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Linking Past and Future Research about University-Industry Cooperation: A Systematic Review

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Abstract: A systematic literature review conducted analyzed scientific articles related to cooperation between universities and industry indexed in the ISI Web of Science. Based on 251 scientific articles published between 2000 and 2015, the university-industry cooperation field was prospected, having been identified possible publication trends in this area. Specialized scientific journals were identified (the research policy journal leads in the number of publications in this area but also appear in the publications technovation magazines International Journal of Engineering Education and others). The results may enable researchers interested in the strategic positioning technology transfer from research in their universities in order to maximize your publishing possibilities and the impact of these publications. Results can also be useful for technology transfer office managers who wish to identify the antecedents and consequences of this relationship in order to develop management and more efficient political practices.

Key words: University-industry, cooperation, systematic review, cooperation, publications, magazines

INTRODUCTION

This study emphasizes the existence of an academic cooperation between universities-industries for a long period which is not a new phenomenon (Foray *et al*., 2012). According to Etzkowitz *et al*. (2000), university creators of scientific knowledge have inserted another role in theirs mission, the commercialization of knowledge that exists to contribute to the improvement of private industries and local and regional development.

According to Perkmann *et al*. (2013), the difference in the more recent type of cooperation is to reflect the universities interest in commercialization and this means that there is a decrease in the published research on the theme.

Many studies have advanced to show that the effects of University-Industry (UI) relationships are positive, since, this type of applied research is more involved and the results have more practical application for commercialization such as Di Gregorio and Shane (2003), Perkmann and Walsh (2007), Tijssen (2012), Wong and Sing (2013).

The contribution of this study is to build a systematic review of the university-industry cooperation. It is intended to consolidate the results of existing studies and extract the results applicable to the subject. Thus, the aim of this study is to identify and understand of university-industry cooperation through a systematic review. This study should answer the following question: What are the antecedents and consequences of university-industry cooperation like others researchers that use various terms to say cooperation such collaboration, linkages, relationship and others words that represent partnership in this script, we use a generic category "university-industry cooperation" to represent all types to partnership.

University-industry cooperation: According to Plonski (1992), the university-industry cooperation it is a collaborative model between fundamentally different nature organizations which may have different purposes and adopt very different formats. According to Ankrah and Omar (2015), this cooperation concerns the interaction between the higher education system and industries with the main objective of the promotion of knowledge transfer to technology. As stated by Perkmann *et al*. (2011), there are five forms of relations between universities and industries.

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Collaborative research (or joint): This research refers to formal collaborative arrangements aimed at cooperation in Research and Development (R&D) (Hall *et al*., 2001). In many cases, these surveys may be subsidized by public and government funds.

Contracted research: This refers to research that is relevant to businesses and is tradable, so, it is generally ineligible for public support. It is specifically, ordered by businesses and the work is more often useful to industry than in this the form of collaborative research (Looy *et al*., 2004).

Consulting research: This refers to research or consultancy services provided by individual academic researchers to its customers industries (Perkmann and Walsh, 2008). Consulting projects are typically ordered directly by industry partner and the income derived from them often goes the individuals, although, it can be channeled through the support of research spending.

Licensing: This refers to a contractual assignment doing the research intellectual property generated by the university (e.g., patents) to external organizations.

Academic entrepreneurship: This is the "development and commercial exploitation of technologies pursued by academic inventors through a company they (partly) own" (Perkmann *et al*., 2011).

Patents and academic entrepreneurship as all of the types of relationships between university-industry cited by Perkmann *et al*. (2011) are just ways in which companies take ownership of knowledge generated by universities. The degree of cooperation between universities industry will depend on the involvement of partners.

According to Tijssen (2012), the university-industry cooperation brings benefits to businesses as they allow direct access to the expertise of university researchers, providing a deeper understanding of new areas of research and development of technological innovations. Ring and Van de Ven (1994) in their analysis of the development of cooperation processes between organizations differentiates three basic stages in the whole of process of the cooperation: initiation, development and dissolution. This basic scheme analysis can extrapolate the study of university-industry relations to understand how to develop and evolve.

