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Mona Roshani
Nadia Lehoux
Jean-Marc Frayret

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Bureaux de Montréal :
Université de Montréal
Pavillon André-Aisenstadt
C.P. 6128, succursale Centre-ville
Montréal (Québec)
Canada H3C 3J7
Téléphone : 514 343-7575
Télécopie : 514 343-7121

Bureaux de Québec :
Université Laval
Pavillon Palasis-Prince
2325, de la Terrasse, bureau 2642
Québec (Québec)
Canada G1V 0A6
Téléphone : 418 656-2073
Télécopie : 418 656-2624

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University-Industry Collaborations and Open Innovations: An Integrated Methodology for Mutually Beneficial Relationships

Mona Roshani[1,2,*], Nadia Lehoux[1,2], Jean-Marc Frayret[1,3]

[1] Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation (CIRRELT)

[2] Department of Mechanical Engineering, 1065, avenue de la Médecine, Université Laval, Québec, Canada G1V 0A6

[3] Department of Mathematics and Industrial Engineering, Polytechnique Montréal, P.O. Box 6079, Station Centre-ville, Montréal, Canada H3C 3A7

Abstract. The purpose of this report is to propose a framework for establishing successful collaborations between universities and industry. As collaborations between academics and industry play an essential role in driving innovation processes, a step-by-step structure for implementing open innovation in a company as well as an investigation into linking open innovation and university-industry collaboration are discussed. With the aim of proposing a two-tier framework to create a clear structure for implementing both university-industry collaboration and open innovation, the adapted research methodology is based on a combination of various approaches such as analyzing and comparing case studies, conducting interviews, and literature search. In this research, it was found that industry and universities might benefit from greater knowledge and technology transfer as well as strategic networking when working together based on an open innovation philosophy. Similarly, open innovation, as a new approach for gathering ideas and improving innovation, helps companies in implementing inter-organizational linkages. University-industry collaboration has been studied from different perspectives. Nevertheless, less effort has been devoted to implementing open innovation in organizations and studying university–industry collaboration from an open innovation point of view. As a result, this study proposes a step-by-step procedure for putting open innovation within a company into practice while showing the key link between university-industry collaboration and open innovation.

Keywords. University-industry collaboration, open innovation, collaboration development framework.

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* Corresponding author: mona.roshani@cirrelt.ca

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1. Introduction

In this competitive world, if companies want to ensure good economic performance, they have to produce innovative products, meet customer needs, and respond quickly to market demands. But companies do not necessarily have all the competencies to perform every operation in-house (Lehoux *et al.*, 2008). Therefore collaboration as a pooling of substantial resources e.g., information, money, labor, etc. between two or more partners, can help in solving the set of problems which may not be solved individually. Furthermore, in recent years, many organizations have established collaborations with centers of knowledge like universities. On the one hand, companies have limited access to all required competencies, skills, equipment, capital, etc. On the other hand, it is important for universities that their scientific results are commercialized, that financial support for research precedes research projects and their reputation is enhanced. This is why collaboration between industry and universities can be a good approach to combine knowledge and ideas as well as decide on how to use and develop new concepts. In order to create new products and solutions, innovation is also a key factor for organizations; so they have to embed the innovation process in their daily business and long-term strategy. To properly exploit external resources, the innovation process and collaboration in new product development are becoming more open, leading to a new concept called *open innovation*. Although the potential achievements from university-industry collaboration have been well recognized, there are barriers to ensuring successful partnerships. These obstacles were categorized by Van Dierdonck & Debackere (1988) as: a) ***cultural***, such as different functions and aims, incompatible tendency concerning Intellectual Property Right, and lack of common languages, as: b) ***institutional***, such as different natures of work, divergent understanding of what is an outcome, change of responsibilities and structure on the firm's side, and as: c)

operational, barriers such as different organizational processes of partners, inefficient project management, and lack of information about partner preferences related to results.

In recent decades, university-industry collaboration has been studied from different perspectives. For instance, Pertuze *et al.* (2010) described and analyzed the results of a three-year study at 25 multinational companies in order to identify the best practices for university-industry collaboration from an industry point of view. Another research concerning European universities' activities for developing collaborations with industry (DG Education & Culture, 2011) was also accomplished to understand how this type of collaboration can be managed from a university point of view. Furthermore, Barnes *et al.* (2002) investigated six case studies in the United Kingdom for a better understanding of the management of university-industry collaboration. At the same time, some authors focused on describing open innovation concepts and their motivations (Gumus & Cubukcu, 2011; Chesbrough, 2003), and more recently on defining competent business strategies (Antikainen, 2011). However, less effort has been devoted to implementing open innovation in organizations and studying university–industry collaboration in open innovation context.

This study aims to develop a framework for collaboration between universities and companies in order to support the process for partner selection and the implementation of the other collaboration phases. By developing even more partnerships with key organizations such as universities, we believe that companies from different industrial sectors could certainly move towards greater innovation in product development, improved knowledge of market needs, hiring of highly-qualified resources in the future, and many other advantages. As collaborations between academics and industry also play an essential role in driving innovation processes, a

step-by-step structure for implementing open innovation in a company as well as an investigation into linking open innovation and university-industry collaboration are proposed.

This report is organized as follows: Section 2 introduces a review of the relevant literature and concepts. Section 3 describes the research methodology, while Section 4 presents the developed framework to support university-industry collaboration. Some concluding remarks are provided in the last section.

2. Literature Review

In today's economy, many operations have to be performed in order to produce more complex and innovative products. In the past, these activities were done and managed separately, but individual organizations are now interested in linking them together. Collaboration often occurs when individuals or organizations work together towards certain common goals. In fact, collaboration is valuable because it is a good way to achieve goals which are difficult or impossible to achieve individually (Huxham, 1996). In order to meet diversified customer needs, product development is usually required, and the main motivation for firms to collaborate in this case is to reduce and share the risks and costs of product development (Parker, 2000). According to Barratt (2004) and Simatupang & Sridharan (2002), a distinction can be made between vertical and horizontal collaboration. In vertical collaboration, a core company collaborates with external resources including the downstream (suppliers) or upstream (customers) as well as internal collaboration across functions. In horizontal collaboration, a core company collaborates with external resources that are competitors or other non-competitor organizations such as universities or private and public centers (Barratt, 2004). In this research, horizontal collaboration is the one considered and the focus is on collaboration with university as an

external non-competitor organization. Therefore, in the increasingly competitive market, university-industry collaboration, as a form of partnership, is a way to advance product and service innovation. Different objectives and advantages have been presented to motivate universities and industry to collaborate in several papers. These objectives include new knowledge and technologies acquisition and development in order to develop new products or improve product quality.

