

A Conceptual Framework for the Effect of Open Innovation Practices on Innovation Performance

Ashkan Rangamiztousi, & Assoc. Prof. Dr. Kamariah Ismail

Faculty of Management (FM), Universiti Teknologi Malaysia (UTM)

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ABSTRACT

Through open innovation strategies, companies could access to external knowledge and technology with its own innovation process to create value for customers. To the best of our knowledge after systematic review of prior empirical studies regarding to open innovation, several problems identified such as the direct relationship between open innovation and innovation performance has been largely neglected, or mainly focuses on investigating the effect of inbound processes on performance, while the effect of outbound and the coupled process of open innovation was overlooked. Prior studies measured open innovation with external sources of knowledge to estimate only how much open innovation adopted, however cannot find more details about different kind of adoption (inbound, outbound, coupled). Hence, this article focuses on the identifying the different open innovation activities in three-core process of open innovation paradigm. And then show the effect of open innovation activities on four types of innovation (product, process, services, and marketing) as well as innovation focus (radical and incremental). Subsequently, a conceptual framework is proposed. Our study contributes to the technology and innovation management literature by providing new insights on how different open innovation activities could enhance innovation performance. For researchers, the framework clarifies the contributing practices of open innovation in three core processes and its impact; it provides opportunities for researchers to validate and test the framework. Validation results will further contribute to knowledge in innovation management and its role in corporations.

KEY WORDS: Open innovation, Radical Innovation, Incremental Innovation, Strategies, conceptual model

INTRODUCTION

By adopting innovations over time, organizations intend to adjust their external and internal functions so they can respond to environmental demands, operate efficiently and effectively, and maintain or improve their performance [1]. Nonetheless, innovation performance is critical to firms' success and survival, and the innovating company should actively access and integrate external knowledge and technology with its own innovation process to create value for customers. Innovation research focuses variously on innovation as a strategy [2], a process [3, 4] or an outcome [5]. One process touted as important to improving innovation outcomes is open innovation; in theory, firms adapting open innovation activities should be able to support innovation outcomes [6]. In modern innovation management, open models for systematic innovation have been designed to overcome the limitations of closed systems. Open models differ from closed systems in their definition of success [7]. In open models success not only entails the successful implementation of ideas in the original business domain of a company, but also outside that domain [7, 8].

Chesbrough defined open innovation as "a paradigm that assumes that firms can and should use external as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology" [9] and "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively" [10].

The interest in open innovation has been on the rise in both the industrial and academic worlds. The benefits of open innovation have been established in previous case studies and empirical research. In recent years, research on open innovation has continuously extended to a variety of scopes, indicating a positive response toward open innovation from both companies and researchers [11]. Furthermore, open innovation is a phenomenon that has become increasingly important for both practice and theory over the last few years. The reasons are to be found in shorter innovation cycles, industrial research and the escalating development costs as well as in the dearth of resources [12]. Gassmann and Enkel [12] stated that open innovation consists of different strategies in three archetypes of open innovation processes. These three aspects of the open innovation process include inbound or outside-in, outbound or inside-out and coupled processes.

*Corresponding Author: Assoc. Prof. Dr. Kamariah Ismail, Faculty of Management (FM), Universiti Teknologi Malaysia (UTM), Email: m-maria@utm.my Tel: (+60)75566911

To the best of our knowledge and with a systematic review of prior empirical studies regarding open innovation, several problems have been identified. One is the direct relationship between open innovation and innovation performance that has been largely neglected, and next, the main focus on investigating the effect of inbound processes on performance, whereas the effect of outbound and the coupled process of open innovation are overlooked. Open innovation has been measured with external sources of knowledge to estimate only to what extent it is adopted, but there are no further details about different kinds of implementation (inbound, outbound, coupled). Few exceptional studies measured open innovation with different activities, but the measurement of open innovation practices was very general as some practices are broadly defined and the list of open innovation indicators is probably not complete. Therefore, it is important to investigate several types of open innovation activities that may influence the innovation performance of companies in different ways. Hence, this study focuses on identifying the diverse open innovation activities in three core processes of the open innovation paradigm. Then the effects of open innovation activities on four types of innovation (product, process, services, and marketing) as well as innovation novelty (radical and incremental) are shown. Subsequently, a conceptual framework is proposed. The paper contains six sections. This section introduced a background of the research. In Section 2, the research design is discussed. A discussion on open innovation is presented in Section 3. Section 4 represents innovation performance and Section 5 provides a discussion of open innovation effectiveness and its link to innovation. A set of propositions are offered and a conceptual research framework is recommended for further exploration. Finally, Section 6 concludes the paper.

2. Research design

A systematic literature search is used to conceptualize an open innovation effectiveness framework adapted from Bryman [13] approach. In the first step, the research question is defined as a means to guide the purpose of the review. The second step establishes the criteria to guide the selection of studies through identifying appropriate databases for research context searches and use of relevant keywords. The third step synthesizes the literature review with the development of a conceptual framework. The research question is:

RQ: What are the activities and impact of open innovation effectiveness in innovative firms?

