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To cite this article: Dafna Schwartz & Raphael Bar-El (2015) The Role of a Local Industry Association as a Catalyst for Building an Innovation Ecosystem: An Experiment in the State of Ceara in Brazil, *Innovation*, 17:3, 383-399

To link to this article: <http://dx.doi.org/10.1080/14479338.2015.1075855>



Published online: 22 Dec 2015.



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The Role of a Local Industry Association as a Catalyst for Building an Innovation Ecosystem: An Experiment in the State of Ceara in Brazil

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(Received 25 February 2015; accepted 20 July 2015)

We show that an industrial association can play the role of a catalyst for change where government intervention does not provide a sufficient response to market failure in the development of innovation activities, especially in less developed regions. This experimental study was conducted in the State of Ceara in Brazil by the UNIEMPRE program of the federation of industries (FIEC). The findings show the positive influence of the local association of industries as a catalyst for the innovation process, acting through five main channels: increasing the awareness of all actors, providing information and knowledge, assisting firms in developing their innovation capabilities, developing the milieu's innovation capabilities, and establishing long-term sustainability of the process.

Keywords: innovation management; innovation policy; innovation ecosystem; innovative milieu; industry association; industry federation; Brazil

Introduction

The existence of a market failure in innovation advancement

The term ecosystem refers to the complex structure of linkages formed by “the interaction of the participating community within an environment”. ... “The environment is core markets where the community coexists and the adjacent markets from which know-how is shared” (World Industry Reporter, 2013). Both scholars and practitioners have increasingly recognized the reliance of the innovation process on the existence of innovation ecosystems. Studies have shown that the locus of competition has shifted from the individual firm to the ecosystem (e.g., Velu, Barrett, Kohli, & Salge, 2013). Developing innovation ecosystems empowers both entrepreneurs and economies. A highly developed innovation ecosystem helps participants operate beyond firm boundaries, enabling the transformation of knowledge into innovation (Mercan & Deniz, 2011). To encourage the innovation process, a suitable innovation ecosystem must meet various conditions, encompassing natural, structural, organizational, and cultural factors.

Innovation ecosystems are not a matter of single actors, but of interacting populations of actors residing in a certain environment (Durst & Poutanen, 2013). They consist of economic agents and economic relations, as well as non-economic components such as technology, institutions, sociological interactions, and culture. Non-economic

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components of innovation structure can enable idea-making, presenting the innovations, and following their diffusion (Mercan & Deniz, 2011).

A key factor in the innovation ecosystem is the flow of technology and information among the actors – the people, enterprises, and institutions. This process involves interaction between all the actors who are needed in order to turn an idea into a process, product, or service in the market. The term innovation ecosystem emphasizes the role of independent factors working together to enable entrepreneurs and to allow innovation to occur in a sustained way in a particular location (Lawlor, 2014).

Innovation has been recognized as a major engine of economic growth, and is considered an important component in the competitive ability of a business, region, or country. Still, it is widely recognized that the existence of a market failure (such as externalities related to innovation, high risk levels, limited access between demand and supply, etc.) prevents the optimal development of innovation activities. Consequently, as in any case of market failure, the involvement of the government is necessary, and in fact government plays a vital role in the advancement of innovation. In the familiar triangle of industry–academia–government (a triple helix), government usually assumes the leading role in strengthening the innovation ecosystem, acting as a catalyst in the innovation process. The governments of most developed countries intervene in this process by supporting R&D, encouraging collaboration between industry and academic institutions, elaborating on appropriate regulations, investing in infrastructure and education, and providing subsidies or other incentives, etc.

In reality governments do not always appropriately carry out this role (for various reasons that are not in the focus of this article), leading to a failure in the attainment of optimal economic growth to the detriment of both the national economy and the industry itself. This is especially true in less developed regions, where measures taken by the government do not necessarily fit their specific conditions. We claim that an additional actor in the innovation ecosystem, i.e., an industrial association, can play a major role as a catalyst for the innovation process, responding to some of the constraints leading to the market failure and at the same time provoking the government and other players of the ecosystem to take appropriate measures.

Our hypothesis is that an industrial association can play the role of catalyst for the innovation ecosystem by stimulating links between the actors of the ecosystem, and by influencing the government's channels of intervention. In doing so, the industrial association has the advantage of physical and cultural proximity to the ecosystem actors, as well as familiarity with the economic and social environment. We should emphasize here that our hypothesis relates to the industrial association's role of catalyst: the industrial association is expected to stimulate links or provide knowledge in order to permit a more efficient building of the innovation ecosystem, and therefore the test of this hypothesis should be determined by the successful achievement of such a role, not necessarily by the creation of an innovation process (which is expected to be a direct result of a more efficient innovation ecosystem).

