Science Parks as Central Agents for Regional Development Strategies Based on the Promotion of Cluster Capacity for Disruptive Innovation

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Abstract

This articles aims at discussing the role of Science Parks as central agents for regional development strategies based on the promotion of cluster capacity to compete on a disruptive innovation basis. This article specifically inter-relates the clusters and the Science Parks as strategies for regional development, emphasizing the disruptive innovation as a requirement for the competitiveness of a region, a limitation for the clusters and a potential as well as a challenge to Science Parks.

Keywords: science parks, clusters, disruptive innovation, regional development.

1. Introduction

The transition in paradigms that take place in the society along its history sets some challenges to its players. One of them lies in the fact that strategies that used to generate satisfactory results in the former paradigm, are not adequate anymore in dealing with the elements of the new one. That explains why, in the entrepreneurial context, for example, different managerial models have been outstanding in different periods of time. That is, managerial strategies that enable a company to become a leader on its market in a certain period of time can cause their failure further on, in view of new elements in the context that were quite unexpected. The governments, seemingly, also face systematic challenges in finding new paths for promoting social and economic development.

Therefore, we shall notice that policies currently adopted by the governments are quite different from those common in the seventies, for example. According to the Institute for the Development of Industrial Studies (IEDI, 2005), the governmental policies "gradually changed their focus from specific industrial projects and big sectoral technological ones to an emphasis on innovation, on interaction between academic and entrepreneurial research, on more horizontal programs and instruments". That reflects the perception that the central challenge to present society is innovation. It is also an understanding that innovation is an utterly interactive phenomenon (Lundval, 1992). That strong relation of innovation with interactive environments justifies the rise of strategies emphasizing partnerships and networks. The emphasis itself on regional development, apparently paradoxical in a global context is, nonetheless, justifiable in the strongest intensity of geographical proximity, regardless of remote interaction made possible by current technologies.

In mentioned context, the governments have supported different mechanisms contributing to regional development and that are tuned up with the complexity of present society. Among those, we can mention the business incubators, the technology transfer centers, the science parks and the clusters, which have been displaying a systematic growth all over the world.

Each one of those mechanisms has an intrinsic focus of innovation in its very concept, as well as an interaction principle. Anyhow, in the case of the clusters, for example, some experiences point to their capacity for innovation as a fragility (IEDI, 2003; Cooke, 2002). That fragility can be considered even

more intense if we are concerned in distinguishing the nature of the innovation carried out. A natural difficulty in carrying out more intense innovations, characterized by the creation and diffusion of absolutely new products or services, based on new value curve, is to be noticed.
That limitation of the clusters occurs despite the great interactivity characterizing the operation of their mechanisms. That can suggest that the interactions maintained by the clusters might not meet the requirements of innovation of such dimension. The above referred to studies indicate the endogenous nature of said interactions, restrained to the cluster itself, that can not, frequently, comprise institutions with a natural vocation for the innovation development
At this point, present article assesses technological parks as a mechanism which role is precisely to provide instruments to enable the companies a quality leap in their innovation strategies, exceeding cumulative limits to enter the transformation field. The interaction between clusters and science parks is also the matter now.
Thus, present article aims at discussing the role of science parks as strategy central agents, oriented to the promotion of regional innovation capacity. The article proposes, specifically, the inter-relation between clusters and science parks, as strategies for regional development, pointing out innovation capacity as a requirement for the competitiveness of a region. Therefore, according to the regional development concept proposed, science parks act as propellers of the regional capacity for systematically generate disruptive innovation.

