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Bridging the Gap between the Regional Systems of Innovation Approach and Knowledge Creation Theory

—A Survey of Viewpoints and a Framework towards Understanding and Enhancing Regional Knowledge Creation—

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Abstract

In the last decades, two issues have gained a lot of attention in papers dealing with the knowledge based economy and society: on the one hand, the studies on how the local environment promotes innovation; on the other hand, the *SECI* model knowledge creation theory, mostly based in the firm level. Both approaches present interesting and original points but lack a bridge that could unify the concepts towards a better understanding of the knowledge creation process at the regional level. In this paper, notions of the regional innovation systems are re-conceptualized from a knowledge creation perspective and knowledge creation theory concepts are adapted to the regional level. Later, a framework is developed for grasping and enhancing regional knowledge creation. In order to promote innovative industries, regions should have policies to promote knowledge creation and diffusion and should have a good understanding on how the process of knowledge creation occurs. By directing policies towards knowledge creation, regions would be able to create a knowledge base and knowledge creating system particular to that place and achieve self-sustained development based on knowledge creation.

Keywords: Knowledge creation, Regional innovation, *SECI* model

1 Introduction

Knowledge has been an important subject of study since Solow (1956) and Swan growth model. In it, technology, recognized as the engine of growth, is a continuous, expanding set of knowledge that is given, not specifically created by economic agents. Since the works of Romer (1986) and Lucas (1988), the question on where technological progress came from attracted the attention of researchers. Technological progress is achieved in the dynamic process of economic

activity, where through the use of knowledge we use our resources in different ways. As the world entered the knowledge economy, understanding the processes of knowledge creation becomes an important issue.

The knowledge creation process has spatial constraints. In a world where information flows easily within and across borders, this characteristic allows regions to keep their production particularities and develop a particular local environment where productive and economic life is carried out. When we consider these geographical limitations, regions become the natural areas of study (Doloreux and Parto, 2005). Fostering a regional

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socioeconomic system that promotes knowledge creation becomes, then, a central objective in regional policy in order to develop economically and productively. Many studies have approached the issue from an innovation perspective, but as they were not based on a knowledge creation framework, the mechanisms of knowledge creation at the regional level couldn't be completely unfolded.

We believe it is imperative to increase our understanding in how the knowledge creation process occurs. That is why we consider in this paper Nonaka and Takeuchi's knowledge creation spiral model, the *SECI* model, in which knowledge is seen as the combination and conversion of explicit and tacit knowledge in the context of the *Ba*. They applied their model to the firm level, but we believe that applying it to the regional level will be a step forward towards understanding processes of knowledge creation and designing policies to foster this process.

The objectives of this article are: to make a survey of the studies on regional systems of innovation approach and knowledge creation process theory; to adapt their concepts to the other view's notions and findings; and to develop a framework to grasp and enhance knowledge creation at the regional level. To achieve this, in section 2 and 3 we will present the survey on both views, in section 4 we will present the adaptation of regional systems of innovation concepts from a knowledge creation theory perspective and the adaptation of knowledge creation theory concepts to the regional level; finally, in section 5 we will introduce our framework.

2 Innovation at the regional level

(1) Agglomeration and diversity

Knowledge has been generally considered as a "residual" in economics, which is growth not attributable to capital or labor; it is attributable to another factor of production: improvements in technology. The implication that knowledge

"just happened" led to an emphasis on capital accumulation and labor improvement as sources of growth. Since the new growth theory in the 1980s technology—and knowledge—stopped being considered a passive factor or residual: it became seen as an active factor of production. Central to this change are the special characteristics of knowledge. Ordinary goods and services have the properties of rivalry and excludability, while those that are neither rival nor excludable—like a lighthouse or national defense—are called public goods. Knowledge, while partially excludable (through patents and copyright law) is a non-rival good, therefore sharing some characteristics of the public goods. Ideas, in opposition to objects, are not scarce, and can be reproduced at almost a zero cost. By accumulating knowledge, we enable the economy to develop further (Cortright, 2001).