So, Hernandez (2012) develops a tailored scheme of the basic stages by Ring and Van de Vem (1994), to show a series of questions to analyze the development of the relations in the knowledge transfer process that are:

- Initial stage (start)-with whom? how to start? why?
- Stage two (evolution)\-Intermediaries? duration? funds?
- Final stage (end)-interruption? valuation?

According to Hernandez (2012), on the initial stage of cooperation, relationship must be identified with whom he cooperates, how to start these relationships and the reasons why. Next, the stage of evolution of relations asks if there is intermediate cooperation which the duration of the commitments and whether there is external financing for development. In the final stage of those relationships, they need to analyze whether there were interruptions of the cooperation agreements between the parties and they will be value those whole process of this relationship.

MATERIALS AND METHODS

In accordance with Briner and Denyer (2012), Systematic Review (SR) brings together in a organized and objective way the best quality of all available evidence relevant to a particular problem or issue. This study consisted of the systematic review to identify and summarize empirical data. According to Bow *et al*. (2010), the Systematic Review (SR) is "considered the most comprehensive tool for decision-making by practitioners, policy-makers and consumers". Bow *et al*. (2010) said that, "systematic reviewers aim to identify all relevant data for a given question and synthesize the findings in a rigorous and transparent manner".

A systematic review uses transparent procedures to find, evaluate and synthesize the results of relevant research. "Procedures are explicitly defined in advance in order to ensure that the exercise is transparent and can be replicated. This practice is also designed to minimize bias" (Phelps and Campbell, 2012).

Given the semantic amplitude of the concept and their meaning, we intend to explore the diversity of perspectives that are used in scientific articles existing in the ISI database (Web of Science). In the first stage of the exploratory study, we propose to know and define the concept of university-industry cooperation used in the academy.

ISI (Web of Science) database: The periodic basis and citation also called bibliographic database are used to

match the information related to the bibliographic productivity to facilitate the identification of researchers of publications and sources of publication citation (Chirici, 2012).

A large number of databases for citations are available but its coverage is limited to certain specific scientific areas. Other more general databases were constructed to cover the larger set of academic productivity. The bases are Web of Science, Scopus and Google Scholar which are the most popular databases. For this study, we chose the Web of Science database to be the more complete database in the academic world and because it has in its base, mostly, journals with large impact factors.

Garfield (1955) builts the first citation database for combining information on associated publications and citations for given scientific journals.

Thomson Reuters Scientific founded in 1964, continue the legacy started by Garfield (1995) and developed the citation database, now known as the Web of Science (WoS). The WoS consists of seven different databases of which five are for Journal Citation (http://www.thomsonreuters.com), allowing access to references and abstracts in all fields of knowledge. The search can be held in the collections Science Citation Index Expanded (SCI-Expanded, Social Sciences Citation Index (SSCI); Arts and Humanities Citation Index (A and HCI); Conference Proceedings Citation Index-Science (CPCI-S); Conference Proceedings Citation Index-Social Science and Humanities (CPCI-SSH); Derwent Innovation Index and Book Citaton Index.

Through the WoS, we can use tools for citation analysis, references index h, that allow for bibliometric analyzes. It covers over 12,000 international journals (Thomson Reuters, 2014). For a long time, WoS has been the only citation database available. This study examined the trend of the publication regarding the evolution of the university-industry relationship in order that they can develop actions and more effective policies.

RESULTS AND DISCUSSION

The first search was conducted with the terms "University and industry" that resulted in 1,792 publications in journals and conferences. We applied two filters. The first used the term insertion "cooperation" (and other terms such collaboration, linkages, relationship and other terms that represent partnership), using "university and industry and cooperation", resulting in a sample of 251 publications including journals, books, patents and conferences (Table 1). We just put the term "cooperation" in the script because it is synonymous.

