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The evolution of universities' relations with the business sector in Brazil: What national publications between 1980 and 2012 reveal

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RESUMO

A evolução das relações da Universidade com o setor empresarial no Brasil: o que revelam as publicações nacionais entre 1980 e 2012

Este trabalho aborda as mudanças nas relações entre universidades e empresas (U-E) no Brasil em atividades de inovação, com base em levantamento dos artigos publicados nos principais periódicos nacionais ou apresentados em congressos brasileiros e regionais mais relevantes, entre 1980 e 2012. O ano de 1980 marca a criação dos Núcleos de Inovação Tecnológica (NIT), primeira iniciativa do governo de estímulo à transferência de conhecimentos das universidades para empresas. O segundo foi a Lei de Inovação, instituída em 2004. O pressuposto é que, após esta lei, cresceria a produção acadêmica sobre o tema, com novas propostas de modelos e reflexões para melhoria desta relação. A metodologia empregou abordagem qualitativa, exploratória, utilizando pesquisa bibliográfica, estudo bibliométrico e análise de conteúdo em 247 trabalhos. A revisão da literatura contempla trabalhos internacionais que mostram problemas e sugestões de melhorias, enquanto no Brasil ainda se discute se esta colaboração deve ocorrer, e se este é um papel legítimo da universidade. A análise de conteúdo revelou poucos trabalhos sobre novas configurações e processos de gestão da parceria. As conclusões mostram que as relações U-E ainda não constituem um processo regular e amplamente aceito nas universidades públicas brasileiras, e refletem um viés ideológico contrário à cooperação com empresas.

Palavras-chave: cooperação universidade-empresa, inovação, núcleos de inovação tecnológica, propriedade intelectual, universidade empreendedora.

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1. INTRODUCTION

There is still a long way ahead towards cooperation between universities and companies in Brazil, in the search of efficient models to increase the country's degree of innovation. This is a natural partnership in developed countries, where firms seek external sources of knowledge, despite having vast resources and their own R&D laboratories (Chesbrough, 2003).

The increasingly rapid pace of creation of new goods and services demands sources of creativity that go beyond the boundaries of firms, and cooperation with customers, suppliers, research institutes and even competitors is already common. Cooperation is most needed in emerging countries, where universities are the main source of knowledge that can lead to innovation, and agents of economic and social changes. But it is in these countries that cultural differences and prejudices inhibit collaboration (Economic Commission for Latin America and the Caribbean [ECLAC], 2010, p. 33).

In Brazil, this cooperation is needed in a broad spectrum of sectors and activities in view of the past. From the early 1950s throughout the 1980s, Brazilian economic policy favored industrialization based on an import substitution strategy, with large presence of state-owned enterprises in industries linked to the primary sector (mining, petrochemical, steel) and in granted public services, and multinational companies rose in the consumer goods sector (Mello, Maculan, & Renault, 2011). The country grew at high rates, with the protection of tariff and nontariff barriers that kept it away from international competition without the widespread practice of products and processes' innovation. Established multinationals innovated in their home countries, hindering local technological qualification through learning. Hence, Brazilian companies in general have no tradition in conducting R&D, given the high costs and risks of this activity, and also a history of protectionism that encouraged the entry of foreign capital and technologies to increase competitiveness (Coronel, Azevedo, & Campos, 2014).

On the other hand, the science and technology (S&T) policy aimed at technological autonomy, by sending abroad teachers to get Master and PhD degrees to allow the establishment of graduate courses in Brazil. This dissociation between the two policies resulted, years later, in a group of highly trained professionals working at universities and public research institutes, without concern for the of companies' needs, which were met by imported technologies. Since the economic liberalization in the early 1990s, domestic companies have been forced to adopt modern actions to face competitors in the country, after the arrival of new foreign companies. Innovation was necessary and technological capability became the main objective of the industrial policy, for which cooperation with universities was essential (Mello *et al*., 2011).

In 1993, a comprehensive study commissioned by the Ministry of Science and Technology and the World Bank concluded that a new policy for S&T should perform apparently contradictory tasks: "to encourage freedom, initiative and creativity of researchers and, at the same time, establish a strong link between their activities and the needs of the economy, of the educational system and of the society as a whole" (Schwartzman, 1993 p. ii). At the time, this topic gained great relevance. The University of São Paulo (USP) Journal published the *University-Industry Dossier* (1995), IBICT (Brazilian Institute of S&T Information) edited the book *University-Industry Interaction*, in two volumes (1998, 1999) and the Journal of Management (RAUSP) published a special issue on the subject in October/December 1999.

In the last decade, open innovation was pointed as the preferred path for companies' growth, through the collaboration among firms, universities, research institutes, suppliers and customers. The famous quote by Henry Chesbrough (2003) - "*not all brilliant scientists work in your company"* – features well this new era of innovation.

Recently, international literature has been discussing new concepts such as "academic science", "entrepreneurial university", "capitalization of knowledge", "academic entrepreneurship", and the differences in the underlying values of this transformation (Lam, 2011; Siegel, Wright, & Lockett, 2007; Etzkowitz, 2008). Critics mention "commercial science" "academic capitalism" and "privatization of knowledge" (Oliveira & Velho, 2009; Chauí, 1995).

The first Brazilian governmental efforts to bring universities and companies together in innovation projects date back to 1980, and resulted in the creation of the Technological Innovation Offices (NITs) in 1981, a program of the National Council for Scientific and Technological Development (CNPq), with the support of FINEP - Innovation and Research. However, as it occurs in several public initiatives, over time financial resources became scarce, many organizations failed to keep them in activity and most were closed (Medeiros, Stal, & Souza, 1987). Other programs and laws to stimulate cooperation followed: Act 8661/93 (tax incentives for innovation), Act 8248/91 (tax incentives for Information Technology companies), Partnership for Technological Innovation (a program of FAPESP - São Paulo Foundation for Research Support, 1995), Green-Yellow Fund (2000), other sectorial funds with calls for partnership projects, and the Innovation Act (2004). In Article 16, this act requires that public S&T institutions establish Technological Innovation Offices for the purpose of managing their innovation policy, and sets their minimum skills. Over three decades, there has been progress, especially with the institutionalization of these technology transfer offices, but there are still thoughts and attitudes contrary to cooperation.