Because of its characteristics as non rival and partially excludable (Romer 1986, 1990), knowledge has spillovers: creators of new ideas cannot fully retain their inventions and other agents also benefit from those ideas. According to Romer, knowledge accumulation and spillovers are the bases for endogenous growth in an economy. Spillovers play an important role in fostering innovative activity and increasing productivity. To control knowledge is difficult and costly (Foray, 2004). This spillover process is the driving force for economic growth (Lim, 2007). Substantial evidence has been provided in the recent empirical economics literature that a significant fraction of knowledge spillovers tends to be localized (Acs and Varga, 2002): the social-institutional environment defines the capacity of the region to absorb and create technological progress. Technology is embodied in capital goods, so any person or region can acquire it, but is also embedded in a social economic system, which is particular to each place: knowledge-rich, creative regions will produce more disembodied technological progress, generating regional growth disparities. (Armstrong and Taylor, 2000). For spillovers,

proximity matters. In this context, an important debate emerged on what kind of industrial pattern promotes innovation and knowledge spillovers better.

On the one hand, following the path initiated by Alfred Marshall in 1890, a group of researchers proposes that co-location of firms of the same industry incentives knowledge flow and reduces costs. Recent papers have argued that the clustering of economic activity in geographic space gives advantages to the firms, both in productivity (Henderson 1986) and in the pace at which innovation occurs (Baptista and Swann, 1998). The existence of these agglomerations has stimulated a large literature that seeks to explain the existence of clusters by unveiling the advantages by which firms benefit from being close to similar and related firms, rather than being in isolation. Researching on this issue, a bulk of studies has seen the light in the last decades (Maskell and Malmberg 1999, among many others¹). They argue –in general– that the flow of knowledge between firms and people in the same industry is larger than it would be in a diverse environment and that “a local culture with specific norms, values and institutions (formal and informal) makes it possible to transfer forms of knowledge from one actor to the other” (Malmberg and Maskell, 2002, p. 433). Despite their approaches differ in several important aspects, they all see innovation and learning as key issues for firm competitiveness and consider that cultural and institutional factors of the local milieu affect the firms’ activities and capacity to innovate.

On the other hand, a group of researchers follows Jane Jacobs’ (1969) concepts, which proposed that a diverse industrial and social environment promotes knowledge spillovers. Jacobs affirms that the most important sources for spillovers are external to the firm’s industry.

This group claims that urbanization is the main force behind innovation, as the mixture of views, knowledge, experiences, capacities and interests, fosters creative thinking and therefore allows knowledge to flow. They say that geographically close industries foster innovation through the exchange of complementary knowledge.

The debate is likely to continue, as the empirical results have been varied. Feldman and Audretsch (1999) find that “specialization of economic activity does not promote innovative output” (p. 427). In the same line, Rondé and Hussler (2005) find that “competences held by industrial neighbors within a region have more impact than those developed by geographical neighbors involved in the same industrial sector” (p. 1164). Baldwin et al (2008) find that productivity performance of plants is positively influenced by access to buyer-supplier networks. Florida (2002, 2005) shows that the most diverse cities have the highest innovation records. The results may also vary according to the conditions of the local economic system or the industry that clusters in the region: Henderson (1997) finds that concentration is important for productivity in traditional industries, but in high tech industries, industrial diversity is more important. We find that these processes are not exclusive: both can co-exist within a region and should co-exist in order to create knowledge (see section 5).

Underlying this debate is the competition among regions to nurture or attract companies that can develop high added value products and services through the creation and use of knowledge. In a context of increasing globalization and flow of information, production and innovation processes have still a very strong geographical component, and some regions clearly outperform others. Investigating the reasons for this phenomenon are economists, geographers and policy makers, who want to assure a region’s self-sustained economic growth through the formation and maintenance of its competitiveness. As Cooke and Memedovic (2003; 8) say:

1 See Maskell and Kebir (2004) for a recount on the number of studies on agglomeration, which in the period 2000–2004 quadrupled the number of studies from 1953 to 1989.

“There is a growing awareness among regional authorities that the economic growth and competitiveness of their regions depend largely on the capacity of indigenous firms to innovate. Offering the appropriate support to indigenous firms to become more competitive through innovation is a rising star on the regional policy agenda”

Today’s regional economic advantage goes beyond cost advantage and efficient use of the resources (although of course they remain important factors): it is created through innovations based on the expansion and use of knowledge. As Jacobs said, “Innovative industries expand and develop. Economies that do not add new kinds of goods and services, but continue to repeat old work, do not expand much nor do they, by definition, develop” (1969, p. 49). Knowledge creation, then, becomes a central issue for today’s regions self sustaining growth (Florida 1998) and a key topic of study for regional economic analysis.