Table 1: Publications in the base ISI WoS database using the key words university-industry and cooperation (or collaboration)

Years	Records	Books and conferences	Papers
2000	5	1	4
2001	11	9	2
2002	6	3	3
2003	7	1	6
2004	7	3	4
2005	6	4	2
2006	8	6	2
2007	11	6	5
2008	18	6	12
2009	24	14	10
2010	17	8	9
2011	24	12	12
2012	33	23	10
2013	31	17	14
2014	21	9	12
2015	22	3	19
Total	251	125	126

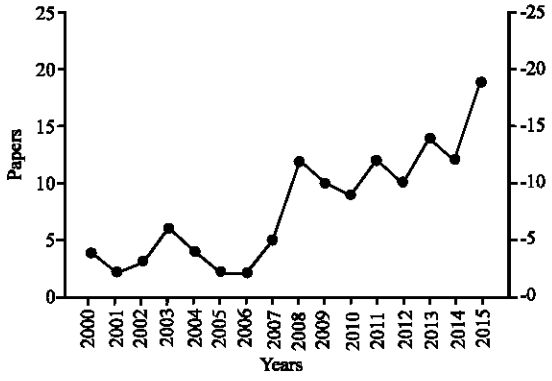

Fig. 1: Paper distribution per year (The used terms was university, industry and cooperation)

The second filter was related to the type of document which is related to only peer reviewed articles. After the second filter, the sample was reduced to 126 articles which were submitted to another filter selection that included applying of the inclusion criteria by reading the title and keywords.

In the text of this study we use a generic category "university-industry cooperation" but we also used the others terms that represent partnership in the search.

The interest of the scientific community for the subject has increased in the last seven years. Figure 1 proves that the number of studies published in the ISI-Web of Science (WoS) database using key words and university-industry cooperation.

According to scientific journals with the highest number of publications in this area, research policy has been dominated the others research journals which has an impact factor of 3.117 (JCR) and 2.317 (SJR) in 2014

Table 2: Top journals per number of papers (2000-2015, Oct 2015)

Journal	Papers	Impact factor (SJR) or (JCR)	Paper published (%)	Areas	Countries
Research Policy	14	2, 317 (SJR)	11.1	Business, Management and Accounting; Decision Sciences; Engineering	Netherlands
Technovation	5	1, 42 (SJR)	4.0	Business, Management and Accounting; Engineering	United kingdom
Journal of Technology Transfer	4	0, 83(SJR)	3.1	Business, Management and Accounting; Engineering	Netherlands
Scientometrics	3	1, 18(SJR)	2.4	Computer science; Social Sciences	Netherlands
European Planning Studies	3	0, 8(SJR)	2.4	Social Sciences	United Kingdom
International Journal of Engineering Education	3	0, 31(SJR)	2.4	Engineering Social Sciences	United States
International journal of Technology Management	3	0, 39(SJR)	2.4	Social Sciences	United Kingdom
Production	3	0, 23 (SJR)	2.4	Engineering	Brazil
Technology Analysis and Strategic Management	3	0, 9 4(JCR)	2.4	Management	United Kingdom
Others with less the 3 papers	85	-	67.4	-	-
Total	126	-	100.0	-	-

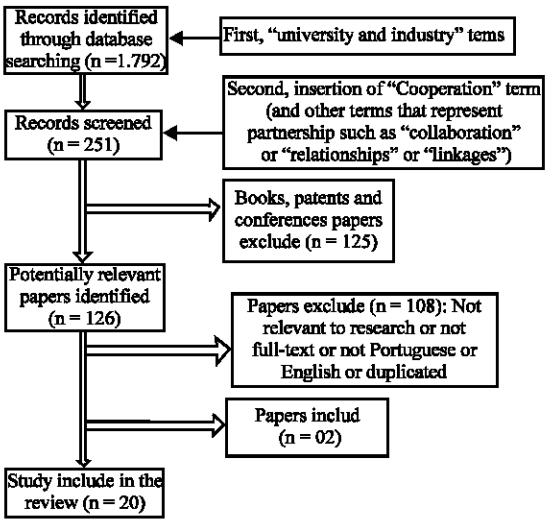

Fig. 2: Flow chart of search and selection process

(Table 2). The study and exclusion selection process is described in Fig. 2. As we said, the search in the database WoS yielded 1792 articles and 251 were potentially relevant and identified in the lists of articles with full text references. Of the 251 publications, 125 were excluded for being books, patents and conference, leaving 126 articles in journals with peer review.

