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**ANALYSIS OF BRAZILIAN POLICIES IN SCIENCE,  
TECHNOLOGY AND INNOVATION FOCUSING INNOVATION  
CULTURE AND INTEGRATED ACTION OF  
AGENTS OF THE INNOVATION SYSTEM**

**ANÁLISE DE POLÍTICAS PÚBLICAS BRASILEIRAS EM CIÊNCIA, TECNOLOGIA E  
INOVAÇÃO COM FOCO NA CULTURA DE INOVAÇÃO E ATUAÇÃO  
INTEGRADA DE AGENTES DO SISTEMA DE INOVAÇÃO**

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**ABSTRACT**

Considering the importance of innovation for the productive, academic and governmental segments, this article presents an analysis of the public policies of innovation in Brazil with regards to the promotion of systemic and open innovation, envisioning opportunities and challenges that are presented to all those involved the generation of innovation in the country. Through the application of the 'Content Analysis' method, these policies were analyzed about the presence of culture of innovation focusing on the knowledge and integrated action of agents of the innovation system. It was observed that public policies promote cooperation between organizations that are part of the innovative system, but there is no evidence of incentive or guidelines for the participation of people not linked to organizations, certainly a challenge for both policymakers and all those who dedicate themselves, to promote the broad participation of organizations and individuals in innovative activities.

**KEYWORDS**

Knowledge generation. Innovation culture. Innovation systems. Open innovation. Innovation policies.

**RESUMO**

Considerando a importância da inovação para os segmentos produtivo, acadêmico e governamental, se apresenta uma análise das políticas públicas de inovação vigentes no Brasil no que tange à promoção da inovação sistêmica e aberta, vislumbrando assim oportunidades e desafios que se apresentam a todos os envolvidos com a geração de inovação no país. Por meio da aplicação do método 'Análise de Conteúdo' as referidas políticas foram analisadas quanto à presença de cultura de inovação enfocando o conhecimento e ação integrada de agentes do sistema de inovação. Observou-se que as políticas públicas promovem a cooperação entre organizações que integram o sistema inovativo, entretanto não há evidências de incentivo ou diretrizes para a participação de pessoas não vinculadas a organizações, seguramente um desafio tanto para elaboradores de políticas quanto para todos que dedicam-se a promover a ampla participação de organizações e pessoas em atividades inovativas.

**PALAVRAS-CHAVE:**

Geração de conhecimento. Cultura de inovação. Sistemas de inovação. Inovação aberta. Políticas públicas de inovação.

## 1 Introduction

Certainly, our society and the current situation of nations is the result of the accumulation of all discoveries, inventions, improvements, and efforts of generations that came before us (LIST, 1841; FREEMAN; SOETE, 2008). Based on the premise that the significant inventions and improvements that have been implemented consist of innovations, we can affirm that innovations were always part of humanity's trajectory.

Although they were initially described as new combinations of productive processes (SHUMPETER, 1982), innovations spread as elements of competitive advantage and organizational differentiation, conceived and developed within the closed system of an organizational context.

Since the 1980s, a systematic approach to innovation has emerged which considers innovation as the result of integrated actions by different organizations with a common goal; hence National Innovation Systems (NIS) appeared, characterized by integrated actions on the part of both the public sector and private industry, in the form of academic and institutional services. Innovation is no longer seen as the result of the isolated efforts of organizations; it is now understood as a product of the interaction between different agents, a very relevant concept given that, in many countries, a large fraction of knowledge is produced at universities and research institutes, especially cutting-edge scientific and technological knowledge.

More recently, since the 2010s, with the arrival of social media and other information communication technologies, we observe increasing participation of civil society in innovation processes even though civil society is not directly linked to innovative organizations. Often this appears as crowdsourcing Internet events known as 'Idea Challenges' or Hackathon', characterized by incentives for anyone to contribute with a proposal, idea, or solution for the innovation process created by an organization.