2. Innovation - The Importance of the Disruptive Perspective in the Competitiveness and Development of a Region.

The concept of innovation has been broadly discussed and involves different approaches and concepts. A relevant approach to the present article is Christensen's (2002), who distinguishes disruptive from sustaining innovation. Sustaining innovation brings a better product to the market which is oriented to the company's current customers. Thus, sustaining innovation improves the characteristics of the product and/or service that is already valued by present customers.
Disruptive innovation, proposes product, service and process performance parameters that are absolutely new regarding the existing ones. That type of innovation generally displays, in the fist stage of its development cycle, an inferior performance, considering the main products already established on the principal markets, regarding characteristics valued by their present customers. On the other hand, it has other characteristics valued by a number of new customers.
So, the disruptive innovation diffusion process tends only to succeed following an identification and exploration of new niches. As sustaining innovations emphasize the improvement tax of process and product performance, the companies tend naturally to develop those innovations rather than focus on the disruptive ones.
The disruptive innovation strategy can be located at the opposite end of the benchmarking one, which is explicitly focused on technology improvement, within an established value curve. For the market, benchmarking stands for more supply and a further quality increase and price reduction. Nevertheless, for the companies that offer the technology, the competition based on that premise is extremely fragile, for the systematic launching of similar products by the competition corrodes potential innovation profits, negatively affecting expected outcome of the investments made. That is specially true when we consider that the life cycle of technologies is systematic and remarkably reduced. In that context, the advantages we can expect from the innovation investments are limited.
On the other hand, the disruptive strategy grants the company, for some time, the advantages of monopoly. That is possible not only in view of a policy of intellectual property protection, but also of the status of the competitor in the learning curve relative to the development, production and trading of the new technology. Even though he can copy a given product, all the knowledge built up by the pioneer will keep the latter ahead in terms of distribution and position on the market.
That explains the importance of disruptive perspective in the devising of innovation strategies, from the point-of-view of potential influence on the competitive capacity of a company. And the devising of the strategy is directly influenced by the logic permeating the decision-making process of the company.

Kim (2004) classifies logical strategy adopted by the companies in two types: the conventional logic and the value innovation logic. The companies which activities are based on a conventional logic are strategically focused on overtaking the competitors and they act to be better than them.
The perspective of those companies, considering the above, is more deterministic, once they see the conditions of their industries as a limit for the strategic thought. That fact holds them on to the sustaining innovation possibilities. In their quest to establish advantages regarding the competitors, the companies keep competing for incremental quotas. Or better, meaningful quality leaps are rare in that scenario.
In a very distinctive way, for companies oriented by value innovation logic, the competitors are not their central attention focus. Their strategy is not to be the best. From the premise of transcending the conditions of the industry, those companies win the market by being different from the rival ones.
Whereas the companies of the former groups see the competitors as the center of their attention and devise strategies based on standards they themselves have devised, for the ones that believe in the value innovation logic, the customers can even be classified as being irrelevant. They are, therefore, closer to the possibilities opened up by disruptive innovations.
Although the logic of value innovation does not have as a priority to establish advantages over the competitors, paradoxically, that is the result the companies engaged in that policy end up obtaining. Furthermore, the creation of a new value curve makes imitation difficult and costly, being a barrier for new competitors. That difficulty can be explained through the concept of value network, presented by Christensen (2000). A value network is the context in which a company identifies and responds to their customer needs, solves their problems, seeks their inputs, reacts to their competitors and, in short, it is the context in which it acts aiming at becoming lucrative or maintaining its profits. The value networks interfere in a number of aspects, from the architecture of products and cost structure, for example, up to the competitive strategy of the company, its market choices and the perception of the economic value of a new technology. That happens in view the tendency to repeat well-succeeded patterns of the past.
As has already been seen, that attitude is intrinsic to the quest of certainty and stability that the known allows for. It is worth noting, furthermore, that as the company builds up experience within a certain network, it also develops abilities, organizational structures and cultures to fit that specific network. And, therefore, it is in said network that the competence of the company is concentrated, as well as the reference of the people, their knowledge and their experience that justify the hierarchic position of same.
As that knowledge and experience may become irrelevant in the future, any change means a menace (Hamel and Prahalad, 1997). Hence, if the value network constructed in the past brought a company to a leading position, it tends to keep it expecting a future performance.
That function of the value networks is an important advantage for the disruptive innovator, since the attractiveness of the new technological opportunity takes some time to be perceived by the company that is submerged in its network. Once it is noticed, the competence to carry out the innovation generates another difficulty, for the resources and capacities of that company are structured on premises of the former network. Thus, the disadvantage of companies based on conventional logic, that link them to a sustaining innovation strategy, is not derived from a lesser organizational or technological ability; it is about different positions in the value networks.
Therefore, the value networks may “suffocate” the innovative ability of companies. In that sense, interactivity is the key-element, specially if the established relation network considers their compounds complementary, in terms of innovative competences and vocations.

3. Innovation: an interactive phenomenon

The cycle of innovation starts with scientific research. Nevertheless, an innovation is only consolidated when the results of the scientific research are applied to the productive sector and diffused to the point of generating social and economic gains. For that purpose, technology transfer, trading and distribution processes are necessary.

