2nd International Triple Helix Summit
10th to 13th November 2018
Dubai, United Arab Emirates
The role of Government/Academia/Industry in Building Innovation-based Cities and Nations

Entrepreneurial University and its Engagement in the Triple Helix System:

Roadmapping to leading innovation on early stage: the technology transfer office whole

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Abstract: This paper presents as main contribution the standardization of complex areas in the development and empirical demonstration of a managerial roadmap tool applied to the TTO (Technological Transfer Office) scenario, which primary role is to anticipate trends in technological and innovative skills at the level of firm to meet the demands from smart cities solutions, among University engagement and Industry. Implementing roadmapping on early stage in innovation provides convergence in key-technologies at the Nuclear an Energy Research Institute, addressing structural, regional, institutional role in Intellectual Property and complementarities to development market front-to-end throught chains in health, environment, food, agriculture, energy, chemistry, education, entertainment and arts in the context of the knowledge economy.

Keywords: Innovation Convergence; Market Orientation; Capital Intellectual Property Polices Disclosure

1 Introduction

The objective of this work was to attend the demand to highlight the relationship between the protagonists of the university-industry-government of the innovation system called Triple Helix (ETZKOWITZ, ZHOU, 2017). In the constitution of the Fourth Helix model according to Carayannis and Grigoroudis (2016), society is often determinant in establishing the level of demand, it is a user of innovation and also presents a strong link in the generation of knowledge and technologies through its function, application and utility curve.

To the view to the long-term survival of distinct institutions and the reduction of their exposures and vulnerabilities from the environment that can provoke the systemic and non-systemic variables relations between controllable and non-controllable variables, the institutions launch the function of forming interconnected structures in a network, interconnecting the supply chain and clusters to stretch the link to efficiency and sustain a competitive advantage to attend market demand more and more efficiently.

It is notable the movement of institution integration to a channeling of strategies, the objectives and decision making together to aggregate value along the chain in the effort to obtain the market differential in the construction of sustained competitive advantage. The configuration along the chain provides specialization of roles between each actor in the network, and each member is responsible for adding value in the delivery of the product and / or service to a level above the competition focused on meeting the multiple wants and needs of the end customer or society. It is still expected that each actor is contemplated by the aggregation of value, since the idea is for the partners to develop, economically or otherwise, in the way that motivates, integrates and develops, thus reinforcing the link between the partners network.

Due to the growing importance of innovative technologies in the current economy, it is necessary for institutions to have the *know-how* to perform good management and development in this subject at the firm level in the context and conjunctural competitive environment, bidding a context of liability and trust in the governance structure between the parties to the long-term relationship, performing mature of structural policy disclosure axis.

Established in 1957 as the world center for nuclear cooperation, the International Atomic Energy Agency (IAEA) works with its Member States and multiple partners

around the world to promote the safe and peaceful use of nuclear technologies. Among the priorities of the IAEA agenda was to balance the work of the main areas such as: technology transfer, security, protection, and technology verification and evaluation. It aligns the support to Member States in the use of nuclear science and technology in the achievement and economic development of global goals and challenges, from meeting growing energy needs and protecting the environment to improving food security and human health (IAEA, 2016).

In its latest review, the Manual has added the economic impact of innovation and the ability to leverage and integrate organized economic systems, including local, regional or global varieties. At the institution level, it is possible to measure organizational innovation, product and process innovation, and marketing innovation (OCDE, 2005).
To the technology transfer to be used as a driving force for a new cycle of expansion of national development, it´s fundamental the articulation between the business sector and the origin of research centers and science institutions. This a promising path of technology licensing or generation of technology-based companies, stimulating the protection of intellectual property and the transfer of technology and the modernization and regulation of research activities with socio-economic impact.

The nuclear area is a special thematic area in this government triennium 2017-2019 (MCTIC, 2016). The nuclear area has an important role to play in consolidating a diversified, sustainable and efficient energy matrix, as well as applications in industry, health and agriculture, requiring continuous, basic, applied and technological scientific research. Under the management vision structured by key indicators, it requires the understanding of purpose of the firm's Master Plan of generating sustainable value to stakeholders. Kaplan and Norton (2004) propose the structure of strategic maps in backing of decision making, converting intangible assets into future benefits, through the management of key indicators.

Roadmapping is one of the most widely used tools as predictive exercise, supporting systematic planning and standardized strategy development. Many countries have developed standardization of roadmaps in various areas reported in intelligent systems, identifying significant opportunities and challenges associated with standardization in complex areas (HO and O'Sullivan, 2017).