Nations should keep an eye on the means of generating innovation and should create public policies which are able to promote the participation of any competent person to contribute to the innovation and development of the country. From that perspective, the objective of this paper is to present an analysis of public policies which are in effect in Brazil with respect to the promotion of systematic and open innovation, glimpsing the opportunities and challenges that face all those who are involved in the generating innovation in the country.

Hence this is why we discuss concepts of open innovation and systems and ecosystems of innovation. This paper will reflect upon the role of innovation public policies in the context of NIS and will present Brazil's public policies of science, technology, and innovation. In the following sections are clarified the methodological procedures and the presentation and analysis of results, sections extracted from the doctoral thesis defended in 2018 by the author. The final considerations are presented below.

## 2 Open Innovation, Systems and Ecosystems of Innovation

Open innovation, a concept introduced by Chesbrough (2003), understands that the external environment of a business offers valuable contributions to the innovative activities of that organization.

According to the Organization for Economic Co-operation and Development (OECD), changes in the innovation environment such as globalization, multidisciplinary, more and more intense competition, and shorter and shorter life cycles have made innovation riskier and more expensive. In this context, businesses must now generate innovation in cooperation with clients, suppliers, competitors, universities, research institutes, etc. (OECD, 2008). Likewise Stal, Nohara, and Chagas Junior (2014, p.296, translation by the author) state that open innovation is the result of:

[...] combined action from various sources in the innovation process, which use the internal skills of the business not only for R&D but to simultaneously procure, select, and access opportunities and assets outside the company. This model sees innovation as the result of the formation and action of systematic (not one-time) networks of cooperation, which offer knowledge, ideas, and patents for the generation of new products and processes.

The concept of action by different agents for the development of innovations is at the heart of the systematic approach to innovation, which “[...]focus of policy towards an emphasis on the interplay between institutions, looking at interactive processes in the creation of knowledge and in the diffusion and application of knowledge.” (MANUAL..., 2005, p.17). That allows the recognition of the influence that non-commercial institutions have in the generation and implementation of innovation, a dynamic process based on learning and interaction.

The systematic approach to innovation appeared in the 1980s, when a new world order consolidated the point of view that innovation is not only the isolated activity of a business, but rather the fruits of the creation of knowledge and the integration of various agents, both public and private. Lundvall et al. (2002, p.224) state that “[...] The new context is more than anything else characterised by a speed up in the rate of change giving a stronger importance to learning processes for economic performance.

According to the OECD (1997, p.9), “The concept of national innovation systems rests on the premise that understanding the linkages among the actors involved in innovation is key to improving technology performance”.

Johnson (1992) wrote that a NIS is made up of the interrelation between all the institutional and structural factors of a country which generate, select, and spread innovation. Edquist (1997) on the other hand defines NIS as all the economic, social, political, organizational, and other factors which influence the development, spread, and use of innovations. Godin (2009) adds that the elements which constitute NIS are businesses, public

laboratories, universities, financial institutions, the education system as a whole, regulatory bodies, and governments, all of which act in an integrated way. Figueiredo (2012) clarifies which institutions make up NIS:

[...] a cluster of organizations which includes businesses and various support organizations such as universities, research institutes, training and educational centers, technical schools, consultant companies, standards organizations, patent offices, etc. (FIGUEIREDO, 2012, p.6, translation by the author).

With the arrival of the internet, and especially social media, the interactions which are the nexus of innovation went beyond formal, institutional relationships and now encompass the contributions of individuals who are not tied to a specific institution, such as students and self-employed professionals.

To the extent that innovation processes now include civil society with dynamic relationships between the agents, without necessarily having a formal contractual relationship, it's pertinent to promote ecosystems of innovation in which capital, know-how, and human resources are fluid and in which the speed of transactions is driven by an unceasing search for opportunities and financing.