In addition to the Innovation Law, other government actions encouraged partnerships between universities and companies, such as the Good Law (Law 11,196/2005), which grants tax incentives to firms that conduct R&D, even if such activities are commissioned to universities and research institutes. And the

Program for Economic Subsidy, which grants non-reimbursable public funds to companies, and whose regulatory framework was established by these two laws.

In view of this context, the paper focuses on the evolution of university-industry relations in Brazil regarding innovation, and is based on the analysis of articles published in major national journals or presented in the most important national and regional conferences between 1980 and 2012; more specifically, we wish to verify the impact of the 2004 Innovation Act on the scientific production in subsequent years. Our assumption was that, from then on, the academic literature on the topic would grow, with new ideas and propositions of models for improving this relationship, considering some articles of the law such as the possibility of researchers getting a leave of absence to create spin-off companies and the mandatory establishment of NITs.

Our literature review identified two articles that evaluated the Brazilian academic production on this topic. Zanluchi and Gonçalo (2007) did a survey of the most important papers of the ten previous years. However, they failed to explain which relevance criteria was adopted, and used a flawed sample that ignored the main national events where these papers are presented such as the National Meetings of Production Engineering (ENEGEP), the Symposia of Technological Innovation Management (SGIT) and the ALTEC Seminars (Latin-Iberoamerican Association of Technological Management), where Brazilian authors are the majority. On the other hand, the definition of categories used to classify the articles is relevant. And Closs and Ferreira (2010) examined the articles on technology transfer from universities to companies published in national journals, covering the period 2005-2009.

This paper has six chapters, including this Introduction. The second chapter provides a brief review of the literature and the most relevant topics for discussion today. Following, we present the methodology, results, analysis and discussion, and conclusions. In the end, the references are listed.

2. LITERATURE REVIEW: UNIVERSITY-BUSINESS RELATIONS IN THE WORLD AND THE BRAZILIAN CONTEXT

Etzkowitz (1989) was one of the first to identify a new role for the university. To its original educational mission for the training of qualified personnel, it incorporated research activities, in the late nineteenth century, which were done until then by individual inventors at domestic workshops. He drew attention to a new academic revolution, resulting in the "capitalization of knowledge." Hence the concept evolved into the Triple Helix, which explains the intersection of relatively independent institutional spheres, creating hybrid organizations such as technology transfer offices in universities and research institutes, and new funding agencies, such as venture capital companies and networks of angel investors (Etzkowitz, 2008).

The landmark of university-industry relations for innovation is the Bayh-Dole Act (Public Law 96-517), approved in the United States in December of 1980, amid concerns about the country's loss of competitiveness, and it was considered a watershed on the issue of licensing technologies developed at universities. At the time, Congress was debating ways to promote private sector growth through the use of research conducted with public funds, whose results should be offered to all interested parties, in exchange for autonomy to choose their direction - the only rights accepted for inventors were the satisfaction and recognition for the inventions (Etzkowitz, 1989).

Approval of the law was not easy because of the possibility that foreign companies would gain financial benefits from the results of years of research funded by the government. One example mentioned at the time was the partnership between German company Hoechst and Massachusetts General Hospital of Harvard University, for the marketing of biomedical research (Matkin, 1990). Before the law, government retained ownership of all patents resulting from public funding and the right to license them, without exclusivity, to any interested company. To some extent, this hampered innovations because companies did not want to develop products over which they wouldn't have exclusive commercialization rights (Schacht, 2006). Thus, only 5% of government-owned patents were used by the private sector, although much of this portfolio had market potential. The Bayh-Dole Act was created to increase the rate of patents' use, by enabling universities, small businesses and non-profit institutions that received federal support to hold the ownership of the results and license them to companies (Thursby & Thursby, 2011).

Since then, there was a dramatic increase in the number of inventions disclosed, along with the requests for university patents and their exclusive licensing, in exchange of royalties' payment. Other laws were created in following years, forming a coherent set of instruments to stimulate innovation, but the Bayh-Dole Act remains the most relevant.

Over time, there have been criticisms regarding conflicts of interest and a presumed bigger emphasis on applied research at the expense of basic research, particularly in biotechnology -agricultural and medical inputs (Schacht, 2006; Glenna *et al.,* 2011). Some noted that the Bayh-Dole Act "*introduced the motivation for profit directly into the heart of academic life*"; "*diverted teachers from basic research motivated by curiosity*" and "*favored the execution of research projects with a more immediate market potential*", yet such arguments have not been proven (Thursby & Thursby, 2011). A survey with 3,400 teachers in six American universities, between 1983 and 1999, suggests that the share of basic research has not changed, and licensing increased 10 times. Although this is the best way to maximize social returns on public investments in R&D, it does not diminish the effectiveness of open channels of knowledge dissemination, such as publications, conferences

and consulting, even in the pharmaceutical industry, where patents are extremely important (Thursby & Thursby, 2003).

The development of the US economy in the second half of the 1990s was extraordinary, especially in fields such as biotechnology and information and communication technologies, and this is related to the significant increase of patenting and licensing of academic research (Mowery *et al*., 2001). Lee (1996), in a national survey with about 1,000 academic researchers, noted greater will to collaborate with companies than in the 1980s. Most of them supported the idea of an active participation in local and regional economic development, through the commercialization of academic research and consultancy to private companies by teachers. However, researchers opposed to the involvement of universities in business partnerships with companies, such as assisting the creation of start-ups or having equity interest in companies, in exchange for the payment of patent licensing fees or royalties.

Kenney and Patton (2009) are against the model established by the Bayh-Dole Act, in which they see information asymmetry, ineffective incentives and contradictory motivations for the university, for inventors, for potential licensees and for technology transfer offices (TTOs). And suggest two alternatives for commercializing research results: to grant the property rights to the inventor, who would choose the best way to license it – to the university's TTO or to another organization. In return, the university would receive an equity stake over marketing returns. The second alternative would be to make all inventions available in the public domain or to grant non-exclusive licenses. In a subsequent paper, these authors studied the creation of spin-offs from six universities - five American and one Canadian, the University of Waterloo, the single one that grants intellectual property rights to the inventor. And it was significantly more successful in creating technology-based companies (Kenney & Patton, 2011).

Several European countries were inspired by the Bayh-Dole Act to promote technology transfer from universities to industry, but Mowery and Sampat (2005) drew attention to the structural differences among countries' higher education systems, meaning that simply transposing the law to another institutional environment would not guarantee its success. In the 1990s, European universities began to seek new sources of research funding, in view of decreasing government budgets, replaced by competitive funds oriented to applied research, and by business financing (Geuna & Nesta, 2006). Patenting by universities has grown, but is heterogeneous across countries and sectors. And licensing has not been profitable for most universities, although some have attracted significant additional revenues. The optimistic projections on income resulting from patents licensing did not consider the expenses with the process and maintenance of patents, and with the operation of the technology transfer offices.

