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An Up-to-date Survey in Barriers to Open Innovation

Rachid Oumlil ^{1*}, Carlos Juiz ²

Abstract: Open Innovation (OI) is recently recognized as a key factor in the competitiveness of companies. Firms that are not engaged in OI practice risk of becoming uncompetitive. However, innovating firms are likely to face several challenges often illustrated by barriers. Many researchers studied OI barriers without giving importance to their category. The main objective of this survey is to identify and categorize some barriers to OI practice by analysing how the literature on this topic has evolved for the last seven years (2009-2015). Our understanding of OI barriers can be insightful for future research on OI and it can assist managers, in fostering an innovative culture by supporting new ideas and avoiding an attitude that creates resistance towards these ideas.

Keywords: Innovation; open innovation; barriers; categorization.

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Introduction

In the past century innovation was increasingly seen as the most important success factor of the companies' organizational performance, regardless their size and the industry they belongs to (Bigliardi et al. 2013). Many companies have been able to reinvent themselves with successful innovation projects (Pontiskoski and Asakawa, 2009). Results of the American Management Association Survey revealed the main importance of the innovation in the success of businesses (Jamrog, 2006). Innovation is considered extremely important for the company's long-term survival.

However, innovation has been defined in different ways. Booz, Allen and Hamilton (1983) considered innovation as a linear process of sequential events from research and idea generation to commercialization. Otherwise, it is as a process through which ideas are transformed into new products, services or processes (Baregheh et al., 2009). Besides, Damanpour (1991) defined innovation as "*an idea or behaviour, whether a system, policy, program, device, process, product or service, that is new to the adopting organization*". For Weerawardena (2003), innovation is the capacity of a firm to perform a range of coordination actions in order to deliver new products and new services to the market, in a way that surpasses competitors. Innovation is defined as a process through which ideas are transformed into new products, services or processes (Baregheh et al., 2009).

Indeed, innovation is performed on the basis of the knowledge of the people involved in its process. However, many authors stated that innovation is often driven from the contingency peculiarities particularly related to firms' competition, deregulation, scarcity of resources, and customer demand (Damanpour and Schneider, 2009). In this sense, Rothwell (1992) includes internal interaction between departments and external interaction between the firm and its customers, partners, and suppliers. This is due to the hype of the knowledge society where information and knowledge are accessible and being

a part of the competitiveness of organizations and also individuals (Coras and Tanatau, 2012). Moreover, companies cannot avoid the impact of the current environment variations such as: intensified competition, broad and fast knowledge diffusion, and rapid growth of R&D investments, amounts and shortness of the product and technologies life-cycles. Hence, companies should rethink about how to innovate their business and their processes.

Today companies are conscious of the constant flow of novel ideas for their innovation process. They continually pay close attention to users, as a source of valuable feedback and relevant use case experiences. They integrate outside knowledge and ideas, research projects, and concepts into their own offering. Furthermore, the ubiquitous of Information Technology advances has rendered organizational boundaries very porous; by the way they allow the facilitating knowledge transfers inward and outward (Whelan et al., 2010). Moreover, the traditional resource-based view into a firm would harm and hinder today's innovation practice. Accordingly, companies should find new ways to do things. Interestingly they could focus only on what they are good at and outsource what they cannot do themselves. They could also integrate outside ideas, new knowledge into their own offering, and then migrate from the traditional to a modern practice of innovation called open innovation.

Open Innovation (OI) is considered as a new paradigm of innovation, where organizations innovate with partners to share risks and rewards. It is popularised by its initiator Chesbrough (2003), as an opposite to the traditional paradigm of innovation: 'closed innovation'. Unlike this later, where companies innovate relying on internal resources only, in OI, company boundaries become porous and allow resources integration between the company and external collaborators (Chesbrough, 2003). OI is a new practice regarding the manner in which firms conduct and commercialize innovation outputs (Liao et al., 2014). It is defined as "*the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the*

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markets for external use of innovation, respectively, (Chesbrough et al., 2006). Hence, OI invites actors outside the organization to pursue innovation driven either by non-profit (Kuk and Davies, 2011) or profit (Ceccagnoli et al., 2011) motivations. Rice et al. (2012) noted that OI acts as an innovation catalyser and will never overcome fundamental deficiencies or ineffective systems and capability configurations elsewhere in the company.

Moreover, OI has been catalysed through the ubiquitous of Information technology. This later allows access to a bulk quantity of data in a more open fashion, throughout the outside innovators (Boudreau and Lakhani, 2009). Moreover, regarding Chesbrough (2003) three main factors are behind the migration towards this practice: (1) the increasing availability and mobility of knowledge workers (2) the flourishing of the Internet and venture capital markets, and (3) the broadening scope of possible external suppliers. Mortara et al. (2008) added four other reasons behind this migration: (1) Reducing time to market for products (2) Availability of new technologies (3) Access to competencies (4) Exploitation of internally developed technologies.

