HIGH IMPACT DRIVERS IN INNOVATION ECOSYSTEMS: THE CASE OF TECNOPUC-FBK JOINT LAB

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Abstract. *Innovation ecosystems are developing new organization models of collaboration towards sustainability and creation of high impact. It requires the development of new ways of collaboration, both from the academic and company's point of view. This research analyzes the way of working of two innovation ecosystems that are highly supported by Information and Communication Technology (ICT). This way helps research, companies, and society to address their needs by the identification of four impact drivers of success, which are: consultancy, collaboration, education, and mobility. The main findings observed during the long-term collaboration of two innovation ecosystems extend the field of living labs and innovation platforms. Further research could validate and measure the success of the four drivers in the generation of high impact. The research presents practical implications for managers of innovation ecosystems.*

Keywords: *innovation ecosystems; innovation platforms; collaborative innovation; open innovation; living labs.*

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1 INTRODUCTION

Organizing innovation for high impact is an emerging issue for researchers and managers, where the role of key actors can be crucial for the high impact of the results of innovation ecosystems, an argument supported by Pisano and Verganti (2008). Innovation parks and business ecosystems seem to be the most effective ways to create environments capable of delivery both business and societal impact towards sustainability, which is also supported by Seebode et al. (2012) and Adner et al. (2017).

This research use as reference the definition of innovation proposed by Baregheh et al. (2009), which is "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace". This definition is particularly relevant because is based on an in-depth analysis of sixty definitions of innovation from a multidisciplinary perspective.

Towards understanding the development of complex innovation process, this research explores the collaborative innovation models capable of delivering measurable results to companies (e.g. Bogers et al. 2017) and society, in particular, by addressing key drivers and exploring the innovation ecosystems around living labs. Additionally, this research adopts the definition of Katzy et al. (2012) for living labs, "innovation intermediaries that coordinate network partners for the execution of innovation processes with the engagement of end-users for which they provide the technical and organizational infrastructure", which is based on the research of Howells (2006) and Almirall and Wareham (2008).

Innovation ecosystems are a powerful way of creating conditions to catalyze economic growth, and there is a need to explore its success factors (Oh et al. 2016), in particular, towards the societal high impact by increasing employment rate and quality of life of local citizens. From this perspective, Winter et al. (2017) argue about the success factors of mobile ecosystems by analysis the role of technology in creating platforms of collaboration for companies and users.

This research expands the theory by creating new drivers for performance measurement in innovation ecosystems, as suggested by Ritala and Almpanopoulou (2017). And, this research also explores new opportunities for identifying new constructs to be measured, which could be directly related to ecosystem performance and capability (e.g. Adner et al. 2017).

From this perspective, the research question is: *What are the main drivers for the collaboration of innovation ecosystems that enable performance measurement towards the high impact on business and society?*

2 LITERATURE REVIEW

The background research used to understand this phenomenon is at the intersection between organizational innovation (such as living labs) and innovation platforms (e.g. Gawer and Cusumano, 2014). Furthermore, the organization innovation body of knowledge focused on living labs (e.g. Battisti, 2014) leverages Information and Communication Technology (ICT) as the central mechanism of support for high impact creation, via the participation of organizations and people (e.g Stewart and Hyysalo, 2008). It enables powerful actions for dealing with societal challenges, in particular exploring key actors, such as social entrepreneurs' roles and motivations for driving high impact, as suggested by Surie (2017).

Technology and innovation ecosystems can be considered organizational structures aimed at enabling research, development, and production of technology towards the development and growth of companies, as supported by Clarysse et al. (2014). Furthermore, Giugliani et al. (2014) argue about the importance of ICT to support the governance and development of innovation ecosystems (e.g. Bogers et al. 2017), in particular considering the complexity involved in the ecosystems after worldwide financial and social crisis.

Following this line of thought, Battisti (2014) argues the collaboration between companies and society towards undressing the most pressing issues must be a key driver, and he suggests the creation of living labs as the main mechanism to foster innovation for high impact creation in the academia, in the business arena, as well as in society. It could be useful for supporting ecosystem managers (Borgh et al. 2012), in particular, when companies are exploring the context-based experience provided by the key people in such ecosystems (e.g. Almirall and Wareham (2011).

The knowledge-intensive companies play a crucial role in the success of innovation ecosystems and creation of high impact, as supported by Chiaroni et al. (2008), Battisti (2012) and Borgh et al. (2012). Aiming at extending the value creation of knowledge-intensive, Pompermayer et al. (2016) and Battistella et al. (2017) argue about the importance of creating the mechanisms (e.g. business accelerators) that enable the launch of global-born companies, which potentially can create disruptive platforms for long-term competitive advantage.