Since the late 1990s, most European countries changed the intellectual property rights, which went from "*inventor ownership*" or "*professor's privilege*" to "*property of the institution*", which already occurred in research institutes (Geuna & Rossi, 2011). Denmark was the first country to make these changes in 2000, followed by Germany, Austria, Norway and Finland, between 2001 and 2007. France, Greece, Spain, Switzerland and the United Kingdom, where this was already a policy, were encouraged to reinforce these rights and increase technology transfer. Italy did the opposite movement, adopting the *inventor's privilege* in which the university receives between 30 and 50% of licensing revenue. Unlike other countries, Italian legislation of 2001 considered inventors more capable to take advantage of their inventions, because universities did not have the expertise or the culture to do so; Sweden keeps the system based on the *professor's privilege*, in which all revenue goes to him, who bears the costs of patenting and licensing. In these countries, patenting and transfer of knowledge are increasingly recognized as legitimate and relevant academic activities.

Greenbaum and Scott (2010) advocate the establishment of regional TTOs instead of having them at each university. Regional offices could operate with economies of scale, with a trained staff in technology transfer, and assist several universities. Geuna and Rossi (2011) suggest a modern version of the professor's privilege, which would give researchers the intellectual property rights, and these would be licensed by the regional offices, without the universities' intervention. This would speed up the process of technology transfer, besides encouraging entrepreneurship.

After the large number of articles praising the Bayh-Dole Act, and others that show that the initial concerns about the shift from basic to applied research were not proven, in recent years some articles have proposed improvements in the law, especially regarding the performance of TTOs. Also, the literature on the creation of spin-offs or start-ups has expanded, as a mechanism for commercialization of intellectual property, besides the traditional licensing mechanism (Siegel *et al*., 2007). This form of technology transfer requires reviewing the structures and practices of the university, because it takes longer, is more uncertain, and involves the search for venture capital and development of marketing capabilities. In the case of disruptive technologies (genetics and stem cells), moral and ethical issues demand a more active role by the university.

Several papers examined the changes that took place in researchers' profile. Lam (2010) surveyed opinions of 734 scientists from five major United Kingdom universities. According to more or less favorable views on university-industry relations, forms of interaction, motivating factors, the perceived legitimacy of the commercialization of results, work strategies and identities regarding their role, the author suggests a typology of scientists: *traditional*, *traditional hybrid*, *entrepreneurial hybrid* and *entrepreneurial* (Figure 1).

Perkmann *et al*. (2013), in an extensive review of the literature, classified the relationships between universities and companies into two types. Collaborative research, consulting

contracts and informal relationships for knowledge transfer were considered "academic commitment"; while "marketing" involves the creation of intellectual property and academic entrepreneurship. They conclude that the former is the most practiced type and differs from commercialization activities because they are strongly aligned to the traditional academic research, whose goal is to raise funds for the researchers' working agenda.

Rothaermel *et al.* (2007) made a comprehensive review of articles published in international journals, under the broad topic "entrepreneurial activity in universities", including patenting, licensing, creating new companies, technology transfer through incubators and technology parks, and contribution to the regional economic development, reaching 173 articles published between 1980 and 2005. Although covering a 25-year range, the vast majority of articles have been published in recent years, with a large increase of papers on academic entrepreneurship, as of the late 1990s. This growth is also the result of several special issues - between 2000 and 2005 127 articles of the sample were published.

International studies depart from the natural reality of cooperation. Much of the current literature discusses how to improve it, how to structure the technology transfer offices to make them more efficient, examine the profiles, motivations and justifications of researchers who cooperate or not with companies, and reflect upon the trend towards greater academic entrepreneurship as compared to the traditional form of technology transfer through licensing. There are many quantitative studies, since the practice of cooperation results in large data sets. There is a questioning arising precisely from this practice. Several articles discuss whether this relationship will have harmful effects on basic research and on the production and dissemination of scientific knowledge, with distinct results, but most of them in favor of cooperation (Larsen, 2011).

Table 1

A Typology of Scientists' Orientations Towards University-Industry Links

	Beliefs about academia and industry boundary	Extent and modes of engagement with industry	Main motivating factors	Perceived legitimacy of commercialization	Boundary work strategies and role identities
Type 1 "Traditional"	Believes academia and industry should be distinct and pursues success strictly in academic arena	Some collaborative links but of an intermittent nature	Mainly to obtain funding for research	Resistance An assault on academic *ethos* and autonomy	Boundary separation and expulsion Retain academic role identity
Type 2 "Traditional hybrid"	Believes academia and industry should be distinct, but also recognizes the need to collaborate	Mainly collaborative links with intermittent involvement in some commercial activities	Funding for research most important	Accommodation Not desirable but an inevitable development	Boundary testing and maintenance Protect dominant academic identity
Type 3 "Entrepreneurial hybrid"	Believes in the fundamental importance of science-business collaboration, but recognizes the need to maintain boundary	Continuous engagement in a range of collaborative and commercial activities	Funding for research most important Application of research, knowledge exchange and *networking* also important	Incorporation and co-optation Pursue commercialization but not all its associated meanings	Boundary negotiation and expansion Hybrid roles but retain focal academic identity
Type 4 "Entrepreneurial"	Believes in the fundamental importance of science-business collaboration	Continuous engagement in a range of collaborative and commercial activities Strong commercial ties with firms	Application of research most important Funding for research, knowledge exchange and *networking* also important Personal pecuniary gain relevant	Acceptance and veneration Commercial practices embedded in work routines	Boundary inclusion and fusion Fuse dual role identities

Note. Source: Lam, 2010

However, as regards biotechnology and its strategic importance for the production of new drugs, the discussion is deeper and deals with conflicts of interest, requiring incentives and public funds to preserve the role of the university in carrying out non-proprietary basic research, complementing investments from the private sector (Glenna *et al*., 2011).

The papers mentioned above show that in developed countries the situation is quite different from Brazil. We are still discussing if cooperation between universities and companies should be encouraged, whether it is good or harmful for the university, and if it should patent the research results in order to transfer them or to create spin-offs, stimulating entrepreneurship (Fujino, Stal, & Plonski, 1999; Póvoa, 2006; Mello *et al*., 2011; Suzigan & Albuquerque, 2011; Oliva, 2013; Raupp, 2013).