The studies on knowledge spillovers, agglomeration and urbanization have contributed a lot to our comprehension on the relation between certain aspects of the institutional environment and the innovation capacity. They have demonstrated the links between knowledge producing inputs, outputs, and knowledge spillovers, noting that a firm’s innovative activity is affected by spillovers that come from other firms. They have also helped to give regions more power to create and exploit their own institutional and cultural characteristics, while building a sense of belonging through the formation of a clear industrial identity. They have proved the importance of distance for knowledge spillovers, as personal exchanges and meetings are a basic way through which knowledge flows. Nevertheless, they have failed to unfold the process by which knowledge is created. As the concept of knowledge is elusive and difficult to grasp and measure, just certain narrow aspects of it were considered in order to explain how the region “produced” knowledge, but the mechanisms behind it remain obscure.

(2) Regional systems of innovation approach

The ability to innovate is one of the most powerful sources of competitive advantage for modern regional economies. As Simmie (2003, p. 608) says “competitive advantage for advanced regional economies is changing from competition based on the costs of traditional factors of production to competition based on knowledge driven innovation”. In the search for explaining how the local system incentives or hinders innovation, a myriad of theories and concepts have emerged, as innovative milieu, regional innovation systems and learning regions. All of them have some related factors and approach to the innovation process with concepts such as collaboration, cooperation, learning and partnership, among others.

Research studies of Lundvall (1992), Nelson (1993) and Edquist (1997) have pointed to the importance of the National Innovation Systems (NIS) in promoting and allowing innovation. NIS is defined by Lundvall as “the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge... and are either located within or rooted inside the borders of a nation state.” (p. 2) NIS is systemic: there are a number of discrete elements that can be analyzed separately and the relation between them is important. Elements can be universities, R&D institutes, firms, etc. and linkages can be flows of knowledge and information, clubs, partnerships, etc.

The focus of study was quickly changed to the regional level, as innovation and knowledge creation were increasingly seen as a local phenomena, both because of the local character of tacit knowledge and the big number of institutions that are local rather than national (Cooke et al, 1997). Proximity increases the chances of exchange and builds long lasting relations based in trust. Innovation is shaped by a variety of institutional routines and social conventions that reduce uncertainty. In the same line, innovation is seen as an interactive process, far away from the linear model of innovation (market pull, technology

push).

These concepts have helped stimulate the debate on the *learning economy* and, more to our interest, in the concept of *learning regions*, where knowledge flow is facilitated through “continuous improvement, new ideas, knowledge creation and organizational learning. Regions must adopt the principles of knowledge creation and continuous learning; they must in effect become learning regions. Learning regions provide a series of related infrastructures which can facilitate the flow of knowledge, ideas and learning.” (Florida 1995, p. 532) If we took the NIS definition of Cooke and Morgan (1998; p. 25) as “a nationally structured system of interactive learning” and pass it to the regional level, the concepts of learning and adaptation became essential for regional innovation theory. “Innovation and learning are closely linked” say Cooke et al. (1997, p. 484). Learning is linked to a certain institutional structure and it requires means, incentives and the ability for individuals or systems to acquire knowledge. In the late 1990’s, an increasing quantity of studies in the issue of Regional Innovation Systems and Learning regions appeared (Asheim, 1996, Morgan 1997, among others). Although their views are diverse, they share some points:

1. The focus on regions as foci for global economic competitiveness on the part of firms
2. An emphasis upon the importance of the institutional setting of norms, routines, etc.
3. A recognition of informal networks as well as formal organizations as mechanisms for sustaining high trust relationship that minimize transaction costs.
4. A re-evaluation of the importance of geographical proximity or agglomeration characteristics for facilitating innovative tacit-knowledge exchange and other externalities.
5. Recognition of the importance of an institutional and organizational *learning* propensity, that is to create regional advantage through knowledge creation and continuous

improvement of institutions and the production system.

In a similar line, the concept of milieu, associated with the GREMI², assumes a good regional institutional endowment in terms of universities, research laboratories, public support institutions, firms, etc. and focuses on major forces that make these institutions interact and be co-ordinated in ways that lead to positive regional outcomes, notably innovative firms.

