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Adaptation, measurement, and comparison of the innovation quotient in a technological academic environment in Brazil and France.

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Abstract

This paper identified the perception of students of engineering courses of a Technological Education Institution in Brazil and France, about the culture of innovation in the academic environment in which they are inserted to enhance the opportunities for university-industry interaction. An exploratory survey was conducted with a quantitative approach, based on the adaptation and application of the innovation quotient tool. The results reveal an important difference between the studied universities; one environment reached a level of excellence, while another is an environment where much is said, but little of done in relation to innovation. Improve the index found, for the construction of an innovative environment that can be experienced by the academic community, is necessary, thus, in innovation and interaction opportunities experienced by future engineers in the development of their industrial careers, they become the link between their educational institution and the industry, as a potential partner for interactions in innovation and technology transfer.

Keywords: Innovation, University-Industry Interaction, Innovation Quotient, Technology Transfer.

1 Introduction

Collaboration between industry and the university faces significant challenges. While university functions are, above all, teaching and creating new knowledge, private companies are focused on capturing the valuable knowledge that can be leveraged for competitive advantage (Bruneel et al., 2010).

Although these issues have been recognized in the literature regarding university-industry interactions (U-I), relatively few studies have investigated the nature of the barriers and factors that can intimidate them. Due to the central importance of this issue, as evidenced by efforts toward a policy that will build and strengthen U-I relationships, lack of research on barriers to collaboration becomes a serious failure to develop effective policies (Teece, 1986; Etzkowitz and Leydesdorff, 1997; Etzkowitz, 2008; Bruneel et al., 2010; Etzkowitz, 2012).

The university should take the role of an economic agent of law, and the production of scientific knowledge becomes a tool for revenue generation, becoming an "economic development" (Etzkowitz, 2008).

Etzkowitz (2012) defines "*Permeable Borders*" as an interface that provides ease of movement across borders, being a key step in the development of an entrepreneurial university. In a sociological analysis, many institutions protect and retain their knowledge within the limits of their own borders, concentrating domain over knowledge, keeping “*insiders*" and "*outsiders*" of this domain. However, the university has very strong boundaries, borders are very restricted, and this can be a problem for regional innovation. The maintenance of this excessively restricted border can work against the interaction that is needed to encourage university-industry integration.

Brazil is a country in transformation, occupying a prominent place among the world's largest economies, but is not prepared for the position it occupies. Although it is a country with several competitive advantages, land, natural resources, scientific knowledge, an important country in the generation of knowledge, it has weaknesses. It is an unprepared country, hence the need for government, industry, academia, and society in general to join efforts to improve the country, because opportunities are associated with this process (Prata, 2012).

Due to several reasons, Brazil has a low technological innovation index in many sectors, being a country of few engineers, and this needs to be improved. Transforming the country into a scientific, technological and innovative power is a big challenge (Prata, 2012).

Brazil's biggest challenge is to make the industry invest more in research and development. World Bank studies that show the distribution of R&D&I amongst the countries comprising G20 (group of 20 largest economies in the world), indicate that investments from public sectors, are within the same level, with values ranging from 0.6% to 0.9% of the GDP.

What draws attention in this context is the wide variation in the values coming from the private sector, ranging from 0.16% to 3.0% of the GDP, mainly in the industrial sector, and this is the great challenge; to make the industrial sector capable of investing more in research and development, which will reflect in the way that Brazil builds its wealth.

Of the total exported by Brazil, only 17% is associated to the technological context, the most worrying issue is that this figure frozen at this level (World Bank, 2016).

The Federation of Industries of the Paraná state - Brazil (FIEP), has held monthly research on the cyclical performance of the industry since 1986, and has used a mechanism called "*Industrial Survey*" for the past twenty editions, which is an annual publication that gathers and expresses the industrial community of Paraná state's views. This Industrial Survey 2015/2016 counted with the participation of 371 Paraná industrial companies from all regions of the state and of all sizes.

One result in particular draws attention in the Industrial Survey 2015/2016, is that only 10% of the industries use the university in search of knowledge, partnerships, new technologies or innovations (Fiep, 2016). This research shows the great gap that exists between the industrial sector and the university.