3. METHODOLOGY

We use a qualitative exploratory approach, through literature research and a bibliometric study, followed by content analysis. This approach sought to understand the phenomenon from the perspective of those involved, by means of a content analysis of the papers, in order to verify if the Innovation Law has influenced the subject and depth of the articles as of 2005. Bibliometric analysis produces quantitative data from the encoding of textual data and subsequent frequency counts of the codes, but the analysis itself is qualitative (Strauss & Corbin, 2008). The need to define investment priorities in S&T encouraged researchers and public officials to seek indicators to measure and quantify scientific and technological activities and assess production in different areas of knowledge and in a particular geographic and temporal space. Bibliometry emerges as a research front based on mathematical models to create indicators, from the analysis of the production features and the use of bibliographic records, as well as the flow of scientific communication and its relation to technology in the process of knowledge building (Fujino, 2006).

We used bibliometric procedures to understand the relations between: keyword and author (to check the authors' focus of interest and thematic productivity); keywords and year (to check the distribution of themes along the period of analysis); institution and author (to check the increase in the number of researchers on the subject per institution); institution and year (share of papers per institution over time may reflect support or interest); keywords and institution (topics of interest for institutions); author and year (authors' interest on the subject along the period); and collaboration networks among authors on the theme.

Content analysis (Bardin, 2006) was used after extensive research of articles published in national journals and papers presented at the most relevant conferences in the field, between 1980 and 2012, for their categorization by sub-themes within university-industry cooperation for innovation. According to this author, content analysis can be quantitative or qualitative. The former is based on the frequency of appearance of certain elements of the message, while the latter uses indicators that allow inferences such as the presence or absence of these elements, which can result in a more significant index. Among the various techniques of content analysis, categorical analysis is the oldest and most employed, and thematic analysis was used to categorize the articles.

We surveyed the Symposia on Technological Innovation Management (until 1986 named as National Symposium on Science and Technology Management), ALTEC Seminars, ENEGEPs, Annual Meetings of the National Association of Research and Graduate Studies in Business Administration (ENANPAD, Division GCT - Management of Science, Technology and Innovation) and the National Meeting of Economics (sponsored by the National Association of Graduate Centers in Economics - ANPEC). The research was limited by the availability of the proceedings on the Internet or at the FEA/USP library (printed versions or CDs).

We also searched the following journals: Journal of Business Administration (RAE), Journal of Contemporary Administration (RAC), Journal of Management (RAUSP), Journal of Business and Innovation (RAI), Brazilian Journal of Innovation (RBI), Management & Production (G&P), and Strategic Partnerships (Parcerias Estratégicas). Likewise, we included the special issue of the USP Journal (1995) that published the *University-Industry Dossier*.

The ANPEC Meetings were included because they have received, in recent years, several papers that resulted from the thematic project "Universities and Research Institutions Interactions with Industry in Brazil", funded by FAPESP between 2008 and 2012, and whose team consists of many economists. We also found articles by this group in the Journal of Economics, Journal of Political Economy, and Contemporary Management. We used the relevant information from these articles in the discussion chapter of this paper, although they were not part of the sample.

PhD and Master theses were not included in the bibliometric analysis, since they didn't pass through the process of anonymous assessments (peer review) - we assumed that relevant results of these studies were later published in academic journals or presented at conferences. Neither were considered articles dealing with specific arrangements for the promotion of innovation – such as incubators, technology parks, local clusters, national, regional and local innovation systems – or about spin-off creation. We only included studies that specifically addressed the individual relations between companies located in incubators or technology parks, and local universities.

We searched the literature to set the discussion context and to point some authors that, regardless of their presence in the sample, are a reference on the above issues allowing a better definition of the the analytical perspective. From a

historical point of view, we situate the context in which the NITs were created in the early 1980s, by a government initiative in collaboration with some public universities and research institutes. Regarding the sample, Table 1 shows the selected papers according to the delimitation. The categories were determined as follows, by adapting the classification suggested by Zanluchi and Gonçalo (2007):

A – papers on U-I cooperation in general, including theoretical essays and surveys, that feature positive aspects, barriers and challenges of the relationship; the triple helix; tools and management strategies; studies on intellectual property policy, licensing and marketing by universities;

B1 – papers that deal with interface mechanisms at universities which induce and facilitate cooperation (offices, information services, services networks, technology transfer structures);

B2 – studies that specifically deal with the relations between companies located in incubators, technology parks and business networks with universities;

B3 – papers that focus on issues of technology transfer from universities and research institutes to companies. They include single or multiple case studies, with field studies in companies, to diagnose specific aspects of the process;

C – studies on the cooperation with universities or research institutes, from the companies' perspectives;

D– papers from the perspective of the government and the society. They include studies on public policies and programs to encourage innovation

Papers were categorized by content analysis, especially thematic analysis. We analyzed 247 studies, of which 201 were presented at conferences and 46 published in journals (Table 2). Those presented at events and subsequently published were considered on the first release.

The events with the highest number of papers on the subject were the ALTEC Seminars and the SGITs (Symposium on Technological Innovation Management), which received 49.4% of all the papers presented at events. Considering that the conferences show research results faster than journals, most studies on the subject were presented between 1999 and 2005 (Table 3). There were 38 studies in SGIT 2000 (11), 2002 (19) and 2004 (8), with a decline thereafter; and ALTEC seminars presented 28 papers in the period - 8 (1999), 5 (2001), 5 (2003) and 10 (2005).

This period coincides with extensive discussions and the launch of the Innovation Act in 2004 and its regulation in 2005, which modified U-I relations, especially as to the requirement for establishing NITs in universities and federal research institutes. It is worth mentioning some studies that reflect the researchers' concern on the subject and portray the prospects and challenges for U-I cooperation. Stal and Fujino (2005) investigated some experiences of collaboration and the expectations of businessmen associated to ANPEI (National Association of Innovative Companies' R&D) about their technological partnerships with universities, the management of intellectual property (IP) and the Innovation Law in order to improve technology transfer mechanisms. The results showed the need for improvements in the law and a better definition of academic policies for cooperation with companies on issues related to the management and sharing of IP.