In this sense, Gulati (1999) argues that network resources accessed by each company could be directly related to their company performance and Gulati et al. (2000), argue that the organizational network's configuration could be used to access learning and know-how to improve the innovation's capacity and performance. Furthermore, Brass et al (2004) suggest that actors are embedded within networks to obtain opportunities and overcome constraints and Gulati et al. (2009) argue that competitive advantage derives from identifying the contingent role of partnering experience.

From this perspective, Laursen and Salter (2006) found that in early stages of the product life cycle when the state of technology is in flux, innovative firms need to draw deeply from a small number of key sources of innovation, such as lead users, component suppliers, or universities. Linking competitive advantage with innovation Bell and Zaheer (2007) suggest that knowledge could be accessed across the organizational boundaries using networks of partners aiming at the production of innovation. In order to develop a better competitive performance, networks must have a company leader acting as a kind of catalyst hub of knowledge and coordination.

Considering that social proximity could be considered a key factor for the success of the innovation development because it is socially embedded relations between agents, Boschma (2005) suggest that these relations between actors are socially embedded when they involve trust based on friendship. In this sense, Dhanaraj and Parhe (2006) suggest the importance of the network position of the hub companies (i.e. it could be considered the managers of the innovation ecosystem) and the ability of this hub to manage dispersed resources and capabilities of network members. Additionally, Boschma (2005) presents the five dimensions of proximity for collaboration between organizations, which are: cognitive, organizational, social, institutional and geographical proximity.

Getting insight from the University role inside the partnership of organizations aiming at innovation development, Laursen et al. (2011) suggest that in local territories the geographical distance between a company and a university matter. And, they argue there is a high influence of geographical proximities and quality of the universities in the decision making of companies to collaborate with universities, such as in technology transfer for innovation. Furthermore, they found that geographical proximity is a key success factor for university-firm collaboration, and they suggest that the effects of this collaboration are very significant for value creation of the company's core capabilities and competitive advantage.

Understanding the dynamics of innovation ecosystems could be a way to predict and act towards high impact. In this way, Ghallab et al. (2014) argue the need to focus on the key actors

to address technology development, "action" in a conceptual way is a world-transformation step that can be used to perform a task (i.e. a specific action that affects the process of solving needs). Furthermore, this specific action could change based on the environmental dynamicity of the place where this task is performed, an argument supported by Pistore et al. (2006).

This research takes as reference the definition of Davis et al. (2009), which stated that dynamic environments are characterized to present four main variables: velocity - the rate at which new opportunities emerge; complexity - the number of features of an opportunity that must be correctly executed to capture an opportunity; ambiguity - the lack of clarity such that it is difficult to interpret opportunities; and unpredictability - the amount of turbulence in the flow of opportunities such that there is less consistent patterns.

Dynamic environments require rapid developments within innovation processes and quick innovation outcomes of specific projects or joint collaborations. It is a requirement to deal with stakeholder needs while exploring the advantages of technology evolution, in particular, due to the nature of temporary advantage of products launched in the markets by SMEs (e.g. Battisti, 2013). Furthermore, Ghallab et al. (2016) argue that literature models are mature to deal with some project constraints, as time, resources, continuous change in the requests of society, the need to manage the request of multiple stakeholders, and uncertainty.

The need of creating new collaborative planning, in order to handle time and uncertainty in a proper way is a key factor (Ghallab et al. 2016), in particular when considering the dynamics of the environment (e.g. Pistore at al., 2014). Moreover, Schweitzer et al. (2011) suggested that open innovation is more beneficial for companies in dynamic, rather than stable conditions, and Prikladnicki et al. (2003) argue that global open software development can increase the competitive advantage of companies.

3 METHODOLOGY

This paper applied "action research methods" considering the dynamicity of the phenomenon under study. It focuses on clinical inquiry research (Schein, 2008), which is the most appropriate method to describe and analyze the collaboration between the actors and their ecosystems. In particular, clinical inquiry research enables the researchers to collect data from the empirical field in the most actionable way, obtaining more in-depth and detailed information when compared with other research methods.

This research also leveraged on the case study methodology principles proposed by Yin (2009) and Eisenhardt and Graebner (2007). In particular, they suggest single case studies can

enable the creation of emerging theories because in single cases the researcher can apply their theory exactly to the particular case, and as whole inductive research is a good tool to develop, measure, and create new research propositions. In the same way, as suggested by Edmonson and McManus (2007), our research focuses on the creation of new avenues of research in the field of innovation ecosystems, and it was based on the high diversity of materials collected from the empirical field, which enabled the researchers to develop new positive recommendations for the managers of the innovation ecosystems.