The innovative milieu is defined as:

“the set, or the complex network of mainly informal social relationships on a limited geographical area, often determining a specific external “image” and a specific internal representation and sense of belonging, which enhance the local innovative capability through synergetic and collective learning processes” (Camagni 1991, 3).

Three main sets of elements mark innovative milieux:

1. Effective actor relationships within a regional framework (location, for easy face to face contact). Creativity emerges from a new combination of ideas from different fields of activity that were not associated previously.
2. Social contacts that enhance learning processes. Informal contacts favor mutual trust, uncertainty is reduced and learning and innovation accelerate.
3. Image and sense of belonging. “A motivation for activating milieu relationships and joining forces often emerges from shared objectives of regional development” (Fromhold-Eisebeth 2004, p. 4)

Although the approaches have concentrated in the innovation processes, we have to say that there are still some shortcomings in their theorization. There is a concentration in innova-

2 GREMI: Groupe de Recherche Europeen sur les Milieux Innovateurs, an association of European and American researchers established in 1986 that studies the processes and the innovation policies at the local and regional level.

tion instead of knowledge formation, as if both processes were the same. Innovation (although the term is sometimes vague and difficult to measure completely) has a strong impact on regional firms' performance. But we understand innovation as a result of new ways of cognition, of comprehending and understanding the world we live in. We believe that innovation is the purposed translation of knowledge into the economic process. In a same line, Luecke and Katz, say that "Innovation is the embodiment, combination, or synthesis of knowledge in original, relevant, valued new products, processes, or services" (2003, p. 2)

Both views explained in this section make valuable contributions to the understanding of the knowledge creation process, which cannot be thought without considering knowledge spillovers and the influence of cultural and institutional factors. In order to understand the process of innovation, we should first comprehend the processes that lead to the flow and creation of new and meaningful knowledge and analyze the knowledge creation process by itself, departing from a knowledge creation theory. By understanding this process we may be able to comprehend how the local milieu influences the flow and creation of new knowledge, which would be, in turn, an important constructed competitive advantage for its firms and its economic system as a whole.

3 Knowledge creation theory

(1) Knowledge, definition and characteristics

Knowledge is increasingly seen not only as a defining factor for production and competitive advantage but also as a concept that affects social life, culture and the views and actions of individuals. We take Nonaka, Konno and Toyama (in Nonaka and Nishiguchi, 2001) knowledge definition, as "a dynamic human process of justifying personal belief toward the "truth" (p. 14). Knowledge is context specific and relational, and is dynamic: it is dynamically created in social

interactions. It is a cognitive process that differentiates from information, as "information is a flow of messages, while knowledge is created by that very flow of information and is anchored in the beliefs and commitment of its holder" (p. 13).

On other definition, the OECD says that "information is structured and formatted data, whereas knowledge empowers its possessors with the capacity for intellectual and physical action." (Johnston, 2004; p. 4) Knowledge is the capacity, generated in the understanding of the environment we live in, to change things and actions according to our beliefs. It is a concept that, although it is of relevant importance for economic life, it is not directly tied to economics. It is far broader than the innovation definition of the previous section, which relates to the translation of (new) knowledge into the economic process. Despite this shortcoming for the study of knowledge in the economy, we do not aim at discussing from an epistemological point of view, so we will tie from now on the "knowledge" concept to the understanding of economically purposed social life.

Knowledge is both an individual and a social phenomenon, so we cannot fully detach each dimension. That is because, following Saviotti (2007), we understand that knowledge has two properties:

1. It is a co-relational structure: we interact with the external environment and we detect observables and variables, which are mental representations. Observables are "entities that can be responsible for observed phenomena". To each observable we can associate one or more variables that represent and measure different aspects of the observable. The behavior of any observable or variable will not be independent of the behavior of any other observable or variable. These interactions imply the existence of co-relations.
2. It is a retrieval or interpretative structure: it requires the knowledge of one or more sub-

sets of the external environment to be comprehended. The more advanced knowledge is, the more comprehension one needs of its basic parts to understand it: knowledge is cumulative.

Saviotti proposes that, in the observable space of the external environment, the greater the distance between the actors and the external knowledge, the more difficult it is to acquire that external knowledge, therefore concluding that knowledge is cumulative and has a strong local character. We can say, then, that knowledge is created and flows in the creation of variables of observables from the external environment, based upon structures of knowledge that allow us to make sense of this process, thus having an individual as well as social dimension.