On the other hand, though the companies are able to develop new technologies internally, scientific knowledge is normally fundamental. Principally when the companies wish to carry out more vigorous innovations, research developed in different sciences can have a crucial contribution. Furthermore, other interactions with companies active in other sectors or even competing ones have opened paths along which innovation can be accomplished, through licensing contracts, joint ventures, among other mechanisms (Landau, 1991). The sharing of knowledge among different companies and institutions is very enriching for the innovation process, since each element has a distinct history, as well different abilities and experiences.

In ONUDI (2002) three principal strategies are pointed out through which the companies establish their cooperation relations. The first of them is with same value chain companies. Through that strategy, the companies can acquire technology developed by their providers in a quick but costly way. The second strategy – alliances and consortiums – foresees less costs and less risks. It is a plausible alternative to soften the volume of resources and the intensity of uncertainty which characterize principally the basic and pre-commercial phases of the innovative process. Partnerships of that nature have had a great impulse in the last decades.

ONUDI (2002) informs that only between 1980 and 1998, 5.100 strategic alliances were formed and that that movement was conducted by the USA, which were responsible for 80% of the known agreements. In those agreements, the participation of European companies was in 80% of the cases; the Japanese companies are less frequent, with only 15% of the alliances.

Still in the scope of the second strategy, a recognized alternative to meet the same needs is geographic agglomeration. Having already been the target of several discussions among economists, the advantages of geographic agglomeration have had a new impulse with the identification of its advantages in sharing knowledge intrinsic to the development process of new technologies, besides optimal use of resources, large scale economies, among others traditionally recognized as such.

Those two strategies suggest the feasibility of cooperation experiences restrained to only one value chain. Through alliances as the ones already presented, advancements obtained in different sectors or areas of knowledge can go unnoticed, thus impairing the learning process and the innovative potential as well.

The third strategy pointed out in ONUDI (2202), exceeds, notwithstanding, that limitation. The companies are the ones that are currently investing in tighter bonds with the basic sciences, so as to benefit from the specialized knowledge in the universities and research centers. Inasmuch as those companies have a multidisciplinary character, that strategy means an opportunity the companies have to access knowledge from different sciences, which does not occur in the two strategies previously presented.

So, innovation is an interactive process in which the company, besides acquiring knowledge derived from its own experience in the stages of design, development, production and commercialization, is also in a permanent learning process, in view of its relations with external sources, such as suppliers, customers, competitors, consultants, universities and research centers Freeman (1995). That results in a complex and interactive process that exceeds the understanding of innovation from a mechanistic premise, based on sequential and linear models, from research to production and on to the market (Todling and Kaufnann, 2002).

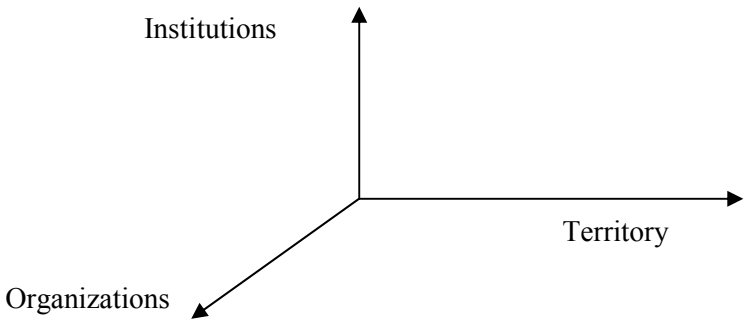
The interactivity of the non-linear model refers no only to the internal collaboration among different departments of a company, but also to the interaction of the company with different players of its environment. From that fact emerges the notion of innovation systems, that are directly associated to two key-concepts of this work: clusters and science parks.