The university-industry interaction processes in developing countries, largely boil down to activities based on provision of services. Changing that tends to be a long-term effort, a way of acting in this direction would be the diffusion of the innovation culture to the industrial sector.

1.1 Assumptions

• The first assumption on which this article is based is that efforts to increase university-industry interaction is not sufficient, it is necessary to change the focus of this interaction, adding value through innovation. Instead of providing services, the interaction should be focused on partnerships driven by innovation, bearing fruitful results for both partners.

• The second assumption is based on interpersonal communication and dissemination through the graduates, engineers who were students at the university, current engineering students, who take part in the market, both as employees and as interns. This group intrinsically carries information about their institution, and as opportunities for innovation emerge, the information about their institution may be disclosed, promoting the great value of partnerships, providing investment multipliers to the academy and the market.

Therefore, it is necessary to measure, know the vision of engineering students, future engineers, graduates who are in the labor market, on the innovation potential of the University they attend or attended.

2 Background

2.1 The IQ innovation - innovation quotient

The terms related to the word innovation are highly valued, and the self-proclamation, innovative institution, and innovative company, has become a common practice in both the private sector and the public sector.

Today's executives want their companies to be more innovative. They consume piles of books and articles, participate in conventions and courses on innovation, hoping to find the elixir of success (Rao and Weintraub, 2013).

Both experience and research show that sustained innovation is the product of an innovative culture. Unfortunately, the corporate culture is a slippery concept. Scholars define how the group of attitudes, experiences, values, rules, beliefs and assumptions have involved managers and employees; these items, in turn, guide behavior. Unfortunately, such culture defining elements are equally slippery, with the result that any executive who wants to create a culture of innovation will have no way of measuring the current culture; and without measure, he will find no clear point as to where interventions should be made to create positive change. Recognizing this problem, Rao and Weintraub (2013) proposed the following:

• Identify the building blocks of innovation culture and parts: which component should be called "factors" and "elements", respectively, and;

• Development of a practical tool that any executive or manager can use to measure the strength of the culture building blocks under his control.

They called this measure "IQ - Innovation Quotient."

Rao and Weintraub (2013) argue that a culture of innovation can be broken down into 6 modules and each module into 3 factors, that are represented in Fig 1.

Fig 1. Building Blocks of IQ Innovation

Source: Elaborated based on Rao and Weintraub (2013).

These building blocks are responsible for generating 54 elements, which can be measured by the intensity with which they exist in the organization. Measuring "IQ" opens the door to concrete actions to improve the climate for innovation.

To calculate the innovation quotient of a team, department or company, the research should be applied to members of the chosen sample.

Survey respondents should rate their organization on each of the 54 elements, on a scale of 1 to 5, using the following scale: 1 = Not at all; 2 = To a small extent; 3 = To a moderate extent; 4 = To a great extent; 5 = To a very great extent.

The overall average scores for elements are further averaged to provide the factor score, and the factor averages similarly result in the building block average. That average of the six building blocks is what is called the group's "Innovation Quotient."

A practical result of this evaluation tool is that it can be applied at any level. Even in a company with a caustic culture, building innovative thinking and action is possible. The leader of any unit, division, department or team, can determine the innovation quotient of their area of responsibility, then start a campaign to make positive change (Rao and Weintraub, 2013).

2.2 Innovation from the Standpoint of University-Industry Interaction

Some sectors criticise the universities for being more skilful at developing new technologies than transferring them to the private sector (Siegel et al., 2004). A strong interaction between the scientific base and the industries has been identified as crucial to improve the performance of an innovation system (Heinzl et al., 2013).

The Bayh-Dole Act was passed to create patent procedures between the universities and industries of 1980, and the LOU Act, The Fundamental Law of Universities Act of 2001, drastically changed the incentives for industries and universities to engage in innovation. These procedures simplified technology transfer by instituting a uniform patent policy and removing several restrictions to licensing (Siegel et al., 2004), and represented a transition to a university model that chiefly targets technology transfer (Berbegal-Mirabent et al., 2013).

