Subject: Interactions between Triple Helix, actors and investigators in the social sciences, humanities and fine arts, and their influence on ‘ transdisciplinary' problem-oriented research and innovation.

Interaction between Innovation Agents under the Perspective of Transdisciplinarity: The Case for the Innovation Development Program in Minas Gerais

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Abstract

This paper is aimed at contributing to the issue of transdisciplinary research and its importance to the transformation of knowledge production to the innovation process. By using the *Triple Helix* conceptual theoretical model the study is intended to determine how the interaction between the main innovation agents (university, company and government) occurs and understand the extent to which the Company Research Support Program – PAPPE foster transdisciplinarity in the development of research for the innovation process. As a partial result of the research, considering the innovation projects, it is important to stress the interaction dynamics existing between the various agents. The number of projects intended to develop transdisciplinary research is an indication of the effort to overcome the barriers to the relationships between the actors involved and suggest that, although slower than expected, the program contributes articulation to knowledge production.

Keywords: Innovation Agents; Triple Helix; Transdisciplinarity; Science and Technology Policy; Company Research Support Program -PAPPE.

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1. Introduction

Within the political, scientific and entrepreneurial contexts the institutional dynamics based on the creation of wealth and sustainable development bases on the generation of knowledge and its effective application has been increasingly acknowledged. The market demands more

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competitive companies which, in their turn, demand better qualified employees with a view to speed change and innovation processes. The globalization dynamics of the market and the arrival of new competitors to the regional economies give emphasis to this process. With the increasing speed of the changes, agents and organizations are confronted with new problems, and their solution demands new qualifications (Organization for Economic Cooperation and Development /OECD 2000). It seems obvious, however, that the increase in knowledge production within the universities is not enough.

In developed countries, the changes experimented by the universities in their relations with business organizations through the 1980's and 1990's, invited many investigators to develop detailed studies on this matter. The works by Leydesdorff & Etzkowitz, (1996 e 1997), show that the universities have been playing an economy role in the society by adopting the theoretical, methodological concept known as triple helix. Through the triple helix metaphor, they seek an interpretation of the interactive relations between these three innovation actors: university, organizations, government. As Etzkowitz (2005) puts it, the interaction between these actors is more and more providing the foundations for the social and economic development of the developed industrial societies and of the developing societies as well. Authors like Dagnino (2003) and Etzkowitz (2006) approach those new relations between universities and business organizations as an "academic revolution", while others interpret them as an extension of the university "mission". Until the 1980s the university had three core functions: teaching, developing research and offering extension activities. Starting in the 1990s, a new function was added related to the economic development of the society and the business organizations, considered as a fourth function or mission corresponding to the so-called "academic revolution" (ETZKOWITZ, 2006; SANTOS, 2005; SONKA E CHICOINE, 2004).

With public policies to Foster innovation, the governments begin favoring the transfer of knowledge and technology between universities and organizations aiming to develop research focused on the solution of social problems. The university is no longer the sole producer of knowledge. The number of persons with access to knowledge in public laboratories and research centers, in organizations or in any institution where those activities are developed is continuously growing. It is within this context that the innovation development programs are implemented in Brazil, creating new room for research while fostering the coordination of various organizations and knowledge areas.

With this connection as focus for their studies, the NCitTI has been developing a piece of research on the PAPPE (Research Development Program in Business Organizations - Programa de Apoio à Pesquisa nas Empresas) and its possibilities as a form of support for the innovation process. A review of the contribution brought about by the documentary and bibliographic studies were developed by using the successive approximation method, which allows a comparison between the empirical data and the corresponding theories. This method, which goes from the general to the specific, allows for the identification of the peculiarities of the object being reviewed. As a conceptual support for the study, the Triple Helix method is equally used to ensure the cooperation between investigators, professionals and entrepreneurs aimed to face the complex challenges of the contemporaneous society (KLEIN, 2004).

This means that the society is becoming more complex, which demands approaches which appropriately address the combination of multiple disciplines. Thus the need for the use of transdisciplinarity as a new and relevant research strategy aimed to an understanding of the most important, complex and difficult issues currently challenging the world (SOMERVILLE e RAPPORT, 2002; NICOLESCU, 2008; ZIERHOFER e BURGER, 2007). Transdisciplinary approach means a contextualized research position to set a close relation with the society so that the issues to be solved are not limited to an only discipline, but involving many. [i]

Of course, this definition requires a less prescriptive and fragmented, better integrated view of this matter. The proposal is not simply aimed to be a response to the limitations of the various science fields, but is extending to the articulation of an insight into the existence of a number of events which cannot be properly approached by an only discipline. These are the events emerging from the uncertainty between the social, personal and environmental contexts, which are not subjected to a segmented observation of the multiple levels of the reality. A result of this fragmented view is now the new attitude towards science and technology.