In this article we use an experiment performed by the Federation of Industries in the State of Ceara (FIEC) in Brazil, in order to carry out an exploratory study to test this argument. The increasing difficulties of the Ceara industrial sector in competing in national and international markets, as well as the perception by industry that the existing federal and state measures did not provide an adequate response to their specific needs, led the FIEC to the conclusion that they should be taking a more active role in the innovation process. They decided to play the catalyst role, and gradually encouraged other entities to join in the process.

The current exploratory study follows this process, surveying the measures that were taken by FIEC during the years 2011 to mid-2014 and evaluating their impact and effectiveness. The findings of this study can assist in the formulation of measures for the business sector, as well as for intermediaries, to enable them to take on an active role as leaders of an innovation process or as complementary entities that collaborate with other organizations.

Theoretical Background

An external intervention for solving a market failure should, in principle, be made by the government, since the government can consider the global gains for society (or for all sectors of the economy) in conditions where a private operation may not be beneficial to a specific firm. Therefore, it can be asked why an industrial organization should play a public role in stimulating activities that has not been taken by its members in free market conditions. The answer is that an industrial association considers the global interest of all its members, and supporting innovation is expected to benefit all or most of them as a consequence of the externalities involved in innovation activities. The stimulation of innovation in some industries or sectors is expected to bring – in the long run – benefits to wider sections of the industry through spillovers, higher quality inputs, demand for new inputs, knowledge diffusion, higher mobility of labor force, etc.

Still, actions by industry are not meant to replace the role of government. Instruments used by the government, such as infrastructure building, education, regulations, and legislation, cannot be implemented by other entities. The main role of the industrial association, besides specific actions that it can take directly, is one of a catalyst within the global innovation ecosystem, which includes government agencies, universities, researchers in academic institutions, financial institutions, and providers of business services (transportation, ICT, patent offices, design, etc.). In the following, we show the context of the innovation ecosystem and the role that an industrial organization can play within it.

The locality and geographical aspects

The question to be asked now is why should a certain region within a nation, such as a specific state, be concerned with the issue of an innovation ecosystem. Theoretically, one could claim that innovation ecosystems act on a national basis (in fact, they are frequently called “national innovation ecosystems”), and therefore the operation of an ecosystem should be analyzed at the level of a nation as a whole and not of a specific state or region. In fact, most research and empirical findings show that an innovation ecosystem is embedded within a geographical and cultural context. Innovation is regarded as a spatially embedded process in which the local social and economic interactive relationships of the actors are important factors for success – beyond the interactions at the national and global level.

The strong influence of local factors has, in fact, led to the concentration of innovation activity mostly in the central regions, and less in the more peripheral and relatively poor regions (Avnimelech, Schwartz, & Bar-El, 2007; Cooke & Schwartz, 2008; Frenkel & Shefer, 2001; Schwartz & Bar-El, 2007).

The main factors behind such a concentration include knowledge accumulation and knowledge spillovers, relational capital, tacit knowledge, external learning and processes of knowledge acquisition, innovation networks, and innovative environments, as

described briefly in this section. Knowledge accumulation and knowledge spillovers (Quah, 2002) refer to the positive externalities firms receive in terms of knowledge from the environment in which they operate. Spillovers are evidently “spatially bounded” (Baranes & Tropeano, 2003), and should be examined in terms of geographical location (Schwartz & Bar-El, 2007; Wallsten, 2001). Social and relational proximities are important channels of knowledge spillovers, and “when simultaneously present, different kinds of proximities generate synergic effects on growth” (Basile, Capello, & Caragliu, 2012, p. 697).

The process of knowledge acquisition in a firm refers to the channels of knowledge acquisition coming from external sources. Zellner and Fornahl (2002) identify three kinds of knowledge acquisition channels: recruitment of personnel, external information networks of employees, and formal cooperation between the firm and other institutional agents. In addition, they claim that the type of knowledge required by each firm determines the attraction level of specific locations. A study on the mechanisms of external learning by Almeida, Dokko, and Rosenkopf (2003) reveals that external learning actually increases with start-up size, but this may be offset by the lower motivation for informal learning. Smaller firms use more informal mechanisms for external learning, and therefore there is a higher expectation for them to be located closer to other related firms. Proximity assists in the establishment of trust among actors of the regional network. Network interaction is embedded in social settings, allowing for the development of trust. According to Gossling (2004), trust between actors is an efficient functional economic tool for transactions; it is equivalent to contracts, guarantees, insurance, safeguards, etc. The author claims, however, that this does not necessarily produce moral spillover effects.

Innovation networks, as described in previous studies (e.g., Harmaakorpi & Melkas, 2005; Sternberg, 2000), are important not only for business success but also for the economic performance of a region. Innovation networks (Collinson & Gregson, 2003; Cooke, 2004) provide firms with accessibility to external resources (Dashti & Schwartz, 2008). This is particularly important for small and medium firms, as it helps them overcome some of the disadvantages of their limited size (Havnes & Senneseth, 2001; Kaufmann & Schwartz, 2008, 2009; Schwartz, Bar-El, & Malul, 2008).

