

TRIPLE HELIX MODEL TO CREATE GLOBAL NETWORKS OF CLUSTERS OF INNOVATION (NCOI)*

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Abstract

In this paper, we analyze the emergence and rapid growth that has been recently observed in some environments around the world. Specifically, we study how mobility of resources and global connections among individuals, startups and other organizations in geographically remote environments has contributed to their emergence and growth. We base on the Global Cluster of Innovation Framework (Engel and del-Palacio, 2009) to identify what we think are the key elements of an effective innovation policy that could help an specific environment to get involved in a global Network of Clusters of Innovation (NCOI). Further, we analyze examples of policies that have failed because they had not been appropriately articulated and identified the reasons why they have not succeeded. We use the Triple Helix model to understand the role played by each of the spheres in these policies. Finally, we build on the results of these analyses to propose a guideline for policymakers to create a globally competitive Cluster of Innovation (COI).

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Introduction

In recent years, many governments in Europe, Asia and America have tried to foster entrepreneurial culture. Their goal is to recreate the success of several territories such as Silicon Valley that are known for having rapid innovation and entrepreneurial cycles. The policies adopted to reach this goal have evolved over time and vary significantly from one country to each other. While before 1990 most of these policies were defined just as independent and punctual incentives (e.g. tax reductions or specific infrastructure and financial provision), more recently, the policies have become more complex to target simultaneously a wide range of stakeholders and activities involved in the innovation process. Ultimately, the literature has stressed on the importance of taking global-perspective measures. Specifically, this approach asserts on the importance of creating strong regional innovation systems in order to get involved in global knowledge networks and achieve global competitiveness. The Global Clusters of Innovation Framework stresses on the importance of having technology and knowledge, capital and people move and collaborate in this global context.

The Global Clusters of Innovation Framework is a standard and comprehensive framework for understanding the innovation patterns in entrepreneurial environments. These environments are known as Clusters of Innovation (COI) and are characterized for using entrepreneurial processes to create and exploit business opportunities. The Framework includes COI, the emergence of Networks of COI (NCOI), and Super-COI, as well as the durable and covalent linkages that bind them. All these elements and the Framework itself have been extensively analyzed in a paper published in the *Business Horizons* journal. In that paper, it is also explained how some regions around the world (e.g. China, Taiwan, Israel and Singapore) are rapidly emerging and flourishing, and how global connections are contributing to this development. Previous literature has studied some of these rapidly emerging regions (e.g. Taiwan has been analyzed by Saxenian in several research collaborations, and Israel has been analyzed by Breznitz, Avnimelech and Teubel among others). It has also been analyzed how these regions have a heightened affinity to collaborate with geographically close or distant entrepreneurs, small and big companies, investors, governments as well as with research institutions among others. However, since critical concepts such as *cluster of innovation*, *entrepreneurial process* and *global connections* had not been defined and integrated into a common framework, it has been difficult to use the results of these studies for fostering innovation in other countries, companies and other organizations around the world. We believe that the Global Network of Innovation Framework can help managers in companies to innovate and gain competitive advantage globally, and can also help policymakers in defining successful innovation policies. In this paper we based on the Framework to write some recommendations to formulate effective policies for promoting the creation of local COI and to integrate them into the global innovation economy utilizing global NCOI. Specifically in this article, we aim to:

1. Highlight the elements that make a cluster different from a COI and to gain a global competitive advantage within a NCOI.
2. Identify the role played by the three spheres of the Triple Helix in the Framework.
3. Propose some recommendations for policymakers to develop the elements of a COI and to get involved in global NCOI.

We use a case study methodology to illustrate how the Framework can be used to understand and promote innovation patterns by connecting geographically distant individuals, companies and

regions. We provide examples of COI and identify the elements that make them different from simple agglomeration of companies. We also provide examples of countries that have tried to use these COI as role models and analyze the reasons determining their success as well as failure. The examples help us to contribute with some recommendations for policymakers to create COI and to get globally connected with other innovation regions. In this article we claim that the three spheres of the Triple Helix play an important role and need to be committed in order to foster the creation of intensive innovation nodes and for helping them grow based upon global connections.