Recently, Regina Gattringer *et al.* (2014) have worked on a research concerning the Austrian Centre of Competence in Mechatronics (ACCM). They showed that a university-industry collaboration network has many benefits for its various stakeholders and can overcome barriers in knowledge transfer, based on 42 interviews among all groups of stakeholders (i.e., industrial partners, scientific partners, representatives of the regional governments, representatives of the federal governments, area coordinators, and Engineering Service Providers (ESP)). Furthermore, ESP seems to have an essential role in this network because its main function is to facilitate the development of final products from scientific findings. This qualitative research approach demonstrated that a network-structured university-industry collaboration with a strong value added chain can be a very successful form of knowledge transfer. However, some other issues and limitations should be considered.

In university-industry collaboration context, the process of transferring knowledge from university to industry can occur in two forms: formal and informal. Formal transfer leads to tangible and visible results. Its outcome includes patents, research papers, licensing agreement, etc. While most attention has been given to formal knowledge transfer, informal transfer can benefit both parties. Informal transfer leads to intangible results. Its impact includes conferences,

workshops, social networking, joint research projects, consultation, and qualified employees (Van Horne *et al.*, 2008). Although the effectiveness of university-industry collaboration has been discussed in the literature (Lee, 2000; Hurmelinna, 2004; Turk-Bicakci & Brint, 2005; Ryan, 2006; Van Horne, 2009; Bruneel *et al.*, 2010; Kaymaz & Eryiğit, 2011), there is a general lack of precise indicators to measure and quantify the productivity of scientific research collaborations (Schartinger, 2002). Since measuring intangible knowledge is difficult, the focus is on those aspects of knowledge which are more explicit and easy to measure. A measurement approach could be proposed based on quantitative indicators and codified characters such as: the number of patents and inventions made by firms, universities or both, the number of solved technical problems, the occurrence of spin-off firms, and so on. Evaluation of benefits and number of successes also depend on who performs the evaluation, because university and industry often have different points of view, which can decrease the reliability of evaluations. So, different results might be gained by different methodologies of measuring, especially if the evaluation is made by different people inside the organization (Bailetti & Callahan, 1993).

Along the same line, innovation is a phenomenon that brings advantages and value for a company that is in competition with other companies (Barney *et al.*, 2001). Because of the wide borders of knowledge, no company can achieve all required competencies alone. So organizations should adopt a new "open" model of innovation, called "open innovation" (Chesbrough, 2003). The core concept of open innovation has to do with fuelling the innovation process by both external and internal ideas. There are several factors that force organizations to pass through closed innovation and move toward open system. For instance, experienced people can easily relocate from one company to another. Therefore, a huge volume of knowledge is transferred directly as people change from one company to another. Another factor is increasing

the availability of venture capital that facilitates development of innovative ideas outside the firms (Gumus & Cubukcu, 2011). Open innovation system helps companies share and decrease R&D costs while saving time. On the other hand, too much openness could lead to loss of core competencies, and as a consequence, could negatively affect companies' long-term innovation success, while a closed innovation approach does not meet the rising and rapid demands of market in shorter innovation cycles. Nowadays, companies need to use every available resource to create products and services faster than their competitors and at the same time protect their core competencies. This necessitates achieving an appropriate balance between the open and closed innovation approaches (Enkel *et al.*, 2009).

Broström & Lööf (2008) have studied collaboration between firms and universities as perceived by R&D managers in open innovation framework. This study is based on interviews with R&D managers at 45 randomly selected firms that collaborate with two research universities in Sweden. They have shown that collaboration contributes significantly to the development of the firm's R&D capacities and management of corresponding costs and risks. Also, collaboration allows firms to strengthen their innovation networks and manage human capital, while helping them promote the capabilities necessary to successfully translate market opportunities evolving within the firm or from contacts with other firms into technical or organizational problems. They have concluded that the impact of university-industry collaboration in open innovation model on R&D results is as important as creating new R&D programs. Along the same line, Broström & Lööf (2008) highlight the particularities of university-industry collaborations while proposing some facilitators and steps to put into practice for establishing them efficiently.

In the next sections, we propose a two-tier framework to support university-industry collaboration based on the analysis of different case studies. Furthermore, we show how this type of relationship can be linked to the open innovation concept so as to advance the innovation process in companies.

3. Research Methodology

In order to develop a framework that could guide organizations in implementing university-industry collaboration, we have first analyzed and compared several case studies from the literature. These case studies include some activities and practices that universities and companies need to perform to develop this type of relationship. They were specifically selected because they considered different aspects of collaboration, covered both industry and university points of view, while being recognized as key research papers cited by many other authors (i.e., cited multiple times). The analysis of this specific literature also led us to identify some gaps that could be filled.

We have next conducted interviews with both academics and industries in the province of Quebec, Canada, to complete our findings about university-industry collaboration. Our goal being rather to extract information from the literature, only one company and two research centers were interviewed. Further work will certainly involve conducting more interviews to improve the validation stage of our framework.

Another main part of the research concerned practices analysis for implementing open innovation in a company. The literature was again the main tool used to extract those concepts. For this purpose, we searched journal databases like Science Direct and Emerald, as well as

different websites and books. We selected articles and references that included the keywords "open innovation", "closed innovation vs. open innovation" and "implementing open innovation" in their title or body text because open innovation is a new concept that was given in 2003 for the first time. Most of the references were about the concept of open innovation and its comparison with closed innovation, but among all of them we focused on a book and another resource that consists of activities and steps for implementing open innovation. Based on this study, we then developed a structure which aims to present the process of implementing open innovation in a company step-by-step. The literature also led us to link university-industry collaboration with open innovation so as to point out the key role of universities in transferring innovation to companies (Figure 1).