The spatial proximity of the partners in a network is important for the establishment of innovative linkages between the partners (Sternberg, 2000). We refer here to proximity only from the geographical perspective, although we are aware of other dimensions such as social and technological proximities (Boschma & Frenken, 2010; Breschi & Lissoni, 2009; Broekel & Binder, 2007; Frenkel, Israel, & Maital, 2015; Nooteboom, Van Haverbeke, Duysters, Gilsing, & Van Den Oord, 2007). Gebauer, Nam, and Parsche (2005) emphasize that an investigation of the regional network has to take into account all the actors involved in the network – not only horizontal and vertical relations among firms, but also the contacts with universities and other research institutions. Boschma (2005) argued that proximity “facilitates interactive learning, most likely by strengthening the other dimensions of proximity. However, proximity may also have negative impacts on innovation due to the problem of lock-in”, and he suggested that mechanisms should be used to “enhance effective coordination and control . . . , while they prevent actors to become locked-in through ensuring openness and flexibility” (p. 71). The role of government agencies, institutions, and interest groups, which provide financial support, technical information and services, should be taken into consideration.

The role of the industry association in the innovation ecosystem

In the past, business associations were perceived mostly within the contexts of lobbying, regulation, group pressure, and the policy-making process, but these roles have changed over time, as described in the following studies. Nordqvist, Picard, and Pesämaa (Nordqvist, Picard, & Pesämaa, 2010) showed that industry associations create an environment where people and companies share common interests and are brought together: “They build cooperation, foster information sharing, offer training...” (p. 52). The associations also provide a wide range of services designed for helping members improve business performance, as well as allowing new social bonds to be formed (McPherson, Smith-Lovin, & Cook, McPherson, Smith-Lovin, & Cooke, 2001).

Business associations can play an important role in the process of innovation, mainly in the context of knowledge accumulation and knowledge spillovers, relational capital, tacit knowledge, external learning and processes of knowledge acquisition, innovation networks, and innovative environments, as described briefly in this section. One study (Bessant, Alexander, Tsekouras, Rush, & Lamming, 2012) highlighted the role of policy agents (regional and national government, trade and sector associations, etc.) in developing “innovation dynamic capability” through the learning process. According to these authors, this process depends on sustained research and experiment, but also on the ability to extract and embed key behavioral routines which support innovation. Learning networks often involve a triggering entity that brings together members of the network and supports the sustainability of the network. Bessant et al.’s study shows that in this process, the “policy agents” can play an important role. The article focuses on the mobilization of shared learning among formally configured groups of organizations in peer-to-peer learning networks, and finds that these groups form an increasingly important channel within innovation support policy.

Bessant and colleagues’ (2012) study also explored the implementation of learning networks, drawing on empirical data from three studies. The first is a study of 38 networks established as part of an initiative in the Southeast UK targeted at small businesses, under the “Profitnet” banner. The second is a cross-case comparison of two learning networks established in South Africa as part of post-apartheid industrial upgrading. Finally, the third is a cross-case comparison of experience in setting up and operating learning networks as formal vehicles for supply chain development in the UK. In all three cases, the role of the network promoter was found to be significant. Bessant et al.’s study suggests that there are some key issues, especially those evolving around trust building and network operating processes, which have a marked influence on the successful operation of such networks.

Perry (2007), in a study that was conducted in New Zealand, supports the above findings, emphasizing the role of associations in facilitating business interaction. This is cited as the main motivation for members to join the associations, as reported in an interview survey conducted among the directors of 100 industrial associations. According to the directors, an important motivation for membership is the opportunity to learn from other members and from the activities that provide forums for member interaction, such as conferences, workshops, and training events. In addition, many associations do not restrict their involvement solely to members, allowing the associations to play a role in integrating a broader range of activities than just the ones for their fee-paying members.

Maennig and Olschlager (2011) showed in their study in Germany that due to the ability of associations and chambers of commerce and industry to build and maintain

formal and/or informal social relationships, these associations can create relational capital and thus promote the development of an innovative milieu. Relational capital (Capello & Faggian, 2005, p. 77) refers to the relationships established among firms, institutions, and people “that stem from a strong sense of belonging and a highly developed capacity of cooperation typical of culturally similar people and institutions”. Such relationships enable the transfer of tacit knowledge. Tacit knowledge (Howells, 2002; Maskell & Malmberg, 1999) refers to the knowledge that is not coded and that is, for the most part, embedded into the nature of the economic activity. It is primarily transferred through close, ongoing contacts within a certain location. Geographical proximity is important because of interactive collaboration and the significance of social and cultural bonds. When such embedded tacit knowledge is codified it can then be more easily transferred, and therefore becomes “tradable”, leading to a decrease in the importance of location or proximity to other firms. The importance of tacit knowledge may be higher in cases of academic spillovers, as can be seen in Adams (2002) for R&D in the US, and Kaufmann, Schwartz, Frenkel, and Shefer (2003) for biotechnology in Israel.