2. The transdisciplinarity proposal

A new production of knowledge, coined by Gibson et al. (1994), the term identifies the transformation of the scientific production into a research system which is highly integrative and socially distributed.

Since the 1980s, the studies by Bohme (1983), Irvine and Martin (1984), point to the growing movement of science towards strategic purposes, and confirm the subsequent production of relevant knowledge. In recent years, such approach has been strengthened.

This new mode of knowledge production, called MODE 2 – to refer to regular science – MODE 2 – has features which distinguish it from conventional research (HESSELS E LENTE, 2008).

Augsburg e Henry (2009) define interdisciplinary research as a form of individual or team research which combines information, data, techniques, models, insights, concepts and theories from two or more disciplines or specialty knowledge areas to advance the understanding or the solution of problems which demand going beyond the scope of one discipline or field of knowledge. The main characteristic of interdisciplinarity, as the term implies, is to promote the interaction between disciplines and generate something new. The novelty emerges from the tension which leads to the fulfillment of a gap between the disciplines. These areas of tension serve as a form of finding new unsolved problems thus allowing the investigator to transform them into original lines of research. When interdisciplinary research is developed to solve a question considered as a legitimate demand of the society, this is said to be “Mode 2 Science” or transdisciplinary research (BOHME, 1983; IRVINE e MARTIN, 1984).

Transdisciplinarity is a new approach to research and problem solving. The Manifesto of Transdisciplinarity signed by the Locarno Congress participants in 1997, with the UNESCO support, resumed the discussion started with Jean Piaget in 1972, and acknowledges the search for the unification of knowledge aimed to an understanding of the world of today.

The changes in climate are a clear example of this new form of doing research. The global warming was first detected by scientists. The subject became a government matter and one of the main demands of the society. Right now, putting together the knowledge of various disciplines, the investigators are trying to reduce global warming (BUCKERIDGE, 2009). In this type of research, the scientists have become more reflective and follow more comprehensive quality criteria compared to the traditional disciplinary mode.

As a result of this trend, a number of efforts are developed to allow for the advancement of knowledge, among which research network stands as a form of linking multiple actors and organizations to produce collaborative transdisciplinary knowledge. Worth noting are the works by Bohme (1983), Irvine Martin(1984) showing that Europe has been taking this approach for some time now, with a number of deep discussions on this matter.

Since the publication of the work by Gibbons et al. (1994), MODE 2 or Transdisciplinary Science, has gained visibility in the present reflections on the scientific practice. Such notion is referenced in more than one thousand scientific papers and seems to have had an impact on the policies for science, technology and innovation (HESSELS & LENTE, 2008:).

This concern with research aimed to strategic purposes is found in the views about local development, which imposes a number of complex, crucial questions: what is the role of the universities in the qualification of people aiming to improve the process of company innovation and promote the social and economic change of a city or region? What conditions are required to make this change sustainable?

These questions refer us back to the need for a new formulation of science, technology and innovation policies from the convergence of diverse theoretical and analytical approaches translated into the articulation of multiple actors to produce knowledge aimed to the construction of a national system of innovation.

In this sense, the efforts to develop innovation in the organizations, which are translated into public policies and the impact of the demands of the society as well, which value knowledge as a core asset for the productive process, have been changing the relations between companies and teaching and research institutions.

The search effort and the competitive struggle focused on innovation depend on two key dimensions: 1) enterprise capacity to identify new products and processes, and 2) local capacity to learn and create a new environment for change and advancement towards collective and regional learning.

The opportunities to design a system of innovation are found in this context, to benefit from scientific disciplines and research activities shared with companies and institutions to generate an environment of "cross fertilization" and synergies for the spreading and deepening of knowledge.

3. Linking innovation agents for the creation of the National System of Innovation

Connecting science producing sectors with the entrepreneurial sector is an important step for the creation of a national system of innovation. There are a number of mechanisms and structures to make the transfer of knowledge and outcomes of research and technology from the universities to the industries into an easy process. This is, for instance, the case of the business incubators. The business incubators for technology-based companies are organizations which house newly-born enterprises, mainly arising from scientific research, with a design which implies innovation. Those organizations offer subsidized room and services which favor entrepreneurship and the development of highly technological and scientific content products or processes.

The concept behind the incubators is grounded on the need for a mechanism which allows the investigators to prove the commercial potential of their work, decide whether to advance the process of knowledge transfer and explore new potential opportunities. This implies having adequate surroundings with an affordable workspace, management infrastructure and access to consultancy as well as technical, legal and financial support (BAÊTA 1999). Such incubators are physical entities internationally acknowledged as effective vehicles for the process of knowledge transfer, which have benefited the regional economies with their concept and application (SANTARITA & BAÊTA, 2008).