Furthermore, these acts allowed universities to hold patents that arise from federal research grants. The authors of the Bayh-Dole and the LOU Act stated that a rational federal policy for the transfer of technology, university property, and intellectual property management would streamline commercialisation because it provides the universities with greater flexibility to negotiate licensing agreements, and the industries would be more willing to engage (Siegel et al., 2004; Berbegal-Mirabent et al., 2013).

Students, professionals, and policymakers recognise the innovative potential of these acts to narrow the gap between industry and technology transfer of universities around the world. These laws promote the creation of university-industry partnerships, and encourage the dissemination of innovations from the universities to the industries (Berbegal-Mirabent et al., 2013).

Other reforms include the modification of the LOU Act in 2007 and the enactment of the strategic framework of the Spanish university in 2009. The latter reform targets the transfer of knowledge between universities, improving the exploitation of innovation results, translating the Spanish system of higher education into legal and structural changes, and establishing new political frameworks, governance structures, and funding priorities to help universities increase their commitment with their regions (Berbegal-Mirabent et al., 2013).

According to the theory of national innovation systems from around the world, the characteristics of the systemic context, in terms of types of institutions, institutional contexts, and the relationship between them, affect the ability of the industries to develop innovations because they determine the allocation of resources and capabilities that are available to industries to support their innovative activities. The actors that come into play in this context are public and private research organisations, knowledge infrastructures, university-industry interfaces, intermediary organisations, and the labour market with its own characteristics (Baglieri et al., 2014).

All these different actors follow different standards and rules of behaviour, and the connections between them shape the relationship between the "production and innovation environments", and influence the adoption of innovative environments (Berbegal-Mirabent et al., 2013).

Hewitt-Dundas (2012) reports that, although the positive effect of universities in relation to industrial innovation has been widely studied using the level of data on innovation in industries, bibliometric studies of patent citation (Wada, 2016), and studies on how these benefits are affected by organisational and institutional differences between universities are less well known.

The knowledge about the factors that determine the impact of universities in the innovation systems and the different functions they can perform is quite incomplete. This is surprising since in almost all the countries university research is devoted to the subject, with quality, heterogeneity, in terms of property, size, and disciplinary variation, for an even greater contribution. If this heterogeneity is reflected in disparities in innovation and technology transfer, questions should be asked about the adequacy of uniform policies geared to universities to promote and support an approximation between universities and industries (Hewitt-Dundas, 2012).

The interaction between innovation, entrepreneurship, and regional economic development has become a central theme in many political circles (Tijssen et al., 2016). Inspired by examples such as Cambridge in the UK, Cambridge in the USA and, more emphatically, the phenomenon of Silicon Valley, nearly all European regions are currently seeking the ingredients needed for endogenous economic growth, based on the capability of innovation and entrepreneurial dynamics that can be mobilised in a particular region (Hewitt-Dundas, 2012).

A broader view emerges from greater recognition of the fundamental role of knowledge and innovation in economic growth, technological performance, and international competitiveness. Consequently, the concept of "innovation systems" has been generally accepted since the mid 1980s, and has been used as a framework to create innovation policies and appropriate institutional arrangements to support these policies (OECD, 1999).

In these models, the institutions that generate knowledge, such as public and private universities and research laboratories, and, more recently, government agencies, are considered key actors in terms of the innovation potential of society (Looy, et al., 2011).

Complementary contributions can be found in works on the "triple helix" concept that gained the spotlight in the second half of the 1990s (Leydesdorff and Etzkowitz, 1998; Etzkowitz and Leydesdorff, 2000).

Looy et al. (2011) found a strong positive relationship between scientific knowledge, the productivity of universities, and their industrial performance. They also report that universities with a strong scientific production seem to be in a better position for the development of industrial activities, and suggest that industrial partners consider the scientific results of universities as criteria for the selection of academic partners. The incentive for innovation largely depends on the effective management of scientific knowledge (OECD, 2003).

According to Bekkers and Freitas (2008), the importance of university knowledge for industrial innovation has been widely studied. There seems to be some consensus regarding the positive effect of academic research on the development of industrial innovation. In particular, some actors have shown that around 10% of new products and processes introduced by industries would never have been developed, or with significant delay, without the contribution of academic research.

In spite of this evidence, there is no consensus on the role of universities in the development of industrial innovations, or in the channels through which knowledge flows between universities and industrial companies (Bekkers and Freitas, 2008).