Today, OI practice is perceived by companies as means to improve their innovation performance (Huang et al., 2015) and accelerate its rate (Lam et al., 2013). Indeed, it has been adopted first in the high-tech sectors (Chesbrough, 2003; Kirschbaum, 2005), and then emerged within low-tech sectors, such as the industry (Holmström and Westergren, 2012), small and medium-sized enterprises (SMEs) (Gassmann et al., 2010; Henkel, 2006; Lee et al., 2010; Parida et al., 2012; Rahman and Ramos, 2013), food industry (Fortuin et al., 2009), etc. The majority of extant research on OI is drawn from firms operating in North America and Europe (Chaston and Scott, 2012). Subsequently, OI practice is still limited and requires more application. For this issue, we research about OI barriers as drawbacks to foster its application.

The extensive literature written on open innovation subjects highlights the motivations and the benefits of the OI. Nevertheless, studies about OI barriers are still limited and none of these researches has gone over the classification of OI barriers. Given these limitations, we consider of high weight the need to stress on these barriers. Hence the aim of this survey is to fill this gap by reviewing and classifying by categories the main current barriers toward innovation practice. We referred to key concepts related to barriers or obstacles of OI cited in researches published since 2009. Moreover, by undertaking this paper, we purpose two main objectives: (1) to beef up the scarce literature on open innovation barriers by providing a basis on OI barriers, (2) to shed light on the factors that a firm needs to approach in order to foster a culture for open innovation.

We have structured this paper as follows. Section 2 provides the theoretical basis for OI paradigm. Section 3 reviewed recent researches related to OI barriers and present a meta-analysis of the OI barriers. In section 4 we conclude and highlights some managerial implications and paths for further researches.

Open Innovation Paradigm

Indicate Nowadays, organizations are faced to many challenges, varying from complex tasks to creation of the competitive advantage and surviving in the dynamic environment (Dess and Picken, 2001). Innovation is considered the main key to overcome these challenges. It is seen as the bloodline of any organisation aiming to succeed in such environment (Schulze et al., 2012). Lichtenthaler and Lichtenthaler (2010) stated that traditionally, innovation was stucked to Research & Development (R&D) departments, where importance was devoted to the internal knowledge only, so that off-the-wall ideas were less interesting. Afterwards, the abundant knowledge due to the massive usage of IT obliged companies to not entirely rely on their own ideas to innovate. Subsequently the emergence of a new paradigm called: Open Innovation (OI).

In 2003, Henry Chesbrough introduced the concept of OI. His research works at Xerox PARC (Chesbrough & Rosenbloom, 2002), IBM, Intel and Proctor & Gamble, revealed the firm necessity to innovation strategies allowing innovation flows across firm boundaries and outlined the role of company-to-company partnerships. Furthermore, OI has become one of the critical topics in innovation management literature (Chesbrough, 2003; Christensen et al., 2005; Gassmann, 2006; Westergren and Holmström, 2012). It has quickly gained the interest of practitioners and researches from a wide range disciplines, including economics, psychology, sociology, and even cultural anthropology (Von Krogh and Spaeth, 2007).

Chesbrough (2006) defined OI as *“The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology”* (Chesbrough et al, 2006, p.1). Otherwise, it explains the way of innovation when a company provides internally generated knowledge for the market and external knowledge flows in. For West et al. (2006, p.286), OI is described as *“both a set of practices for profiting from innovation and a cognitive model for creating, interpreting and researching those practices”*. West and Gallagher (2006) added that OI is a wide range of internal and external sources for innovation opportunities consciously integrated with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels.

OI explains how firms would enhance their innovative performance by exploitation external knowledge, as well as how they would benefit financially by using external paths to market (Chesbrough, 2003; Gassmann and Enkel, 2004). It aims to accelerate internal innovation, and to expand the markets for external use of innovation respectively (Chesbrough et al., 2006). It incorporates accumulation of ideas, knowledge, licenses, intellectual properties, patents, and inventions (through licensing, joint ventures, spin-offs). In addition, internal inventions that are not being used in a company's business process

should be taken outside the company (through licensing, joint ventures, spin-offs) (Chesbrough and Crowther, 2006). Hence, OI could be seen as a combination of two differently directed processes: inbound and outbound. From other side, Enkel et al. (2009) proposed to combine the inbound activities with outbound activities in order to co-develop, commercialise and co-capitalise on innovation. In the “open” innovation model, companies make use of external ideas and competence, to strengthen its own innovation capabilities (Chesbrough 2003; Gassman 2006; Mortara et al., 2009). Thus, open innovation is paradigm assuming that firms can and should use internal and external ideas, and internal and external paths to market, as the firms look to advance their technology (Chesbrough, 2003)

West and Gallagher (2006) identified three main inherent management challenges related to: (1) maximization that include outbound IP licensing and patent pooling (2) incorporation where firms should identify relevant knowledge through scanning, recognitions, absorption and political willingness to integrate external innovation and (3) motivation in which firms have to assure continued supply of relevant external technologies and IP. Instead of relying on its own R&D department to enhance the company innovation abilities, the open innovation model mobilises the key organisational networks and players (suppliers, customers, public and private research centres, institutions, universities and even competitors) (Clausen and Pohjola, 2009; Piperopoulos, 2012)

Despite of being widely researched, there is no clear consensus upon what constitutes open innovation practices, however, it has been defined as an antithesis of its predecessor, “closed” innovation, (Bullinger et al 2012), where companies relied on internal channels for research, development and commercialization of their inventions (Chesbrough 2003; Gassman and Enkel, 2004). It figures out that firms should use external ideas and internal and external paths to market, as the firms look to advance their technology (Chesbrough, 2003).