Another study (Xavier Molina-Morales, Capó-Vicedo, Theresa Martinez-Fernández, & Expósito-Langa, 2013) analyzes how the structural and relational dimensions of social capital determine a firm’s sense of belonging to the industrial district. In their conclusions they emphasize the role of local institutions and gatekeepers, which “can help individual firms redundantly connected with other participants in an industrial district gain access to new external information and opportunities”. According to their study, “Districts may include mechanisms to face external changes and establish external linkages that come from their role in global value chains” (p. 786).

Sessin-Dilascio, Prager, Irvine, and de Almeida Sinisgalli (2015) show that, based on a case study in Cardoso Island State Park in Brazil, a Participatory Advisory Council is one of the important factors that facilitate co-management in protected areas. However, they also found that “co-management cannot be taken for granted once established. Continuing investment in trust and relationship building is needed to ensure the necessary social capital” (p. 487).

Industry associations can play the role of a change agent, especially for an industry that has undergone a transformation period, as shown by Nordqvist et al. (2010) in regards to newspaper associations. The findings of this study, based on a review with key people from four newspaper associations, show that associations see their role as helping the industry understand these changes and pressures, as well as supporting efforts to change and adapt the industry to the contemporary situation.

The role in the policy-making processes of different policy instruments concerning energy and environmental issues in the Netherlands is discussed in a paper by Chappin, Hekkert, Meeus, and Vermeulen (2008). The “enabler role” of industry associations is presented by Dalziel (2006), based on a Canadian case study. The paper shows that industry associations have a strong impact on the ability of Canadian firms to innovate, and that industry associations have the specialized knowledge and capabilities that are typically performed in innovation enabler roles.

Given the significant influencing potential of industrial organizations, and given the tendency of innovation ecosystems to focus mostly on central and economically advanced places, the question to be asked now is to what extent can a local industrial association contribute as a catalyst for the strengthening of a local innovation ecosystem? Our research is expected to show that in a remote region such as the State of Ceara, far from the center of economic activity in Sao Paulo and other southern states,

the initiative taken by the local industrial association is able to lead the development of an efficient innovation ecosystem.

The Case Study: The State of Ceara in Brazil

The State of Ceara is one of the poorer states in Brazil. It is located in the northeastern part of the country, with a population of approximately eight million inhabitants. Its gross domestic product (GDP) per capita is less than half that of Brazil as a whole. In 2010 it reached R\$9,212 (in PPP terms purchasing power parities, less than US\$5,000), as compared with R\$19,764 in Brazil. This amount is close to that of the entire north-east region of Brazil (with more than 50 million inhabitants). Still, Ceara is currently demonstrating a quite rapid economic growth, higher than that of Brazil as a whole (see Table 1).

As for the industrial sector’s structures, manufacturing is the most significant one, followed by those related to civil construction and public utility industrial services. In 2010 the industrial sector of Ceara represented 23.7% of the State’s economy, and agribusiness and services had a 4.2% and 72.1% share, respectively.

FIEC – Ceara Federation of Industries

Created in 1950, the FIEC is a permanent forum for debate and action for the sustainable development of the State of Ceara. The Federation is currently made up of 38 sectorial associations representing 10,500 industrial firms. The FIEC participates actively in the economic growth, expansion, and modernization processes of Ceara, assuming institutional and political representation among diversified sectors. It also stimulates the implementation of actions supporting the industries through consulting services in the fields of technology, entrepreneurial strategies, economical studies and research, and qualification of entrepreneurs and their employees. The FIEC’s areas of activity are agriculture, chemistry, plastics, construction, building materials, electrics, electronics, environment, food, furniture, logistics, transportation, machinery, mechanical equipment, renewable energy, and tourism. (www.fiec.org.br/cin)

The industrial association of Ceara has the advantage of being familiar with Ceara’s economic and social environment, which is quite different from that of other states in Brazil, especially states in the south where most of the country’s economic development is concentrated. As such, it is considered to be a trusted partner by the actors of the community, and is expected to serve as a platform for meetings for the relevant innovation actors: companies, economic and social leaders, research institutions, universities,

Table 1. Ceara Outlook.