Matias-Pereira and Kruglianskas (2005) discuss the innovation management policies in Brazil, evaluate the law consistency, and compare them with the successful experiences of other countries in establishing industrial and technological policies. They conclude that despite some shortcomings, the Innovation Act represented an important milestone in building a model of technological development for Brazil. Garnica *et al*. (2007) assessed the management of IP at the University of São Paulo in face of the challenges imposed by the law, pointing difficulties and the need to update procedures, thus reinforcing the corporate vision mentioned in Stal and Fujino (2005).

Therefore, we decided to assess in detail the contents of the papers published or presented as of 2005, which fell into the following categories: A (essays and surveys), in order to observe new approaches to the subject, after the implementation of the Innovation Act; B3 (technology transfer), to identify changes in U-I relations after the Law; and B1, which deal with universities' interface mechanisms that facilitate cooperation. From 1980 to 2012 we found 21 studies, 11 as of 2005. Previous studies dealt with large mediating structures, such as information systems or services (belonging to the university or regional), technology transfer offices, Technological Innovation Offices (NITs). Since 2005, the papers focus specifically on the NITs.

In this second analysis, B2 papers, about incubators and technology parks, were not considered for the reasons already mentioned. There are few studies on category C (almost all written by academics, but portraying the corporate vision), and these were not included because they are outside the purpose of this study, which is to examine the opinions of university researchers on cooperation and their propensity to work on applied research, of interest to companies for creating innovations. Few studies fell into category D, and none deals with the Innovation Act and its effects on university-industry cooperation.

4. RESULTS: UNIVERSITY-INDUSTRY RELATIONS IN THE BRAZILIAN LITERATURE

Here we present the results of our research, based on content analysis and a bibliometric study. Tables 2 and 3 show the distribution of papers by event or journal and their thematic classification (Table 2), and by publication period (Table 3).

In categories A, B1 and B3 we found 92 articles, from 2005 to 2012 (110 in all categories) in conferences and journals, which represent 44.5% of the papers surveyed.

There are 49 in category A, 11 in B1 and 32 in B3, as shown in Table 4. In category A we found: literature review studies; papers about the academic environment in order to assess the potential implementation of the Innovation Act; challenges for the management of intellectual property in universities; suggestion of best practices for innovation from international experience; propositions of management models; evaluation of adopted policies; analysis of management strategies of innovation networks and partnerships; mapping of capacities at universities; implementation of the triple helix; proposals for building a national assessment system; knowledge management for cooperation; motivations for collaboration. In category B1, there are articles about interface mechanisms to induce and facilitate cooperation in universities, especially on the creation and consolidation of NITs at various universities. Category B3 gathers descriptive studies, such as diagnoses in companies to identify the potential of universities/research institutes' participation in the development of innovations; identification of external sources used by firms or opportunities for technology transfer from universities; studies that identify barriers for transfer; relationship difficulties due to cultural differences; interaction stages; evaluation of implemented projects; and forms and mechanisms of technology transfer.

There were few papers that fit the above mentioned assumption, and these are here summarized, based on content analysis. Carvalho *et al*. (2006) proposed a methodology for prospecting and identifying relevant research groups at universities and research institutes and their expertise in certain technologies and industries - which they called "strategic search". The project developed, tested and implemented procedures to map and classify the skills of several groups. Commissioned by Renault, to find out the capabilities existing in the automotive industry, the methodology can be used in other sectors. Garcez (2006) proposes a Partner Selection Matrix, a new model to help define the type of partnership that the company needs, depending on such variables as innovation complexity, stage of the technology's life cycle, competence degree and internal domain of the technology, risk, uncertainty level and period of maturation.

Garnica and Torkomian (2009) studied the institutional policies and challenges for technology transfer at the five public universities located in the state of São Paulo (USP, UNESP, UNICAMP, UNIFESP and UFSCAR), to identify difficulties and successes in the process, through interviews with universities' officials and partner companies' professionals about contracts, thus allowing a comparative analysis. In all

Table 2

Distribution of Surveyed Papers, by Event/Journal and Thematic Classification A – Papers On U-I Cooperation in General, Including Theoretical Essays and Surveys, that Feature Positive Aspects, Barriers and Challenges of the Relationship; the Triple Helix; Tools and Management Strategies; Studies on Intellectual Property Policy, Licensing and Marketing by Universities

SGIT 1980-2012	ALTEC 1985-2011	EnANPAD 1980-2012	ENEGEP 1996-2011	EnANPEC 2001-2011	RAE 1980-2012	RAUSP 1980-2012	RAI 2005-2012	RBI 2002-2012	Gest&Prod. 1994-2012	Parcerias Estrat. 2000-2012	RAC 1997-2012	TOTAL
73	49	37	33	9	4	21	4	5	3	7	2	247
34 A	15 A	15 A	12 A	6 A	2 A	11 A	2 A	5 A	1A	6 A	---	**109 A**
7 B1	**8 B1**	**5 B1**	**5 B1**	**---**	**---**	**3 B1**	**---**	**---**	**---**	**---**	**1 B1**	**29 B1**
4 B2	3 B2	1 B2	**----**	---	---	---	1 B2	---	---	---	---	9 B2
23 B3	**15 B3**	**9 B3**	**10 B3**	**2 B3**	**2 B3**	**5 B3**	**1 B3**	**---**	**2 B3**	**---**	**----**	**69 B3**
3 C	4 C	6 C	4 C	---	---	2 C		---	---		1 C	20 C
2 D	4 D	1 D	2 D	1 D	---	---	---	---	---	1 D---		11 D

B1 – papers that deal with interface mechanisms at universities which induce and facilitate cooperation (offices, information services, services networks, technology transfer structures);

B2 – studies that specifically deal with the relations between companies located in incubators, technology parks and business networks with universities;

B3 – papers that focus on issues of technology transfer from universities and research institutes to companies. They include single or multiple case studies, with field studies in companies, to diagnose specific aspects of the process;

C – studies on the cooperation with universities or research institutes, from the companies' perspectives;

D – papers from the perspective of the government and the society. They include studies on public policies and programs to encourage innovation

cases there was an increase in patenting and licensing. At the same time, we found studies such as Póvoa's (2006), which discusses if the university should patent inventions based on the logic of scientific production, on literature criticisms and the results of a survey on technology transfer that used CNPq's Directory of Research Groups (2004 census). The author concludes that it is necessary to reconcile patenting with the free dissemination of results, and suggests that licenses should not be exclusive, leaving the invention available to any interested party. Dias, Balbinot and Souza (2011) identify the distinctive organizational capabilities of NITs through a survey with the participating units of FORTEC (National Forum of Innovation Managers and Technology Transfer) and of the State of Minas Gerais Network of Intellectual Property. The differential competencies involved IP management; national patenting; consulting provided by researchers; identification of the areas of excellence in each research institution, based on the number of registered patents, publications and relevance of the research groups. The methodological proposition for measuring these skills and their constituent factors stands out.