A proportion of excluded studies were not related to the area under study (n = 106) and were focused on statistical models or studies of specific areas such as pharmacy and electrical engineering and they used the words "university, "industry" and "cooperation" but do not focus in our theme of study. More than one paper was discarded because it was a duplicate. We included two papers that are not related in the search but the papers are about university-industry collaboration. In the end, we stayed at total of 20 papers in the analysis.

The study process was recorded fowling the flow chart (Fig. 2). Table 3 shows the part of the abstract of the 20 papers selected that cover about university-industry cooperation and Number of the Citations (NC).

Etzkowitz (researcher at the State University of New York/USA) with Leydesdorff (researcher at the Nieuwe Achtergracht/Netherlands) were most referenced authors in accordance with our results in the period 2000-2015 (Table 3). Their study were fully cited in 993 papers in the WoS database and it is a study that incentives to other study. After Etzkowitz and Lydesdorff (2000), the study Etzkowitz and Brisolla (1999) was cited 393 times and Di Gregorio and Shane (2003) was cited 247 times.

Evolution studies of university-industry cooperation: According to Carayannis in a capitalist economy, the wealth does not flow to those who control financial capital but to those who can get direct intellectual capital. A company that uniquely exploits knowledge resources is expected to attract more employee specialists who consequently will be more creative with "increasing returns" (Arthur, 1996). As Carayannis as "the information often is not distributed symmetrically, knowledge (which is based on information) is concentrated unevenly". Pure competition in knowledge-based markets generates excellent results, compared with a balance of "cooperation and

Table 3: Papers used (2000-2015, Nov 2015)

NC	Researchers (years)	Part of abstract
0	Bstieler *et al.* (2015)	"This study examines the roles of universitie's Intellectual Property (IP) policies and of shared governance for trust formation between academe and industry. The study also examines how UI champions moderate this process and how trust between university and industry partners affects UI collaboration outcomes"
0	Ehrismann and Patel (2015)	"In this study, we explore some of the more testing aspects of these collaborations, approaches that various industrial players have taken and provide our own views on the matter. We found that understanding and respecting each other's organizational culture and combining the intellectual and technological assets to answer big scientific questions accelerates and improves the quality of every collaboration"
0	Franco and Haase (2015)	"The objective of this study is to examine the interface between researcher's motivations and interaction channels concerning university-industry cooperation we found that the traditional service and bi-directional channels play an important role in interaction with industry. Use of these channels depends on researcher's motivations and disciplinary affiliation"
0	Mirabent *et al.* (2015)	"(TTOs) are the main institutions responsible for the establishment of university-industry partnerships. R&D contracts exemplify the indirect mechanisms through which enterprises and universities collaborate on a win-win basis. This study addresses organizational and institutional aspects that act as drivers for the establishment of successful university-industry partnerships. Results indicate that successful R&D contracts depend on university and TTO characteristics and the university's location"
0	Ankrah and Omar (2015)	"We employed a systematic procedure to review the literature on Universities-Industry Collaboration (UIC). The review resulted in identifying five key aspects which underpinned the theory of UIC. We integrate these key aspects into an overarching process framework which together with the review, provide a substantial contribution by creating an integrated analysis of the state of literature concerning this phenomenon. Several research avenues are reported as distilled from the analysis"
2	Thune and Gulbrandsen (2014)	"The aim of this study is to investigate how research partnerships between firms and universities emerge and evolve over time, focusing on the relationship between initial conditions and development trajectories"
51	Perkmann *et al.* (2013)	Apart from extracting findings that are generalizable across studies, we ask how academic engagement differs from commercialization, defined as intellectual property creation and academic entrepreneurship we conclude by identifying future research needs, opportunities for methodological improvement and policy interventions."
4	Okamuro and Nishimura (2013)	"We argue that the university IP policy that is equitable in sharing revenue and royalty from innovative outcomes and applied flexibly according to the partner's needs may contribute to improving project performance by enhancing the commitment of firms and we test our hypotheses using a sample of japanese firms obtained from the original survey"
1	Wong and Singh (2013)	"The analysis suggests that UICPs (University-Industry Co-Publications) do have a significant positive influence on universitie's technology commercialization outputs after controlling for the quantity and quality of their research and for their commercialization resources
26	Perkmann *et al.* (2011)	"We investigate how universitie's research quality shapes their engagement with industry. Previous research has predominantly found a positive relationship between academic's research quality and their commercialization activities"
57	Park and Leydesdorff (2010)	"This study examines the longitudinal trend of systemness in networked research relations in South Korea using a Triple Helix (TH) indicator of University-Industry-Government (UIG) relations however, inter-institutional collaboration in the first decade of the 21st century was negatively influenced by the new national Science and Technology (S&T) research policies that evaluated domestic scientists and research groups based on their international publication numbers sather than on the level of cooperation among academic, private and public domains"
41	Abramo *et al.* (2009)	"This research investigates public-private research collaboration between Italian universities and domestic industry, applying a bibliometric type of approach"
38	Giuliane and Arza (2009)	"In this study, we explore the factors driving the formation of 'valuable U-I linkage's, conceived as those linkages between universities and firms that have a higher potential to diffuse knowledge to other firms in their regional economy. The empirical strategy combines case-study methodology with econometric techniques using data from two wine clusters in Chile and in Italy. The firm's knowledge base is found to be a key driver of 'valuable' U-I linkages. We conclude that selectivity should be encouraged among policy makers endeavoring to promote U-I linkages"
210	Este and Patel (2007)	"This study examines the different channels through which academic researchers interact with industry and the factors that influence the researcher's engagement in a variety of interactions"
37	Caro *et al.* (2006)	"The growing importance of regions in the analysis of innovation and the pressure on European universities to interact with their environ ment justify this study. It argues that faculty support for the objectives of University-Industry Relations (UIR) does not vary across disciplines and does not respond to university encouragement in a region with low absorptive capacity. These results are in contrast with those obtained in studies of technology leading countries like the USA empirical evidence is obtained from a sample of faculty from the valencian community (Spain) and analyzed through a set of models for discrete choice"
141	Fontana *et al.* (2006)	"This study presents an empirical analysis of the determinants of research cooperation between firms and Public Research Organizations (PROs) for a sample of innovating Small and Medium-sized Enterprises (SMEs). In contrast to earlier researche's that provide information about the importance of PRO's research we know the number of firm/PRO collaborative researche's and development (R&D) projects. This allows us to study the determinants of firm collaboration with PROs in terms of both the propensity of a firm to undertake R&D projects with a university (do they cooperate or not) and the extent of this collaboration (number of R&D projects)"

