

The New Brazilian Legal Framework of Science & Technology: Barriers, Borders and Opportunities for Innovation

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Abstract

The recognition of science and technology as a risk activity, focusing on results rather than procedures, means that researchers are more effectively engaged in activities involving innovation. The purpose of this article is to analyze the applicability of law known as the Legal Framework of Science and Technology, and it was constructed with bibliographical support seeking to contribute to a different view of the control organs regarding the research. The new Brazilian legislation brings with it the expectation that research and market have a process of approximation, reducing the distance between the knowledge produced in universities and their transformation into wealth. The possibilities arising from the new legislation tend to have effects in solving problems of quality, productivity, cost reduction, with the possibility of incorporating benefits to production and competitiveness, with the introduction of technology, methods and processes aligned with lean production. It concludes that the Legal Framework for Science and Technology, with its specific purpose of reducing bureaucracy in the country's research and innovation activities in general, is an important instrument in the integration of the academic and scientific community at all levels, and companies, representing a new path to boost the process of education.

Keywords: Innovation; Knowledge Management; Legal Framework of Science and Technology; Lean Culture.

1. Introduction

The new Brazilian landmark of science, technology, and innovation represents a turning point for universities and for the development of the Brazilian economy in the renewal of its market capacity because it provides for stimuli to scientific development, research, scientific and technological training and innovation. The old legislation hindered the paid work of researchers from public institutions in projects related to the productive sector, and the new legislation allows private initiative, research institutes, academy members and public educational institutions to work together to market scientific production of which in many cases was lost in laboratories. This approach tends to make it possible for knowledge restricted to the academic environment and larger organizations to be effectively incorporated into small and medium-sized enterprises, which tend to have greater difficulties in incorporating knowledge into their operations.

The Decree No. 9.283 [1], which regulated the Legal Framework, since it brought the forms of concessions of benefits and incentives to R&D and Innovation activities, the legal formatting appropriate for the achievement of these instruments, and established the tools that allow Public Entities to grant legal privileges for research, development, and innovation in the technological field is analyzed. Brazil is now ranked 69th in the Global Innovation Index, based on a study by the University of Cornell at the World Intellectual Property Organization (WIPO) [2]. Among the 18 countries in Latin America, Brazil ranks 7th. The biggest problem identified is the downward trend, since the country ranks 47th in 2011.

In the implementation of the new law, the collaboration between universities and research institutes was prevented by the current regulations restricting the participation of researchers from public universities in remunerated activities of innovation or applied research. Professors from public universities, with exclusive work contracts, were prevented from promoting paid research in collaboration with companies. In addition, the control mechanisms did not offer legal certainty to the companies requesting the research, away from universities and research institutes. The Innovation Survey (PINTEC), which is a research carried out every three years, by the Brazilian Institute of Geography and Statistics (IBGE) [3], was used to give a brief overview of the scenario of innovation activities undertaken by Brazilian companies. PINTEC follows the Oslo Manual recommendation, in which product and process innovation are defined as the implementation of products (goods or services), new or substantially improved processes [4].

According to Damanpour [5], an innovation can be a new good or service, a new production process, a new structure or administrative system, or a new plan or program adopted by the organization. In this sense, innovation implies the generation, development and implementation of new ideas and behaviors, paying particular attention to their usefulness. The documentary research carried out in the previous legislation, the results presented in PINTEC and the comparison with the new possibilities introduced in the new Legal

Framework, made it possible to outline a prospective scenario for the new moment presented for relations between the Academy, Governments, and Companies.

The need for organizations to promote systematic value creation for customers and thus position their products to the standards required by global market competition drives organizations on a constant search for innovation. This requirement position Lean as the management philosophy that, for consistent results, is capable of promoting significant changes in the way companies handle their processes. Growing interest in Lean has provided the development and sharing of new techniques and experiences that enhance results and enable a growing learning curve. The Lean set of knowledge essentially aims to eliminate waste and solve problems, which implies that processes and products are constantly undergoing evaluations and changes, which are the basis of the innovation processes necessary to maintain the competitiveness of organizations and adapt to market needs.

This applies to all types of organizations, whether private or public. It is precisely this need to eliminate barriers to innovation where the new Brazilian Science, Technology and Innovation legislation will play a fundamental role when fully implemented. Since there is no way to dissociate the Lean from Innovation, it is in this view that the article is based.