The most valuable market-based marketing assets are brand value, customer value and intellectual capital, as they influence and capture value to the institution (RUST et al., 2004; SRIVASTAVA, SHERVANI, FAHEY, 1998). In the Knowledge Age, Sveiby (2013) points out that in recent years the research on measuring Intangible Assets has produced a number of proposed methods and theories. The author considered that the main point in choosing the appropriate methodology is to define what motivated the initiative and more, that any adequate methodology was not find that serves all purposes. The most popular purposes are for public reporting, compliance, and for managerial control and not for learning, as, according to the

author's, it should be the primary purpose to initiative. According to him, the reasons for the measurement of intangible assets can fit in:

• Monitor performance;
• Acquisition / Merger (Evaluation);
• Report to Stakeholders (Justification, Public Reports);
• Oriented investment (Decision Support);
• Discovery of hidden values (Learning).

2 Objective

The main objective is the definition of the institutional role of innovation actors in the conjectural context of IPEN among University of São Paulo, Industry and Estate in Brazil scenario.

The specifics objectives constitute:

- To define Government general competences in the conjectural context;
- To define University competences in the conjectural context;
- To define Industry competences in the conjectural context;
- To define TTO competencies, skills and abilities in the conjectural context;
- To present results from exhibitions, program and projects performed by the TTO in the conjectural context among University, Government and Industry

3 Literature Review

As long as the higher competition on the environment, more the institutions development ability to respond to the environment forces or, instead, to be pro-active leading the change. The first step in the strategic formulation management it´s the establishment of mission and vision of the business. The mission is the fundamental purpose of existence of a firm, constituted of base values and ground of activities and functions destined to a certain market. The vision, in turn, is the statement of an ideal and makes explicit the long-term direction and strategic intent (Bateman and Sneel, 1998).

Innovation is vital in improving supply at all touch of supply chains of products and services, influencing and affecting the competitiveness of supply chains beyond the firm's boundary, strengthening peer relationships, and integrating agents. Positively enlarge productivity, and efficiency at the global level in the development of sectors sensitive to national sovereignty (Lazega et al., 2017).

It is imperative to understand the mechanism that propitiate the innovation system and produce it, inserting it into a solid organized and integral economic in order to mitigate traditional social exposure in early stages. It prioritizes the institutionalization of integrated management to the managerial decision-making based on the institutional performance oriented to increase the intelligence capacity in the structured decision-making in the management of intellectual capital. It implies in the formulation of public policies in the scope of generation, sharing and diffusion of information, knowledge and intelligence creating isonomy in the satisfaction of the common business of stakeholders as a disruptive factor in the level of innovation along the supply chain. It will seek to list aspects of institutional leadership that can leverage the skills and practices of technological development and innovation in the short and long term in the formation of public policies in Intellectual Capital (Rocco, 2007; Chesbrough, 2007).

The essential competence or a core competence is a hall of activities that the firm does especially better in relation to its competitors, usually becoming a set of skills or stocks of experience in some activity. Normally, when a firm has core competencies in any area important to market success, these skills form the basis for the development of competitive advantage. Firms develop partnerships or strategic alliances with other(s) institution(s) that have complementary competencies, allowing them to gain new markets, develop new technologies or launch news products (Prahalad and Hamel, 1990).

The integration of core competences strategic presents four approaches: **i)** concentration: focus and one and only one business sector; **ii)** vertical integration: its involves the extrapolation of dominium boundaries in the supply chain or distributions channels; **iii)** concentric diversification: its evolves of the entrance of new business related from the original core competence and, **iv)** conglomeration diversification: it´s a strategic that the expansion of business boundaries was not related between the parties (Bateman and Sneel, 1998).

Productive restructuring and competitive pressures in developed economies since the early 1980s have instituted new and more efficient organizational forms. It is in this context that strengthens the articulation of agents as networks, chains and productive arrangements whose fundamental objective is the complementation of resources, information and skills. Thus, competence and skill in establishing governance and coordination. Governance defines relationships of hierarchy, control, and power structure to establish rules and parameters for the other members of the chain. Coordination, on the other hand, ensures implementation and adherence to these rules (Rocco, 2007).

When governing and coordinating productive chains, one should not define the subject only in relations of interests, but of structures supported by public policies, at their various levels. Suzigan (1989) pointed out that measures taken by developed

countries to restructure their productive sector involved consideration of the nature of macroeconomic policy, the impact of these policies on employment, business strategies and technological incorporation.

In the field of microeconomics, the supply of capital, nature and labor and are classic, tangible production factors that drive development. The supply of technological production factor is conceived with the greater displacement of the market equilibrium, causing potential increase of the frontier of production, of greater market efficiency (Pindyck and Rubinfeld, 2002).