The article is organized in three sections. The literature review in the first section is divided in two parts. First, we review the literature related to the evolution of the innovation policies and second we define the Global Clusters of Innovation Framework and justify why is it important for defining an effective innovation policy. In the second section, we analyze several examples of innovation policies in order to identify the strengths as well as weaknesses of the policies. Finally, in the third and last section we write the conclusions and contribute with some recommendations for policymakers to create active COI and to integrate them into NCOI. We also stress on the importance of building up on strengths of the three spheres of the Triple Helix for accelerating the process.

Literature review: innovation policies and the Global Clusters of Innovation Framework

Previous literature have shown how some entrepreneurial regions are rapidly emerging and flourishing. Some of these innovation clusters have been the subject of extensive analyses i.e. Taiwan (analyzed by Saxenian and Sabel, 2008; Lee and Saxenian, 2008; Yang and Hsia, 2007; Yang, 2006; Saxenian and Li, 2003; Hsu and Saxenian, 2000; Mathews, 1997), Israel (analyzed by Breznitz, 2007; Avnimelech and Teubel, 2006), and India and Ireland (compared by Bresnahan and Gambardella, 2001; Bresnahan and Saxenian, 2001). Among these clusters, Silicon Valley is a leading example of a high-technology entrepreneurial environment. In fact, some studies have shown that many of these rapidly emerging COI have evolved by using Silicon Valley as a role model (Adams, 2005). Silicon Island in Singapore (Mathews, 1999), Silicon Wadi in Israel (Abdel, 1999), Silicon Bog in Ireland (Dearlove, 2001) and Silicon Glen in Scotland (Schofield, 1995), for example, have some common factors with Silicon Valley. But what are these factors? Have these factors been evolved as a result of any kind of innovation policies? What are these policies? Could these policies be replicated? Despite the accurate analyses developed on each of these clusters, these analyses lack comparability due probably to the absence of a standardized schema and thus are somewhat limited to be used as role models for other countries' innovation policies.

In the last decades, the design and characteristics of innovation policies have evolved significantly. Before 1990 most of the policies were defined as independent incentive programs targeting specific areas. Some of the most frequent policies address established companies and provide them R&D subsidies or start-ups for funding their early-stage development. These incentives were and are still criticised for neglecting the absorption capacity of the firms and thus for wasting the majority of the efforts (Tödling and Trippel, 2005). Subsequently, the policies became more complex trying to be integrated in a more general Regional Innovation Systems (RIS). According to Cooke, Gomez and Etxebarria (1997) a RIS represents an innovative regional cluster consisting on firms that have access to other firms in their sector, such as customers, suppliers or partners,

that may operate in formal or informal networks; knowledge-centers such as universities, research institutes, and other research organizations and technology transfer agencies; and a governance structure of private business associations, chambers of commerce and public economic development, training and promotion agencies and government departments. Where these agents are available in a region, they interchange on matters of importance to innovation (Cooke and Morgan, 1998) and have access to financial infrastructures needed to enable firms to gain the necessary venturing finance and invest the necessary qualities of capital to generate endogenous innovation, we may speak of a RIS (Cooke, Gomez and Etxebarria, 1997). Based on RIS, the new innovation policies integrated all the agents of the RIS, known as Local Knowledge Spillovers (LKS), and promote local collaborations among them (Asheim, Coenen and Svensson-Henning, 2003; Wolfe, 2003; Asheim and Isaksen, 2002; Malmberg and Maskell, 2002; Cooke, 2001). But most of the policies did not succeeded.

The limited success of previous policies focused on LKS have attracted the attention of many researchers, analysts as well as journalists around the world in order to identify the reasons of failure. As a result last trends on innovation research stress on the importance of including the global innovation perspective in governments' agenda (e.g. Chaminade and Vang, 2008; Cooke, 2005). Specifically, this approach claims that much of the effort targeting nation-state elements should be moved to the global integration of global value chains (Cooke, 2005). They stress on the importance of creating strong regional innovation systems as a preliminary step to form global knowledge networks (Chaminade and Vang, 2008; Cooke, 2005). The Global Network of Innovation Framework contributes to this global perspective and allows governments and others to promote local strengths, to mobilize global resources and to integrate regions into the value chain of a global NCOI.