In his discussion of the transformation from what he defined as static activities (consumption and production) to dynamic activities (innovation), Cooter [6] argues that laws aimed at innovation must create an open competition structure for innovators to develop their ideas. Indeed, laws that increase the pace of economic innovation must support laws that increase entrepreneurial profits as a driving force for innovation, as well as prioritize their protection and results.

Stiglitz [7] argues that the production of knowledge is not free, so there has to be some way to finance it. In the field of innovation, laws and procedures for regulating intellectual property must be re-evaluated, and one issue is the difficulty of determining the boundaries of property rights, as well as the degree of novelty that the idea envisages. The author also maintains the need to redesign the intellectual property regime to increase its benefits and reduce its costs in order to increase economic efficiency and probably drive the pace of innovation. In this context, Greenwald and Stiglitz [8] argue that industrial and economic policies must be aligned with government policies to avoid conflicts and collapse of more robust economic models based on innovation.

Granieri and Renda [9] emphasize that innovation is perceived as the main way to achieve economic growth and competitiveness, where technological innovation is an essential factor for long-term well-being, as it is attributed to the improvement of well-being and benefits to future generations. However, innovation is perceived as complex under the prism of public policies, since it involves both governmental and private investment and has a broad scope and interests, ranging from the existence of public policies to encourage innovation, from education to intellectual property, among other demands, as well as their degree of reach, which may be local, regional or international. The authors further explore the changing meaning of

innovation and innovation policy and how the modes of innovation have changed, depending on the characteristics of the models, i.e. from traditional patterns to systemic and collaborative patterns, proprietary models, modular and granular models, innovation based on user offer and innovation, from closed to semi-open and open business models.

The need to involve all actors in this process requires an adequate degree of governance, in order to meet the real needs of companies, entrepreneurs, universities, research institutions, among others, each one with its purposes. With the aim of boosting innovation levels, Europe has launched The Framework Program as a promoter of the European innovation system. Frietsch *et al.* [10] argue that such initiatives could provide stability and growth, both in terms of funding and in terms of a political message that placed a high priority on science and technology. The most recent initiative is the new Framework Programme Horizon 2020 that integrates various EU funding activities for research and innovation, which are properly regulated [11].

2. Literature Review

In the context of innovation, be it product, technology or processes, we present below a brief discussion about the Brazilian scenario in the context of innovation and the new legal framework, in order to understand the new possibilities related to this process.

2.1 Brazilian scenario

The legislation in force before the new Legal Framework was a deterrent to Brazil's innovation actions. In order to be able to visualize the possibilities brought in by this new moment, an analysis of the results of the PINTEC 2014 survey is necessary. The study shows that there was a growth in 2012 of 1.90% of GDP in relation to the previous year and, respectively, of 3.00% and 0.50% in the years 2013 and 2014. The survey indicates that in Industry, 14.5% of companies promoted product and process innovation and 18.2% only process. In the Services sector, 15.9% made innovations in product and process 11.8% only in process. The innovation in processes in the Brazilian industry was 32.7% and in the services sector 27.7%.

An analysis of Table 1 shows that the smallest companies have the lowest rate of innovation in processes, and this is due to the budget constraints of smaller companies to invest in materials, equipment, hire skilled labor, and have access to Science and Technology Institutions (STIs) and the lines of development of government agencies, such as BNDES and FINEP. These would be the major beneficiaries of the new legislation because they can benefit from the approach to universities and institutes and research, and can access techniques and methodologies capable of introducing significant improvements in their products and processes, at a cost compatible with their capacity, or even without no cost of implementation, possible in partnerships where they are objects of academic research. For companies that implemented some innovation in the period from 2012 to 2014, research shows that the introduction of technological innovations in the market is important for 30.8% of companies in the industrial sector and 46.4% of service companies.

The acquisition of external R&D and Innovation is considered important only for 5.4% of the industries and 5.3 for the service companies. Internal R&D and Innovation development are important for 15.2% of industries and for 39.2% of service companies. Training of human resources is considered important by 61.5% of the industries while the services sector has a percentage of 67.5%. In their manifestations of importance, Brazilian companies do not consider research institutes, and technology centers as sources of information for innovation. The industry index stood at 18.5% and the service sector at 25.5%. Similarly, universities are considered sources of information for innovation by 16.4% of the national industry and by 25.7% of the service sector, which indicates the distance between academia and the market.