According to Moore (2006), an ecosystem of innovation includes the establishment of a vision of the future which must be shared between the agents involved, who cooperate, compete, and evolve in an environment that creates opportunities. Hence an ecosystem of innovation consists of a network of relationships in which information and talent flow via “coopetition” and supporting value (ETZCOWITZ; LEYDESDORFF, 2000). Thus, an ecosystem of innovation consists of a network of relationships in which information and talents flow through co-creation and sustained value (ETZCOWITZ; LEYDESDORFF, 2000).

Based on the systematic approach to innovation and given the importance for nations to become more innovative, countries create public policy with the intent to guide, encourage, and/or promote innovative activities, hoping to thereby bring development to their nations. From that perspective, the role of innovation public policies stands out:

- There is no simple policy answer to problems as complex as those raised by technology/employment relationships in a knowledge-based economy;
- An efficient policy strategy must combine a number of macroeconomic and structural policy actions;
- The coherence of the policy package is a condition of success, and it depends on the validity of the policy framework as well as on the quality of the process of policy formulation (MANUAL, 2005, p. 18).

Considering the tendency towards systemic action regarding the generation of innovation, it is certain that the national environment can have a considerable influence to stimulate, facilitate, delay, or impede the innovative activities of businesses (FREEMAN; SOETE, 2008), therefore the study of innovation public policies certainly offers an important

contribution to detect opportunities and challenges in the development of a nation's innovative activities.

### 3 The Role of Innovation Policies in the NIS Context

According to Lundvall and Borrás (1997, p.13) “[...]Learning is necessary both in order to adapt to the rapidly evolving market and technical conditions and in order to achieve innovation of processes, products and forms of organization”. Given the issues related to the speed of global transformations, the systematic approach to innovation and the centrality of learning and knowledge must integrate the concerns of innovation policymakers. However the complexity inherent in the establishment of public policies must also be considered, as emphasized by Fernandes (2007, p.203, translation by the author), who demonstrates that:

Although it is a technical and administrative domain, the sphere of public policies also has a political dimension since it is related to the decision-making process. That is, the State must decide which aspect of society to act upon and where, why, and when to act. These choices on the part of the State, which transform into decisions, are conditioned by the interests of a variety of social groups. They represent conquests which translate legislatively into rights and guarantees defended by society.

Generally, policies of innovation are traditionally conceived as tools to support the production and implementation of innovations of countries or regions and their respective IS. The academic and political debate on innovation policies has focused mainly on supporting the generation of innovations. The concepts and indicators of innovation, which usually focus on assessing and comparing competitiveness between countries, confirm this, focusing mostly on issues related to the supply of innovation (CORNELL UNIVERSITY; INSEAD; WIPO, 2016).

In the scope of the elaboration of policies of innovation, the analysis about the supply-side approach and, also, demand-side by innovation are considered important. From this perspective, three functions of innovation that can guide innovation policies are listed:

- The first function of innovation is to drive economic development, so it is fundamental to take into account the fact that the economic dynamics of nations depend on both the demand - speed of adoption and absorption of innovations - and supply - production and implementation of innovations.
- The second function of innovation is to satisfy national and local needs, which must be articulated as demands. IS have limited legitimacy if the innovation they offer does not meet the needs of their own populations, if they are not geared to local demand.

- The third role of innovation is to tackling big global challenges, because is not enough to produce increasingly sophisticated technologies if they do not reach the entire population in need and / or will not be sufficient to meet existing challenges. This means that demand must be articulated and connected with supply, and potential buyers and users must be able to understand and use innovations that meet existing challenges (EDLER, 2016).

It's especially necessary to take into account the need to identify the social and economic impact of innovation policies, as well as the mechanisms which turn out to be the best alternative to develop policies in a society which is more and more based on knowledge and learning (LUNDVAL; BORRÁS, 1997). From that perspective, the next section will present and analyze the public policies related to innovation which are in effect in Brazil.

#### 4 Brazilian Policies in Science, Technology and Innovation

Brazilian guidelines intended to promote and generate innovation are supported by a set of public policies, mainly regulatory ones, which aim to establish guidelines and roadmaps for the innovative activity of the country.