In recent years, industrially developed counties have identified the cooperation between industry and public research universities as a significant political priority (OECD, 2007; Karaulova et al., 2016). Similarly, students of innovation economy have analysed the modalities through which public and private interaction occurs (Abramo et al., 2010; Abramo et al., 2011; Karaulova et al., 2016).

In the view of Ahrweiler et al. (2011), innovation activities are currently conducted in extremely complex networks with heterogeneous actors, multidimensional interactions, and multiple knowledge flows. The increasing complexity creates new challenges for understanding the innovation process. In order to understand phenomena such as university-industry relations, and capture the global effect, it is no longer possible to rely solely on the traditional methods of analysis.

According to Ahrweiler et al. (2011), a possibility would be modelling based on the involved agents since it provides a broader perspective based on micro interactions between heterogeneous actors. This methodology conveys the emergence of macro dynamics from the micro relations, exchanges, and connections between heterogeneous actors restricted to individuals and rational organisations, thus capturing, in a relatively simple way, most of the complexity of the real world.

The results presented by Ahrweiler et al. (2011) show that cooperating universities increase the levels of knowledge and competencies of all the actors involved, increase the variety of knowledge between companies, and increase the diffusion of innovation in terms of quality and speed. Moreover, companies that interact with universities are more appealing to other companies, leading to the consideration of new partnerships. However, no direct relationship has been found between university contributions and economic success.

The importance of external connections for innovation has been highlighted in literature and empirical research, but industries that seek to explore external ideas to complement internal knowledge still face some problems, especially if they resort to sources that are not included in the supply chain, such as suppliers and clients, but, instead, seek public research organisms, such as universities (Comacchio et al., 2012).

In addition to the importance of developing a network between the three systems of innovation (the triple helix, university-industry-government relations) (Leydesdorff et al., 2006), particularly between universities and companies (Siegel et al. 2003), several studies suggest that these relations are well below their potential (Siegel et al., 2004; Yusuf, 2008).

The difficulty in creating a market for technological knowledge is one of the reasons for this, as pointed out in a study on industry-university research collaboration in the Italian context. In this study, Abramo et al. (2011) found evidence that problems in the flow of information are the cause of inefficiencies.

According to Okamuro and Nishimura (2013), the open innovation system, especially research collaboration, has attracted considerable attention worldwide. Through university-industry cooperation, the university researchers can access research funds and benefit from the ideas and knowledge of private companies, whereas companies can absorb and use the advanced scientific knowledge created in the universities.

Juanola-Feliu et al. (2012) describe the new role of the university inside the value cycle of research and development, revealing the interaction stage between the needs of industries, innovation, and the university. This effort should be given priority and made effective to reach financial results for an innovation.

It is known that the well-being of more advanced economies is at risk, and that the only way to resolve this situation is through the regulation of knowledge economies with a focus on the convergence of sciences and technologies. To reach this ambitious goal, it is imperative to enhance the performance of each dimension in the “knowledge triangle”, that is, education, research, and innovation (Juanola-Feliu et al., 2012).

Studies stress the importance of strategies that optimise added value and marketing during the R&D process to fill the gap between the laboratory and market, and thus ensure the successful commercialisation of new technology-based products (Musso, 2009).

It is also widely accepted that the role of universities evolved from conventional education and research to serving as a centre of knowledge and the promotion of innovation. In this role, the universities became deeply rooted in the national innovation systems and key actors in the promotion of technological innovation and the economic development of their regions of influence (Juanola-Feliu et al., 2012).

Today, universities actively seek to promote interactions to link research to application and market. As a result, the processes of creation, acquisition, diffusion, and implementation of knowledge are in the heart of university functions (Juanola-Feliu et al., 2012). One way of ensuring the success of these initiatives of interdisciplinary interaction is research conducted in a way that scientific knowledge flows into scientific collaboration within and among the academic disciplines (Bellotti et al., 2016), and among engineers, researchers, and industries, while remaining involved in efforts to develop or improve the devices and processes (Juanola-Feliu et al., 2012).