Table 1. Innovation in Processes by company size

| Busy Person Tracks | Innovation in processes (in%) | |
|--------------------|-------------------------------|----------|
| | Industry | Services |
| 10 to 49 | 30,00 | 25,80 |
| 50 to 99 | 40,10 | 35,70 |
| 100 to 249 | 44,80 | 35,40 |
| 250 to 499 | 49,40 | 44,30 |
| over 500 | 59,80 | 43,60 |
| Total | 32,70 | 27,70 |

Source: (IBGE, 2014)

Considering the sectors of industry, electricity and gas and services, the investment in innovative activities and internal R&D and Innovation of Brazilian companies was 3.31% of the companies' net revenue. The service sector was the one that most invested in innovation and R&D and Innovation, totaling 9.94%, followed by the manufacturing industry with 2.84%, the extractive industry with 1.85% and the electricity and gas sector with 0, 74%. Sectors that depend fundamentally on intellectual capital, such as software development, have investments of more than 10%. Architectural and engineering services, which have not yet incorporated Building Information Modelling (BIM) into their processes, have investments of less than 2.5% in innovation. It is not the purpose of this study to evaluate these numbers, but the percentages presented show that R&D and Innovation activities are outside the immediate objectives of a large number of Brazilian companies.

It is of great concern to the industrial sector that, instead of aiming to meet world quality standards, especially those related to the implementation of systems aimed at Industry 4.0, demonstrates the preference for the acquisition of innovation incorporated into machinery and equipment, with 40, 2% of the expenses for this item and, despite considering important human resources training, in 2014 only 1.0% of the expenses had this destination. The internal expenses with research and development were 31.5%, and the external expenses were 8.0%.

Considering that part of these expenditures involves the purchase of knowledge, this is a clear option for the innovation incorporated into equipment, which allows manufacturing with better quality and more

quantity without, however, having the development of innovation from R&D and Innovation as a goal. This can be a dangerous strategy for the medium and long term, especially when one observes the low percentage of revenue invested in innovation.

Even more worrisome for Brazil is the low number of post-graduate human resources in research and development activities in industrial and service companies. The last survey (Innovation Research: 2014 / IBGE, 2016) identified 146,000 professionals working in internal research and development activities in full or part-time companies and presents another worrying factor that is the trend of displacement of professionals from the integral period for a partial period in the activity. When analyzing the qualification of these professionals, it is verified that only 7.9% in industry and 15.3% in the service sector have a post-graduate level education. The largest contingent of researchers has an undergraduate degree, with 60.5% in industry and 63.2% in the service sector. Certainly, this affects the quality of the results of the investigation processes.

Keeping a professional with a Ph.D. in his or her workforce is not feasible for smaller companies and considered expensive by medium and even larger companies. The solution to this problem is the partnerships between companies, universities, and research centers who did not happen due to the obstacles of previous legislation. The results above show a low level of investment in innovation, coupled with the low qualification of the human resources involved, as a result of improvements in products and processes introduced. The approach of the companies with the Academy is fundamental for an organized and continuous updating of the business processes with the best practices and technologies being implemented. The promotion of this interaction tends to introduce state-of-the-art practices into production.

2.2 The new Brazilian legal framework

First of all, it is necessary to say that there has always been a segregation between the Public and Private Authorities in Brazil. The Federal Decree n°. 9.283 [1] regulated the provisions of Federal Law n°. 13.243 [12], known as the Legal Framework for Science, Technology, and Innovation, and promoted significant changes regarding this separation. A framework was inserted in the Brazilian Federal Constitution through Constitutional Amendment n° 85, which changed and added provisions in the Constitution to update the treatment of Science, Technology and Innovation activities.

The new set of legal rules has as its main mission to encourage the creation, implantation, and consolidation of environments that promote innovation. The purpose is to promote technological development, remove bureaucratic barriers that hamper the activity of innovative researchers and entrepreneurs, increase competitiveness and interact among the characters involved in this R&D and Innovation ecosystem, including Public Agencies, Development Agencies, Technology Parks, Institutions Scientific and Technological Research, Private Companies, among others.

The aim is to stimulate and support strategic alliances, development of cooperation projects between companies and STIs for the generation of innovative products, processes and services, transfer and

diffusion of technology, contemplate networks and international projects of technological research, technological entrepreneurship and creation of innovation, incubators, and technology parks, training and qualification of qualified human resources.

Universities and public STIs may share intellectual capital, laboratories, equipment, instruments, materials and other facilities with companies and individuals for research, development and innovation activities, if such permission does not directly interfere with their activity or conflict with it. In addition, it may directly assign to companies the use of real estate for the installation of environments that promote innovation. The legislation prior to the Legal Framework explicitly prohibited that such actions were implemented, characterizing this type of collaboration as misuse of public resources, subjecting managers to penalties such as reimbursement of values to public coffers and large fines.