Table 3: Continue

NC	Researchers (years)	Part of abstract
297	Di Gregorio and Shane (2003)	"The results of this study provide insight into why some universities generate more new companies to exploit their intellectual property than do others. We compare four different explanations for cross-institutional variation in new firm formation rates from university Technology Licensing Offices (TLOs) over the 1994-1998 period the availability of venture capital in the university area, the commercial orientation of university research and development, intellectual eminence and university policies"
37	Carayanis *et al.*	"The emergence of collaboration is facilitated by the sharing of knowledge across organizational boundaries which promotes the formation of trusted relationships and builds social capital for further cooperation. Furthermore, these partnerships are a vehicle for accelerating organizational learning and for coordinating trans-organizational "communities of innovation". Understanding the nature, process and content of such collaborative research and technological development ventures can endow with strategic insights both the government policy making and the corporate strategy crafting that informs, shapes and evolves such partnerships"
393	Etzkowitz *et al.* (2000)	"Deploying the triple helix model (of academic-industry-government relations) recently developed elsewhere an emergent entrepreneurial paradigm is outlined in which the university plays an enhanced role in technological innovation. Governments encourage this academic transition as an economic development strategy that also reflects changes in the relationship between knowledge producers and users"
993	Etzkowitz and Leydesdorff (2000)	"The Triple Helix of university-industry-government relations is compared with alternative models for explaining the current research system in its social contexts. Communications and negotiations between institutional partners generate an overlay that increasingly reorganizes the underlying arrangements. The institutional layer can be considered as the retention mechanism of a developing system"

competition". The competitive strategy was very discussed in the traditional theory of strategic management of the years 80 and 90 (Porter, 1980) and there was a limitation to encourage the cooperation. Carayannis says in his study that, Brandenburger and Nalebuff (1996) used the term "competition" only to designate the use of cooperative and competitive strategies. Carayannis also comments that at the time saw the industries acted as competitors and suggested that the industries should recognize that some of your opponents may add value to products and services of the industry. "Cooperation with complementors transforms the apparent zero-sum situations into positive sum that generate gains for all".