4. Clusters and Science Parks in the Innovation System context

The concept of innovation systems is associated to a body of institutions, organizations and companies that interact in a given environment, so as to promote innovative capacity of companies. According to Freeman (1995), more than being associated, the innovation systems derive from the interaction and relationship networks that characterize the very nature of innovative art. Lundvall (1992) emphasizes that the interactive process, in which companies, institutions and organizations get involved to

produce, use and diffuse knowledge in the form of new products, services and processes, underlies the concept. Therefore, it is a concept that goes far beyond the innovation paradigm as a linear and endogenous phenomenon regarding companies.
So far, two components have been outstanding as part of innovation systems: organizations (in which companies are included) and institutions. Silva (2003) proposes the inclusion of territory as a third component. In a graphic way the model proposed by said author can be represented as follows:

Chart 1: Components of Innovation Systems



Source: Adapted from SILVA, Fábio Q. B. Local Innovation Systems: Some reflections for building a conceptual base. I Symposium on Strategic Business Management. Rio de Janeiro, 2003.

Chart 1 enables the understanding of innovation system classification on two different levels: national and regional ones, from which derive the National and Regional Innovation Systems. Following the concepts outlined in Chart 1, the National Innovation Systems could be understood as resulting from interactions between the axis of the organizations and the institutions, once the territory component would be more fragile in view of the low geographic concentration intrinsic to that concept.
The Regional Systems, on the other hand, would be an offspring of the interactions of three axes, considering that, apart from local and regional organizations and institutions, high geographic concentration allows the inclusion of the territory component
That could suggest the regional system is, potentially, superior to the national one. However, what can be perceived is that the two concepts are complementary. The roles, limitations and potentialities of both, in terms of contribution to the economic development, after the increment of the company innovative capacity, are complementary.
So, innovation occurs on different geographic levels and is influenced by regulatory structures and by regional, national, as well as international authority policies. In view of that, one of the key-aspects for the policy organization of innovation is a good dialogue among different levels. Or, so to say, in the external networks in which the companies interact aiming at the development of their innovative capacity, government and fomentation agencies occupy a space to create and develop policies contributing to the consolidation of an innovation friendly environment.
In the concept of innovation systems, those players are placed in the institutional component and it is desirable that the territorial component acts to promote complementary activity among programs derived from said policies. Thus, on a regional level, those players would be focused on the development of actions capable of meeting peculiarities not attended to by national programs and in synergy with a policy common to all the components of the system. This means that the concept of innovative systems pre-supposes responsibilities centered on national status, along with interlocution to companies related to regional and local instances.
An important difference between regional and national systems is concentrated upon the learning process made possible in each of them. In view of the territory component, the regional systems outdo the national ones in the sense that they can afford sharing of tacit knowledge (Nonaka and Takeuchi, 1997) that requires direct interaction, confidence, complicity and other elements in which the

geographic distance can be fatal. Lundvall (1992) and Porter (1990) are big defenders of that potentiality intrinsic to territoriality. Nevertheless, that advantage can easily become a weak spot if the components of the regional systems keep their relation network limited to territory. Researches exemplify that assumption pointing out that the companies confined to their region tend to have a lower level of innovation compared to those that maintain external networks (Todling and Kauffmann, 2002).

No matter how important sharing tacit knowledge can be to the innovation process, the knowledge available within a certain geographic region tends to be inferior to the possibilities existing outside it. And besides, as Toddling and Kauffmann (2002) remark, regions present differences in terms of pre-conditions for innovation; elements as quality of education or research infra-structure, for example, can make some regions superior to others concerning peculiar elements.

Extra-regional interactivity can turn those differences into one more learning element. Another example to illustrate that perspective can be obtained in Asheim and Isaksen (2002). Those authors are explicit while relating the small and medium enterprise capacity for disruptive innovation to the existence of complementary relations to those that can afford informal and tacit knowledge. For them, in the long run, an enterprise cannot support itself only with local learning, but has instead to have access to more universal knowledge, via, for example, interaction with the national or even international innovation systems.

Cooke (2002) explains that the different levels of innovation systems are complementary. For him, nonetheless, it is important to emphasize the different vocations of the national and regional systems. More specifically, the issue of funding for research and venture capital are stressed as weak spots of the regional systems, unveiling the importance of the role of national systems.

That complementary factor of vocations and roles can, thus, be added to the different types of learning that different levels of the network can afford. As Cooke (2002) himself puts it: while acknowledging said complementary aspects we can assume that horizontal and vertical networks are essential to the development of the innovation capacity of a company alone, a cluster, an institution or an entire region. That implies more than territory extrapolation. It means to go beyond sector barriers towards the variety of knowledge necessary to materialize innovation, as a multi-disciplinary phenomenon (Norway Ministry of Trade and Industry, 2004).