This unfavourable environment of cooperation has brought significant damage to all concerned and to the quality of human-resource training at all levels. By preventing the academy from having a closer approximation to the productive environment, the ability of students and researchers to actually implement the objects resulting from academic research was restricted, restricting the learning process based on practical experience resulting from interventions in productive processes, which is a fundamental step for the training of human resources qualified to work in the productive sector.

The new law extended the mechanisms of economic subsidy to micro, small and medium enterprises, implementing, among other measures, the technological bonus, destined to the payment of contracting technological services. It authorizes the law even though the economic subsidy can be used by companies both for the financing of research activities and for capital expenditures. Before, the economic subsidy could not be used for the acquisition of capital goods.

It is important to emphasize that this possibility brought by the norm comes in many ways to contribute to the interaction between the public and the private since few companies have enough capital and expertise to set up their own laboratories. The universities have the infrastructure already installed, and the use of this by the companies is obviously a huge advantage for both parties. There is no point in innovation if you do not leave the university benches for production environments. In order for this migration from academia to industry, it is necessary that the technology transfer process developed in STI takes place.

The new law also allows the Scientific and Technological Institutions (STIs) to sign agreements with companies for the development of joint research, and STI may assign to the private partner all intellectual property rights through financial or non-financial compensation, provided that economically measurable, and technology transfer should be formalized through a technology transfer agreement.

According to the Innovation Law, all ICTs must have a Nucleus of Technological Innovation (NIT) that will be responsible for the management of the innovation policies that should be able to negotiate and manage these contracts, which need for a technical and legal body to supervise the execution of these

contracts, in order to verify if they are in accordance with the contractual clauses. It is important to note that this change in the standard is very attractive for the formalization of a public/private partnership since the ownership of the results of research is no more property of the public institution, who before was forced to open a public competition to license the technology. This system was completely discouraging to private companies since there was no way to be sure that the company that financed the research would license the result.

Likewise, the public government allowed to directly fomenting technological innovation in companies and STIs through various mechanisms, including the direct contracting of research projects involving technological risk, for the solution of a specific technical problem or obtaining of product, service or an innovative process, without the obligation of the acquisition process.

The use of intellectual capital is seen as the possibility of public service researchers in an exclusive dedication to engage in paid research, development and innovation activity in STI or company, if assured to the continuity of their teaching and research activities. Public institutions may be minority quotas in the social capital of technology-based companies and investment funds to innovation, either direct or indirect, through investment funds constituted with own or third-party resources, among other actions.

The federal government may also become a partner of startups. Universities, besides the well-known vocations for teaching, research, and extension, can collaborate for the emergence of companies with the participation of their teachers and students. Usually, academic startups are more successful in transferring knowledge than other companies. This is because they have the technical advice of academics that integrate the corporate structure, knowing the technical aspects of the inventions.

However, it is important to emphasize that the Brazilian Securities and Exchange Commission still needs to regulate this type of investment, which is fundamental for the sector, since it is a measure adopted by the main universities and research centers of the world. The technological order is also one of the innovations brought with the new Legal Framework. Through it, organs and entities of the public administration may contract directly public or private STI, private nonprofit entities or companies, alone or in a consortium, directed to research activities and recognized technological qualification in the sector, with a view to carrying out R&D and Innovation activities involving technological risk, for solving a specific technical problem or obtaining an innovative product, service or process.

The supply of the product or the innovative process resulting from the research, development and innovation activities ordered may be contracted by no-bid acquisition, including with the developer of the order, subject to the provisions of specific regulations. This possibility brought by the norm allows the public sector to break the bureaucratic barriers, until then in force, that established complex rules for the contracting of technological services, which required the elaboration of previous detailed projects and the observation of deadlines for the processing of acquisition, proposals and resources to the results that sometimes took years and did not always reach a satisfactory result.

This extreme bureaucracy has made the Brazilian State an unfavourable environment to adopt technologies that allow the optimization of resources and their availability in the right place at the right time. Therefore, lean philosophies need to be incorporated into the provision of public health services, education, connectivity, among other important actions in a country with more than 220 million inhabitants and a continental size. In parallel with this new contracting format, it is important to highlight that the use of the incorporation of knowledge and technologies of social impact will only have the expected effects if the human resources of the Brazilian public sector are duly qualified.