The data was collected from the period between Jan/2013 and June/2017. The main source of data was the direct observations at the workplace of TECNOPUC and FBK, and interactions of the researchers with key actors inside the two innovation ecosystem. It includes the public and private organization involved, as well as citizens in the cities of Porto Alegre/Brazil and Trento/Italy. Furthermore, secondary data from the websites of the innovation ecosystems, as well as internal archives were used to enrich the study.

The mains motivation for the case selection is the fact the researchers actively working in the two institutions during the research period, having in-depth access to confidential information that was crucial for the case analysis and findings. Furthermore, it was necessary day-by-day interaction with the middle and top management of the two ecosystems, in order to understand the key public and private institutions that interact with TECNOPUC and FBK, and the way they collaborate towards innovation and high impact.

4 CASE ANALYSIS

This research analyzed the collaborative model of innovation developed by TECNOPUC, the Science and Technology Park of Pontifical Catholic University of Rio Grande do Sul (PUCRS) in Porto Alegre, Brazil and Fondazione Bruno Kessler (FBK) in Trento, Italy. This model was defined “TECNOPUC-FBK Joint Lab”.

TECNOPUC is a technology and science park with more than 120 companies and 6000 people, working on creativity and innovation projects in strong collaboration with PUCRS. The main actors, resources, and individual innovation models have been mapped by a recent study of Lamb et al. (2016), which prove the potential impact of this ecosystem. Their goal is to create a community of interdisciplinary people from research and innovation background, that is built on the academic, industrial and government collaborations, which is capable of improving the competitive position of TECNOPUC in the world and enhance the quality of life of citizens. In terms of internationalization, an important partner is UK Trade & Investment (UKTI), an

agency from the United Kingdom responsible for supporting the international exchange of key projects. Moreover, the park is a National and Latin-American reference.

FBK is an internationally recognized Research Foundation with 7 research centers, 410 researchers, 2 specialized libraries and 7 laboratories. FBK conducts scientific research in the areas of Information and Communication Technology, Advanced Materials and Microsystems, Theoretical and Nuclear Physics and Mathematics Research. The focus is to conduct excellent research and foster the realization of software systems, experimentation in realistic settings, validation on the field by living labs, industrial applications and high impact to market and society, which prove the high commitment on addressing societal impact. In addition, FBK carries out its mission by disseminating and publishing results and transferring technology to companies and public entities.

From this perspective, and towards combining the two innovation ecosystems for the creation of high impact in society, the Joint Lab performed the following actions:

- **Special projects:** Development of research and technology projects for private firms, local governments, or other public agencies to design tools to foster better organizations and societies, leveraging on fundraising from European and Brazilian funding agencies; considering project complexity as a key factor.
- **Education:** Creation, development and operational support of joint Ph.D. programs and post-master courses in business, innovation, knowledge management and interdisciplinary studies, which are strongly connected with the fields of Engineering, and Computer Science.
- **Consultancy:** This action is related to the consultancy services to public and private organizations, addressing the intersection between innovation management, knowledge management, and other interdisciplinary areas.
- **Social Innovation:** Development of ICT-based social innovation projects. The lab explores this paradigm to research, develop, deploy and test new technologies, to improve organizations, cities, and societies, in order to help on solving social issues in Brazil and Italy, boosting to merge interdisciplinary fields.
- **Exchange of people:** Exchange of students, researchers and faculty staff between the parties, in order to promote the exchange of knowledge, joint teaching activities and seminars, and face-to-face collaborations in projects.
- **Co-creation:** Development of creativity and co-creation activities for new processes and services based on design thinking for understanding needs, and agile methodologies to implement technologies that cope with stakeholders' needs.

- **Business acceleration:** Synergy for the acceleration of new business opportunities between companies and final customers, as well as technology transfer from the research to the target markets; considering the management under uncertainty a key driver for the selection of startup for acceleration.
- **Go-to-market:** Support the launch and growth of high scalable start-up around the innovation ecosystems (e.g. technology-based innovation platforms), in order to enhance technology and business developments towards the go-to-market actions.

From the analysis of the activities performed by the Joint Lab, this research categorizes the main similarities and complementarities of the lab towards the identification of the main drivers of success. Thus, the main observed "similar characteristics" are presented in Table 1.