Traditionally innovation takes an importance place within companies and has been the way several industries operated. It started closed where firms look beyond their internal environment and limited resources for knowledge, ideas, opportunities and partners, (Chesbrough, 2003; Spithoven et al., 2012). This way is called the vertical integration model or the closed innovation paradigm. This paradigm refers to an understanding that successful innovation requires also control processes (Pontiskoski and Asakawa, 2009). Moreover, research and development activities within organizations are considered strictly internal processes and should be guarded from external influences (Westergren and Holmström, 2012). In the sense of Chesbrough (2003), companies have to bring out their ideas and then to develop them, build them, market them, distribute them, service them, finance them and support them on their own in the closed paradigm. Otherwise, ideas should be generated in-house and the only way to market them is through the originating firm (Chesbrough, 2006 b). Besides, companies should be strongly self-reliant, because one cannot be sure of the quality, availability, and capability of others’

ideas (Chesbrough, 2003). Also, the closed paradigm supposes that innovation must be kept in-house and the intellectual property generated through R&D department is a trade secret.

Although the closed innovation paradigm worked well for quite some time and many, the current innovation landscape has changed (Vrande et al., 2009). Hence a many developments within and outside the innovation arena revealed the ineffectiveness of the traditional innovation system and engender the necessity to change the innovation process and migrate to the open one. These developments consist of knowledge workers and information technology breakthroughs, the increased mobility of workers, the growing presence of venture capital, the increasingly shortened product life cycles, the growing competition, the globalization of economy, the improved use of information technology, and the wide availability of knowledge from multiple sources engendered the outdate of the closed innovation and the migration the OI paradigm (Rahman and Ramos, 2010). Based on Chesbrough (2003) assumptions, the open paradigm is driven by four main factors: (1) The increased availability and mobility of skilled “knowledge-workers”, (2) the new external options available for unused ideas, (3) the external suppliers increasing capability and finally, (4) the emerging venture capital markets that created new strategic opportunities for companies.

The OI paradigm assumes that firms should use external ideas as well as internal ones, internal and external paths to market, as the firms look to advance their technology (Chesbrough, 2006). Otherwise, it refers to a strategy and business philosophy where companies actively look for both internal and external ideas’ sources to accelerate their innovation process. It is an emerging paradigm that is based on the fact that external ideas and internal paths are placed at the same level of importance. Referring to Chesbrough et al. (2006), OI paradigm can be understood as the antithesis of the traditional paradigm. It is seen as the use of purposive inflows and outflows of knowledge and ideas for both accelerating internal innovation and expanding the markets for external use of innovation.

The open innovation paradigm provides a new perspective towards external collaboration. It acknowledges that companies have a strong interest to partner and to integrate external sources of knowledge. Innovation becomes, then, a collective activity integrating a great number of stakeholders for production and R&D. in the same sense, Lichtenthaler (2011) suggested two main OI characteristics distinguish from the innovation collaborative approaches: (1) the integration of inward and outward knowledge transfer, and (2) the complementary character of internal and external innovation. By adopting an OI paradigm, firms can pursue it in three different ways: (1) engagement in enriching their own skills and knowledge through the integration of stakeholders (suppliers, customers,...) into the internal innovation process (Enkel et al. 2009), (2) carry out outbound OI activities by bringing ideas, patents, and any intellectual property rights form to the market (Lichtenthaler, 2008) and (3) co-creation with complementary partners (Enkel et al., 2009) that combine the outbound and inbound OI activities. Table 1 summarize peculiarities of open and closed innovation paradigms.

Table 1. Inspired from Closed Innovation Vs Open Innovation *Chesbrough, H. W. (2003 b)*

Open Innovation	Closed Innovation
Not all of the smart people work for us” so we must find and tap into the knowledge and expertise of bright individuals outside our company	The smart people in our field, work for us
External R&D can create significant value; internal R&D is needed to claim some portion of that value	To profit from R&D, we must discover, develop and ship it ourselves
We don't have to originate the research in order to profit from it	If we discover it ourselves, we will get it to market first
Building a better business model is better than getting to market first	If we are the first to commercialize an innovation, we will win
If we make the best use of internal and external ideas, we will win	If we create the most and best ideas in the Industry, we will win
We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model	We should control our intellectual property (IP) so that our competitors don't profit from our ideas.

Barriers to Open Innovation (OI)

In 2009, Pontiskoski and Asakawa, described in a conceptual paper, how companies overcame barriers to use open innovation strategy in R&D and commercialization projects. The two authors studied three companies able to reinvent themselves and their business: Nokia n-series, Nintendo Wii, and Apple iPod. They compared three of their product development and commercialization projects. Their objective was about comparing and contrasting open innovation success factors and pitfalls from the three companies. To do this, they exploited secondary data related to the cited companies, and then they identified three levels of open innovation barriers: cognitive, behavioural, and institutional.