The Global Clusters of Innovation Framework is a standard and comprehensive tool for understanding new innovation patterns that are more frequently observed in COI. These innovation patterns are based on frequent mobility of resources, mainly people, technology and capital, as well as on establishing global collaborations among individuals, small, medium and big corporations, and other organizations. The Framework is accurately defined and analyzed on Engel and del-Palacio's article published in 2009 in the *Business Horizons* journal. It builds upon cluster literature and allows for a deeper understanding of the mechanisms behind the formation of COI and their importance in start-up success. A COI is defined as an environment that favours the creation and development of high potential entrepreneurial ventures, and is characterized by heightened mobility of resources, including people, capital and information. Each COI consists of a critical mass of start-ups and mature corporations, entrepreneurs, investors, service providers, universities and R&D organizations among which assets such as money, people, and information, is frequently moved, facilitating rapid innovation cycles (Freeman and Engel, 2007). Unlike in Porterian clusters, in COI other agglomeration benefits dominate, defined not by industry specialization, but by the stage of development and innovation. In fact, entrepreneurship is the core competence of the components in a COI, and thus innovation is augmented and accelerated through new firm creation.

Four are the main elements of a COI:

- 1) Resources, mainly people, capital and technology are mobile and lead to rapid formation, experimentation, and innovation cycles (Freeman & Engel, 2007).
- 2) Innovation occurs principally through new firm creation and thus startups in a COI benefit from being co-located with other companies, suppliers, and service providers specialized in or compatible with entrepreneurship (Saxenian, 2006).
- 3) New born companies have a global perspective earlier in the venture development cycle than the historical norm.
- 4) Finally, extraordinary mobility of resources leads to a heightened affinity to collaborate while these collaborations are enforced by mechanisms to align incentives and goals among all stakeholders in the environment.

As a result of the constant mobility and the born-global perspective, individuals, technologies and resources in a COI cross regional and national boundaries, and collaborations involve individuals and companies in geographically distant COI. Not only big companies look for international markets but also start-ups are involved in global collaborations. Consequently, a multidimensional web of strategic interrelationships is frequently created around COI. These network include weak ties, durable bonds, and covalent bonds, and constitutes the global Network of Clusters of Innovation (NCOI).

The NCOI connects clusters that are organized around associated teams of people and capabilities, consisting of mobile resources engaged in the creation of value utilizing born global startups. Both, intra- and cross-country relationships are supported by formal and informal international networks of contacts, including individuals, born global companies, universities, research centers, associations, mature corporations and other organization that excel in rapid innovation, experimentation and commercialization. The connections among them include weak ties, durable bonds and covalent bonds. Weak ties are the most frequent connections created by mobile people using networking and face-to-face relationships. Information flows rapidly through weak ties that link people working in the same business, or in the same or related industries, or who are doing business together. When these weak ties get stronger, communication is frequent, and when the contact exchange information as well as technology, capital, and make business together, the weak ties become durable bonds. These relationships are stronger and more stable, but still dynamic and fluid; in fact they are continuously being created and recreated. Further, when new additional and multiple covalent bonds are continuously created and recreated between individuals and entities in two or more geographically dispersed COI such that they operate in a coordinated fashion, the NCOI may become a Super-Cluster of Innovation (Super-COI). In a Super-COI, the two dispersed entities are linked through covalent bonds through which information, capital, and commodities occurs in both directions, and benefits both players, but at the same time establishes a linkage of mutual dependency.

Analyzing innovation policies: an explorative analysis

In this section we are going to study several examples of innovation policies in order to identify the strengths and weaknesses of these policies. The examples are used to illustrate and characterize current trends of innovation policies. In this case study, qualitative evidence is not used to build theory but rather to better understand how to use the Framework as a tool for policymakers and to write some final recommendations (Eisenhardt, 1989). As we will see not all innovation policies

reach the expected success, and not all agglomeration of high-technology companies can be considered to be COI.