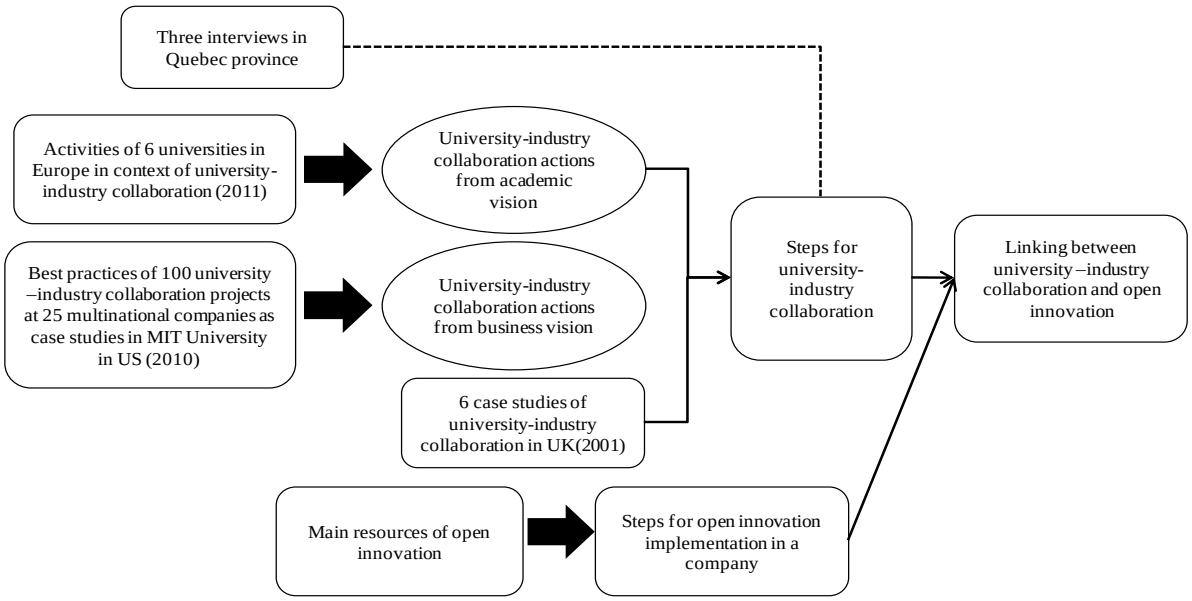

Figure 1.Methodology structure

3.1 *Case studies*

A study concerning the knowledge transfer practices of several European universities was first analyzed so as to better understand how collaborations between universities and industry may be

developed (DG Education & Culture, 2011). This study is presently in support of University-Business Forum (UBF) which has been created to facilitate collaboration development between businesses and universities. Among the different cases described, fifteen covering all the university activities toward developing university-industry collaboration were retained. Investigating university activities revealed that they mostly try to develop their interaction with industry by establishing different plans and even centers to better connect universities and firms. In fact, these proceedings could be considered as the prerequisites to begin the process of collaborative projects. However, these cases do not cover all the required aspects of university-industry collaboration because they were just related to university actions as a partner of collaboration. Other studies were therefore necessary to better understand this point.

We next analyzed a case study from the Massachusetts Institute of Technology that has determined seven practices to better assist university-industry collaboration after a three-year study (Pertuze *et al.*, 2010). More than 100 projects conducted in 25 multinational companies were involved in this study. The study was done through interviews with project managers and senior technology staff related to industry-university collaboration projects and also these projects involve both successful and unsuccessful cases. Seven best practices for managing collaborations have been defined according to quantitative and qualitative information regarding the levels of success of the collaborations. From these seven practices, the first four practices deal with how to select the collaboration and then connect it to the university research. The last three practices pertain to project management and how to promote productive relationships between the company and the university researchers. According to this study, it could be concluded that company practices on developing collaboration between university and company have been planned based on benefits for companies and their limitations and situation. We found

a great amount of information about company activities for improving university-industry collaboration. On the other hand, academics and industry activities were not investigated mutually.

We then look at a study conducted by Barnes *et al.* (2002) involving six case studies of university-industry collaboration in the United Kingdom. Based on their observations, they developed a framework that includes the main practices to implement for establishing university-industry collaboration. They also mentioned many factors which have effects on quality of these practices and on achieving outcomes. However, the authors did not propose a real step-by-step framework for implementing collaboration.

As a result, using Barnes *et al.*'s model as well as best practices from the UBF (DG Education & Culture, 2011) and MIT (Pertuze *et al.*, 2010), we developed the steps of the framework shown in Figure 2. These steps, if implemented adequately, may then lead to expected outcomes also summarized in the figure.

4. General Framework

This report proposes a two-tier framework whose aim is to support the process of creating successful university-industry collaboration in the context of open innovation. The first tier describes the general context of university-industry partnership. The second tier deals more specifically with the implementation of an open innovation process involving university-industry partnerships.

4.1 *Framework for university-industry collaboration*

The proposed framework is a step-by-step framework for implementing collaborative projects which starts with the selection of the partners based on key evaluation factors. The process of implementing collaboration between university and industry continues with the steps that actualize university-industry collaboration. If these steps perform well, the framework will lead to mutual outcomes.