4.1. The Space of Clusters in Innovation Systems

A comparison between the concept of clusters presented by Porter (1998; 2001) and the components of innovation systems pointed out by Silva (2003) suggests that clusters can be understood, "per se", as regional innovation systems. Geographic concentration of companies and institutions guarantees the territorial, organizational and institutional components to the concept, as is expected of a regional innovation system.

So, to the examples of cluster components given by Porter (1998) – specialized input suppliers, such as services, compounds and equipment and specialized infra-structure providers – we can add existing institutions, such as universities, research centers, science parks, fomentation agencies, government departments and enterprise associations.

Generally speaking, the success of a cluster is assessed for the competitive capacity of the companies that compose it. The contribution of the cluster to increment competitiveness of companies occurs in view of a series of advantages (Tödling and Kauffmann, 2002), such as: support to the development of specialized local suppliers; generation of scale economies; enlargement of work market availability and flexibility; availability of information; elimination of common technology bottlenecks, among others. Additionally, as has already been seen in view of the interaction and networking processes, intrinsic to the cluster, made easier by physical proximity, it enables its constituents more possibilities for collective learning and for the conversion of tacit knowledge into concrete actions and benefits.

Nevertheless, parallel to the advantages successful clusters afford their members, some unfavorable aspects have been observed in a number of experiences and they deserve mentioning. Among those aspects we can point out:

a. tendency for partners in their own region;
b. whenever there is an external cooperation, same is centered on customers and suppliers in the own productive chain;
c. low cooperation frequency with external partners focused on innovation;
d. low cooperation with academy and other productive chains;
e. more intense focus on the solution of problems rather than on opportunity exploration;
f. inflexibility generated by excess of specialization;
g. low expenditure on innovation and product development;
h. difficulties in accessing information on products and market tendencies;
i. lack of specialized technical and professional services.

Some of the aspects above can limit cluster potential to engage in more vigorous innovation processes, mainly those of disruptive nature. The interaction brought about by clusters contributes intensely for the process of constant improvement, related to the concepts of incremental and sustaining innovation. Associated to those results is the sharing of tacit knowledge, made feasible through confidence, cooperation and interaction relationships frequently established inside the cluster. Nonetheless, though those innovations are relevant to the maintenance of entrepreneurial competitiveness on the global market, more remarkable advantages require more and more quality leaps associated to disruptive innovations.

Anyhow, the lack of relations located outside the cluster limits its access to cultures, experiences and, consequently, to more heterogeneous knowledge. Furthermore, the lack of institutional components in the network of the cluster, specially of institutions focused on innovation, can represent limitations to the companies, with regards to their capacity for more intense and vigorous innovations, as is the case of disruptive ones.

In order to bring about those disruptive innovations, the role of basic research is crucial. Although that kind of research is not an entrepreneurial vocation, the interaction with universities, research centers, incubators, science parks and technology transfer centers, can guarantee access to that knowledge, on the part of companies pertaining to the cluster.

Hence, as the companies pertaining to the cluster restrain their relationship networks to the other players in their own agglomeration, the cluster can set forth actions to limit innovative potential of same companies. Or, better, the value network of the cluster starts acting as a filter to the potential of disruptive innovation. Science parks, as they accommodate players of different nature and sectors, besides interacting with different clusters, can provide the means to go beyond that threat.

4.2. The space of Science Parks

Going back in the history of science parks, Annerstedt and Haselmayer (2004) have classified them in three different generations:

- First Generation: having started in the sixties, this generation was inspired in the models of Stanford University and other American universities. That first generation is an extension of the university and comprises company incubators for start-ups, services for companies and interaction with research-based technologies. The philosophy of said innovation is science push. Those parks are deliberately away from the urban context and located in a zone specially designed for that purpose.
- Second Generation: the parks remain as an extension of the universities (or research institutes). Nevertheless, the decisive energy derives from businesses interested in the creation and growth of innovation-based companies. The managers of the park offer a mix of services and high quality structures. Those parks are market pull and therefore not very much concerned with the initial exploration of scientific outcome, but with the final stages of the innovation process.
- Third Generation: that kind of park offers a more complex set of services related to innovation. A key-difference of that generation of parks is their urban nature, integrating them to a broad range of social, economic and cultural activities. The philosophy of a third

generation park is "cluster-oriented interactive innovation". It is simultaneously science push and market pull.