Toledo *et al.* (2011) present the results of a project for training the Technology Innovation Offices (NITs) to prepare or update their internal policies of intellectual property management, as well as for the establishment of bodies and procedures for its transfer, negotiation and licensing. The *InovaNIT project*, funded by the Ministry of Science, Technology and Innovation, promotes the exchange of employees, contributes to the professionalization of technology transfer in Brazil, and stimulates the creation of new Technology Innovation Offices and the improvement of existing ones, through the free training of universities and research institutes' personnel. From August 2007 to December 2010, 833 professionals were trained, 279 institutions were attended, and over 20 offices were created, showing that government initiatives aligned to the needs of

Table 3

Distribution of Surveyed Papers, by Publication Period

Period	SGIT 1980-2012	ALTEC 1985-2011	EnANPAD 1980-2012	ENEGEP 1996-2011	EnANPEC 2001-2011	RAE 1980-2012	RAUSP 1980-2012	RAI 2005-2012	RBI 2002-2012	Gest&Prod. 1994-2012	Parcerias Estrat. 2000-2012	RAC 1997-2012
1980-1984	1	---	1	---	---	---	1	----	---	---	---	---
1985-1989	1	4	---	---	---	2	4	---	---	---	---	---
1990-1994	5	2	3	---	---	1	7	---	---	---	---	---
1995-1999	3	10	3	3	---	---	8	---	---	---	---	---
2000-2004	38	11	6	12	2	1	1	---	1	1	5	---
2005-2012	**25**	**22**	**24**	**18**	**7**	**---**	**---**	**4**	**4**	**2**	**2**	**2**
	73	49	37	33	9	4	21	4	5	3	7	2

Table 4

Number of Articles in Categories A, B1 and B3 in Each Event/Journal Between 2005 and 2012

Number of articles	SGIT	ALTEC	EnANPAD	ENEGEP	EnANPEC	RAE	RAUSP	RAI	RBI	Gestão &Produção	Parcerias Estratégicas	RAC	TOTAL
Total	21	18	17	17	8	---	---	2	4	2	2	1	**92**
A	12	7	5	10	7	---	---	1	4	1	2	---	**49 A**
B1	4	3	2	1		---	---		---	---	---	1	**11 B1**
B3	5	8	10	6	1	---	---	1	---	1	---	--	32 B3

Table 5

Annual Distribution of A, B1 and B3 Papers, Between 2005 and 2012

Year	Number of Papers
2012	12
2011	14
2010	13
2009	9
2008	9
2007	10
2006	11
2005	14
Total	**92**

organizations may have a positive impact on the National Innovation System.

Bibliometric analysis showed 83 individual authors with productivity varying from 1 to 7 papers in the period. Of these, 9 authors are among the 10% that wrote at least 3 papers. They are Torkomian, A.L.V. (7); Puffal, D.P. (5); Rapini, M.S. (5); Benedetti, M.H. (4); Garnica, L.A. (4); Ferreira, G.C. (4); Porto, G.S. (3); Kovaleski, J.L. (3) and Righi, H.M. (3).

In this list there are researchers with recognized experience on this subject, like Torkomian, from UFSCAR - sometimes with individual studies, sometimes with papers co-authored by her graduate students, as Benedetti and Garnica. Ferreira, from PUC-RS, is also an author with relevant work, especially in the topic of technology transfer, while the production of Porto (USP/RP) focuses on several aspects of industry-university cooperation, among them technology transfer mechanisms. Kovaleski, from Universidade Federal Tecnológica do Paraná (UTFPR), has papers on university-industry interaction mechanisms, mainly on the transfer of academic research results.

We also observed the presence of members of the thematic project team coordinated by UNICAMP "Interactions of universities and research institutions with industrial companies in Brazil," such as Puffal, Rapini and Righi, with papers presented at ANPEC meetings.

The correlation analysis between author and institution of origin, in order to identify new research groups on the subject or any institutional policies to stimulate the constitution of research groups, proved unfeasible. There are many papers in which advisors and their graduate students are co-authors, and these students sometimes identified themselves as members of the institutions where they were studying, other times they mentioned the institution where they belonged.

Hence, although in the overall score institutions like UNICAMP and USP (SP) both appear with the highest number of authors (22), the analysis of the academic production shows different situations. In the case of UNICAMP, the 22 authors participated in nine studies, four resulting from the aforementioned thematic project, and five papers were done by other researchers, on several issues of university-industry cooperation, including the ones by Toledo *et al.* and by Carvalho *et al*., described above.

In the case of USP, São Paulo campus has 22 authors in 11 papers, among these two stemming from the thematic project coordinated by UNICAMP; and Ribeirão Preto (RP) campus appears with 10 authors in five papers, three of which with the participation of Porto. UFSCAR has 17 authors in nine studies, most of them focused on technology transfer, patents and performance evaluation in university-industry cooperation. One of the studies examines the Project Inova São Paulo, to stimulate technological innovation, which brings together seven scientific and technological institutions located in the state, whose authors are researchers from UNICAMP, CTA (Centro Tecnológico da Aeronáutica), IPT(Instituto de Pesquisas Tecnológicas), UFSCAR and UNESP.

Regarding the annual distribution, our research did not confirm a significant increase in the number of papers after 2005, as shown in Table 5. The thematic focuses were already mentioned in previous paragraphs, and there was no special concern about some aspects of the Innovation Law, such as the three-year license for researchers to create spin-off companies, or the discussion on sharing intellectual property. Case studies that mention the creation or evaluation of Technological Innovation Offices are exceptions.

5. ANALYSIS AND DISCUSSION OF RESULTS

Our results go beyond the literature review made by Closs and Ferreira (2010), which involved only articles published in national journals classified by Qualis (a categorization adopted by the Ministry of Education) in the first five strata (A1, A2, B1, B2 and B3), in the areas of Business Administration, Accounting and Tourism, between 2005 and 2009. Its main objective was to identify the motivations for cooperation, the difficulties of the process, and the university structures designed for interaction with companies.