Mortara et al. (2009) tried to identify barriers and challenges related to implementation of OI in companies belonging to divers sectors (Fast moving consumer goods, Energy and oil, Aerospace and defence, Software and media, Electronics and telecommunication, Intermediaries such as knowledge and service brokers). Methodologically, they interviewed 26 managers of these companies and underlined the influence of several barriers ranging from internal cultural issues, lack of appropriate skills, lack of resources and appropriate structural change.

In the same intent, Fortuin and Omta (2009) attended to find out the main drivers and barriers to open innovation in the food processing industry in Netherlands. Also, they explored how far this industry can rely on the principles of innovation management developed in high-tech industries to improve its innovation performance. The two authors referred to the theoretical insights derived from the industrial organization theory and the resource-based view to develop their questionnaire. Results of the data collected from research director, CTO, or CEO of the nine companies participating in the study, light out the importance of the barriers related to the underutilization of open innovation in the food industry.

Vrande et al. (2009) explored barriers for open innovation in SMEs,

acting in manufacturing and service industries. They used a survey database collected by EIM, a Dutch institute for business and policy research, in December 2005. The authors suggested many OI innovation barriers ranging from, administration, finance, knowledge, marketing, organizational culture...

In 2010, Hernandez-Mogollón et al. studied the role of cultural barriers in the relationship between open-mindedness (OM) and organizational innovation towards SMEs. The study was conducted in a population of 57.000 firms of the Extremadura region, Spain. Authors adopted a simple aleatory sampling and mailed their questionnaire to the selected SMEs. Their finding exposed the impact of the cultural barriers on the relationship between OM and organizational innovation in these enterprises. In the same context of SMEs, Rahman and Ramos (2010) emphasized various open innovation strategies by focusing transformation of innovation process from closed boundary to networked paradigm. They tried to provide an overview on innovation strategies and to discuss about some challenges and barriers that SMEs are facing in implementing OI strategies. To identify these barriers, the two authors referred to the contributions of Hadjimanolis (1999) and Rush and Bessant (1992).

As for Savitskaya et al. (2010), they proposed to analyse the barriers to open innovation from three different aspects: (1) internal firms' environment, (2) institutional factors or innovation system and (3) cultural background. They targeted around 800 companies in the Yunnan province (China) and collected their data through email and a paper survey, and also by phone, in a few cases. The authors were limited on the following factors considered as the main barriers to manufacturing and service sectors OI companies: Not-invented here syndrome, no adequate technologies on offer, fear of losing own innovation ability, lack of marketplaces for technologies and not-sold here complexity of IP rights and fear of infringements.

Lee et al. (2010) investigated three main problems: (1) to place the concept of open innovation in the context of SMEs (2) to suggest the input of an intermediary in facilitating innovation and (3) to report

accounts of Korean SMEs' success in working with an intermediary. They pointed up many barriers to OI in the SMEs Korean context: Difficulties in finding suitable manpower in a labour market, market uncertainty in innovative products, imitation possibilities of technology innovation, short of ability in R&D planning and management, lack of market information, frequent turnover human resources (usually for R&D),...

Holmström & Westergren (2012) studied indirectly barriers to OI by exploring its preconditions in iron ore mining sector and highlighted the critical influence of trust. Besides, Lüttgens et al. (2012) attempted to identify both critical incidents that may occur during the implementation of crowdsourcing in the innovation process and also to derive suggestions for organizational interventions to overcome these barriers. To do, they based on a design science approach and a longitudinal study of six companies engaged in piloting of open innovation.

In 2013, Lam et al. purposed to understand drivers and barriers to OI type called the Industry-University Collaboration (IUC) in Hong Kong. They hypothesised that these drivers and barriers ranged from unavailability of competent external partners to provide the necessary knowledge and technologies, fear of disclosing their own intellectual property to external partners, innovation too easy to copy, or lack of demands from clients/customers for generation of knowledge and technologies, existing legislation, norms and regulations,...

In their conceptual paper, Coras and Tantau (2014) stressed on the benefits, the barriers and the drawbacks entailed by open innovation projects. They explored the incentives of firms embarking in collaborative relationships, and the diversity of risks entailed. They revealed many barriers related to: Workforce, knowledge sharing, collaboration, market, clients finance technology and intellectual property. Furthermore, Hjalmarsson et al. (2014) proposed a framework of OI barriers to of digital services. This framework has been designed using a systematic research approach including a literature review of existing barriers related to cost, finance, innovation, knowledge, market, organization, strategy, regulation, society and technology.

Recently, McCormack et al. (2015) conducted a research to identify drivers and barriers to adopt OI in Galway MedTech cluster in Ireland. They firstly classified these barriers into many categories: Knowledge, marketing, organisation culture, property rights, quality of partners, competence of employees, commitment and idea Management, and secondly they administrated an online survey to a population of 43 companies. Moreover, Janevski et al. (2015) focussed on SMEs and studied level of awareness and constraints for adoption of open innovation strategies in the Republic of Macedonia. Authors conducted a survey among 63 firms and investigated barriers related to many category constraints of the Macedonian context: Recruiting constraints, general constraints, competition constraints, and policy constraints. With the similarly research subject, Nafi et al. (2015) examined the issues and challenges facing the implementation of OI among the SMEs in Malaysia. They inspected the issue of trust and its relation to the study of open innovation and collaborative networks.