Region	Population (2010)		GDP (2010)			GDP per capita - PPP	
	Number (in millions)	% in the country	Amount (in R\$ billions)	% in the country	Annual Growth 2001 - 2010	Amount (R\$)	Of the country’s GDP per capita
Ceara	8.5	4.4	77.9	2.1	4.0%	9,212	46.6%
Northeast	53.1	27.8	507.5	13.5	3.9%	9,561	48.4%
Brazil	190.8	100.0	3,770.1	100.0	3.5%	19,764	100.0%

and policy makers. The role of a catalyst, according to our hypothesis, includes taking steps that stimulate the innovation process. These include increasing awareness and demand for the process, assisting in the sharing of information and knowledge, assisting in developing a dynamic culture of interactions to foster innovation, and assisting firms to innovate.

The current study surveys the measures that were taken by FIEC during the years 2011 to mid-2014, and analyzes their impact and effectiveness on the basis of a few pilot projects initiated during that period. In 2011 the industrial association established a special program, called UNIEMPRE, dedicated to these objectives. The working methodology adopted and implemented by this program includes the following steps:

- (a) Diagnosing the status of innovation in the State of Ceara, including evaluating the activities taken by various firms, and making a preliminary identification of the prevailing ecosystem attitudes of representatives of all factors of the ecosystem. Such a diagnosis would permit the identification of the major bottlenecks in the innovation process.
- (b) Devising intervention measures and initiating their implementation.
- (c) Performing a follow-up analysis and evaluation.

A series of studies were done in order to diagnose the prevailing situation and the attitudes of the various factors of the ecosystem, leading to the elaboration of specific measures to be taken. As a whole, the intention of such measures was to focus on the following elements:

- (1) The ability to provide the aforementioned services, and to encourage the actors to participate in awareness activities, provide and share information, develop interactions among the actors, and encourage firms to participate in the training and monitoring activities.
- (2) Recruitment of other partners from the government and universities to join in the process.
- (3) The sustainability of the process; to determine if it establishes both a solid interest in and routines for the sustainability of the dynamic process.

Diagnosis

The diagnosis focused on two main elements: the firms and the actors of the innovation ecosystems. It was based on two main instruments: a survey of firms, and a number of workshops conducted with actors of the ecosystem that ended with a short questionnaire being filled out by the participants.

The survey of firms included 57 enterprises, and information was collected on their innovation activity, awareness of the ecosystem, and collaboration with their actors. The survey was sent by the FIEC to all firm members through the Internet, in order to get a preliminary indication about the attitudes of the industry. Those who responded to the questionnaire cannot be considered as a sample that represents the industry as a whole. Still, the distribution of the firms among the various economic branches represents a quite appropriate picture of the reality: 10 firms of food products, 9 of textile and clothing, 2 of leather and shoes, 5 of printing, paper and wood products, 4 of chemical and pharmaceutical products, 4 of non-metallic minerals, 5 of metal and metal products,

etc. Such a group of firms is not expected to be a statistically representative sample of the industry of the State, but it still responds to our needs, taking into consideration the fact that this study is defined as exploratory, and the fact that the objective of this survey is restricted to the evaluation of attitudes and to obtaining a general picture.

We focus here on a few relevant findings. We found that most of the firms declared that they were very much aware of the importance of innovation, and that they were doing or had done some kind of innovation. However, a more detailed investigation showed that their innovation activities were very superficial, and that the interaction with other elements of the innovation ecosystem was very weak. Table 2 illustrates this situation: When asked to evaluate their interaction with other actors on a scale of 1 to 5, the participants indicated quite low levels.

Any innovation activity was mostly restricted to employees of the firm. The involvement of other firms was only rated 2.6 out of a scale of 5, which is higher than that of other factors but still quite low. The level of interaction in the innovation process with research institutions, government, financial institutions, public consultancy services, and risk capital funds was also quite low, indicating a rather insignificant functioning of the ecosystem.

In order to identify the factors that may explain the constraints in the functioning of the innovation ecosystem, and in order to evaluate the role that can be played by the industrial association, a number of workshops were conducted, each with the participation of representatives from all areas of the ecosystem (academia, industry, and government). A total of 70 representatives participated in these workshops and filled out a short questionnaire. The number of participants from the industry was 33 (47%), from academia 20 (29%), and from the government and public institutions 17 (24%).

The focus of the workshops was the interaction and collaboration between industry, academy, and government. During the workshop the participants were asked to answer a structured questionnaire aimed at exploring their attitudes towards increasing interactions and knowledge-sharing between industry and academia, the potential benefits to be gained from this, and possible barriers to the process. In addition, they were asked to make suggestions for further actions to be taken.

All participants emphasized the importance of collaboration between industry and academia, and expressed their strong desire for collaboration and sharing knowledge, which was defined as a “win-win situation”. Nevertheless, as presented in Table 3, there were obstacles that hindered this collaboration, and therefore the linkages were very weak. The greatest obstacle according to the survey was lack of communication between the industry and academia sectors; more than two-thirds (68%) of the participants mentioned this as an obstacle to collaboration. The second obstacle was a lack of information and knowledge in the industry regarding possibilities for collaboration with academia (40% of the participants), and conversely, of academia’s knowledge of possi-

Table 2. Level of Interaction of 57 Firms with Main Actors of the Innovation Ecosystem (1 to 5).