Powers and Campbell (2011) conducted a study in which one effect of emerging norms in relation to confidentiality and an increasing lack of interest in divulging the results, stimulated by a culture of commercialisation and income generation, was considered the cause of the decline in the traditional form of disseminating knowledge and collaborative projects with researchers in other institutions; a phenomenon that seems to threaten that which is widely considered the essential drive of innovation.

This phenomenon has hindered innovation through the traditional mechanisms of publishing (research and collaboration), and questioned the success of policies to accelerate the use of generated knowledge outside the board of academic laboratories, to society (Powers and Campbell, 2011).

3 Methodology

This study was based on the adaptation, to the academic environment, of a tool that was originally developed for the industrial environment. This tool adapted to the academic environment is shown in table 1.

Table 1. Building blocks of the tool adapted for the academic environment

VALUES					
(Entrepreneurial, Creativity, Learning)	**1**	**2**	**3**	**4**	**5**
We have a burning desire to explore opportunities and to create new things.					
We have a healthy appetite and tolerance for ambiguity when pursuing new opportunities.					
We avoid analysis paralysis when we identify new opportunities by exhibiting a bias towards action.					
We encourage new ways of thinking and solutions from diverse perspectives.					
Our workplace provides us the freedom to pursue new opportunities.					
We take delight in being spontaneous and are not afraid to laugh at ourselves.					
We are good at asking questions in the pursuit of the unknown.					
We are constantly experimenting in our innovation efforts.					
We are not afraid to fail, and we treat failure as a learning opportunity.					
BEHAVIORS					
(Energize, Engage, Enable)	**1**	**2**	**3**	**4**	**5**
Our teachers inspire us with a vision for the future and articulation of opportunities for the organization.					
Our teachers frequently challenge us to think and act entrepreneurially.					
Our teachers model the right innovation behaviors for others to follow.					
Our teachers devote time to coach and provide feedback in our innovation efforts.					
In our university, people at all levels proactively take initiative to innovate.					
Our teachers provide support to project team members during both successes and failures.					
Our teachers use appropriate influence strategies to help us navigate around organizational obstacles.					
Our teachers are able to modify and change course of action when needed.					
Our teachers persist in following opportunities even in the face of adversity.					
CLIMATE					
(Collaboration, Safety, Simplicity)	**1**	**2**	**3**	**4**	**5**
We have a community that speaks a common language about innovation.					
We appreciate, respect and leverage the differences that exist within our community.					
We work well together in teams to capture opportunities.					
We are consistent in actually doing the things that we say we value.					
We question decisions and actions that are inconsistent with our values.					
We are able to freely voice our opinions, even about unconventional or controversial ideas.					
We minimize rules, policies, bureaucracy and rigidity to simplify our workplace.					
People take responsibility for their own actions and avoid blaming others.					
Our people know exactly how to get started and move initiatives through the organization.					
RESOURCES					
(People, Systems, Projects)	**1**	**2**	**3**	**4**	**5**
We have committed leaders (teachers) who are willing to be champions of innovation.					
The university has access to innovation experts who can support our projects.					

The university has the internal talent to succeed in our innovation projects.					
The university has the right recruiting and hiring systems in place to support a culture of innovation.					
The university has good collaboration tools to support our innovation efforts.					
We are good at leveraging our relationships with suppliers and vendors to pursue innovation.					
We give people dedicated time to pursue new opportunities.					
The university has dedicated finances to pursue new opportunities.					
The university has dedicated physical and/or virtual space to pursue new opportunities.					
PROCESSES					
(Ideate, Shape, Capture)	**1**	**2**	**3**	**4**	**5**
We systematically generate ideas from a vast and diverse set of sources.					
We methodically filter and refine ideas to identify the most promising opportunities.					
We select opportunities based on a clearly articulated risk portfolio.					
We move promising opportunities quickly into prototyping.					
We have effective feedback loops between our organization and the voice of the customer.					
We quickly stop projects based on predefined failure criteria.					
Our processes are tailored to be flexible and context-based rather than control-and bureaucracy-based.					
We quickly go to market with the most promising opportunities.					
We rapidly allocate resources to scale initiatives that show market promise.					
SUCCESS					
(External, Enterprise, Individual)	**1**	**2**	**3**	**4**	**5**
Our customers think of us as an innovative organization.					
Our innovation performance is much better than other educational institutions.					
Our innovation efforts have led us to better financial performance than other educational institutions.					
We treat innovation as a long-term strategy rather than a short-term fix.					
We have a deliberate, comprehensive and disciplined approach to innovation.					
Our innovation projects have helped our organization develop new capabilities that we did not have three years ago.					
I am satisfied with my level of participation in our innovation initiatives.					
We deliberately stretch and build our people’s competencies by their participation in new initiatives.					
We reward people for participating in potentially risky opportunities, irrespective of the outcome.					