But not all that we know can be translated into methodical explanations of the processes that lead us to know. As Polanyi (1967) famous quote says, we know more than we can tell. To explain this difference, Polanyi referred to codified and tacit knowledge distinction, which were recently rescued by economic geographers (Maskell and Malmberg 1999, 2007), economists and knowledge management theorists (notably Nonaka and Takeuchi) in order to theorize about the process of knowledge creation and flow.

1 Codified knowledge is the one that can be articulated, systemized and be stored. It can be easily transferred and therefore has a “universal” face. ICT has spread the quantity of codified knowledge available to people everywhere. Although the easier access, it does not imply the ability to understand and acquire that knowledge.

2 Tacit knowledge: knowledge that people carry in their minds and that is the result of a process of learning through interaction with the environment. It needs oral communication and reciprocity and therefore distance matters. It provides a context for understanding ideas and experiences. Its elements are difficult to codify. Concepts as mutual trust, cooperation, common codes and personal contact are specific to this

knowledge, therefore stressing the importance of the proximity between the agents. It is embedded in a culture and its institutions, as they provide the context in which social interaction happens.

(2) Knowledge creation: the *SECI* model

Nonaka and Takeuchi in *The knowledge creating company* (1995) developed a theoretical framework to understand knowledge creation and applied it to organizations. Based on Polanyi's distinction between explicit and tacit knowledge, the authors developed a model of knowledge creation (the *SECI* model) based on the conversion and combination of these types of knowledge through four modes: Socialization (tacit to tacit knowledge), Externalization (tacit to explicit knowledge), Combination (explicit to explicit) and Internalization (explicit to tacit). These types of knowledge interact and change into each other in the creative activities of humans (knowledge conversion).

Knowledge creation is both an individual and social process. “Knowledge is created through such interactions among individuals with different types and contents of knowledge.” (Nonaka and Nishiguchi, 2001; 14). The organization (Nonaka and Takeuchi applied their concepts to the firm level) has to use the tacit knowledge at the individual level for its benefit, amplifying it and taking it to the next ontological level, process that is called knowledge spiral. Organizational knowledge creation is a spiral process, starting at the individual level and moving up through expanding communities of interaction.

Knowledge is exploited and created in a certain time and place, which receives the name of *Ba*. *Ba* is “a platform where knowledge is created, shared, and exploited. It functions as a medium for the resource concentration of the organization's knowledge and the individuals who own and create such knowledge” (*ibid.* p. 19). It is “a shared space for emerging relationships. This can be physical (e.g., office, dispersed business

space), virtual (e.g., shared experiences, ideas, ideals), or any combination of them.” (Nonaka and Konno, 1998; 40). The most important aspect of *Ba* is that it is created through interaction among individuals and with the environment. If knowledge is separated from *Ba*, then becomes information. There are four types of *Ba*:

- 1) Originating *Ba* (associated with the socialization phase) is where individuals share feelings, emotions, experiences and mental models.
- 2) Interactive *Ba* (associated with the externalization phase), which is consciously created and requires dialogue in order to make tacit knowledge explicit.
- 3) Systematizing *Ba* (associated with the combination phase), which is the interaction in the virtual world for the combination of new and existing knowledge.
- 4) Exercising *Ba* (associated with the internalization phase), which requires learning by doing and training, i.e. the use of knowledge in real life or simulated applications.

Since the late 1990s, several attempts have been made to transport the *SECI* model and the concept of *Ba* to the regional level. Lawson and Lorenz (1999), connect the concept of learning to tacit knowledge and innovative capacity. They take the *SECI* model to the regional level (in Minneapolis, USA, and Cambridge, UK) in order to understand regional innovative activity. Nonaka et al. (1998) think the knowledge creation process from a regional perspective, stressing the importance of developing *Ba* that foster innovation and knowledge creation. They see the interaction of central and local governments, firms, NGOs, individuals, as the base for knowledge creation, and the region as a multi-layered *Ba*, where exchanges between experts from the same and different areas, expression of new ideas and concepts and the construction of a common vision is constructed throughout that purposed interaction. In a more detailed way, Kosttinen (2002) takes the different *Ba* and explains what specific actions

could be taken to build those *Ba*. From the creation of these *Ba*, knowledge creation through the *SECI* model can be understood.