Actors involved in the innovation process	Level (1–5) Average (s.d.)
Employees of the firm	3.6 (1.3)
Other firms	2.6 (1.3)
Financial institutions	1.5 (0.9)
Research institutions	1.5 (0.9)
Government	1.5 (0.9)
Public consultancy institutions	1.4 (0.9)
Risk capital funds	1.2 (0.7)

Table 3. Principal Obstacles for Collaboration Between Industry and Academia – % of the Participants.

Obstacle	% of participants
Lack of communication between industry and academia	68
Lack of information of the academia on the collaboration possibilities with industry	40
Lack of information of the industry on the collaboration possibilities with academia	40
Conflict of interest (different motives)	36
Differences in culture	32
Lack of innovation strategy	30
Lack of financial resources	16
Bureaucracy	10
Lack of human resources	4

bilities with industry (40% of the participants). Other factors were differences in culture and conflict of interest between the two sectors (32% and 36%, respectively).

In regards to recommended measures that should be implemented (Table 4), most of the participants (90%) expressed the need to take active measures to improve the dialogue between industry and academia. This reflects a consensus about this necessity, as expressed by practically all participants, independently of their being industrialists or academics or public servants. The need to establish a strategy for innovation enhancement was also expressed by a majority of participants (52%), slightly less by public representatives and slightly more by academics.

Another measure recommended was the provision of information to both sides – industry and academia. This was recommended mostly by members of the academia, who felt that they lacked information regarding the possibilities of collaboration with industry (30%).

Regarding FIEC's expected role (Table 5), most of the participants expected the FIEC to take a proactive role in "activating the ecosystem" by playing both the role of catalyst for the processes (66% of the participants) and that of coordinator (52%). The high priority attributed to these functions was shared by all sectors: the industrial sector, the public sector (which is expected to play this role itself, but apparently welcomes the contribution of the industrial association), and the academic sector (with a stronger emphasis on the role of catalyst than the role of coordination). Through these roles, the

Table 4. Measures to be Taken – % of Participants.

Recommended measures	% of participants
Improve the dialogue between industry and academia	90
Establish a strategy for innovation enhancement	52
Provide information for academia on collaboration possibilities with industry	30
Provide information for industry on collaboration possibilities with universities	20
Students should apply for internship in industry as part of the university curriculum	18
Make up for lack of financial resources	16
Deal with the bureaucracy	6
Increase compensation of academics in industry	4
Joint research	4

Table 5. What is the FIEC’s Role in this Context? % of the Participants.

The expected role of FIEC	% of participants
Catalyst for collaboration between academia and industry	66
Coordinator for encouraging collaboration	52
Organizing events that enable the interactions (conferences, workshops, working groups)	42
Providing information	28
Providing financial resources	6
Organizing a strategy for industry–academia collaboration	4
Initiate mutual visits of academia and industry	4

FIEC was expected to initiate activities that would encourage interaction between the parties, for example holding conferences that include both sectors.

Interesting findings show that the “provide financial resources” role was ranked very low in comparison to the other factors of the ecosystem (6%). This is reasonable when the question was directed to the industrial federation, which is not expected to provide finances. However, slightly higher but still very low evaluations were indicated for this item in the context of main obstacles and even in the context of main measures to be taken in order to stimulate innovation (16%). There is no doubt that the financial factor is crucial in the process of innovation, but it seems that all parties were aware of the fact that it comes as a later priority, after factors such as easing access and collaboration between the actors of the innovation ecosystem.

The results of the three tables are coherent and clearly state an important message: The main obstacles preventing innovation are insufficient access to knowledge and too low levels of coordination and of interaction between the actors of the ecosystem. The action to be taken is to facilitate such access, and the industrial association can provide a substantive contribution for the achievement of this goal.

Initiatives taken by the Industrial Association through the UNIEMPRES Program

The main activities of FIEC to activate the innovation ecosystem during the investigated period can be classified into five categories. Many of these activities were initiated by FIEC, conducted jointly in collaboration with other institutions and entities in the region (from the beginning or during the process). From the perspective of ecosystem building, this effort apparently was successful, since it served the target of developing interactions among actors, and therefore developing the local ecosystem.

Awareness of the importance of the ecosystem

In order to build a successful ecosystem, it was necessary to increase awareness among the actors of the idea that they must work together, and of the externalities derived from this cooperation. The following initiatives were taken:

- Workshops: The FIEC conducted workshops for all actors of the ecosystem in order to increase the awareness of the importance of interaction, and to share knowledge and information between the actors. Specific workshops were also offered to professional groups, for example industrialists, in given sectors.