In Europe, many governments have tried to foster entrepreneurial activity and support R&D within small, medium and big organizations. In Germany for example, several policies have been defined aiming to leverage on local strengths (the aforementioned Local Knowledge Spillovers, LKS). From 2000 three have been the main policy programs: the BioRegio¹ (Dohse, 2000, 2003), EXIST² (Kulicke, 2003) and InnoRegio³ (Eickelpasch, Kauffeld and Pfeiffer, 2002). These programs aim to promote research projects developed cooperatively by local research groups or 'networks' of actors. Some of the programs have been relatively successful. The BioRegio context for example was started in 1995 in order to stimulate the growth of existing companies and the provision of venture capital for start-ups. As a result, the program contributed to the creation of many new companies in the biotech industry. Specifically the number of biotech companies in 1997 amounted to 465 compared to the less than 100 firms existing before 1995, the year when the BioRegio was started (Schitag, Ernst and Young, 1998).

However and despite this relative success, the results have been criticized for not responding to the substantial amount of resources invested in the program. The main criticism is related to the geographical limitations of the program. In fact, companies can not apply to collaborate with organizations in other countries. Further, the collaborations are limited to companies located within the same region which moves the development of global collaborations to a secondary and later stage (Eickelpasch and Fritsch, 2005). We believe this program failed to meet expectations of creating a globally connected COI because it did not sufficiently focus on promoting mobility of knowledge, capital, and people, and did not create mechanisms for encouraging entrepreneurial business practices, aligning incentives and goals of individual participants. Some studies have also criticized the long-term carrier employment system in Germany. A recent research developed by Casper (2007) states that in Germany scientists and engineers tend to spend most of their life within one firm due to the regulations of the employment system and the restrictions to hire and fire. In the case of Germany, despite the large agglomeration of high-technology companies and the rapid expansion of the number of star-ups, limited mobility of resources have blocked the emergence of rapid innovation cycles and thus the emergence of COI.

One example of a button-up development process is the one experienced by the little region named Basel (Switzerland). Swiss policies have been very successful in creating strong linkages or durable bonds with companies and other organizations in highly innovative environments. Basel is located in the northwest Switzerland on the river Rhine and today hosts some of the largest bioscientific companies in the world including Novartis, Roche, Syngenta and Lonza, as well as many biotechnology firms such as Actelion, Discovery Technologies and GeneData (Cooke, 2005). In the last years the government has promoted the creation of many research institutes in the region of Basel and also supported collaborations and thus the formation of covalent bonds with companies in both San Francisco and San Diego. Lately, governments' interest has also targeted Asian markets through programs such as KIA-Asia program that promotes co-operations in applied R&D with universities and firms from Asia.

¹ www.bioregio.com

² www.exist.de

³ www.innoregio.de

Israel is also an example of a country in which government has played a vital role for promoting entrepreneurial activities. According to the Central Bureau of Statistics, Israel is now home to 7.4 million of people, most of them Jewish (76%) and has one of the most advanced economies in Southwest Asia; an economy with significant investments in the ICT industry. The emergence and growth of the country has been mainly attributed to the strong commitment of public policies focused on fostering product R&D activities and on enabling labor mobility. On the one hand, several scientists and industry leaders are allowed to move back and forth between local state and private industry (Breznitz, 2007). On the other hand, several public programs have also promoted international mobility of talent. RAFAEL is one of these programs. It is one of the first policies that contributed to the emergence of the innovation and entrepreneurial culture in Israel. The program was developed in the 70's by the Israel Armament Development Authority and sponsored graduate academic education for a few hundred of its employees in top US engineering schools such as MIT, Stanford and Berkeley. The experience was prolonged over time as some these graduates returned regularly as visiting scholars to the American universities. As a result, researchers of RAFAEL established relationships with other researchers, entrepreneurs, big and small companies, and investors in Boston and Silicon Valley, and created a multidimensional web of weak ties that rapidly expanded and led to the creation of more durable bonds. The network is now strong enough to support the mobility of information and technology among individuals and organizations between Israel and some American States. Many technology companies from Silicon Valley including Intel, Google and Yahoo set up R&D centres in Tel Aviv and Haifa in order to take advantage of the world class scientists and engineers from Israel. The relationships among individuals in Israel and in some areas of the US have evolved to the point that many of the organizations involved in the collaborations are mutually dependent. According to the Global Clusters of Innovation Framework, Israel and Silicon Valley form a Super-COI.