Since the mid 1980s the Brazilian Government has fostered the creation of technology parks and technology-based incubators, both considered relevant elements for the construction of the National System of Innovation. The increasing growth of the number of incubators in the past twenty years is a testimony of their importance and timing, as shown in Table I below.

Table 1 – Growth in the number of incubators in Brazil in 20 years

YEAR	INCUBATORS
1988	2
1990	7
1992	12
1994	19
1996	38
1998	74
2000	135
2002	183
2004	283
2006	359
2008	377

Source: Santarita & Baeta, 2008

Although the incubator movement has been very promising, and has been qualifying the entrepreneurs to enter into partnerships and create innovation networks, it is worth remembering that enterprises arising from incubators are only a small fraction of the total number of companies in the country. Recent studies confirm that the preference of most Brazilian companies is for buying foreign technology instead of developing in-house R&D (ROCHA e FERREIRA, 2006).

Additionally, simply connecting those sectors, or offering scientific knowledge to companies is not a guarantee that the socioeconomic scenarios anticipated for sustainable development will be effectively achieved.

The review of a governmental program such as the PAPPE may clarify some relevant aspects for the elaboration of the science, technology and innovation policies which contribute effectively to the competitiveness of the organizations while defining the PAPPE institutional arrangement in Minas Gerais. This can be achieved by reviewing the relations between the participants, the roles they have in the process with a view to establishing a new way of producing knowledge and technology.

4. 4. Defining the Program

As previously mentioned, this paper is a partial result of a research which began in 2008 based on a pilot project – Research Development Program in Business Organizations – PAPPE-MG. Using the successive approximation methodology, together with the Triple Helix analytical method, the aim was to seek an understanding of the articulation of the various innovation agents for the development of innovation projects.

The theoretical framework based on the Triple Helix to propose the interaction between the innovation agents as a foundation for the construction of the capacity to innovate points to the relevance of the National System of Innovation as the partnership between those agents implies institutional conditions which favor the innovation process.

From this perspective, Brazil has been implementing a number of initiatives which may be viewed as resulting from public policies in the areas of science, technology and innovation, with a view to qualifying the productive sector for innovation. One of those initiatives is the creation of incentive programs for the activities of R&D within the company. One program to be referred to as a good example is the PAPPE, object of review in this paper.

The PAPPE is a joint, shared program of the Ministry of Science and Technology (MCT), FINEP and the state Research Development Foundations – FAPs, aimed to offer financial support for the activities of research and development of innovative products and processes developed by investigators who work directly or collaboratively with technology-based companies.

4.1. Research Development Program in Business Organizations

The review of the Research Development Program in Business Organizations – PAPPE points to the interest of the Government in the implementation of the national system of innovation aimed to foster competitiveness in Brazilian companies via the effective collaboration between the various innovation agents.

Created by the Federal Government, PAPPE is aimed to promote the technological development of the companies, leading them to an approximation with the teaching and research institutions to generate technological innovation.

PAPPE adopts a more pragmatic science, technology and innovation policy seeking to connect multiple agents to promote more favorable conditions to approach the productive sector to the research sector. Through the FINEP – Financiadora de Estudos e Projetos, the Federal Government establishes financial and technical cooperation agreements with the State Research Development Foundations – FAPs and other institutions and federations.

The Program was created in 2004, and the first results indicate that the companies are now engaging in developing research. The previous resistance of the business sector in relation to the activities of the research centers is gradually being overcome. From the first Public Notice in 2004 to the most recent Public Notice there was a significant increase in the demand for funding. The Program has been developed in seventeen states in Brazil.

In the State of Minas Gerais, the Program has been implemented by the Research Development Foundation – FAPEMIG and is now counting the first positive results.

The first agreement was signed in 2004 by FINEP, the State Secretary of Science, Technology and University Education (SECTES) and the Research Development Foundation – FAPEMIG (MARRÔCO et alii, 2008).

In the same year, the Program issued its first Public Notice in the state through the Research Development Foundation – FAPEMIG. Two other Public Notices have already being issued for the following areas: Drugs and Medications; Electrical-Electronics; Oil and Gas; Automotive; Environmental Technology; Energy; Food and Agribusiness; Mineral-Metallurgical; Chemical and Derivatives.

For the first Public Notice, 49 companies signed contracts; PAPPE funded 40 projects in 2005; R$12 million were used for the first Public Notice in 2004, of which 50% was granted by FINEP and 50% by the state funding agency. The company engaged would contribute 20% of the amount requested.

In the 2007 Public Notice, this amount reached R$24 million and 69 companies signed contracts. Refer to Table 3.