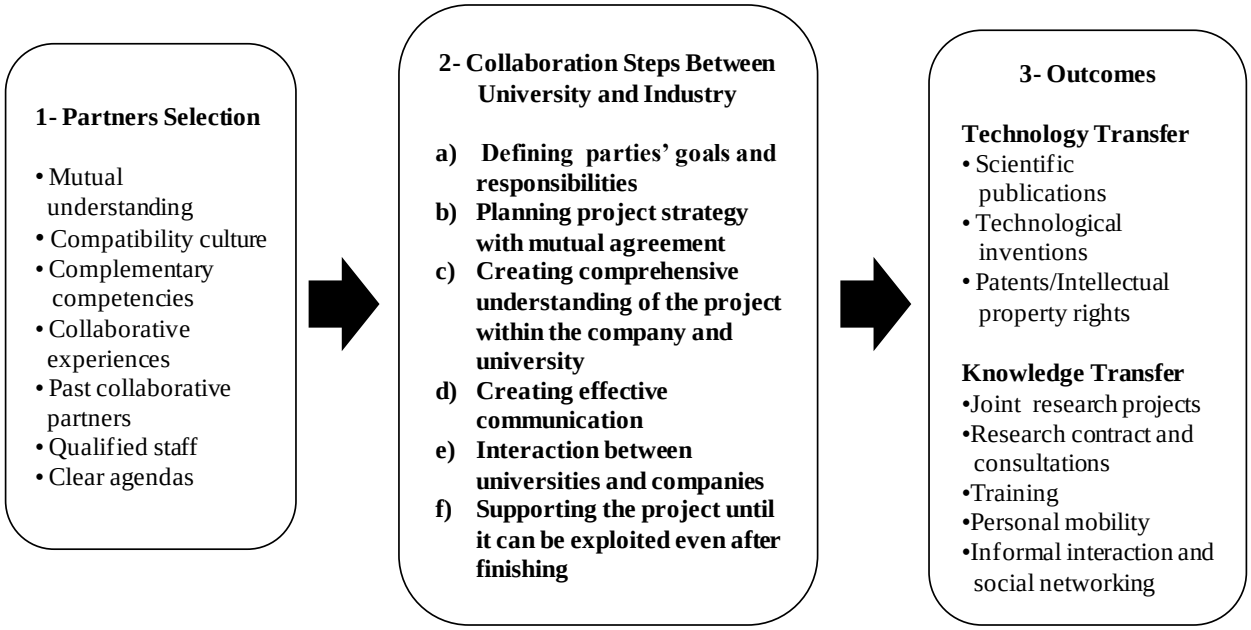

Figure 2. General framework for university-industry collaboration

4.1.1 Selecting partners based on evaluation factors

The company as well as the university should select the partner carefully, based on some specified criteria. In particular, as observed in the case studies and in the interviews conducted, seven factors seem more crucial for adequately choosing the partner: mutual understanding, cultural compatibility, complementary competencies, collaborative experiences, past collaborating partners, qualified staff, and clear agendas. There are also some methods for

evaluating these factors in order to decide which university or company to select as a partner, but we have not focused on those approaches in our analysis. The selection of the right partner is important because even if the parties are champions in their respective domains, the collaboration may fail if specific factors are not matched. The stakeholders can consider all these factors when they are looking for the partners, but based on different projects, some of them will become more important. According to the main challenges of universities for collaboration (e.g., lack of understanding, different cultures, and conflicts in sharing information), mutual understanding, culture compatibility and collaborative experiences could be considered the most important ones.

4.1.2 Collaboration implementation steps between university and industry

These steps, which are identified based on Barnes *et al.*'s model, MIT best practices for university-industry collaboration, and the interviews conducted, are activities that should be done after selecting partners so as to implement collaborative projects between universities and industry. At first, all stakeholders' goals and responsibilities should be defined clearly, and be coherent with one another in order to avoid misaligned expectations (Barnes *et al.*, 2002). In a successful collaboration, project planning and monitoring should not be done by either university or industrial partners, it should rather involve joint project planning (Pertuze *et al.*, 2010, Barnes *et al.*, 2002). Creating comprehensive understanding of the collaborative project within the company and university is the next step. In fact, broadening awareness of the project among individuals in the company and university can increase access to new suggestions (Pertuze *et al.*, 2010). Continuous communication must be established to overcome the lack of common language and mutual articulation. Frequent meetings also help in solving Intellectual Property

Rights issues while educating universities and companies regarding their culture (Barnes *et al.*, 2002). After that, interaction between academia and industry continues with exchanging people and knowledge such as graduate students and postdoctoral fellows from universities to firms (Schartinger, 2002). Supporting the project until it can be exploited even after finishing the project is also very important (Pertuze *et al.*, 2010).

4.1.3 Outcomes

To create value, knowledge and technology transfers could be considered as the outcomes of collaboration (Laundry, 2008). To make a distinction between them, knowledge transfer consists of learning techniques (either on an individual or on an organizational level) or thinking styles, methodologies, and skill transfers (Gopalakrishnan & Santoro, 2004). Technology transfer is rather involved with an object or a tool to explicitly visualize the knowledge and may affect the environment. Unlike knowledge transfer that could take place without technology transfer, technology transfer without knowledge transfer is impossible. In our framework, scientific publications, patents, and Intellectual Property Rights, besides technological inventions, are categorized in technology transfer as tools to visualize knowledge transfer. Schartinger *et al.* (2002) identified four categories of knowledge exchange: Joint Research (joint publishing); Contract Research (consulting, financial support of university researchers by firms); Personal Mobility (movement of people between universities and companies); and Training (training of industry staff, co-operation in education). Knowledge transfer also happens in conferences, workshops, and social networking, which appear as informal interaction and social networking in the framework.

4.2 *Framework for open innovation implementation*

During recent years, many companies have decided to adopt the open innovation philosophy progressively for improving ideas generation and developing unique products and services (Thrift, 2006, Antikainen, 2011). However, there is still a need to define the open innovation system more clearly as well as its advantages and disadvantages, so as to encourage more organizations to exploit this new innovation process. In fact, an organization should know why it wants to use open innovation, what it wants to achieve via that, and how its organizational chart will change with open innovation. Furthermore, a roadmap is needed for its implementation.

In this section, we propose a second-tier framework for implementing open innovation in a company, based on the literature explored (Lindegaard, 2010, Stark, 2011). These general steps, shown in Figure 3, can be modified, adjusted or even removed, depending on company's context and situation.