This need will promote a strong acceleration in inclusive Lean programs in the public sector in areas where they are usually not included in the academic curriculum of the courses, such as in the social sciences and health, generating new opportunities for new players and new career opportunities. Another relevant point brought with the Legal Framework is that the accounting procedures of resources passed on under the Law should follow simplified and standardized forms and in order to ensure governance and transparency of information, be carried out annually, preferably through electronic sending of information, according to the regulation.

3. Discussion

Every process of change is an excellent time to put the wheel of the transformation to spin. It is also an opportunity to initiate actions that promote discussions about the role of knowledge in the implementation of new paths for the economy of the state of Amazonas. When you look at the business environment that drives the world's major economies, you can identify what a slogan is innovation. In a simplified way, to generate innovation, you need to have an infrastructure of facilities capable of supporting the necessary research and qualified human resources. Laboratories can be purchased, but qualified human resources, with masters and doctorates, depend on time and investment, and are available in our institutions. The higher the qualification, the greater the likelihood of expressive results leaving the laboratories.

The simplification of procedures and the closer relationship between companies and government research institutions is one of the advances brought by Federal Law 13.243, of 2016, regulated by Decree No. 9, 283, of 2018, known as the Legal Framework for Science, Technology and innovation. Through the Legal Framework, the Brazilian Government's obligation to foster innovation in companies and non-profit entities was generated. The mentioned legal norm extended the mechanisms of economic subsidy to micro, small and medium enterprise, especially the participation in companies.

Public institutions may be minority share holders in the social capital of technology-based companies and investment funds for innovation, either directly or indirectly, through investment funds constituted with own or third-party resources, among other actions, for developing products or innovative processes that are in accordance with the guidelines and priorities defined in science, technology, innovation and industrial development policies.

The legislation establishes that minority participation will be a financial contribution or not, and it must be economically measurable and may be accepted as a form of remuneration for the transfer of technology and for the granting of the right to use or to exploit the creation of ownership of the Union and its entities. One of the attractions for the legal entity to build the relationship with public institutions is that the intellectual property on the results obtained will belong to the company, in the form of the current legislation and its constitutive acts.

The assets of the equity interest may be sold without the need for public bidding, and the funds received as a result of the sale of the equity interest should be invested in research and development or in new equity interests. It is imperative to emphasize that the permit discussed here allows a significant opening in international relations, since the legal norm did not limit the companies to the national territory. Several international companies have innovative processes that would boost the development of Brazilian science, technology and innovation.

In order for this to happen, it is essential to promote joint PD&I activities between the public and private sectors of the Brazilian economy, through relationships that articulate knowledge and resources in a clear and safe way for both. This ensures greater predictability and, as a consequence, attractiveness to investments in the area of CT&I.

4. Conclusion

We can conclude that the new set of legal rules will significantly influence the production of science through articulation with technology and innovation, which will imply the increase of additional resources coming from the private sector. In the same way, it will affect the quantity, quality, and flexibility of scientific production. In order for this to happen, it is essential to promote joint R&D and Innovation activities between the public and private sectors of the Brazilian economy, through relationships that articulate knowledge and resources in a clear and safe way for both. This ensures greater predictability and, consequently, attractiveness to investments in the area of Technology and Innovation.

At the regional level, the state of Amazonas can benefit significantly if actions are taken towards building an environment conducive to the approximation of companies with local institutions, which have a large amount of research on the potential to generate important products economically, but who need investment, management and marketing, so that they can contribute to the formation of a new matrix for the state economy.

The restructuring of the Amazon Biotechnology Center (CBA) is a great opportunity, which can transform the region's biodiversity into products to integrate a new economic matrix for the State, and other similar structures can be designed so that other areas of knowledge can contribute for this construction.

For this to happen, it is essential that joint activities be fostered between the public and private sectors, through relationships that articulate knowledge and resources in a clear and secure way for both, thus ensuring greater predictability and, consequently, attractiveness to investments. Under the new law, universities and public research institutions are now allowed to share their intellectual capital, laboratories, equipment, instruments, materials and other facilities with companies and individuals for research, development and innovation activities, provided that such permission does not directly interfere with its end-activity or conflicts with it.

This approach is the quickest solution to overcome the challenge of making research results turn into products that can deliver real benefits to society, generating jobs throughout the production chain, and results that promote welfare or any other factor that serves society.

Basic research is fundamental to the advancement of science, but applied research, which transforms knowledge into products, is essential for the well-being of society.

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