According to Pindyck and Rubinfeld (2002), the Government acts to correct market failures, reduce risks and uncertainties, minimize exposure to externalities and asymmetry of information in the effective fulfillment of the democratic system of technological transfer as a structuring axis of national and social justice in strategic areas of developing countries. The strategic importance of government marketing planning increases when supply and demand are disconnected (Campomar, 1982; Bubela and Caufield, 2010).

Publicly funded researchers and research institutions of Science, Technology and Innovation **(S&T&I)** are under increasing pressure from partners to go-to-market to bid results to industry. This phenomenon is more recent in Canada than in the USA, in both countries, technology transfer offices **(TTO)** have been established to manage relations between researchers, the private sector and other technology transfer offices (Bubela and Caufield, 2010).

Customer Equity appears as an economic-financial metric, beacon, flow-value calibration mediator, while the geometric structure of the network relations to and with its agents directs the optimization of the application of resources and potentiates the probability of return of the investments. Many studies have pointed out that economic analysis through the client base is a more secure and direct method for the evaluation (GUPTA, LEHMANN, 2003; GUPTA, LEHMANN, STUART, 2004). This approach assumed that all parties have same opportunities to make choices to achieve greater benefits at lower cost, assuming that individuals have the available options that maximize their choices (Calabresi, 1983) and that the market is efficient (Fama, 1969).

The social structure of the Triple Helix Fig. 1 integrates an important approach in the isonomy and symmetry of the relations of and between the peers. **TTO** being hybrid organization witch the hydrous flows institutions the meeting of the common business, approaching and retro-feeding the cohesion of relationship over time (Etzkowitz and Leydesdorff, 2000).

In the path of positively influencing the political environment, managers have a collection of strategic options to lead the best path in the entropy of the technology transfer system, improving security, protection and market regulation, through the

development of public policies, social, ethical and environmental responsibility. The increase of legitimacy and institutional reputation is achieved with the increase in the level of attendance of the social demand among the stakeholders (Bateman and Sneel, 1998).

Based on the bibliographical review carried out with deepening in the 120 empirical cases, Perini (2010, p.111) set-up a denomination of a customer – **customer is an intangible asset:** customer is a scarce resource, desired and expensive to maintain, these factors being more in competitive markets. Customer is an intangible asset when it stores value as it which consolidates benefits which transformed into monetary value at some point in the future. **Customer is a tangible asset** in that it interacts with tangible assets (products and machinery) and intangible assets (brands and intelligence) to the value creation. Customer has a direct relationship with the generation of cash flow while other intangibles do not.

4 Methodology

How can we advance the social understanding of cities and increase the possibilities of creatively addressing urban problems? The evolution of the Scientific Administration to Systemic Administration implies in the development of abilities, competences together of innate characteristics of the leader in four fundamental roles (1) To plan, (2) To organize, (3) To implement and (4) To control (Bateman and Snell, 1998). For Cooper (2003, 32), "the empirical research and critical terms refer to the requirements for the researcher to test subjective beliefs against objective reality and have the results open for further testing."

The elaboration of frameworks and applied structures of the institutional design of the strategic roamapping in the technology transfer was compose from the model of the Triple Helix Etzkowitz and Leydesdorff (2000) and Etzkowitz and Zhou (2017). The conjectural context applied in the IPEN-CNEN/SP, was characterized relating the strategic theory of administration of causes of formation of networks and habitats of innovation to the path of greater regulation in the design of institutional roles in convergence with the industrialized country models and guided by the OECD manuals for collecting, reporting and using data on innovation.

The model of the initial triple helix of IPEN-CNEN/SP was drawn up, evidencing mainly the business competences of displayed sections of each statutes, laws and management committee reports and strategic programs to optimize a bidding in the context related from the institutional historical thematic exhibitions.

The Oslo Manual was characterized by a proposal for Guidelines for the Collection and Interpretation of Data on Technological Innovation, which aims to guide, standardize concepts, methodologies and construction of statistics and indicators of Research & Development in industrialized countries. It´s main contribution was to define internationally parameters aligned in order to parameterize data collection, concepts and language, it defines terms and it clarifies the dissemination of results to the creation of a culture of technological development and innovation (OCDE, 2018; BRASIL, 2004, 2016, 2018).

Description of contemporaneous phenomena and formation of social memories to spread and contribute do innovation culture was observed. It refers to official documents that define institutional competences, relating the form of the relationship with the literature, prioritizing the efficiency and institutional cohesion of technology transfer to society and customer as the first need.