Another aspect to point out, regarding third generation parks, is that they are not based on the linear innovation generating model anymore but, instead, they use more effectively the communication networks in the government, industry and science relationships. So, that generation accommodates the profile of the park, having a potential to act directly for the sake of the innovative capacity of the clusters.

From the practical point-of-view, the relationship of the parks with clusters can occur in two ways. Fist of all, the companies established in the park can act as "problem-solving" and technology bottleneck companies identified in the cluster. That is a strategy centered upon innovation under the sustaining perspective, since, while seeking solutions for problems, innovation projects aim at the short range and low risks. Under said circumstances, a disruptive innovation is seldom developed.

The second way consists of the creation of structures focused on the identification of new market opportunities which are not exploited by the companies of the cluster. Furthermore, that structure should stimulate the development of scientific research (focused on the creation of basic knowledge) and companies creation (focuses on the transformation of basic knowledge into technology) that would provide instruments for the cluster to exploit new opportunities and possibilities.

The science parks are mechanisms with potential to promote integration of the different players necessary to that purpose. The laboratories and university research units, the incubators and the technology transfer centers, are some of the elements contemplated in the parks, with a very specific role in the generation of basic knowledge, in the support of generating innovating companies and in the promotion of university-company interaction. Additionally, the presence of entrepreneurial associations and other private institutions of entrepreneurial fomentation, of already established technology-based companies, external company R & D centers, fomentation agents and high added value service companies, as well as entrepreneurial, law and technological consulting, contribute to the configuration of the parks as proper instruments for the promotion of heterogeneity and inter-disciplinary aspects of the relationship network of the cluster.

Hence, science parks are expected to contribute for the capacity of the companies of the cluster to go far beyond the sustaining innovation limits towards the innovative disruptive character. That can be an important challenge to the science parks in the future, since the companies have managed to absorb activities related to the sustaining innovation processes, occasionally even as routine activities. That is not the case of more vigorous innovations. Those remain as a challenge.

5. Final Considerations

The vocation of the companies for disruptive innovation is limited by a series of factors. Schumpeter (1982) explains us that one of them is the operation of the market itself. That idea is based on the fact that technology can advance quicker than market demands. As allotment of resources is according to demand, once risk and return time are key-factors in the decision-making processes, disruptive technologies become of little attraction, since they, in the beginning, often reach insignificant pieces of the market or face the challenge of creating new markets.

Another factor is the linear and endogenous reasoning that holds company innovation strategies on to specific sectors of their internal structure. A low rate of internal interactivity and, most of all, external one, limits the variety of knowledge that could bring about more vigorous innovation.

In the case of the clusters, the lack of external relations and their location limits their access to cultures, experiences and more heterogeneous knowledge. Furthermore, considering that a cluster can be formed by an organizational component (the companies themselves), a territorial component (the region in which it is located) and an institutional component (the body of institutions that encompass the network in which it interacts, regarding competitiveness), the lack of a third component, specially of institutions focused on innovation, can represent limitations to companies as far as their capacity for disruptive innovation is concerned. The conjunction of those three components (Silva, 2003) is the basis for a regional innovation system, which is a concept associated to a body of institutions and

companies that interact in a given environment, having the promotion of innovative capacity as a target (Freeman, 1995; Lundval, 1992).
Moving on from the cluster to science parks, we notice that said concept is also intrinsic to the three components. But, unlike the clusters, the institutional component of a science park comprises a player network with complementary competences and vocations for innovation promotion. The interactions that take place in said network can supply most of the already pointed out cluster flaws. Nonetheless, more than to overcome such deficiencies to move on to innovation in general, to make those interactions feasible to serve disruptive character innovations can be a key-challenge for science parks in the years to come.
Sustaining innovations require less interaction and they can, as a rule, be developed within the structures of the companies, themselves, since they involve knowledge and competences already mastered. Apart from that, as they are related to already establish markets, they can be financed following the traditional operations of the companies.
Same is not true for disruptive character innovations. To make those feasible requires a much more complex interaction process and further specific financing mechanisms, since they involve higher risks and return periods. Therefore, they cannot happen at a satisfactory pace if they are only left in charge of the companies themselves. Articulating interactive processes to enable the development of a region can be a great contribution to regional development.

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