Table 3

Research Development Program in Business Organizations - PAPPE Subsidy - Minas Gerais

Edition	Resources available	Contracted proposals
1st. Public Notice - 2004	6,6 million	49
2nd. Public Notice 2005	5,7 million	40
3rd. Public Notice 2007	24 million	69

Source: NCiTI, 2008

This first agreement was scheduled to be completed in three stages:

Stage I – Filing and pre-qualifying of companies, investigators and technology project proposal

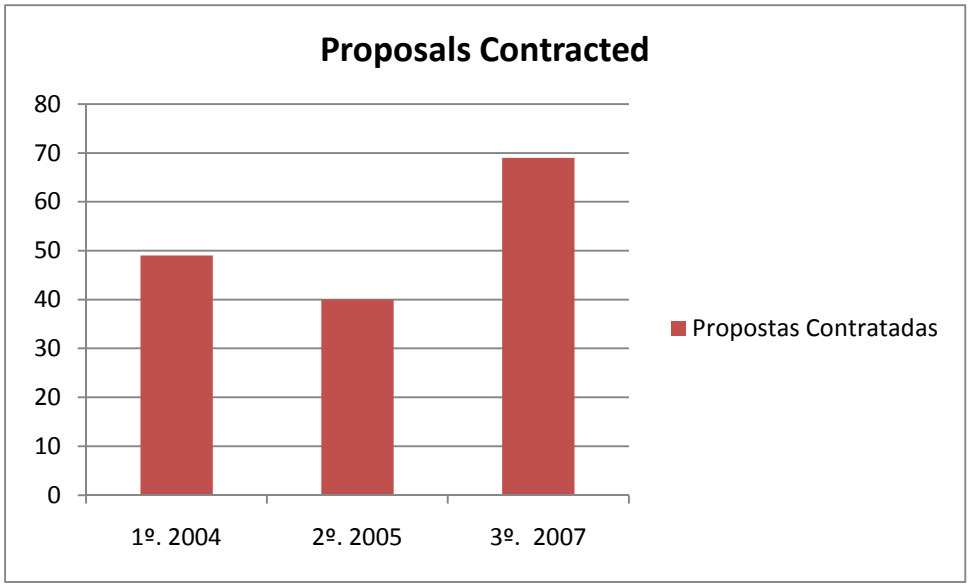
Stage II – Support and technical, economic and commercial feasibility study of projects

Stage III – Support for the development of new products or processes in the stage of time to market

FAPEMIG was in charge of issuing the Public Notices, assess the proposals, execute the contracts and provide the resources, monitoring and review of the outcomes.

As only 50% of the resources made available were actually used, FAP issued a second call for the development stage of the product. The Public Notice was published in 2005 for the amount of R$6 million.

The third Public Notice, published in 2007, saw a significant increase of 244 proposals from which only 69 companies signed contracts. A total of R$24 million was made available and the total funding reached R$19.542.265,00.



Source: NCiTI, 2008

The evaluation of the 2007 Public Notice proposals included technical visits to the companies enrolled. In addition to the evaluation of merit by a committee, 50% of the companies approved were visited by FAPEMIG and FINEP. This stage was included by FINEP.

Brazilian companies have expressed an increasing interest in participating in the Program. The effective product or process outcomes are still low considering the short time since the implementation of the Program.

In November 2008, the Ministry of Science and Technology issued a new Public Notice via Financiadora de Estudos e Projetos (FINEP) for R$80 million to foster more participation of the northern, northeastern and center-western companies in the Research Development in Small Companies – PAPPE-Subsidy in the states of Acre, Alagoas, Amapá, Mato Grosso, Pará, Paraíba, Roraima, Rondônia, Sergipe and Tocantins.

5. Final considerations

Despite the low outcomes obtained to date, some questions arising from those initial studies allow to anticipate relevant indicators for a review of those policies focused on innovation.

A first aspect to be highlighted concerns the interaction dynamics between the agents involved (university, organizations and government). The data shows an increasing demand for the development of transdisciplinary research, indicating an effort to overcome the barriers to the relationship between those agents while suggesting that, although still slowly, the Program has contributed effectively to the production of knowledge.

This initial moment of the Program does not yet allow for a conclusive evaluation of its impact on regional socio-economic development. However, it is clear that the Program has been effectively seeking to promote a closer connection between the entrepreneurial sector, research centers and government funding agencies. The companies engaged are starting to work with the universities with a view to develop transdisciplinary research.

Moreover, the increasing number of companies interested in obtaining funding from the Program show a trend to an increase of company awareness of the importance of knowledge to

the process of innovation and consequently to the competitiveness of the companies in the globalized market.

Future research shall review the efficacy of this policy for the competitiveness of the companies and local development.

Notes :

[1] For the concept of transdisciplinarity, refer, among others, to: Morrin, Edgar (2000); Nicolesco, B.(1999); Santos, Akiko(2005).

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