5 Results and Analyze

Developing the role of Government, University and Industry, "emerging from the Chrysalis to become new social vocations" (ETZKOWITZ; ZHOU, 2017, p.41).

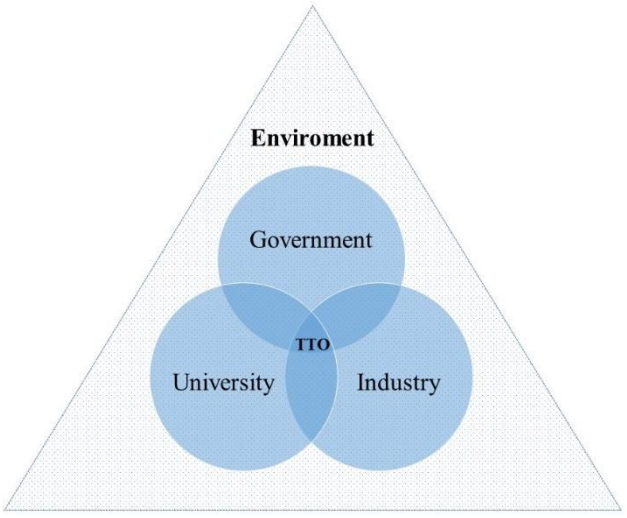

Fig. 1 The social structure of the Triple Helix

Source: Adapted from Etzkowitz and Zhou, 2017, p.41

In the conjectural context, the Government field of the Figure 1 is represented as The National Nuclear Energy Commission (CNEN, 2018), a federal authority created by

Law No. 4,118 of August 27, 1962, linked to the Ministry of Science, Technology and Innovation, with administrative and financial autonomy, with legal institution under public law, with headquarters and jurisdiction in Rio de Janeiro - RJ, Brazil in accordance with the attributions contained in Laws 6,189, December 16, 1974 and No. 7,781, dated June 27, 1989, and in Annex I of Decree No. 5,667, of January 10, 2006, has the following institutional purposes:

> I - collaborate in the formulation of the National Nuclear Energy Policy;
> II - carry out research, development, promotion and rendering of services in the area of nuclear technology and its applications for peaceful purposes as provided for in Law No. 7,781, of June 27, 1989; and
> III - regulate, license, authorize, control and supervise such use.

The Nuclear and Energy Research Institute (IPEN-CNEN/SP) is held at São Paulo, Capital, one of the 10 biggest cities of the globe with high density on population and market demand for a response to urban growth and regional plans associated. The IPEN-CNEN/SP is an autarchy linked to the Secretariat of Economic Development, Science, Technology and Innovation of the Government of the State of São Paulo and managed technically and administratively by the National Nuclear Energy Commission (CNEN) of Science, Technology, Innovation and Communications (MCTIC) of the Federal Government.

According to the IPEN-CNEN/SP Master Plan (2010-2020), the strategic objectives highlight as first priority a) the construction of a Brazilian Multipurpose Reactor, b) Radiopharmacy development, b) Innovation Development and c) Human resources planning.The IPEN's mission is: "Our commitment is to improve the quality of life of the Brazilian population, producing scientific knowledge, developing technologies, generating products and services and training human resources in nuclear and related areas." (IPEN, 2017)

The IPEN-CNEN/SP holds eleven (11) research centers, which most researchers are physicists, chemicals, electrical or mechanical engineers, mathematicians and statisticals. The subject of institutional research center was illustrated in the figure 2:

Fig. 2 Institutional Research Centers
Source: IPEN, 2018.

In the conjectural context, in figure 1 the University of São Paulo (USP, 2018) is a public university, maintained by the State of São Paulo and linked to the Secretariat of Economic Development, Science, Technology and Innovation (SDECTI). The talent and dedication of faculty, students and staff have been recognized by different world rankings, created to measure the quality of universities based on several criteria, especially those related to scientific productivity.

The University of São Paulo (USP), created by Decree 6283, dated January 25, 1934, is a special regime autarchy with didactic-scientific, administrative, disciplinary autonomy and financial and patrimonial management. In its Statute the purposes are:

> I - promote and develop all forms of knowledge, through teaching and research;
> II - to provide higher education for the training of persons qualified to carry out research and teaching in all areas of knowledge, as well as to qualify for professional activities;
> III - to extend to society inseparable services from teaching and research activities.