Source: Elaborated based on Rao and Weintraub (2013).

After adaptation, the institutions in which the tool would be applied were defined to determine the culture of innovation of the academic environment, and analyse the differences, identify the potential, and propose guidelines to drive the culture of innovation in the environment in question.

Brazil and France were considered strategic for this study, so we selected technological education institutions with a certain approximation with the industrial sector to enable a friendlier environment at the time of the empirical research. Consequently, one technological university was defined in Brazil, and named “university B”, and one technological university was selected in France, and named “university F”.

Since the original tool used to collect the IQ Innovation was in English, the translation to French and Portuguese were given special attention.

The application in university F observed the following sequence: firstly, the original tool was translated and adapted to French; secondly, a pilot was created with the help of an engineer of the work team at the university innovation centre, who is a native from France and fluent in English. The inconsistencies found in the translation were corrected and confirmed by the volunteer engineer.

Once the questionnaire in French was completed, it was applied physically by the actual researcher to the 30 engineering students at university F, selected at random.

This step of the empirical research, from the translation to application of the tool, occurred in 90 days between August and November 2015, integrated to a 10-month sandwich doctorate project at university F that occurred from February to November 2015.

Once the sandwich doctorate period was completed, the researcher returned to Brazil and initiated research at university B. Firstly, the original tool was translated and adapted to Brazilian Portuguese, followed by a pilot with the help of an engineer of the work group in the technological innovation unit (NIT) of university B. This engineer is a native of Brazil and fluent in English. The inconsistencies found in the translation were corrected and confirmed by the volunteer engineer.

Once the questionnaire in Brazilian Portuguese was completed, it was applied physically by the actual researcher to the 30 engineering students at university B, selected at random.

This step of the empirical research, since the translation until the application of the tool, occurred in a period of 90 days between May and August 2016.

The next step was to compile all the results simultaneously using the data obtained in France and the data obtained in Brazil to avoid any prejudgment.

For a critical analysis of the results, the authors Rao and Weintraub (2013) declare that the excellence in innovation is translated into an IQ of 4 or more. When the quotient is between 3.4 and 3.75, the sample has done things in innovation, but its actions are deliberate and systematic. Samples with a QI of 2.5 are the ones that speak a lot about innovation, but do little. An IQ of 2 or less indicates that there is still a long way to go.

4 Results and Discussion

The final compilation of the questionnaires revealed the situation presented in Fig 2, where university B reached an IQ = 2.96 and university F reached an IQ = 4.02.

Fig 2. IQ Innovation results of the studied universities

UNIVERSITY "B" "IQ" = 2.96		
VALUES	Factor Average	Buildind Block Average
Entrepreneurial	3.38	3.28
Creativity	3.36	
Learning	3.09	
BEHAVIORS	Factor Average	Buildind Block Average
Energize	3.03	2.97
Engage	2.92	
Enable	2.96	
CLIMATE	Factor Average	Buildind Block Average
Collaboration	3.03	2.90
Safety	3.12	
Simplicity	2.54	
RESOURCES	Factor Average	Buildind Block Average
People	2.99	2.93
Systems	2.91	
Projects	2.88	
PROCESSES	Factor Average	Buildind Block Average
Ideate	3.07	2.63
Shape	2.53	
Capture	2.30	
SUCCESS	Factor Average	Buildind Block Average
External	3.28	3.06
Enterprise	3.17	
Individual	2.74	