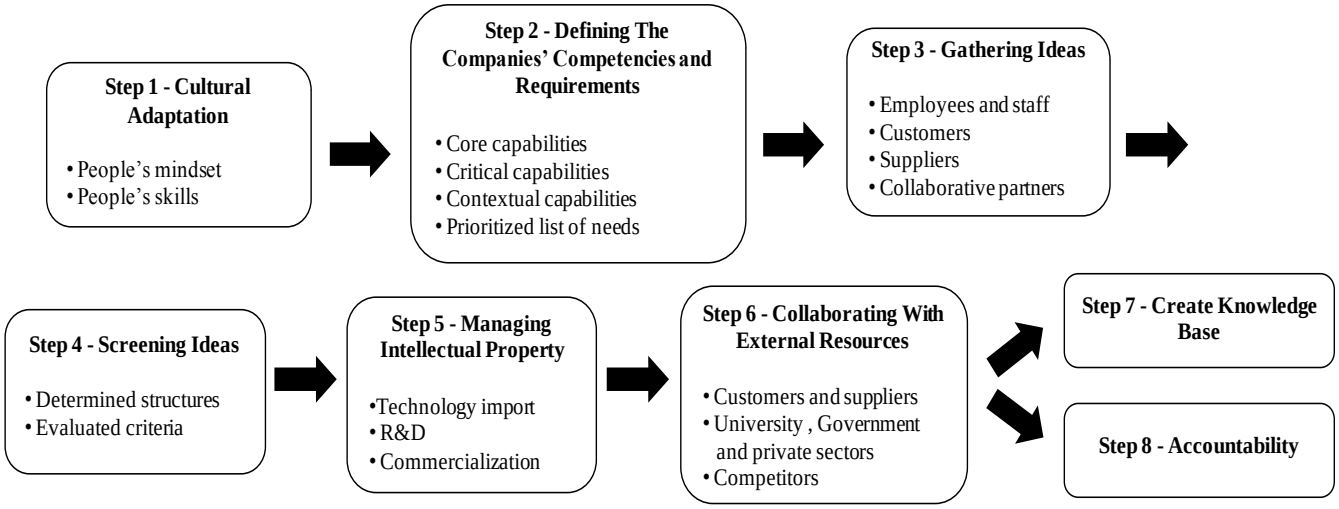

Figure 3. Step-by-step procedure of open innovation implementation

All these steps are explained as follows:

Step 1: Cultural adaptation. This means that the mindset and skills of people involved in the process are important when implementing open innovation strategy. In particular, according to Lindegaard (2010), it involves:

- People who can manage communication and relationships with other partners. Flexible people who have some social skills are required.
- Accepting that all employees are not necessarily perfect, so it is important rather to help them focus on their capabilities. In fact, the company should use the best of both internal and external competencies while trying to establish equilibrium between them.
- Employees that learn that failing in one part of innovation could be an opportunity to gain experience. In addition, the responsibilities and behavior of managers are important when encountering open innovation and other projects.
- Willingness to help employees create knowledge and learn how an idea turns into innovative products and services.
- Willingness to take more risks, because in open innovation systems, everything is not pre-determined.
- Accepting that companies do not need to do everything themselves because they can buy other's Intellectual Property and profit from others' use of their technology and knowledge.
- Understanding that an atmosphere of trust is necessary because open innovation requires open communication when Intellectual Property Rights, knowledge, and technology are being exchanged.

- Having the capacity to not be first all the time. Creating a good structure for the company is more important than being first on the market.

A culture of networking is also a necessary part of company philosophy for developing innovation. Even though the company operates in the global market and does not use open innovation model, networking ability can be very useful. More specifically, since recent technologies and required knowledge are complex, a company's internal people cannot achieve it on their own even if they are talented.

Ibarra & Hunter (2007) identify three kinds of networking: 1) Operational networking, involving all the actors who have an impact on the project in the company and that must come to know and trust each other while satisfying immediate requests (Oprica, 2012); 2) Personal networking, which is developed outside companies for personal improvement by finding opportunities and access to new information and; 3) Strategic networking, that helps in discovering and investigating new opportunities to achieve company goals.

Likewise, in order to maximize the benefit of networking, Lindegaard (2010) highlights the following tips:

- Networking and joining a group with clear purposes;
- Searching before networking about what you want to find;
- Having answers about how to help others and let them know how they can help;
- Teaming up with complementary skills. Some people are good speakers, some are good at writing, and others are great with people.

Step 2: Defining company competencies and requirement. This is important to know which authority to give to the innovation team and which resources are available to them. It is also necessary to define company capabilities (Stark, 2011). The capabilities of a company can be categorized into three types (Pontiskoski & Asakowa, 2009): 1) core capabilities; 2) critical capabilities; and 3) contextual capabilities. Core capabilities are the excellence and distinctive activities of the company, compared with rivals. These capabilities should be kept in-house as far as possible. Critical capabilities have a completion role for success and can be shared with selective partners, while contextual capabilities are necessary for innovation, but there is an abundance of them in the company and markets.

Having this information makes it easier to be honest about where the company lacks proficiency, and therefore where it can benefit from external innovation. From selecting ideas that should be coordinated with company capabilities to external collaboration at all levels, all of them depend on these capabilities**.** All senior managers, innovation leaders, and including common employees, should participate in preparing a list of company requirements. They have to create a prioritized list of needs as a start for the next steps. Idea generation can be oriented toward company requirements (Stark, 2011).

Step 3: Gathering ideas. In an open innovation system, companies gather ideas from inside and outside the organization. They should therefore provide an open environment for employees to express and disseminate their ideas. If employees find managers determined to implement open innovation and enthusiastic about gathering ideas, they will be eager to participate (Lindegaard, 2010). The company can also encourage customers and suppliers to express their opinions and comments about products and services, and prepare the required conditions to support it, like

toll-free telephones and websites. The continuousness of this participation depends on how they are able to see the company taking their opinion into consideration and even notice changes in products and services based on their ideas. The challenge of idea generation concerns the generation of qualitative ideas that will potentially have a positive impact for the company (Innovation Point & Idea Crossing, 2006). The essential point is that having lots of ideas is not a success factor of innovation. If the company collects many ideas into its system without having enough time and resources to work through all of them, it may cause some disappointments.

Step 4: Screening ideas and selecting a few of them. After gathering ideas with external collaborations, screening ideas is essential to find a few good ideas among all those collected. There may be idea competition between participants, but there are some points for this competition that must be specified (Innovation Point & Idea Crossing, 2006). At first, some default rules and determined structures are necessary to consider ideas. Next, it is important to go through the ideas so participants will feel they have a role in the process. Criteria should therefore be defined to evaluate and prioritize ideas, and the results of the ranking should be clearly communicated. In fact, responding to participants avoids discouragement (Lindegaard, 2010). These criteria need to be based on company requirements and competencies. As mentioned earlier, getting lots of ideas may seem good at first but after a certain amount of time, the result is that there are not enough resources to go through all of them. Lindegaard (2010) states that there are usually two approaches: A team with highly qualified people and an average idea and a great idea with ordinary people. If a company wants to be innovative in each of its business activities, people should be prioritized rather than ideas, so focusing too much on ideas is not necessarily useful. Furthermore Pontiskoski & Asakowa (2009) have mentioned that

innovation and new product development usually fail because of poor implementation, not poor ideas.