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- Annual open conferences on innovation: Each conference (full day) was attended by all interested populations of actors, offering presentations by innovation leaders, case studies, etc. The very high level of attendance at these conferences (a total of more than one thousand participants) reflects the extreme importance attributed by the various populations to innovation.
- Ongoing meetings: The FIEC initiated ongoing meetings with representatives from institutions, government entities, economic entities, universities, leading business-people, and the media to increase their awareness and involvement.

All parties involved, from industry, government, and academia, were constantly aware of the importance of innovation for economic development, but the actions taken above apparently contributed to the understanding of the critical role of the ecosystem in order to achieve innovation. A positive sign of this is the increasing attendance in the workshops, open conferences, and meetings, contributing to the mutual understanding of the need and potential for collaboration.

Providing and sharing information and knowledge

A necessary component for a successful ecosystem is the provision of information and knowledge. The following actions were taken by UNIEMPRE.

- Mapping the ecosystem – The first initiative in this direction was to collect and distribute information about the current situation in the context of innovation: actors, industry, business services, companies, start-ups, universities, and other relevant institutions, as well as measures for the innovation activities. A comprehensive survey was conducted by UNIEMPRE, which mapped the relevant entities of the ecosystem. It included industry participants, start-ups, institutions, universities, and technical and business services, etc. It also included mapping of the supply measures for innovation at federal and state levels. As an indication of the increasing awareness of all parties, it is important to state that this work was done in collaboration between the industrial federation and the Federal University of Ceara (UFC), with the full support of all relevant government institutions.
- Joint development and support for innovation studies in academia – The curriculum of the teaching program was developed by the academic faculty in full cooperation with the industrial association, taking into consideration the needs of industry as well as the professional ability of the academy. Such programs had already been developed with two universities, and most of the students were industrialists.
- Information provided to firms on public programs of support for innovation, and assistance to firms in responding to calls for research proposals on innovation. Two-hundred firms applied for subsidized governmental programs, but still only a few firms fulfilled the requirements for financial support. Continuing efforts are being made in order to achieve better results, both in the field of preparation of proposals by the firms and in the field of adaption of public programs to the needs of industry.
- Support services for start-ups and pre-startups. A department was established for this purpose.
- A website was developed at FIEC that focuses on innovation. FIEC initiated the establishment of this website, which includes information, academic and practitioner publications, opinions, and cases.

All the actions taken facilitated access to relevant information and undoubtedly enriched the knowledge of all parties involved. Based on this, we can already identify a beginning of the adaptation of frameworks to the needs of innovation: improvement of public program processes, a more efficient approach of firms to support services, and better adaptation of academic research to the needs of industry.

Assisting firms in developing their innovation capabilities

In addition to the conferences and courses, FIEC initiated several activities to assist firms in developing their innovation capabilities and skills, which included direct guidance and monitoring.

- Innovation agents – This includes training for small and medium companies in the area of developing innovation by offering monitoring. This service is operated using the reach-out approach, where the agent approaches the entrepreneur in his or her area. The agents are not business consultants, and they are selected from young alumni of innovation programs. The role of the innovation agent includes helping to identify innovation potential, providing support for implementation measures, exploiting government programs, reaching finance organizations, supporting industry–academia collaboration, etc. During the initial pilot phase of this program, 19 firms were assisted, and 32 innovation ideas were identified. The information and knowledge provided by the agents were already supporting the efforts of some of the firms in launching innovation programs.
- Open Innovation – Firms were provided with the tools to enable them to be exposed to innovation thorough open innovation programs. The program started as a pilot project with two companies: a cosmetic products company and an electronics company. Both companies launched an invention competition that invited entrepreneurs, companies, researchers, students, and regular citizens to propose their ideas, giving them a chance to make their ideas a reality and take them to market. The competitions offered a cash prize. Both companies received more than one hundred applications, leading to prizes awarded to the three best ideas. New enterprises are already planning to take part in this program.

Both programs have already produced some positive results in taking advantage of the innovation ecosystem and achieving initiation of some innovation processes. Some of the firms that received the support of innovation agents have been able to identify their potential for innovation and the partners with whom they can collaborate. The firms that experienced the Open Innovation program have already reached agreements with some of the proposals and initiated a few innovation projects.

Developing the milieu’s innovation capabilities

The innovation capabilities of the ecosystem milieu were developed through learning processes and by facilitating interaction among parties in the innovation community. Several initiatives were taken to facilitate and encourage interaction among the actors of the ecosystem, and to establish a dynamic, innovative milieu by encouraging interaction and providing routines and infrastructures to facilitate it.