Table 1: Joint lab similarities

TOPIC	DESCRIPTION
Co-working	Companies are co-located in close collaboration with researchers.
Labs with Corporations	Special laboratories with key companies in FBK (e.g. TIM, Engineering and FCA Group) and in Tecnopuc (e.g. HP, Dell, Stefanini and Microsoft).
Industrial PhD students	Students that are co-funded by the companies for the development of state-of-the-art research to address practical problems of the companies.
Research field	Tecnopuc and FBK main research field is ICT, which is also the domain that enables the major number of opportunities for joint research that enabled innovation.
Territorial level	There is strong synergy with regional and local governments in Trento and Porto Alegre, as well as the strong synergy with other innovation actors. FBK with HIT (Hub Innovazione Trentino) and Tecnopuc with the Hub of Science and Technology with UFGRS (The Federal University of Rio Grande do Sul).

Source: Authors

This research observed the main "complementary characteristics" between the ecosystems, which can be considered very useful for the understanding of the importance of collaboration between FBK and TECNOPUC, as presented in Table 2.

Table 2: Joint lab complementarities

PILLARS	FBK	TECNOPUC
Research towards innovation	High H-index of researchers with a good potential for innovation	Transfer of research into business opportunities
Management of innovation	Expertize in capturing financial resources from H2020 framework	Provide experience of managing projects in the agile way
Marketing opportunities	Develop high quality technology to transfer to Brazilian companies	Offers a hub to access Latin America market
Education	Receive international students from TECNOPUC	Provide Ph.D. students to join the international Ph.D. program of FBK

Source: Authors

5 DISCUSSIONS AND CONCLUSIONS

The main contribution of this research to the field of innovation ecosystems is the empirical classification of the TECNOPUC-FBK Joint Lab actions in four drivers of success. These drivers proved to be crucial to keep the strong collaboration of the two innovation ecosystems towards the business, research and societal high impact, as presented in Table 3.

Table 3: Four drivers of success

DRIVER	DESCRIPTION
1. **Consultancy:** Public and private funding support to address business and social needs	It is about carry-out external consultancy for developing and managing strategic projects, in order to understand and address the requests of public and private organizations, including co-creation activities with citizens.
2. **Collaboration:** Small-medium companies are developing products with society and academia	It is about the supporting of new business opportunities between companies towards strong collaboration and knowledge creation, including soft-landing of start-up between Trento and Porto Alegre.
3. **Education:** Companies and society needs are empowering academic to promote joint research	It is about the promotion of Joint PhD programs in the areas of Computer Science and Materials Engineering and Technology, which is key to prepare the next generation of tech people that should be ready to unpredictable social challenges.
4. **Mobility:** Researchers are collaborating together in specific physical places	It is about to provide the physical infrastructure to support people to have a period abroad, focusing on understanding the pain points of researchers, companies, and society.

Source: Authors

The top management of the two ecosystems seems to take into consideration the management of innovation under uncertainty as a critical factor, considering that as the main issue that is pressing Italy and Brazil in the current economic, social and political scenarios. On one hand, the Italian economy is not growing, and the unemployment rate is increasing. It is also caused by the fact that European Union is changing its economic and social models and movements of separation of frontiers are growing. On the other hand, the forecasted Brazilian economic growth seems to be far from the expectations of the financial markets, thus not following the BRIC results in terms of economic development.

By understanding joint lab activities, this research identified four drivers for the success of sustainable collaborations in research and innovation, expanding open innovation theory such as the research of Bogers et al. (2017). Furthermore, these drivers extend the fields of living labs (e.g. Katzy et al. 2012) and innovation platforms (Gawer and Cusumano, 2014), in

particular by confirming the elimination of bottlenecks connections among actors is a key success factor of innovation ecosystems, as argued by Oh et al. 2016.

The practical implications for academia, companies, and society are summarized as follows: intensive work together considering the agendas of organizations; focus on narrow topics and deliver small and impactful results; apply Agile methodologies to develop research and innovation; prioritize key actions to deliver impact to the industry and society; satisfy stakeholders, considering the different priorities for the Countries/Regions.

Limitations are the analysis of two innovation ecosystem in a qualitative way, focusing on finding similarities and complementarities for the creation of high impact driver. This limitation open avenues for further research in innovation platforms and living labs fields, in particular, researchers could validate the drivers via a quantitative method, as well as create a new measurement of performance model that includes the four drivers. Furthermore, the open innovation field of research could be extended by measuring the effects (i.e. short, medium and long-term) of the joint lab activity throughout the involved local territories.

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