Step 5: Develop Intellectual Property strategy. Intellectual Property (IP) of a company requires being modified to use open innovation. It means developing a communication and collaboration strategy to enable companies to collaborate with external resources. The concepts of open innovation and Intellectual Property Rights may seem contradictory at first. Open innovation implies a willingness to exchange knowledge and technology with external resources whereas Intellectual Property Rights implies protection by excluding others from using inventions and knowledge (Hall, 2010). It can be a way to gain maximum profit by selling the patent to other companies instead of keeping it for itself, or to facilitate cooperation by creating patent alliances or new ones with other key companies (Ming, 2010). Some patents may be not exclusive and partners might disagree about patent issues, so they can put their patent in a common pool, grant them to an independent association, or change them to unlimited license that anybody would be able to use.

In open innovation, effective IP management is essential because in addition to finding useful external knowledge, the manner in which the value of IP's is captured is crucial. So, developing IP strategy can be considered as a prerequisite for collaborating with external resources successfully; though modifying IP strategy during the collaboration according to project specifications is necessary. Ming (2010) has suggested three steps for presenting transferred knowledge and technology to the market: technology import, R&D, and commercialization. In technology import stage, search and evaluation is important to obtain full information on patent, avoid working on similar parts, and achieve results that have already been found, causing waste

of time and IP disputes. In R&D stage, companies use knowledge in the previous stage to create new technologies independently or with collaboration. Before launching any technology in the market, patents should be controlled and protected. There are different protection methods, which have various intensities and effects based on the characteristics of the new technology, the industry, and the economic capacity of the company. In commercialization stage, new technologies are diffused outside the organization valuably. In order for there to be effective IP management, internal and external IP contract management should be considered. In internal IP contract management, the technological achievement flows through the company. Guiding employees in understanding what is forbidden to divulge and what is not, training them to update their knowledge, etc., are examples of tasks that could be helpful. External IP contract management involves technology diffusion to the market and authorization for using it.

Step 6: Collaborating with external resources. According to Gassmann & Enkel (2004), based on an empirical study of 124 companies, two core open innovation processes can be put into practice. Companies are able to use a combination of both according to their situation and requirements. These are:

- **The outside-in process**: Improving a company's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing, buying intellectual properties and patents.
- **The inside-out process**: Externalizing the company's knowledge and ideas in different markets, selling intellectual properties, and multiplying technology by transferring ideas to other companies.

In this step, companies can focus on each process or on a combination of both by collaborating with external resources such as universities, laboratories, scientific institutions, SMEs, etc. However, collaboration with some partners like universities sometimes starts from generating ideas, so there is not a clear arrangement for the starting point of collaboration with external partners.

Although the partners of each collaborative project may be different, we have not focused on all the various frameworks for all the various partners a company may collaborate with. But in the case of collaboration with universities, following a framework like the one explained in Section 4.3 is necessary to achieve beneficial outcomes.

Step 7: Creating knowledge base. Creating knowledge base usually happens after the first year of using open innovation in a company because it is a long-term process. Such a knowledge base can be used in order to survey practices and identify the best ones, monitor the progress of open innovation, and access the statistics and results of previous projects. The company can also cross-train people in order to share successful project management practices. Therefore, this step can help ensure durability of the open innovation system.

Step 8: Acknowledgement. This is a key aspect of a program; it aims to acknowledge employees' capabilities and successes. In other words, declaring and highlighting the results of successful projects to the world encourage employees to believe in. As explained by Stark (2011) "*Open innovation does not entail the creation of a massive business concept. Instead, it is the transformation of an internal culture, and the development of a process to encourage and promote innovation from every available source*".

4.3 *Linking open innovation and university-industry collaboration*

In an open innovation system, new competencies should not be achieved only from a company's internal resources, but should also take advantage of external resources' skills. While open innovation literature has traditionally concentrated on knowledge and ideas flowing from one firm to another, universities can also be a useful source for knowledge and technology transfer, without being limited to the transfer of intellectual property (Padilla-Melendez & Garrido-Moreno, 2012). In particular, the open innovation approach may involve universities and public research institutes as external resources because they perform basic research with high risk that private firms cannot necessarily conduct (Saito, 2010). Therefore, universities could be considered as key actors to drive and increase knowledge and technology transfer.

There are different motivations for universities and companies to collaborate in an open innovation system. Accessing new technologies, accessing additional competencies, finding new ideas, reducing product development time to market, reducing cost, and sharing risk are some examples of the main motivations of companies. Commercializing new technologies, accessing empirical data, selling patents, and finding financial support, are illustrations of the main motivations for universities. Perkman & Walsh (2007) define university-industry partnership in seven classes, which are:

- **Research partnership:** performing collaborative R&D activities between organizations;
- **Research services:** contract research, consulting, financing of university research by firms;
- **Human resource transfer:** graduated requirement by industry, training industry employees, internships and learning in the industry;

- **Academic entrepreneurship:** development and commercial exploitation of technological inventions of a university through a company;
- **Commercialization of property rights:** transferring of university-oriented IP like patents and licensing to the industry;
- **Informal interaction:** social relationship, networking, conferences, etc.;
- **Scientific publications:** joint publications such as articles in journals.

Different levels of interaction may exist between industry and academics in research partnerships and research services. While academic entrepreneurship and human resource transfer are related to a medium level of relational involvement, commercialization of property rights needs less relationship intensity. Scientific publication and informal interaction, depending on the situation, can accompany all forms. In high relational links, individuals and teams from academia and industry work together on specific projects to achieve common outputs.

In a context of open innovation, inter-organizational relationships play an essential role in driving innovation processes (Perkman &Walsh, 2007). As a result, even though all kinds of university-industry collaboration are possible in an open innovation system, research partnerships and research services as well as scientific publications and informal interaction with high relational involvement can be more interesting means of achieving all the benefits associated with open innovation. All the links between university and industry and their relationship intensity are shown in Figure 4.

