious circle” mentioned in this paper and cited in Behrens et al. (2018) makes us wonder whether or not in times of crisis the advantages or the disadvantages of belonging to a cluster network prevail.

Secondly, resilience “to what” refers to the connectedness and diversity implied by the social network aspect in a cluster. Almost 500 members are part of Life Science Nord cluster and some of them might have been hit more severely by this crisis than the others, given to this factor of connectedness.

“By what means” in the case of our cluster is represented by the extraordinary member support due to the vast network advantage and all the measures taken up to this point to cope with the effects of the crisis. Apart from a cluster organization-member support, the German state also helps its clusters and small and medium-sized companies with funding in times of crisis.

Lastly, resilience” with what outcome” can be better evaluated after a certain time, when the pandemic reaches a stabilization point. The path of the cluster so far has had a flexibility approach of adaptive resilience capacity. No transformative resilience measures have been yet taken.

An important part of this article is represented by the topic of Cluster Bridge Model, a good example of cluster dynamism, which explains how

cluster organizations, seen as bridge builders, should compensate for the gaps in cooperation, communication, knowledge dissemination or the gaps caused by weak ties between the members in the cluster. A selection of respondents from Life Science Nord Cluster have provided valuable insight into the cluster's evolution steps and its strategy to bridge the existing inter-institutional gaps between its members.

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