Etzkowitz and Leydesdorff (2000) begins his study questioning whether the university can cover a third mission of economic development in addition to its traditional missions of teaching and research. And they said that also question how can these activities contribute to the mission of the university. The researchers cited that as a series of lectures on the Triple Helix (TH) took place by Amsterdam. They provided an environment for empirical issues of discussions by researchers and specialists, coming to different solutions of possible cooperation between universities industry and government, helping to generate alternative strategies for economic growth and social transformation.

According to Etzkowitz and Leydesdorff (2000), there are differences between universities and consulting firms at the forefront of knowledge. The consulting companies work with individual projects, solve particular problems of each client. The companies met in general do not have the organizational capacity to pursue a cumulative research program. The advantages of the university is that it combines continuity with change, organizational memory and research with new people and new ideas through student exchange in generations. "When there is a break in the generations, usually caused by a loss of research funding, a group of academic research disappears and may be replaced by another" (Etzkowitz and Leydesdorff, 2000).

A study by Park and Leydesdorff (2010) examines the triple helix cooperation system in two developing countries, Korea South and Brazil. The researchers report that a national system of innovation such as the Korean and Brazilian can be considered as a complex building integration and distinct mechanisms. Etzkowitz and Brisolla (1999) which is applied within each of the angles of Triple Helix Model by the logic of specific subsystems, also mention this distinction: scholars intend to publish; industries wish to gain financially from collaboration and the governors representing the public interest but also want to win elections.

According to Di Gregorio and Shane (2003) universities differ in how its researchers determine the industrial problems. They said that "some universities (perhaps because of its historical involvement or agricultural extension services industry) more focus their research in relation to industrial needs than others", perhaps by seeking guidance from a source of funding and/or commercialization.

Di Gregorio and Shane (2003) also show that industry-funded research tends to be less risky and less information problems than basic research, being easier to commercialization then.

According to Fontana *et al.* (2006) is important to support policies create incentives for collaboration between universities and industries. Policies should be directed primarily to the creation of incentives with recognition for both parties because in the absence of

proper demand little will be achieved. In the study prepared by Fontana *et al.* (2006), identify that this collaboration is characterized by a high degree of heterogeneity and that each actor must react differently according to their specific characteristics. Fontana *et al.* (2006) also comments that the opening of industries to the external environment is very healthy to explain their patterns of collaboration with universities.

Studies done in Spain, the Region of Valencia by point out that the comparison of relations between universities and industries are different across regions which was beneficial for one, may not be for the another. One explanation is the absorption capacity of different regions within a country such as the socio-economic conditions such as the prevalence of industries in the same industry in a region and the lack of same of cooperative tradition may also explain the different attitudes of the researchers in all regions.

Caro *et al.* (2006) conclude that, it is important to understand the role that incentives and instruments play in generating support for university-industry cooperation. Strengthen openings for researchers, for students and collaborators increase the exchange of knowledge and facilitates innovation in enterprises. According by Caro *et al.* (2006) suggest find specific university policies that produce a significant effect of encouraging university-industry cooperation and also set the basis for a theoretical development which aims to establish a balance between university-industry cooperation.

According to Giuliani and Arza (2009) and cites studies by Cohen *et al.* (2002), Este and Patel (2007) and Fontana *et al.* (2006) show that there are many ways to facilitate links between universities and industry, it is to include the employment of college graduates by industry informal meetings and joint research programs involving both parties. Este and Patel (2007) these types of relationships are more widespread and more relevant. In the study by Este and Patel (2007) at a British University, he pointed out that the engineering departments of the school which has rank lower research are more likely to engage in multiple relationships with industry.