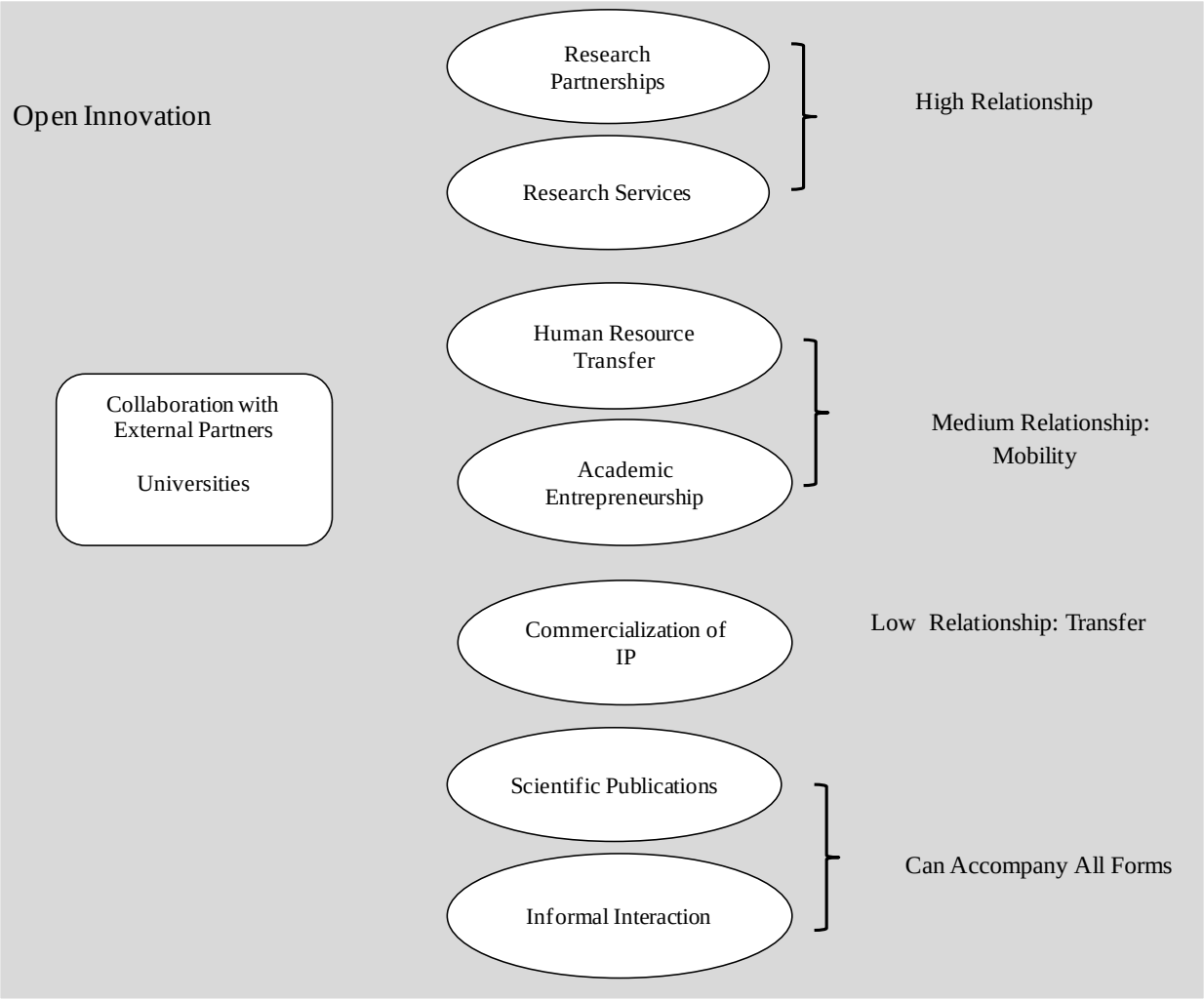

Figure 4. University-industry linkage

By working together following an open innovation philosophy, industry and universities could both benefit from greater knowledge and technology transfer while creating strategic networking that could be useful for future projects and product developments.

5. Conclusion

Collaboration with external partners and universities in particular, is a way to develop products and services that better respond to customer needs. Similarly, open innovation, as a new

approach for gathering ideas and improving innovation, helps companies implement inter-organizational linkages. Among the different kinds of potential partners that could be selected, universities have been investigated in this study. In particular, we have tried to investigate the university-industry collaboration dynamic and the stages to focus on in order to ensure profitable relationships. We have also analyzed the open innovation philosophy and how this type of system could be linked with university-industry relationships.

In order to present a clear structure for implementing both university-industry collaboration and open innovation, a two-tier framework has been proposed. We have then shown that universities, as key external resources for companies, could help in facilitating execution of the open innovation model. High relational links, like research partnerships and research services between universities and industry, play an essential role in driving innovation processes in the context of open innovation.

The proposed framework is general but has the capability to improve the global situation of any industry. Meanwhile, this framework has been developed without regarding activities like establishing different plans and centers to better link universities and firms, which could be introduced as the preliminary steps of our framework. As a result, expanding the proposed general framework with prerequisite steps could be considered as a future work. We have proposed a general structure of open innovation implementation within a company. For future work, it could be interesting to investigate whether universities need to implement open innovation inside their organization or not, or if the proposed structure is effective for universities or not. Finally, more interviews conducted with both academics and companies from a specific industry could be an interesting way to customize and adapt the developed framework.

References

Antikainen, M., Mäkipää, M., Ahonen, M., 2010. Motivating and supporting collaboration in open innovation, European Journal of Innovation Management, 13 (1), pp.19-100.

Bailetti, A.J., Callahan, J.R., 1993. Assessing the Impact of University Interactions on an R&D organisation. R&D Management, 22 (2), pp. 145-156.

Barnes, T.P., Pashby, I. Gibbons, A., 2002. Effective University – Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects. European Management Journal, 20 (3), pp. 272-285.

Barney, J., Wright, M., Ketchen, D., 2001. The resource-based view of the firm: Ten years after 1991. Journal of Management, 27, pp. 625-641.

Barratt, M., 2004. Understanding the meaning of collaboration in the supply chain. Supply Chain Management: An International Journal, 9 (1), pp. 30-42.

Broström, A., Lööf, H., 2008. How does University Collaboration Contribute to Successful R&D Management? Royal Institute of Technology, CESIS - Centre of Excellence for Science and Innovation Studies.

Bruneel, J., D'Este, P., Salter, A., 2010. Investigating the Factors That Diminish the Barriers to University-Industry Collaboration. Research Policy, 39, pp. 858-868.

Chesbrough H.W., 2003. Open Innovation. Harvard University Press: Cambridge, MA.