Our research covered a longer period of analysis - 1980-2012 - with particular emphasis on the period 2005-2012, and also includes the major national conferences in the areas of Administration (EnANPAD and SGIT), Economics (EnANPEC) and Production Engineering (ENEGEP), besides the ALTEC seminars (Latin Ibero-American Association of Technological Management). The journals surveyed were RAE, RAC, RAUSP, RAI, RBI, G&P, and Parcerias Estratégicas.

We also ran bibliometric analyses to identify authors with higher productivity, the emergence of new research groups and cooperation networks among institutions. The main objective was to assess the impact of the Innovation Act of 2004 on the

academic literature in subsequent years. We expected to find out new proposals of models for technology transfer, considering the new possibilities provided by the law, such as the three-year license for researchers to create spin-off companies and the standardization of procedures for sharing the benefits arising from the commercial exploitation of research results, and about the mandatory establishment of NITs.

Public universities still have a defensive attitude towards enterprises, often considering cooperation as the transfer of public resources to private activities (Oliveira & Velho, 2009). Many academic researchers only see their social role as limited to forming qualified human resources to meet the needs of the State (Rosa & Hemais, 2005).

Using the scientists' typology suggested by Lam (2010), with regard to the propensity to collaborate with companies, we can say that in Brazilian public universities the Traditional type still prevails (who does not want to cooperate with companies and values the basic nature of his/her research), but the other types are also found in a less degree. Both the Traditional hybrid and the Entrepreneur hybrid are motivated by the search of additional resources for research. The Entrepreneur type is the rarest, in spite of accepting the creation of small technology-based companies (spin-offs) more than the collaboration with established companies.

Regarding the activities classified by Perkmann *et al.* (2013) as "academic commitment" (collaborative research, consulting contracts and informal relations for knowledge transfer) and those considered "marketing" (creation of intellectual property and academic entrepreneurship), the results of our study show that in Brazil, by contrast, the second type is more common. This is due to a set of incentives offered by public policies. The Innovation Act, as mentioned above, compels federal universities to create NITs in order to protect the intellectual property of research results; PIPE program (Innovative Research in Small Business), created by FAPESP in 1997, was disseminated to all state foundations that support research by initiative of MCTI, under the name of PAPPE - Support Program for Research in Small Business; and the action of incubators, which accommodate small companies, both technology-based and from traditional sectors.

Today, the country has a complex production structure and a comprehensive research system, measured by the number of Masters and PhDs and international publications. However, these two systems remain apart. Companies have a limited capacity to absorb technology and develop innovations, and universities have not yet accepted their new role required by the Innovation Law (Mello *et al.,* 2011). These difficulties were also pointed by the president of CNPq, Glaucius Oliva, in an interview to magazine VEJA (03/27/2013):

> Fortunately, at present there are more and more researchers bent over concrete problems, devoted to applied science. Yet there are still university groups that are lost in ethereal themes, some of them with attitudes biased by their own beliefs and still clung to old ideological flags. [.....] It's a minority, but still there are people in the academia who do not see with sympathy closer ties with the private sector. These centers of resistance, sustained by their ideological speech, have historically contributed to keep companies away from the academic world, and the Brazilian innovation, therefore, far from the top.

A similar speech was made in July 2013 by Marco Antonio Raupp, Minister of Science, Technology & Innovation, at a meeting of the Brazilian Society for the Advancement of Science:

> We need to encourage the relationship between universities and companies in Brazil to stimulate national scientific production. There are Brazilian businessmen who seek partnerships with universities in the United States because here in Brazil everything is very complicated. […] We need to look to this other clientele, the business community.

Suzigan and Albuquerque (2011) show that the collaboration between universities/research institutions and companies in Brazil is characterized only by successful "interaction points", which were systematically built over time. And suggest that one of the causes of this weak interaction is the "articulation between the late character of the creation of research institutions and universities in the country and the late character of the Brazilian industrialization." But cooperation with companies has not turned scientists away from basic research. Most groups that interact with companies improved their performance, generating more theses and dissertations, undergraduate research projects and publications. This effect was also verified by Thursby and Thursby (2003; 2009) and Lee (1996). There is a positive view of U-I relations, although it still is a practice restricted to a few groups.

As Castro and Souza pointed out in a 2012 article, eight years after its rebirth in 2004, the Technological Innovation Offices (NITs) were still trying to achieve internal legitimation and promote the culture of innovation in universities, so that they could exercise their strategic role in mediating the relationship with companies, stimulating entrepreneurial activities and managing the developed technologies. The authors also noted that the Innovation Law has stimulated patenting, but the next step, the licensing of patents to firms, was still restricted.

6. CONCLUSIONS

This study aimed at evaluating the evolution of university-industry cooperation in Brazil, through a survey of papers published since 1980 in major journals and in national and regional events on this subject. We examined 247 articles, and

out of these, 92 that were published since 2005 were assessed in more detail. As a result, it was not possible to identify significant changes in the general behavior of universities and companies, whether in culture, in negotiations or in licensing procedures that could demonstrate an improvement or a trend towards new practices and models for managing collaboration. The vast majority of studies did not utilize individual cases to offer general propositions that substantially allow for a change in the character of these relations. It is worth mentioning that as far as academic papers are concerned, professors/researchers' views about this relationship prevail, whether positive or negative. Some case studies have companies' professionals as co-authors or show results of interviews made with them. The government's view is present in studies on public policies or programs to encourage innovation or in excerpts from speeches and published interviews.

In fact, a comparative analysis between academic production previous and subsequent to the Innovation Act do not allow us to draw a conclusion about new experiences, attitudes or concerns over new models and formats of cooperation, in any of the categories - A (theoretical essays and surveys), B1 (interface mechanisms), and B3 (experience reports/case studies). One of the items of the law deserves mention, which aimed to stimulate an important channel for innovations through academic entrepreneurship - researchers from federal institutions can take an unpaid leave for three years, renewable for another three, to create companies. This item does not appear in any of the articles of our sample.

This study shows that in Brazil issues that were overcome in the US and Europe still persist. International literature on U-I relations is extensive and presents several models and propositions of structures to improve it. There are articles that present the pros and cons, under the academy's point of view, and many studies that try to prove them through surveys and quantitative analysis. Authors discuss the most appropriate model for intellectual property rights and technology transfer – if an individual property (or teacher's privilege) or an institutional property. And also if TTOs must be created in each university or should be regional, increasing its scope and effectiveness.