Categorizing the Open Innovation Barriers

barriers. Selection was based on the following criteria. We primary conducted computerized keyword searches related to Barriers to OI, lacks of OI, and obstacles of OI. We limited the selection to articles that were related to the subject areas 'Management' or 'Business', 'Information Technology' and that were published in the following scientific databases: Ebscohost, Scopus, ISI Web of Knowledge, ABI Inform and Google scholar. Second, we manually searched abstracts from these databases. Then we examined the references from the articles identified in these previous steps to locate additional studies that the other searches were unable to capture. Third, we removed duplicates and articles that were deemed not applicable by the authors.

The final sample consisted of 19 articles published within the last seven years (2009-2015) that handled research questions related to OI barriers. Of these 19 articles, four were published respectively in 2009 and 2010, two in 2012, two in 2013, three in 2014 and four in 2015. Furthermore, we selected barriers used within these 19 articles and we conducted a lexical analysis in order to classify them by category. For this issue, we used two Project R software (R Core Team, 2014):

- a. Rstudio software for a lexical analysis order to identify the common themes between these barriers and the statistical analysis.
- b. RQDA software to classify the barriers by category

Choice of the Project R software is due to the fact that this environment provides a powerful and flexible system for statistical computations. It is considered powerful enough for performing analyses, comparable to other software, e.g. Nvivo, SAS, SPSS (Mangiafico, 2013). Wordcloud package is used to visualise the dominant words within the barriers sentences. Results revealed the dominance of the following words: Management, Market, Knowledge, partners, technology, trust, and extern, etc. are shown in Figure 1. From these words, we generated six general themes related theses dominant words:

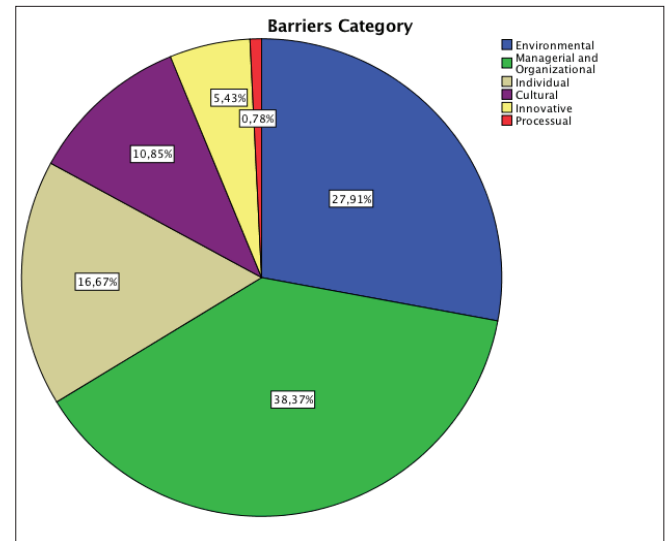
- Environmental (Env)
- Managerial and Organizational (Mgm & Org)
- Individual (Ind)
- Cultural (Cult)
- Innovative (Inn)
- Processual (Pro)

Figure 1. Wordcloud of the dominant words within the barriers sentences

After fixing up the general themes related to the dominant words, we performed a classification of the identified barriers. Table 1 (index) gathers all the barriers used within the 19 articles arranged by theme, by country and by sector. For example, Lüttgens et al. (2012) cited 13 barriers: (1) Negative Attitude, (2) Intellectual property management, (3) Workflow rigidity, (4) NIH (not-invented-here) syndrome, (5) Lack of internal commitment, (6) Bottom-up management, (7) Insufficient resources, (8) Allocating wrong task to pilot, (9) Insufficient top management support, (10) Unrealistic expectation, (11) Legal barriers, (12) Organizational / Administrative barriers and (13) Communication barriers. However, a direct exploitation of these barriers risks to be reductive, whence the reason behind the necessity to classify them. By the way, it becomes easy for managers, CEO and innovators to master the general level of barriers (that could be Individual, Organizational...) instead of analysing them directly. Thereby, for Lüttgens et al. (2012), we identified four main categories of barriers allocated as follow:

- Environmental Barriers: Legal barriers;
- Managerial and organizational Barriers: Intellectual property management, Bottom-up management, Insufficient resources, Allocating wrong task to pilot, Insufficient top management support, Unrealistic expectation, Organizational/ Administrative barriers, and Communication barriers;
- Individual Barriers: Negative Attitude, Workflow rigidity, Lack of internal commitment, and Insufficient top management support
- Cultural Barriers: NIH (Not-Invented-Here) syndrome

Classification in Figure 2 allows the comparison between categories of barriers. The managerial and organizational barriers (38.4%) are the most cited and exploited barriers, followed by the environmental (27.9%), then the individual (16.7%) and the cultural (10.9%). The last places are respectively occupied by the Innovative (5.4%) and the processual (0.8%) ones.