DG Education & Culture, 2011. Case studies taken from: Order 93 –University Business Forum 15 institutional case studies on the links between higher education institutions and businesses.

Enkel, E., Gassmann, O., Chesbrough, H., W., 2009. Open R&D and open innovation: exploring the phenomenon. R&D Management, 39(4), pp. 311-314.

Gattringer, R., Hutterer, P., Strehl, F., 2014. Network-structured university-industry collaboration: values for the stakeholders. European Journal of innovation Management, 17(3), pp. 272-291.

Gumus, B. Cubukcu, A., 2011. Open Innovation Survey in Top Turkish Companies. Proceedings of 11th Technology Management in the Energy Smart World (PICMET), Portland, USA, pp. 1-6.

Hadaya, P., Cassivi, L., 2007. The role of joint collaboration planning actions in a demand-driven supply chain. Industrial Management & Data Systems, 107 (7), pp. 954-978.

Hall, B., 2010. Open Innovation and Intellectual Property Rights: The Two-edged Sword. Japan Spotlight, 1, pp. 18-19.

Hurmelinna, P., 2004. Motivations and Barriers Related to University-Industry Collaboration-Appropriability and the Principle of Publicity. Seminar on Innovation, University of California, Berkeley.

Huxham, C., 1996, Creating Collaborative Advantage. Saage Publications, London.

Ibarra, H., Hunter, M., 2007. How Leaders Create and Use Networks. Harvard Business Review, pp. 40-47.

Innovation Point & Idea Crossing, 2006. Idea Competitions and Breakthrough Innovation. Innovation Point, Retrieved February 1, 2013, from: http://allenjcochran.com/wp-content/uploads/2012/01/Idea-Competitions-and-Breakthrough-Innovation.pdf.

Irvine, J., Martin, B.R., 1983. Assessing Basic Research; the Case of the Isaac Newton Telescope. Social Studies of Science, I3, pp. 49-86.

Julio, A. Pertuzé, E., Calder, E.S., Greitzer M., Lucas, W.A., 2010. Best Practices for Industry-University Collaboration. MIT Sloan Management Review, 51 (4), pp. 83-90

Kaymaz, K., Eryiğit, K.Y., 2011. Determining Factors Hindering University-Industry Collaboration: An Analysis from the Perspective of Academicians in the Context of Entrepreneurial Science Paradigm. International Journal of Social Inquiry, 4(1), pp. 185-213.

Lee, Y.S., 2000. The Sustainability of University-Industry Research Collaboration: An Empirical Assessment, Journal of Technology Transfer, 25, pp.111-133.

Lehoux, N., D'Amours, S., Lavgevin, A., 2008. A win-win collaboration approach for a two-echelon supply chain: a case study in the pulp and paper industry. European Journal of Industrial engineering, 4(4), pp. 493-514.

Lindegaard, S., 2010. The Open Innovation Revolution: Essentials, Roadblocks and Leadership skills. New Jersey: John Wiley & Sons.

Ming, L., 2010. Research on Intellectual Property Management in Open Innovation. Proceedings of the 7th International Conference on Innovation & Management, Brazil, pp. 1443-1450.

Oprica, R., 2012. Why does networking matter? Bulletin of the Transylvania, University of Braşov, 5 (1), pp. 71-76.

Padilla-Meléndez, A., Garrido-Moreno, A., 2012. Open innovation in universities: What motivates researchers to engage in knowledge transfer exchanges? International Journal of Entrepreneurial Behaviour & Research, 18(4), pp. 417 – 439.

Parker, H., 2000. Inter-firm Collaboration and the New Product Development Process, Industrial Management & Data Systems, 100(6), MCB University Press.

Perkmann, M., Walsh, K. 2007. University–industry relationships and open innovation: Towards a research agenda. International Journal of Management Reviews, 9 (4), pp. 259–280.

Pertuze, J.A., Calder, E.S., Greitzer, E.M., Lucas, W.A., 2010. Best Practices for Industry-University Collaboration MIT Sloan Management Review, 51(4) pp.83-90.

Pontiskoski, E., Asakowa, K., 2009. Overcoming Barriers to Open Innovation Apple, Nintendo and Nokia. World Academy of Science, Engineering Technology, 53, pp. 372-377.

Ryan, L., 2007. Developing a Qualitative Understanding of University-Corporate Education Partnerships. Management Decision, 45(2), pp.153-160.

Saito, H., 2010. What Kinds of Firms Collaborate with Universities and Public Research Institutes? Technology Management for Global Economic Growth (PICMET), Proceedings of PICMET, Phuket, Thailand.

Schartinger, D., Rammer, C., Fischer, M.M., Fröhlich, J., 2002. Knowledge interactions between universities and industry in Austria: sectoral patterns and determinants. Research Policy, 31 (3), pp. 303–328.

Simatupang, T.M., Sridharan, R. 2003, The collaborative supply chain, International Journal of Logistics Management, 13(1), pp. 15-30.

Simatupang, T.M., Sridharan, R., 2002.The collaborative supply chain, International Journal of Logistics Management,13(1), pp. 15-30.

Stark, K., 2011. 10 Steps for Creating an Open-Innovation Culture. Industryweek magazine, Retrieved January 23, 2013, from: http://www.industryweek.com/companies-amp-executives/10-steps-creating-open-innovation-culture

Thrift, N., 2006. Re-inventing invention: new tendencies in capitalist co modification, Economy and Society, Vol. 35 No.2, pp.279-306.

Turk-Bicakci, L., Brint, S., 2005. University-Industry Collaboration: Patterns of Growth for Low- and Middle-Level Performers. Higher Education, 49, pp. 61-89.

Van Dierdonck, R., Debackere, K., 1988. Academic Entrepreneurship at Belgian Universities, R & D Management, 18(4), pp. 341-350.

Van-Home, C., Poulin, D., Landry, R., Frayret, J.M., 2008. Three Actor View of Academic-Industry Research Centers: Towards a Taxonomy. CIRRELT 2008, pp. 1-20.

Van Horne, 2009. Innovation and value creation in university–industry research centres in the Canadian forest products industry. Doctorate thesis in Université Laval, Canada.

Winkler, H., 2009. How to improve supply chain flexibility using strategic supply chain networks. Logistics Research 1(2009)1, pp. 15-25.