But there is no more debate over the need for cooperation, which is still common in national papers. There are teachers who cooperate, others that don't, and no university shows unanimity in either position. They discuss the characteristics of universities and researchers more inclined toward cooperation - *entrepreneurial science* and *entrepreneurial academics* -, of *scientific entrepreneurs,* who think of creating spin-off companies, and of *academic* or *expert science*, which only considers collaboration with other researchers as opposed to the so-called *commercial* or *market science*.

The statements made in 2013 by the CTI Minister and CNPq president illustrate the university's resistance to partnership with companies. The analysis of the papers in our sample shows the lack of proposals for new mechanisms to encourage and enable closer ties between the parties. And there are still articles that discuss if the university should patent its inventions (Póvoa, 2006), or consider the different visions of universities and companies as the main limiting element for cooperation (Soria & Ferreira, 2009).

University-industry relations do not yet constitute a regular and widely accepted process in public universities, despite the existence of several programs to support this partnership. Cooperation is not institutionalized and is carried out by professors who believe in its potential to leverage innovation – a few groups in some universities. And this collaboration is critical because universities are a relevant external source of innovation for companies, especially in knowledge-intensive sectors such as the chemical and pharmaceutical ones. In a way, the Innovation Act of 2004 has interrupted the endless discussions about the universities' role in the country's development, by putting a real demand on them - the creation of Technological Innovation Offices.

The more relevant topics found in the international literature are also focused in Brazil. But the main difference is that university-industry cooperation is a natural and widespread phenomenon in developed countries. The papers, many of them of quantitative nature, test the most used forms of technology transfer; examine the profiles of scientists; discuss the results of cooperation; debate if there really was a reduction of basic research in favor of applied research; assess the performance of the technology transfer offices; and suggest new types of organizations to better operate the transfer of academic research results. Most of the surveyed Brazilian articles consist of universities and companies' individual experiences, reports about the difficulties and obstacles to cooperation, of the incentive policies that do not work and of the NITs' performance. Few articles (Garcez, 2006; Carvalho *et al.,* 2006) suggest more appropriate structures to increase collaboration.

Although new programs and fiscal mechanisms have been created by federal and state financing agencies to stimulate innovation in companies and cooperation with universities and research institutes, the response has not been as expected. Institutional voids can be partly blamed for this lower demand. These voids can be an internal problem of the firms, such as little attention paid to the instruments and programs available, or shortage of skilled people to seek funding opportunities for innovation (often the financial area is responsible for this task), or even difficulties in presenting projects consistent with the rules of the agencies, among other factors. And they can be also due to the government agencies or the general business environment in Brazil. In this case, they are conflicting norms, an exaggerated demand of documents and certificates, poor communication, and red tape. Universities also lack clear rules on intellectual property and licensing of results in the case of successful partnerships. And according to a MCTI report (based on the Information Form on Intellectual Property Policy of Science and Technology Institutions, 2013), until the end of

2012 several federal universities had not established NITs, a requirement of the Innovation Act.

Over 30 years have passed since the launching of the Bayh-Dole Act in the United States, its dissemination in Europe, and dozens of studies that showed its benefits and problems, and the prevalence of the former. However, in Brazil the procedures of some state funding agencies like FAPESP (São Paulo), FAPEMIG (Minas Gerais) and FAPERJ (Rio de Janeiro) go against the propositions of that law, as they require a part of the financial results of the licensing of patents that result from state supported research. At the federal level, FINEP gave up any rights in the commercial exploitation of innovations since 1999 (MCTI, 2013), while CNPq abandoned that demand in 2014 (Normative Resolution nº 034).◆

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ABSTRACT

The evolution of universities' relations with the business sector in Brazil: What national publications between 1980 and 2012 reveal

This paper addresses the changes in university-industry relations in Brazil regarding innovation activities. It is based on a survey of articles published in major national journals or presented at the most relevant Brazilian and regional conferences, between 1980 and 2012. The year 1980 was chosen due to the creation of the Technological Innovation Offices (NITs), which was the first government initiative to encourage knowledge transfer from universities to companies; the second was the Innovation Act of 2004. Our assumption was that after the Act the number of academic papers on this subject would increase, bringing new ideas and propositions of models to enhance this relationship. The methodology employed a qualitative, exploratory approach, using bibliographical research and a bibliometric analysis of 247 papers. Literature review of international studies shows the discussion of problems and suggestions for improvements, while in Brazil there is still a debate on whether this collaboration should occur, and if this is a legitimate role for the university. Despite the numerical growth, the content analysis showed few papers on new configurations and procedures for partnership management. We conclude that university-industry relations are not a regular and totally accepted process in Brazilian public universities, which reflect an ideological bias against cooperation with firms.

Keywords: university-industry collaboration, innovation, technological innovation offices, intellectual property, entrepreneurial university.

RESUMEN

La evolución de las relaciones de la Universidad y el sector empresarial en Brasil: qué demuestran las publicaciones nacionales entre 1980 y 2012

Este artículo aborda los cambios en las relaciones entre universidades y empresas (U-E) en Brasil en actividades de innovación, basado en una encuesta de artículos publicados en las principales revistas nacionales, o presentados en conferencias brasileñas y regionales más relevantes, entre 1980 y 2012. En el año 1980 fueron creados los Núcleos de Innovación Tecnológica, primera iniciativa del gobierno para estimular la transferencia de conocimientos de las universidades hacia las empresas. La segunda fue la Ley de Innovación, de 2004. Nuestra suposición era que a partir de la ley, aumentarían los trabajos académicos en este tema, con nuevas ideas y proposiciones de modelos para mejorar la colaboración. La metodología utilizó un enfoque cualitativo, exploratorio, mediante búsqueda bibliográfica y estudio bibliométrico en 247 artículos. La revisión de literatura incluye obras internacionales que muestran problemas y sugerencias de mejora, mientras en Brasil aún hay un debate sobre si debería ocurrir esta colaboración, y si es un legítimo papel de la universidad. El análisis de contenido ha mostrado pocos artículos sobre nuevas configuraciones y procedimientos para la gestión de la cooperación. Los hallazgos muestran que las relaciones UE no son un proceso regular y ampliamente aceptado en las universidades públicas brasileñas, y que reflejan un sesgo ideológico contrario a la cooperación con empresas.

Palabras clave: cooperación universidad-empresa, innovación, oficinas de transferencia de tecnología, propiedad intelectual, universidad emprendedora.

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