These studies make an important contribution to our understanding of the regional knowledge creation process. But we think that considering the views and findings of the regional systems of innovation approach will give a new dimension to our comprehension of the process and create a base to design effective policies for knowledge creation. To achieve this, we will depart from both views, adapt their concepts and develop a new theoretical framework to grasp and enhance regional knowledge creation.

4 Redefining concepts

(1) Re-conceptualizing notions of the regional systems of innovation approach from a knowledge creation theory viewpoint.

After critically reviewing the literature and its concepts, we believe it is essential to re-conceptualize notions proposed by the myriad of studies in regional system of innovations approach towards adapting them to the *SECI* model knowledge creation theory. We believe that, by doing so, we will be able to go beyond this approach, further deepening our understanding on the process of innovation and going directly towards the root of the issue: knowledge creation. In table 1 we adapt six traditional concepts of the regional system of innovation approach from a knowledge creation perspective.

First, we believe our analysis should go beyond communication and contractual costs, which are important as they concentrate on how to reduce and minimize costs in coordination and communication. But when talking about creating new products through more knowledge, it is creativeness rather than efficiency what becomes essential. Creating knowledge has its costs, some of which are more on the surface than others. It is easier to see R&D expenditures

Table 1. Re-conceptualization of regional innovation concepts towards regional knowledge creation

	Traditional concepts	New concepts
1	Communication cost → Cost reduction Contractual cost →	Creative cost: Openness cost
2	Geographical proximity Organizational proximity Social capital	Instilling a vision Formation of creative capital
3	Knowledge spillovers Knowledge transfer Collective learning	Enhancement of knowledge creation processes Regional knowledge creation
4	Co-operation Co-competition	Vision driven co-creation
5	Local self organization	<i>Ba</i> -Knowledge formation led self-organization
6	Regional development policies	Development policies and knowledge creation policies

Source: Inspired by Song (2006) and Camagni (2003)

than to measure the openness of the society. Openness, according to Florida (2002, 2007) –and connected to the theory of Nonaka and Takeuchi–, is an important factor for knowledge creation. Those societies that are more open to new ideas, different viewpoints and people will be able to have more inputs in their construction of knowledge. Therefore, we should also repair in the costs of creating an open environment that fosters creativity.

Second, geographical and organizational proximity are important issues, but they do not assure the creation and flow of knowledge. Proximity may encourage exchanges, but the realization of them would depend on the region's *Ba* and how it helps the actors to commit their efforts towards knowledge creation. We propose that by instilling a regional vision, we would be able to foster this commitment. A vision is a shared image, constructed by the regional actors, of the future they seek to create. It is based on known capabilities and is a horizon towards which actors plan their course of action. Social capital, understood as the informal norm that promotes cooperation between two or more individuals³, is certainly an

important topic. But in order to be creative, societies need to be open to the outside and avoid the lock-in. Following Song (2006), we believe that a balance of trust, diversity and flexibility are needed in the region, and this is called creative capital.

Third, many studies emphasize the knowledge spillover process or how can a region obtain outside knowledge, but they do not deeply explain how knowledge is created or flows: knowledge creation is seen as something natural rather than something actively created. We should vigorously focus on how to build up and analyze knowledge creation processes.

Fourth, we believe that by instilling a vision and having the actors commit to it, the processes of collaboration and cooperation could be enhanced to a stage of co-creation of the regional economy as a whole.

Fifth, self organization cannot be an objective *per se*, but a means towards designing a regional economic-innovative system that nurtures the creation of knowledge while reinforcing its regional knowledge vision.

Sixth, besides designing development policies, regions should also generate policies that aim at

3 See Fukuyama, F. (1999) "Social capital and civil society", IMF working paper WP/00/74, in <http://www.imf.org/external/pubs/ft/seminar/1999/reforms>

creating knowledge at the regional level based in a regional theory of the knowledge creation process.

(2) Adapting the SECI model concepts to the regional level

To fully understand the process of knowledge formation at the regional level, it is imperative that we think it from a regional standpoint. The

SECI model, although thought by Nonaka and Takeuchi for the firm level, is a theoretical framework that focuses on how knowledge is created and therefore can be thought from the regional level. Previous researches have thought the *SECI* model in the regional level but have not consistently adapted its concepts to the region's logic. We therefore believe it is imperative to do that.