An important milestone of that roadmap is Law 10.973 of December 2nd, 2004, which was expanded in Law 13.243 of January 11, 2016, resulting in the “new legal milestone of innovation” which, supported by a constitutional amendment, altered nine decisive laws in different sectors involved with innovative activities, such as immigration, scientific and technological research, public purchasing and contracts, educational and research institutions, imports of goods intended for scientific and technological development, and hiring and professional development of individuals who could be involved with science and technology, as describe in Chart 1.

**Chart 1.** Segments Involved in the Law 13.243

Segments involved	Legislation changed by Law 13.243
Scientific and technological research	Law n. 10.973/2004 Constitutional Amendment 85/2015
Immigration issues	Law 6.815/1980
Purchases and public contracting	Law n. 8.666/1993
Education and research institutions	Law n. 8.958/1994
Imports of assets destined to scientific and technological development	Law n. 8.010/1990 Law n. 8.032/1990
Employment and development of people involved in Science and technology	Law n. 8.745/1993 Law n. 12.772/2012

Source: Elaborated by the author, 2019.



Beyond regulatory policies, innovation policies in Brazil are also viewed through the “National Science, Technology, and Innovation Strategy” (ENCTI in Portuguese) which is in effect between 2016 and 2019. A bill in the Federal Senate proposes the creation of a new national plan for science, technology, and innovation called “Program 2021” which would include the 2016-2019 multi-year plan.

## 5 Methodological Procedures

A study by Silva (2018) analyzed the public policies related to innovation in Brazil, which correspond to the public policies of science, technology, and innovation. The analysis focused on matters related to the production and sharing of knowledge in the context of Brazilian NIS. That study applied the “Content Analysis” method in which the analysis categories were defined a posteriori. Within the categories that were analyzed in Silva (2018), two are highlighted in this work because they show aspects related to the integration between NIS agents, indicating open innovation processes:

1 – Culture of innovation focused on knowledge: Organizational culture geared towards the production of knowledge between agents of the innovation system; organizational culture geared towards knowledge sharing between agents of the innovation system.

2 – Integrated action by the innovation system agents: Integrated actions involving multiple agents with a focus on innovation; integrated actions involving multiple agents with respect to production and sharing of knowledge.

The analysis of the selected categories allowed us to perceive the focus that the science, technology, and innovation public policies give to incentives (or the lack thereof) to open innovation in the Brazilian context. Therefore the next section will present a selection of the results of the aforementioned study.

## 6 Discussion and Results

Regarding the category “Culture of innovation focused on knowledge”, the national public policies showed the presence of elements which promote a culture geared towards the production of knowledge for innovation and towards the sharing of information and knowledge between NIS agents. Those elements are shown in the policies which recommend the establishment of incentives to promote scientific and technological activities linked to NIS; promote cooperation between NIS agents; stimulate innovative activities; and consolidate environments which promote innovation such as industrial parks, industrial centers, and business incubators.



The policies allow for the sharing of infrastructure such as buildings, laboratories, equipment, instruments, and materials without interfering with the main activities of the agents involved. This practice can contribute to a systematic culture of innovation focused on sharing between the NIS agents; however, two factors must be considered: 1) simply sharing infrastructure does not guarantee integrated actions, it only implies resource sharing. Ideally the processes and results of the knowledge production can be shared since that will generate new knowledge for everyone involved; and 2) the production of knowledge in the context of public agents such as universities or research institutes cannot be subordinate to business interests. Production of scientific knowledge must be attentive to the requirements of the applied context, but it cannot limit itself to those requirements because that would compromise the development of cutting-edge knowledge as well as the autonomy of the researchers.

It was proven that the national public policies were developed with the intention of promoting a culture of innovation focused on knowledge. However it is possible to infer that the intended culture still has not been consolidated. That assertion is proven in the “National Science, Technology, and Innovation Strategy” which states that “[...] More effective ways to improve the general public's scientific education must be developed in order to establish high expectations for all, motivating students to experiment and attracting more citizens to science, technology, and innovation careers” (MINISTERIO, 2016, p.68, translation by the authors).