Many studies have also identified the characteristics of the industries and universities; and how their connections are affected while others, Kaufmann and Todtling analyze how much this relationship is beneficial to the innovative process industries (Giuliani and Arza, 2009). By Giuliani and Arza (2009), there is concern in these relationships such as research objectives and public ownership and use of the results of these surveys. Overall industry objectives are to solve concrete issues while in the universities, the objectives are the intellectual freedom of researchers in order to publish their research. According to Louis *et al.* (2001) and Nelson (2004), this view is harmful to the creative potential of long-term university. In this view, Crespo and Dridi (2007) state that, the time-consuming relationships are seen as disruptive and potentially damaging expensive for university-industry cooperation.

From the point of view by Abramo *et al.* (2009), consultancies can serve as an additional income but has little effect on the need for improvements in facilities and skills on the other research in cooperation with industry allows researchers to improve their facilities. This fact is an incentive to motivate the researcher to interact with industry and may make such cooperation in several ways. This different form of interaction allows them to reap both material resources (e.g., improvements in laboratories) and intangible (e.g., the satisfaction of seeing research in application).

Abramo *et al.* (2009) also call the attention about activities of patenting and spin-off that can obscure the presence of other types of university-industry cooperation that have an economic profit much less visible but can be equally (or even more) important, both in terms of frequency and economic impact.

However, compared to the different channels of cooperation, Perkmann *et al.* (2011) says that the patent and academic entrepreneurship are only moderately important means by which industry appropriates the knowledge generated by the university (Perkmann and Walsh, 2007; Este and Patel, 2007).

Okamuro and Nishimura (2013) studied the university-industry cooperation in Japan and found that academic researchers do not have much interest in innovation as industries, since, they are more interested in search engine results publication than in Intellectual Property (IP) protection and innovation profit. Already the offices of intellectual property and technology transfer have a high concern in possession of IP held in partnerships. So, Okamuro and Nishimura (2013) expect that IP protection policy of universities will encourage partnerships with industry where they can earn revenues and sharing royalties innovative and flexible results applied according to the needs of the partner industry which will improve innovation in the industry and commitment to collaborative research which will result in more investments and efforts on joint research.

The consequences of university-industry cooperation are reported by Perkmann *et al.* (2013) which report that there is evidence that the researchers that partners with industry publish much less articles on career and the publication may have an inverse relationship with this type of cooperation. A second issue, Perkmann *et al.*

(2013) refers to the impact of external involvement in the research agenda of academic scientists. Perkmann *et al.* (2013) report that, some observers fear that involvement with industry change agendas of the researchers in the sense applied to the detriment of long-term benefits of basic science.

The impact of the involvement of academics with industry in teaching is not clear and the issue was not addressed in the literature by Perkmann *et al.* (2013). But the empirical study by Thune and Gulbrandsen (2014) reports that, there is no direct relationship between the initial conditions and developing over time partnerships. When groups form a "network" (and may even be an association) is easier to form relationships and have a positive influence in the initial phase of the collaboration but it has limited impact on the long-term development. The study data by Thune and Gulbrandsen (2014) show the weak side of the "networks" which are often efficient mechanism for the formation of relationships but in some cases represent weak commitment of partnerships over time, leading the industry to low or symbolic involvement and high dropout rates.

Ankrah and Omar (2015) shows the model by Mitsuhashi (2002) adapted where cooperation UI consists of 5 stages, depending on the formality and complexity: the purpose of the cooperation; identification of potential partners; the possibility of choice of partners; the partnership negotiation and the signing of the agreement. By Ankrah and Omar (2015), the beginning of a relationship between two organizations is influenced by a variety of reasons and the kind of relationship depends on the motivation of each partner. After formation, the partnership "moves to the operating stage" which is characterized in various activities in which a number of factors may facilitate or inhibit relationship.

According to Mirabent *et al.* (2015), today the university knowledge transfer to industry is an important strategic. In fact, academic research, boosts business by providing new scientific discoveries into advanced technologies that accelerate innovation. Many industries have universities as ideal partners to outsource their research and development activities and remain competitive in the market. As a result the partnership of university-industry cooperation there is an additional source of funding for university research.