In table 2 we present the concepts of knowl-

Table 2. Knowledge creation concepts and their adaptation to the regional level

	SECI Model at the firm level	Type of <i>Ba</i>	Our concepts at the regional level
Socialization (Tacit to tacit)			
Tacit knowledge accumulation	Managers gather information from sales and production sites, share experiences with suppliers and customers and engage in dialogue with competitors	Originating: Individuals share feelings. Care, love, trust, commitment, freedom and safety emerge out of this <i>Ba</i> . Physical, face to face contact are key. Openness stimulates exchanges.	Knowledgeable people share experiences on their field with other people that manage a common language and engage in dialogue → Make full utilization of specialization benefits
Extra firm social information collection	Managers engage in bodily experience through management by wandering about and get ideas for corporate strategy from daily social life, interaction with external experts and informal meetings with competitors		Knowledgeable people receive information and debates industrial experiences and knowledge from outside the institution and region. Promote openness to outside knowledge and knowledgeable people. → avoid lock-in and promote openness toward competing in the global market
Intra firm Social information collection	Managers find new strategies and market opportunities by wandering inside the firm		Exchange with other industries and people with different specializations to take full advantage of the industrial diversity of the region → Make full utilization of diversity benefits
Transfer of tacit knowledge	Managers create a work environment that allows peers to understand craftsmanship and expertise through practice and demonstration by the master		The government, NGOs, firms, etc. create an environment that promotes autonomy, entrepreneurship and knowledge creation as key concepts for production.
Externalization (Tacit to explicit)			
Creating concepts	Managers perform facilitation of creative essential dialogue, the use of "abductive thinking", the use of metaphors for concept creation	Interacting: Consciously constructed. Selection of knowledgeable people with the right mix of specific knowledge that share, reflect and analyze their mental models. Conceptual leaders are challenged to pursue their ideas.	The government and the community seek to compromise key institutions at the regional level (firms, universities, R&D centers, government), assuring that the main actors of the targeted industries actively participate in the exchanges, so there is a variety of approaches to the same issue. → Externalization of the tacit knowledge of the people of regional institutions. ← Look for explanations to their view on certain aspects with the information available to them.

Combination (Explicit to explicit)			
Acquisition and integration	Managers engage in planning strategies and operations, assembling internal and external existing data by using published literature, computer simulation and forecasting	Systematizing: combining new explicit knowledge with existing knowledge. Interaction in the virtual world rather than in same space and time.	Free flow of big amount of information. Access to the newest knowledge, discoveries and views on relevant aspects.
Synthesis and processing	Managers build and create manuals, documents and databases on products and services and build up material by gathering management figures and/or technical information from all over the company		Actors build and create those databases and make them public to transfer information and explicit knowledge.
Dissemination	Managers engage in planning and in implementation of presentations to transmit newly created concepts		Actors support congresses, conferences and meetings with relevant actors to present and discuss new concepts for learning purposes.
Internalization (Explicit to tacit)			
Personal experience; real world knowledge acquisition	Managers share new values and thoughts, share and try to understand management visions and values through communications with fellow members	Exercising: on site. Knowledge creation through action and participation	Government, in accordance with the views of the other regional actors, instills a regional knowledge vision through policies and communication and promotes commitment to that vision, knowledge share and acquisition between the members of the targeted industries. Knowledgeable people engage in these activities.
Simulation and experimentation; virtual world knowledge acquisition	Managers engage in facilitating prototyping and benchmarking and facilitate the challenging spirit; they form teams and conduct experiments and share results with the entire department		Firms have an active role in policy evaluation and proposition. Innovative thinking is rewarded and success cases are made public to reinforce the region's knowledge vision.

edge creation theory at the firm level, the type of *Ba* needed for advancing individual and/or collective knowledge, and our adapted concepts at the regional level.

As we can see in the left column, in the firm level a decisive role is played by the managers, who administer each step of the knowledge creation process. We believe that in a modern society this role cannot be played by the state vertically, but that it requires the commitment of the region's actors (i.e., local governments, firms, NGOs, universities, individuals, among others). Exchanges are not only carried out by each organization, but by every individual of that organization that participates in them. Mainly for the

Socialization and Internalization stages, the characteristics of the participants (openness to express their experiences, to new views on the same issues, etc.) are decisive for the activities' result. The process of knowledge creation is not top-down; it is rather co-constructed by the actors participating in it.