Figure 2. Repartition of barriers by category

Moreover an intersection between the category of barriers and the activity sector expose the dominance of barriers tested in SMEs, followed by industry (Table 2). The digital services sector and IT came in the fourth position. This intersection proved the great intention given to open innovation and its barriers in SMEs. This is due to the fact that this category of firms could be the most concerned with the OI practice. Otherwise, the correlation test between OI barriers and sector pointed out a positive non-significant relationship between category of barriers and type of sector ($r = 0.269$). Hence, explication of OI barriers could not be limited on the characteristics of the activity sectors only. They could be related to the country peculiarities also.

Table 2 Cross tabulation barriers category and Sector

Barriers Category * Sector Cross tabulation									
		Sector							Total
		SMEs	Mechanical engineering	Food processing companies	Digital Service and IT	Biotech & Pharmaceutical	General	Industry	
Barriers Category	Environmental	23	1	0	14	5	17	12	72
	Managerial and Organizational	33	8	0	10	6	17	25	99
	Individual	13	4	0	5	4	10	7	43
	Cultural	5	1	1	6	1	5	9	28
	Innovative	4	0	0	5	0	1	4	14
	Processual	0	0	0	0	0	1	1	2
Total		78	14	1	40	16	51	58	258

Table 3 disclose the relationship between OI barriers and countries. Results revealed the dominance of Sweden followed by Germany in investigating the OI barriers. These results allowed concluding the attention given by these two countries to the OI practice and the desire of its dissemination. Moreover, managerial and organizational barriers marked high score for both of Sweden (27) and Germany (24). This explains the attentiveness that firms should devote to managerial and organizational barriers whenever they wish adopt an OI practice.

Furthermore, a correlation test was performed to study the relationship between category of barriers and countries. Results indicated a very weak correlation between the two variables ($r = 0.015$). Otherwise, dominance of OI barriers does not necessary implies the country commitment in OI practice.

Table 3. Cross tabulation barriers category and countries

Country * Barrier Category Cross tabulation								
		Barrier_Category						Total
		Environmental	Managerial Organizational	and Individual	Cultural	Innovative	Processual	
Country	Germany	8	24	10	4	1	0	47
	Italy	1	3	1	0	0	0	5
	Netherlands	0	0	0	1	0	0	1
	China	1	1	0	1	1	0	4
	Denmark	5	6	4	1	0	0	16
	Sweden	16	27	7	12	7	1	70
	Norway	0	0	1	0	0	0	1
	UK	0	4	4	4	0	1	13
	Malaysia	0	0	1	0	0	0	1
	Hong Kong	7	4	1	1	1	0	14
	Finland	2	1	2	2	1	0	8
	Korea	5	7	1	0	2	0	15
	Macedonia	3	3	3	0	0	0	9
	Portugal	7	6	2	1	0	0	16
	Romania	17	13	6	1	1	0	38
Total		72	99	43	28	14	2	258

Conclusions and further research

The objective of this paper is to broaden the scope of research about Open Innovation (OI) throughout a categorization of its barriers. It presents practically the barriers' approach toward OI practice. This approach could be seen as a powerful mean to better explain individual and organizational behaviours. It could help to foster OI adoption and even solve problems related to its applicability. Indeed, the barriers approach to OI could be considered a meaningful approach in explaining success factors of OI practice. Our work is an innovative in identifying obstacles and problems that organizations and managers have to advance innovative activities. However, further research is needed in finding efficient tool measurements for OI barriers and drawing effective and practical conclusions.

We chose a sample descriptive meta-analysis to account for the limitation of researches studying barriers to OI. We aim for categorizing these barriers and subsequently building a standardized measurement tool for OI barriers. Further researches are probably required to explore and examine barriers by categories and in more detail. They could exploit results of this conceptual paper, especially barriers categorization, to build new constructs explaining OI innovation practice from one or both of the following approaches: organizational, individual, environmental, cultural, innovative or processual. This categorization enables to enrich the findings on barriers to OI and could provide answers to questions of strength and importance of these barriers quantitatively. Moreover, the present study revealed that the barriers to OI are not equal in sectors and even in countries, it could be necessary to develop specific barriers' tool that takes into consideration the differences between organization, activities and countries.

Indeed, OI affects companies' capacity to compete successfully in an increasingly global market. Hence, understanding its barriers can help in the company strategies and policies government development that contribute to economic growth and increased wealth. This paper shows the importance of understanding categories of OI barriers, especially when expressing innovation intention. More attention on OI barriers category can lead to an effective joint action for open innovation promotion. This approach is important especially when the firm is not highly innovative. Barriers assessment becomes a crucial step to its engagement in open innovation practice. Besides, understanding OI barriers can afford to managers tools to foster an open innovative culture within their firms by avoiding negative attitude. An alignment between OI culture and the firm's business strategies can engender great efficiency and efficiency and organizational success.