UNIVERSITY "F" "IQ" = 4.02		
VALUES	Factor Average	Buildind Block Average
Entrepreneurial	4.12	4.27
Creativity	4.59	
Learning	4.09	
BEHAVIORS	Factor Average	Buildind Block Average
Energize	3.51	3.58
Engage	3.66	
Enable	3.57	
CLIMATE	Factor Average	Buildind Block Average
Collaboration	4.43	4.08
Safety	3.99	
Simplicity	3.83	
RESOURCES	Factor Average	Buildind Block Average
People	4.41	4.28
Systems	4.12	
Projects	4.32	
PROCESSES	Factor Average	Buildind Block Average
Ideate	3.81	3.57
Shape	3.49	
Capture	3.42	
SUCCESS	Factor Average	Buildind Block Average
External	4.42	4.33
Enterprise	4.61	
Individual	3.97	

Source: The author.

According to the classification of Rao and Weintraub (2013) the "IQ" found indicates that university F is within the threshold of excellence, whereas university B is at a level where much is said, but little is done in relation to innovation.

Also in view of Rao and Weintraub (2013), this research tool should not be used to search for balance, be it between the building blocks, or among the factors within them. There are samples with factors that have very low scores, and other factors are very high, resulting in a successful innovation culture.

For example, a successful American high technology company, has a low value for the "Climate" block, but a very high value for the other five factors. Finding balance for such a company should not be expected. It may be good and even desirable, for example, for the company control sectors to be less innovative than its marketers.

In this sense, University B should prioritize among the groups with deficit values, act in those where the perception of change has a larger potential of recognition in the academic community, thus, improving the index in the most natural way possible.

When analyzing the methodology for determining innovation IQ, it is shown that 54 items have a linear variation with the same magnitude, therefore when aiming to improve the index, investments in items have the same potential. Thus, the investment priority should be defined by the internal policy of the institution under study.

These results demonstrate the effectiveness of the tool since they agreed with the expectations; the institution of the developed country with more experience, greater investments, and a more effective and lasting approach with the industrial sector performed better than the institution of a developing country with greater challenges. Furthermore, the results outline the direction that university B must take to reach its goals. The success model is there, exposed and proven; however, the challenge is also evident, and investment in innovation are needed and decisive for this development stage of university B.

5 Final Considerations

The use of this assessment tool can become an advantage for the self-evaluation of the academic environment of innovation culture, to know the answers to the 54 questions, the leader of any unit, department or team, can determine the innovation quotient of their area of responsibility and then start a campaign to make positive changes.

The efficiency of measuring the culture of innovation of a teaching environment was demonstrated in this study. This measurement can serve as a parameter for important decisions in academic policies that aim to improve the indices of cooperation for developing countries. When university-industry interaction is treated as the focus of innovation, it can drive development, add value, and facilitate the guided evolution of the academic environment.

From the moment in which the measurement of the "IQ innovation", representing the institution’s culture of innovation, reaches a 4 level ($IQ \geq 4$), it represents that the academic community will naturally be involved with the subject innovation, thus, when opportunities for industry university interaction arises, graduate engineers of the academy will act as promoters, links for approach, increasing the chances of a much beneficial partnership for everyone involved. When a scenario of innovation is reached, the entire community experiences this scenario, and the multiplication of such information will occur naturally, given the opportunity

The comparison between France and Brazil presented a possible outlook and revealed the gap in this subject matter and the challenges that lay ahead; however, it also showed the actions that can be taken to grow in this direction. Since the models of technological universities in Brazil follow the French model, the trend is that the actions suggested in the study will help direct efforts toward innovation-oriented interaction, targeting the environment of excellence in innovation found at the French university.

Higher innovation quotients (IQ) reflect an environment of innovation and university-industry interaction, where the processes can unfold naturally, with the academic community partaking of the same goals and targeting efforts in the same direction. Therefore, these initiatives to enhance interactions that focus on innovation must be fostered and encouraged.

The most effective contribution of this work is focused on initiatives in developing countries, because due to their industrial profile, the most developed features are focused on manufacturing, making the development of new technologies, innovation and the consequent transfer of technology, a greater challenge because these goals are not the targets of industries operating in these countries. Thus, the work presented becomes an important starting point for the focus of efforts towards the level of change in university-industry interactions developed in these countries, seeking to add value and develop the society where these industries are located, and not only benefit from more accessible labor.

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