Regarding the category “Integrated action by the innovation system agents”, we observe the presence of both collective actions by innovation system agents in general and specific collective actions to produce and share knowledge. From that point of view, hopefully public coordinators will stimulate and support strategic alliances and cooperative projects to “[...] generate innovative products, processes, and services and transfer and share technology” (BRASIL, 2016, p.3, translation by the author). To that end, programs such as “Plan for a Greater Brazil”, “Plan for Innovative Business”, “The Brazilian Technology System” (SIBRATEC in Portuguese), and the “Brazilian Research and Industrial Innovation Company” (EMBRAPII in Portuguese) are cited by the “National Science, Technology, and Innovation Strategy” as elements which accelerate the country's scientific and technological development.

That Strategy declares that measures to “[...] refine the human resources and improve the structural conditions for innovation, prioritizing a larger interaction between public research and industry” (MINISTERIO..., 2016, p.51, translation by the author) are increasing, considering specific locations, sectors, and regions, Brazil as a whole, and the world. The sharing of human resources between universities and businesses is seen as fundamental to promote innovation, and as a result there are incentives to support actions which allow businesses to access the skills and infrastructure of universities. Beyond that, the Strategy

proposes investment in modernization, recovery, and strengthening of the country's research infrastructure.

Although the Strategy emphasizes programs which are related to innovation and to improving relations between universities and businesses, it's worth noting that since 2016 changes in the government platform have influenced the development of the initiatives that were cited above (“Plan for a Greater Brazil”, “Plan for Innovative Business”, SIBRATEC, and EMBRAPPII). Some were restructured and others were eliminated. This research demonstrates the importance of developing strategies which minimize the vulnerability of national development policies, programs, and plans, because they must be State policies not policies which depend on partisan or political matters.

To synthesize, Brazilian science, technology, and innovation public policies focus on integrated actions between NIS agents as well as integrated action with respect to the production and sharing of knowledge. This theme appears in nearly all of the science, technology, and innovation public policies that were analyzed, especially those that express the principles and guidelines that the country should follow. On the other hand, there is a shortage of plans which describe projects and actions to implement to attain the objectives that are sketched out in the guiding policies, looking clearly and objectively at the projects and respective actions needed to achieve the goals created in the context of the guiding policies.

It's important to emphasize that we observed a large number of regulatory policies which set out incentives for innovation; programs to hire and retain personnel involved with science, technology, and innovation; and means to obtain the resources and infrastructure. The focuses of the aforementioned regulatory policies are delivered by the “National Science, Technology, and Innovation Strategy”, though not directly. That Strategy has a very broad structure, dealing with the “National System of Science, Technology, and Innovation” (SNCTI in Portuguese), the national challenges, fundamental pillars of NIS, and strategic themes. Strategies associated with those strategic themes are presented such as drafting specific plans in the context of those themes, the creation and/or strengthening of partnerships, support for R&D in specific areas, among others. Hence the set of Brazilian science, technology, and innovation public policies lacks a national plan in that area.

The participation of civil society in innovation processes, in a way not linked to organizations, is almost completely absent from the public policies that were studied.

## 7 Final Considerations

Innovation has an important role in national development and requires careful attention by industry, academia, and the government. This last, among its other responsibilities, must create public policies which can allow integrated action by the different NIS agents and, as a result, promote development.

The analysis of Brazilian public policies demonstrated the incentives for the cooperation of NIS agents, allowing the sharing of infrastructure such as buildings, laboratories, equipment, instruments, and materials without interfering with the main activities of the agents involved. It also demonstrated that the interaction of universities and industry is a priority, including by sharing human resources between universities and businesses. However the policies that were observed do not take into account any incentives for the participation of individuals who are not directly linked to NIS organizations. This participation is a trend, and therefore public policies could take better advantage of it.

Future studies may address research on ways to encourage the involvement of people not linked to innovation system actors, both in terms of contributing to innovative developments and in collective financing processes.

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