The insufficient number of researches studding OI innovation barriers (19 articles only) has been the major drawback performing our work. We are aware of the fact that this meta-analysis is a minor step on the road to gaining a better understanding of the open innovation barriers. Of course, there are still many uncharted categories. We hence, enumerate a number of them without having the ambition to be more exhaustive. The number of researches used in the meta-analysis is low. It could diminish the results power even when they are representative studies in the literature. We only considered six categories of barriers (environmental, managerial and organizational, individual, cultural, innovative and processual) but other typologies exist. But our effort may open a window for a future research to investigate deeply on OI barriers and generate new categories. Findings of this paper can be used in the development of companies' strategy or public policy that support and encourage open innovation practice.

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Table 1. OI barriers arranged by theme, by country and by sector for the period 2009-2015

Author	Year	Barriers	Barriers category						Country	Sector
			Env	Mgm & Org	Ind	Cult	Inn	Pro		
Lüttgens et al	2012	Negative Attitude			X				Germany	Mechanical engineering
		Intellectual property management		X						
		Workflow rigidity			X					
		NIH (not-invented-here) syndrome				X				
		Lack of internal commitment			X					
		Bottom-up management		X						
		Insufficient resources		X						
		Allocating wrong task to pilot		X						
		Insufficient top management support		X	X					
		Unrealistic expectation		X						
		Legal barriers	X							
Hernandez-Mogollon et al	2010	Organizational/ administrative barriers		X					Spain	SMEs
		Communication barriers		X						
Fortuin and Omta	2009	Cultural barriers				X			Netherlands	food processing
		The underutilization of open Innovation				X				
Savitskaya et al	2010	The main barriers to inbound OI: Not Invented Here syndrome				X			Finland	Manufacturing and service sectors
		No adequate technologies on offer					X			
		Takes too much time/resources		X						
		Fear of losing own innovation ability			X					
		The main barriers to outbound OI: Not Sold Here Complexity of IPR, fear of infringement				X				
Pontiskoski and Asakawa	2009	The difficulty of finding buyers	X						Italy	Industry
		Lack of marketplaces for technologies	X							
		Levels of OI barriers: Cognitive, Behavioural and institutional			X					
		Embrace of a more open culture			X					
Bigliardi and Galati	2013	Risk-taking activities		X					Italy	Industry
		Different value chain perceived by the food supply chain	X							
		Complexity in managing the numerous relationships		X						
		Different focus of the different actors involved		X						
		Difficulties in finding suitable manpower in a labour market	X							
Lee et al	2010	Short of suitable manpower within the firm			X				Korea	SMEs
		Market uncertainty in innovative products	X							
		Imitation possibilities of technology innovation					X			
		Short of ability in R&D planning and management		X						
		Lack of technological information					X			
		Funding difficulties		X						
		Technological uncertainty	X							
		Funding difficulties due to high innovation and commercialisation costs		X						
		Lack of market information	X							
		Frequent turnover human resources (usually for R&D)		X						
		Difficulties in using external services		X						
		R&D department without power								
		Monopolistic or oligopolistic market structure		X						
		Funding difficulties		X						
		Delayed payment by customers Needlessness of additional innovation	X							

Vrande et al	2009	Administration: Bureaucracy, administrative burdens, conflicting rules	X						
		Finance	X						
		Conflicting rules				X			
		Finance: Obtaining financial resources	X						
		Lack of technological knowledge		X					
		Competent personnel				X			
		Legal/administrative knowledge		X					
		Insufficient market intelligence		X					
		Market affinity		X					
		Marketing problems of products		X					
		Balancing innovation and daily tasks		X					
		Communication problems		X					
		Aligning partners		X					
		Costs of innovation		X					
		Time needed		X					
		Ownership of developed innovations		X					
		User rights when different parties cooperate	X						
		IPR		X					
		Quality of partners	X						
		Partner does not meet expectations	X						
		Deadlines are not met	X						
		Customer requirements misjudged	X						
		Customer demand too specific	X						
		Innovation appears not to fit the market					X		
		Employees lack knowledge/competences				X			
		Not enough labour flexibility				X			
		Lack of employee commitment				X			
		Resistance to change				X	X		
		Idea management		X					
		Employees have too many ideas,				X			
		No management support		X					
		Administration		X					
		Finance		X					
		Organizational Knowledge		X					
		Individual Knowledge				X			
		Marketing		X					
		Culture					X		
		Organisation		X					
McCormack et al	2015	Resources	X						
		Property Rights	X						
		Quality of Partners	X						
		User Acceptance	X						
		Customer Demand	X						
		Competent Employees				X			
		Commitment				X			
		Organizational Idea Management		X					
		Individual Idea Management				X			
		Supply (Technological information)	X						
		Raw material and finance	X						
		Customer needs;	X						
		Customers' perception of the risk of innovation	X						
		Domestic market limitation and	X						
		International market limitation	X						
Rahman and Ramos	2010	Government regulation	X						
		Anti-trust measure	X	X					
		Policy actions		X					
		Lack of Internal funds		X					
		Technical expertise		X					
		Management time		X					
		Culture and human nature					X		
		Attitude of top management to risk				X			
		Employee resistance to innovation				X			
		Out-of-date accounting system		X					