- Sectorial working groups – Sectorial working groups were established with representatives of universities, industry, and government for priority sectors, including low-tech. The sectorial groups developed ideas and tools for the promotion of a wider range of economic innovation according to their specific needs and characteristics.
- A council was established with mixed representatives of industry, universities, and government. It focused on measures to facilitate the triple helix interaction: industry–government–academia. The council makes policy decisions, implemented by a selected executive group.
- Regional innovation centers – In an effort to bring innovation capabilities to peripheral regions, two regional centers were established, with plans for five others. These centers act in full coordination with the industrial association, but also in collaboration with local academic centers, local government, and economic leaders.

These measures were devised and implemented on the basis of the perception of the locality aspect of the innovation ecosystem. The regional innovation centers in the periphery of the State actually did activate and reinforce the local innovation ecosystem, by coordinating between local universities and research entities, local entrepreneurs, and local government agencies. The innovation agent program mentioned above functioned much more smoothly in such regions, where access to knowledge about local social and economic conditions was more reliable. The same reasoning holds true for the sectorial working groups, which functioned more efficiently due to well-defined professional questions. Still, the activity of the council assured a full harmonization between all sectoral and local actions.

Establishing long-term sustainability of the process

In order to maintain long-term dynamism of the innovation process, the industrial association is investing efforts in the reinforcement of basic structures, such as:

- Constantly increasing the number of participating actors (firms, financial entities, research institutions, governmental bodies).
- Increasing the participation of UNIEMPRES members in governmental and academic groups.

The ultimate test of the intervention made by an industrial association is in the sustainability of the process. Actions taken by FIEC are already showing some encouraging results in this sense. The number of actors participating in the projects is constantly increasing (more researchers involved, more industrialists taking part in initiatives, more government bodies contributing), and on the other hand, there is an increased participation by members of the industrial federation in external relevant bodies (public committees, academic programs, etc.).

Conclusions

The innovation ecosystem is becoming a key factor for the competitiveness and economic growth of firms, regions, and countries. An innovation ecosystem requires a high degree of access to knowledge and of interaction among the ecosystem actors

(entrepreneurs, companies, government, academic institutions, etc.). However, in many cases there is a market failure in this process, due to the lack of consideration of externalities by the individual private firms.

The governments intervene in this process by implementing policies of support through incentives, laws, and regulations. In many cases, especially in less developed countries and even more in less developed regions, the intervention of government does not provide a sufficiently appropriate solution to the market failure. The current study shows that in such cases the local industry association can play an important role by activating and sustaining the process. It was conducted as an experimental case study in the State of Ceara, Brazil, and the role that the FIEC played as a catalyst for building, strengthening, and activating the innovation ecosystem during the period 2011 to mid-2014 was analyzed.

The findings, based on questionnaires that were completed during this study by the main actors of the innovation ecosystem in Ceara, illustrate the need for the external intervention of industrial organizations in the innovation process.

It was found that an awareness existed among the ecosystem actors (industry, academia, government, institutions, and others) of the importance of the ecosystem and of the need for increasing ties between the actors. Nevertheless, the ties between the actors remained very weak, and the functioning of the ecosystem was deficient. The findings show that the actors expected FIEC to take a leading role.

Following FIEC initiatives during the investigation period, it can be seen that the FIEC accepted the challenge of playing the role of catalyst for the building and functioning of Ceara's ecosystem. FIEC, which is an intermediary organization, has the advantage of physical and cultural proximity to the ecosystem actors, as well as a familiarity with the economic environment. These advantages enable it to take an active role in building the ecosystem in Ceara by taking several initiatives to achieve this goal, as described above: increasing awareness, providing information, developing support programs, supporting interaction between the actors, and maintaining sustainability.

These initiatives are in line with those described in previous studies showing that the role of business associations has changed over time (e.g., Nordqvist et al., 2010), from lobbying and acting as pressure groups to that of a more leading role, such as assisting in the establishment of sharing and learning capabilities and routines, and by providing a wide range of services to firms (McPherson et al., 2001).

As shown in this study, FIEC also provides a wide range of services that enable firms to take part in the innovation process, and serves as a triggering entity which brings together the ecosystem actors and the innovation network, and therefore supports the sustainability of the network.

These findings indicate that the experiment conducted in Ceara has apparently been successful. The ecosystem initiatives of FIEC started in 2011, and have continued since then. Hundreds of participants from industry, government, and universities have taken part and continue to be actively involved in the programs they offer. In many of the activities, FIEC not only initiated the process but also succeeded in recruiting other partners, which is a sign of success for ecosystem development. The continuity of the activities, with the ongoing participation of companies, institutions, and universities, shows that innovation routines have been successfully established and that the demand for them is growing.

We therefore conclude that in the competitive dynamic environment of innovation, a business organization (in this case the local federation of industries – FIEC) can play an important role in the building and strengthening of an innovation ecosystem.

Acknowledgments

We are deeply thankful to the leaders of the UNIEMPRE program and of the Federation of Industries of Ceara (FIEC) who provided us, together with our partner David Bentolila, with the opportunity to take part in this important initiative.

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