5 A framework towards grasping and enhancing knowledge creation at the regional level

Based on the previous discussions and through the blending of regional systems of innovation concepts and knowledge creation theory adapted to

the regional level, we developed a new epistemological framework of regional knowledge creation. In order to develop a regional system that not only takes full advantage of its potential but also expands its set of capabilities, a system that promotes the continuous creation of knowledge in an environment co-created by the region's actors is needed. By nurturing knowledge intensive firms that have high added value and are based on conditions that can only be found in that place, regions will be able to create a particular economic system differentiated from others that will compete both in building new things and in reducing costs. This would give the region's economy (and its productive structure) a great boost that will benefit the entire community and assure the region's endurance and development through constantly creating and expanding its knowledge base. With this framework, we will be able to comprehend the mechanisms of knowledge creation at the regional level and what steps should be taken to boost it. The six-step framework is as follows:

1. Understand the previous conditions of the region
 - ① Understand society's image towards knowledge creation, regional identity and economic development. In order to build a region's vision, it is necessary to understand its actors' constructed image of it.
 - ② Understand previous experiences in knowledge-innovation policies in a context of local-national analysis.
 - ③ Knowledge specific: What areas of knowledge are available to the region? In which areas the region may have a comparative advantage and disadvantage? In order to instill the knowledge vision and present attainable objectives, the stock of knowledge of the region's actors' should be considered, not only by themselves, but by comparing to other regions. This will lead to a realistic policy planning and evaluation.

2. Create and energize regional vision through strong leadership and consensus building processes. Create strategies to attain that vision in an open, almost chaotic environment to foster diversity and flexibility. To assure the commitment of the region's actors a shared vision and sentiment of belonging is necessary. A vision is wider than a strategy: it presents a co-created image of how the actors imagine the regional economic system in the future, based on what they know, what they expect and what they wish. Strategies, policies and decisions should be inscribed in this context, which would enhance the knowledge creation process.
3. Build and energize *Ba* in the region:
 - ① Nurture an environment of trust, common identity, and autonomy to reduce creative costs, through the construction of realizable scenarios that bolster creative thinking, local distinctiveness, active participation of the government and risk taking.
 - ② Promote the implementation of the *SECI* concepts at the regional level, in the context of the regional vision. That is to say that the government should promote and mediate strong relations between firms, universities, public offices and NGOs, promote the organization of meetings intra and inter industries, the acquisition of knowledge from outside the region, have policies towards entrepreneurship, build the infrastructure and invest in the creation of knowledge, promote the commitment of the actors towards the co-creation of regional knowledge.
4. This process allows the flow and creation of new knowledge, which would, in turn, externalize to the market in the form of innovation, new businesses, patents, discoveries, etc., which would reinforce the knowledge vision and allow to the continue of the knowl-

edge spiral of the *SECI* model.

5. Creation of a particular knowledge base and knowledge creation-flow system that is the base for competitive advantage based in endogenous factors; the system should be continuously energized through the evaluation and actualization of the region's vision and *Ba*, creating a dynamism that can cope with changes in the global markets
6. The continuous repetition of points 1 to 5 would lead to a self-sustained productive-innovative advantage based in a socioeconomic system that promotes knowledge creation and flow. This process would also exploit the local conditions and give the regional systems particularities that cannot be matched by other regions, thus being the base for the formation of a self-sustained regional economic system with clear identity and differentiation that creates value and economic growth through the creation of knowledge.

6 Conclusion

In this article, we have made a survey of two topics that have attracted a lot of attention: regional innovation and knowledge creation. We have shown that in most cases those theories run in different ways, when in fact they could be understood from a multidimensional viewpoint. We have proposed a framework to understand and enhance the process of knowledge creation at the regional level, which would help understand the regional knowledge creation process and construct self-sustained growth through the enhancement of endogenous factors. Through this framework we not only contribute to bridge the gaps between those views, but we also add new perspectives to each of them, which could be useful to re-think and advance them to the next ontological level. In future work, we will investigate the regional knowledge creation mechanisms in

the Japanese *technopolis* innovation policy and empirical analysis will be done in order to verify the framework.

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