Mortara et al	2009	Organizational Support from top management	X								
		Individual Support from top management				X					
		Create an OI Culture				X					
		Appropriate structural change	X								
		Knowledge of the company	X								
		Knowledge of the company			X						
		Obtaining the right blend of skills			X						
		Motivation of operatives			X						
		Internal cultural issues					X				
		Lack of appropriate skills				X					
		Operational difficulties							X		
		Lack of resources	X								
Holmström & Westergren	2012	External cultural issues						X			
		Trust			X	X				Norway	Industry
Nafi et al	2015	Trust			X	X				Malaysia	SMEs
		Unavailability of competent external partners to provide the necessary knowledge and technologies	X								
Lam et al	2013	Fear of disclosing their own intellectual property to external partners	X								
		Innovation too easy to copy						X			
		Lack of demands from clients	X								
		Customers for generation of knowledge and technologies"	X								
		Higher uncertainty and unpredictability concerning	X								
		Strong internal competence			X					Hong Kong	Industry
		The overall planning and implementation	X								
		Absence of corporate policies to incorporate external ideas	X								
		Existing legislation, norms and regulations	X								
		Lack of demands from clients and customers for generation of knowledge and technologies	X								
		Resistance to including external parties by corporate management	X			X					
		Difficulty in integrating external knowledge and technologies	X								
Janevski et al	2015	Scarcity of skilled employees			X						
		Wages of the skilled employees are too high			X						
		Lack of knowledge in implementing new technology	X								
		The labour market lacks skilled workers			X						
		Increase quality of product/service	X							Macedonia	SMEs
		Increase marketing activity	X								
		Government policies	X								
		Laws and regulations	X								
		Unfavourable business climate	X								
		Importance of external sources	X								
Huang et al	2015	The domestic innovation system is rudimentary and the indigenous						X		China	SMEs
		Innovation capacity has not been well built	X			X					

Coras and Tantau	2014	Workforce Employees resistance to innovation and change			X	X		
		Poor understanding of their role, Safety mentality			X			
		Insufficient technical expertise or training of employees			X			
		Insufficient knowledge about partners	X					
		High staff turnover	X		X			
		Difficulty in finding quality employees			X			
		Low support for innovation	X				X	
		Insufficient expertise partners	X					
		Ethical barriers		X				
		Leaking critical internal resources and disclosure of core competencies		X				
		Conflicting interests of partners	X					
		Developing dependency on partners, relational risk	X					
		Lack of trust and communication among partners	X	X				
		Collaboration suddenly devolved du to partner leaving	X					
		Poor quality of partners	X					
		Poor management of partnership	X	X				
		Volatile and ambiguous industry regulation	X					
		Unethical behaviour of the partners	X					
		Large volume of paperwork	X					
		Administrative burdens	X					
		Lack of market information and transparency	X					
		Constantly changing needs of the clients, requiring customized products	X					
		Lack of financial capital		X				
		High commercialization cost		X				
		Higher management		X				
		Coordination and control costs		X				
		Technology leakage to rival	X					
		Technological uncertainty	X					
		Inability to adapt to technology advances		X				
		Knowledge spill over		X				
		Core knowledge flow towards the competitors	X					
		Inexistence of formal contracts	X					

Romania
Genaral

Author	Year	Country	Industry	Barriers
Hjalmarsson et al	2014	Sweden	Digital Service and IT	High innovation costs
				High cost of finance
				Short-term economic, monetary and financial policies
				Lack of venture capital
				Lack of public funds and assistance
				Easily imitable innovation
				High risk-level of innovation
				Lack of technical competence
				Lack of technical competence and information
				Lack of marketing competence
				Market information
				Lack of management competence
				Lack of innovation experience
				Uncertain product demand
				Lack of innovation motivation
				Weak value offering
				Multifaceted market conditions
				High market competition and saturation
				Lack of partner co-operation
				Lack of time
				Unsupportive organizational culture
				Weak R&D environment
				Lack of innovation champion
				Weak innovation strategy
				Lack of strategic fit
				Hindering government policies and regulations
				Inefficient intellectual property processes
				Lack of public acceptance for innovation
				Unavailable technology
				Regulatory requirements in industry
				Conservative approach to IP
Steninger	2014	Industry	Industry	Internal R&D is the principal source of new knowledge
				Hard to find the right balance open vs. closed
				Traditional values
				NIH syndrome
				Strong sub-cultures
				Rivalry between internal functions
				Low trust in external technologies
				Low trust in external sources
				Low trust internally
				Unbalanced value distribution in collaboration networks
				No top-down strategy for OI
				OI is not in line with corporate strategy
				No corporate technology strategy
				No patent no talk IP policy
				IP Medusa effect
				OI initiatives do not fit into current processes or organizational structures
				OI leads to actions contra dictionary to those that were done before
				Lack of appropriate open innovation tools and infrastructures
				Not possessing the right blend of open innovation skills
				Difficult to coordinate the broad variation of skills,
				External coordination of technology management tasks
				Loss of proprietary knowledge
				Limiting development of internal skill and core technological competence
				Increasing dependency on external technology providers
				Increasing complexity derived from additional interfaces with external parties