In the case study by Franco and Haase (2015) in Portugal, the researchers provided an in-depth analysis of the interface between motivations of researchers and interaction channels used in cooperation UI. It was conducted interviews with representatives of university management and analyzed the Polytechnic Institute reports documents and found that cooperation UI is a matter of great relevance to the institution and its faculty.

Ehrsiman and Patel (2015) try to answer the question "What are the prerequisites for a successful collaboration?" And report that to be successful it is necessary that both involved, universities and industries, bring to the negotiating table which areas are ready to collaborate and they are ready to be competitive. By signaling their skills and aspirations for collaboration are facilitating the decision on and where to invest resources. The reality of a collaboration shows that this factor alone does not guarantee success with many other behavioral factors that also determine the success of cooperation.

Ehrismann and Patel (2015) conclude that in reviewing the different approaches to cooperation, the preferred model in the pharmaceutical field is to promote and support direct interactions among researchers where they can discuss their ideas and concepts. Keeping understanding the needs of both involved in a common interest and respecting and exploiting the differences also increases the mutual trust.

Bstieler *et al.* (2015) examined the intellectual property rules in 105 partnerships between universities and industries and how they are conducted these collaborations in biotechnology (under the industry point of view). The researchers comment that the collaborations between industries and universities happen in biotechnology because in general, these industries have a strong interest in the expertise of universities, who have no knowledge. Universities provide this specialized technological knowledge, particularly in the early stages of the innovation process which can lead to new products. The researchers also comment that the strong point for this relationship to work is trust in reliable collaborations industries can absorb more scientific knowledge and tend to achieve better results from the innovation of its products (Bstieler *et al.*, 2015).

Thus, based on the theoretical analysis, from the period 2000-20015, one can realize the existence of university-industry relationship. However, it was noted the absence of conclusive studies involving the analysis of how this relation is effectively and there is therefore a need for further research. As a general rule, what is observed in previous studies is that there is no specific model clearly to reconcile the interests of universities and companies, so there is a consistent and conscious cooperation implemented through cooperation projects, characterized in gaps that can be explored through scientific studies.

CONCLUSION

This review aims to promote understanding of the types of cooperation between universities and industry that exist in the theoretical knowledge as well as the factors that lead to the adoption of a path over another. The goal is to provide evidence for political and academic actors designing policies for the transfer of knowledge between researchers from universities and universities.

Empirical results support the existence of a spiral of knowledge as a dynamic for the UI relationship involving three collaborative and present projects key attributes that influence the process of knowledge: the financial contribution from the company, the existence of partnerships and long-term patent opportunities. We conclude that, we have already not known which type of interactions is the most beneficial for daily research progress and knowledge transfer within the industries.

In conclusion, this study is a first attempt to understand how knowledge flows underlying the research carried out through collaboration between UI.

Strategic measures require some one on long-term planning before starting a UI interface while tactical measures are seen as practical day-to-day that need to be fulfilled in order to have a smooth implementation of a project in partnership. Everyone should be involved because of two basic elements, common sense planning and the ability to maintain strong informal relations. Such is the case of conventional industrial relations and as such should be well adopted by the universities in order to succeed in the UI partnership.

According to Liew *et al.* (2012), "easier said than done, applying these best practices may not be easy in the execution and therefore the strong project champion and an understanding the working group is required to work in tandem with such values".

The main objective of this study is to understand how is the relationship between university-industry through oh the systematic review and brings as a contribution to the field of knowledge the condensed presentation of the concepts presented in papers published from the period 2000-2015 and shows the need for further studies on the relationship and transfer of knowledge developed in universities to industries. In management terms this research contributes towards showing for industries that projects developed in cooperation may be more efficient to generate new technologies.

Finally, this study shows that most of the papers are actually longitudinal studies that can provide information in a dynamic of cause and effect and can also help assess the "cost" of the whole range of outcomes of these relationships short and long term.

SUGGESTIONS

It was found through the analysis of these study there is a need to investigate alternatives to measure the effectiveness of the UI interface, apart from subjective analysis. For example, the contribution of the number of patents, products, publishing can reflect the real relationship between UI and justify, its cost and risk. In the words by Liew *et al.* (2012) "if you fail to plan, you have planned to fail".

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