Conclusions and implications for policymakers

In this article we have used the Global Clusters of Innovation Framework as an analytical framework to illustrate the strengths and weaknesses of some innovation policies from several countries. The literature review has shown how innovation policies have evolved over time and how achieving a global competitiveness is now one of the most important issues in policymakers' agenda. We have also seen how the Global Network of Clusters of Innovation framework integrates this global perspective and stresses on the importance of having technology and knowledge, capital and people move and collaborate internationally. According to the Framework, a COI includes start-ups, small, medium and large corporations, universities and research centers, entrepreneurs, investors, service providers, as well as other individuals and organizations that (a) use entrepreneurial intensive process as a mechanism for innovation and experimentation, (b) have heightened mobility of resources, principally people, technology and capital, (c) create companies with an early international perspective, and (d) players have shared identities and aligned goals.

In this article we have explored the usefulness of the Framework as a guideline for policymakers to develop effective innovation policies. We have use some examples to illuminate the key elements of Clusters of Innovation (COI) and the linkages among them, and to explore how the different innovation policies have targeted the development of these elements. We found that in some cases, local perspective as well as low mobility of employees have limited the emergence of active entrepreneurial cycles and the integration of these environments into global innovation networks.

According to the Framework these agglomeration of high-technology companies do not fit in the definition of COI. On the contrary, there are other countries in which the government has played an important role in fostering entrepreneurial activity. In the case of Israel for example we have seen that the government promoted international mobility (i.e. having researchers and employees working periodically in American companies and universities such as MIT, Stanford and Berkeley). Nowadays, many individual and companies in Israel are tightly linked to organizations in Silicon Valley. According to the Framework, Israel is an innovative COI and together with Silicon Valley forms the Israel-Silicon Valley Super-COI.

Based on these conclusions, here some practical recommendations for policymakers to develop effective innovation policies:

1. Use the Framework to identify and analyze the elements of the COI:
 - a. Start with a deep analysis and evaluation of the current patterns of mobility of people, capital and technology. Analyze how the government is currently facilitating this mobility from companies to research organizations and vice versa. Analyze also how much money is being invested and reinvested in new technologies, and how is the government reducing the risk of high-technology investments.
 - b. Evaluate governmental policies, laws and regulations that promote or inhibit mobility and alignment; i.e. employment law, protection of IP, ownership of IP, bankruptcy protection, stock ownership regulation so that stock option grants are easy to do, etc.
 - c. Think of the global connections and international presence of the region. Analyze how the global environment is targeted by small and big organizations. Look at the international connections and their characteristics (strength, dependency level and durability).
2. Once this analysis has been done, focus on promoting the four elements that characterize COI. Do not focus on economic factors as much as in social and cultural, and on eliminating legal barriers:
 - a. On mobility: develop programs that foster mobility, not only inwards but also outwards. Facilitate mobility of local talent in order to get connected to individuals and organizations around the world. One of the key issues is to promote mobility and exchange of talent with environments that have rapid innovation patterns and high research capabilities, as well as with these countries that are rapidly emerging. This connections or weak ties will be transformed in more durable bonds soon, and eventually also in covalent bonds.
 - b. On entrepreneurial culture: promote entrepreneurial education in all university as well as masters programs. Focus education on the first stages of development of high-technology start-ups. Educate entrepreneurial mindset.
 - c. On global approach: define specific programs to help companies to reach international markets. Help entrepreneurs to collaborate with international small and big corporations.
 - d. On alignment of goals: promote mechanisms designed for aligning goals among entrepreneurs, managers and investors, and for reducing the risk of high-tech investments (e.g. staged investment formulas in which each stage of the financing is designed to carry the venture to a higher level of achievement and validation).

These are just some recommendation to define effective innovation policies. Many other practices may be learnt by using the Framework as an analytical tool for evaluating internal as well as external innovation policies. We support that a COI may be only created if these four foundations are simultaneously and effectively addressed; otherwise, the impact of the measures and results will be limited, and most of resources may not be efficiently used. This implies the three agents of the Triple Helix to be involved in the creation of COI. An rapid and global development of a COI is only possible if universities are committed to offer entrepreneurial education and get involved in international mobility programs; small companies look for global markets from the start and big corporations are open to collaborate with organizations in other countries; and governments facilitate mobility and collaborations among within the country and with other individuals and organizations around the world.

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