The Industry in the figure 1 can absorb total meaning of marketing in the Customer Equity theory. The vectors that influence customer equity vary from sector to sector. While some segments are focused on short-term transactions, others focus on long-term relationships. The structure of the customer equity is explained by the Brand Value, Retention Value and Value of Value. The Value of Value is defined by the objective evaluation, utility of a brand, the relationship between what is perceived as value and how much is paid of what was perceived as value delivered,

being quality, price and convenience its determinants. Brand Value is defined as the subjective and intangible assessment of the brand by the customer, being influenced by the marketing actions of the company and by the experiences and associations of the customer in relation to the brand. The value of retention is the client's perception of the strength of the relationship between him and the company, being influenced by loyalty, recognition, affinity, and other programs (RUST et al., 2001).

The TTO role actual is to advise IPEN-CNEN/SP on the protection of intellectual property rights and the use of scientific and technological knowledge, through partnerships and technology contracts, for the benefit of Brazilian society. The TTO aims to manage innovation policy with the following minimum attributions in implement, improve and ensure the maintenance of institutional policy to encourage the protection of creations in intellectual properties policy like licensing, patents, project innovation and other forms of technology transfer.

In Brazil, according to Decree 9.283 of February 7, 2018, the incentive for innovation has provided the increasingly strategic positioning of the NIT (s) Nucleus of Technological Innovation to overcome conflicts of the technology transfer system and leverage Brazil among the countries of higher S&T&I development. Table 1 synthesizes the institutional exhibitions of technologies in early stages, which become a year program to attempt patents in potential to shape the smart cities solutions.

Table 1 Institutional Technology Exhibition of IPEN Brazil

Year	Themes	Research Centers	Patents displayed	Invitations	RSVP (*)	Attended
2015	Biotechnology	CB	5	89	17	16
2015	Lasers	CLA	5	125	21	6
2017	New Materials Health and Environment	CB, CCTM, CLA, CQMA, CTR	19	237	73	35
2018	Green Technologies	CQMA, CCTM	17	166	52	13

(*) RSVP is the acronym of the French expression "Répondez S'il Vous Plait" which in Portuguese means "Responda Por Favor". It is very common to see this acronym in invitations to events such as marriage rituals, where confirmation of presence is essential.

The objective of this work was to meet the demand to highlight the link between brands, clients and economic and social value drivers, making links between marketing and finance disciplines. Complex and sophisticated models were avoided,

while the development of an empirical institutional model bidder was demonstrated through the empirical application of simple and intuitive concepts, from information available in reports and public information that can be readily used by any investor or administrator or interested party. The results indicated that the customization of empirical models are indicative of precursors of economic value, promote economic synergies and experiences to the target public in a way that generate and transform economic, social and cultural values over time.

6 Conclusions

To learn from the demand for solutions from big cities and improve the possibilities of creative solutions to the urban problems are one of goals from **(S&T&I)** Institute. A combined relational and cultural approach to the Transnational Nuclear and Energy Research Institute and the most representative academic institution of Brazil, University of São Paulo (USP), and other arrangements and possible formats on beginners, start-ups, spin–offs, business incubators, focusing on alignments and construction of cooperation network to the demand from smarts cities.
Such this conjectural and transitory context in early innovation on creation knowledge with quality value to stakeholders, the TTO must development new competences and skills to address challenges to shape the future, specialty in development marketing and commercial skills on trust and liabilities environment competences instead technology and product development. The key success remarks enlarge *welfare state* in the context of development country.

This prism of utility is typical of the greater intensity of the marketing techniques, being able to be classified in ways to improve the Technological Transfer and Diffusion, being the use of these techniques an activity of the **(S&T&I)** Institutions, that they are Bidders. The prioritization of Customer Value theory to the Quadruple Helix prism, invokes the scale of innovative activities, the characteristics of the **(S&T&I)** Institutions and the internal systemic factors in the reduction of uncertainty and risk minimization, appreciating the maintenance of guarantees of the long-term relations of the understanding the dynamics of the precise relations to the stabilization of the innovation environment.

The descriptive and explanatory analysis dealt with by results found through principles of analysis of local phenomena and international institutional brand reach, as well as its extension of exposure beyond the firm's boundary after the exhibition period, bringing to light collaborations, partners, students, industry, universities and government collaborations of results obtained by through systematic feedback actions between researchers and institutional committee decision-makers.

The roadmapping of technological bid exhibitions organized from the TTO is a key-trend action in the construction of dialogue and point of contact to match supply

and demand to attend smart cities solution. The **Political Action Committees (PACs) are formed** in order to standardize the leadership structure and provide representation of diverse interests, and improve the rationality and quality of the management committee decision process.

Acknowledgements The activity presented in the paper is part of the applied research grant.

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