The bibliometric search was intended to cover studies on open innovation adoption published between 2003 and March 2014. The second step was to conduct a database search using the search term ‘open innovation.’ We used a number of databases (e.g. ISI Web of Science, Ebscohost, Emerald, IEEE, Sage, Springer, Proquest) and selected articles that had ‘open innovation’ in the title, keywords or abstract. Similarly, the timeframe was restricted to articles published from 2003 onwards, as the term ‘open innovation’ was originally coined in 2003. Afterward, the articles were read and footnotes and references to other articles were followed. This led to the inclusion of working papers, dissertations, and NGO publications. Next, we searched for studies with the keywords ‘external sources of innovation,’ which are related to ‘open innovation.’

Given the focus on external sources of innovation and open innovation activities, the authors manually reviewed abstracts for each of the 286 publications in the sample to specify whether each relates to the study and which phase(s) of the process model it discusses (inbound, outbound, and coupled). When an abstract was inconclusive or unavailable, the full paper was examined.

Based on the aim of this state-of-the-art review, a set of three criteria was developed in order to select a limited number of comparable studies that would enable us to answer the research question. The articles ultimately selected had to meet the following criteria:

2.1 Definition of open innovation

As open innovation is not a clear-cut concept, it can come in many forms (Huizingh, 2011) and the definitions used might be substantially different from ours. In our understanding, open innovation encompasses various inbound, outbound, and coupled activities, as defined by Gassmann and Enkel [12] and Chesbrough [8], [9]. Therefore we only selected studies that cover all or a considerable proportion of these activities, and do not focus on particular subjects, such as user innovation or open source. For each study, we analyzed how the term ‘open innovation’ was used in the article and whether it corresponds to our definition of open innovation.

2.2 Quantitative-oriented empirical studies

Case studies are an important method of advancing research, but large-scale studies are the only reliable option if the goal is to validate propositions and theories empirically. Therefore, ‘success stories’ based on single organizations had to be excluded, as these single-firm case studies cannot be

generalized. Following this logic, multiple-firm case studies with only a small number of cases were also excluded [12, 14, 15], as such studies do not provide comparable quantitative data.

2.3 Firm focus

Open innovation was originally introduced as a firm-level concept. van de Vrande, de Jong [16] mentioned that 50% of the empirical papers in their sample took the firm as the unit of analysis. Therefore, it makes sense for us to focus on this area, which is by far the most extensively covered, in order to ensure that our studies are more easily comparable with each other. Thus, we identified 286 documents in scholarly journals, leaving 80 articles about open innovation that fulfilled the search criteria and were analyzed. Of these, 76 articles included some form of inbound open innovation, 21 had some form of outbound innovation, and 12 articles considered the coupled process of open innovation (Appendix 1).

3. Open innovation

To develop and maintain organization competitiveness and ensure economic success, they must steadily improve innovation performance, strive for more innovation and seek new opportunities for commercialization [17]. Among the major factors influencing the success and innovation of firms include R&D and commercialization based on internal resources [14, 18]. Resources developed through internal R&D can act as a powerful barrier preventing potential competitors from entering the same market [19]. However, firms face various problems, such as limited time available for R&D and rapid market changes arising from fluctuating customer needs [20]. Internal R&D efforts can be inefficient and wasteful, in that such efforts require the use of many resources and substantial time, making it intractably difficult to capture growth opportunities and manage a firm's innovation activity [20-22]. Consequently, to survive in increasingly competitive markets, companies have begun incorporating and collaborating with external sources from other firms for the growth and success of their business. This approach to innovation generally makes the boundary between firm and environment more porous, turning the former solid boundary into a semi-permeable membrane [19]. Therefore, the concept of open innovation suggests that ideas and technology for innovation can emerge from outside as well as inside the enterprise [23] to enable companies to reduce fixed costs for R&D and allow them to establish new sources of research funding [9, 24].

Furthermore, the risks from R&D projects, technologies or products can be shared with partners or competitors [25], thus positively impacting long-term firm performance and outweighing immediate cooperation costs [26, 27]. In this context, van de Vrande, de Jong [16] remarked that current innovation surveys, such as the Community Innovation Survey (CIS), mainly focus on R&D and innovation investments of enterprises and external networking activities but disregard other open innovation practices. Furthermore, [28] stated that typically, studies based on CIS work make observations of how many and what types of collaborators/sources firms use. However, they are unable to address the questions that our data can, regarding what open innovation activities they engage in, to what extent and in what way they do so.

To the best of our knowledge and following a systematic review of 80 selected empirical articles, it was found that the majority of prior studies measured open innovation with external sources of knowledge and information (49 studies) to calculate to what extent open innovation was adopted in different industries or countries and examine the effect of openness. Nevertheless, 22 studies included some form of open innovation practice (activity) indicators, and 9 articles measured both external source and open innovation practices (see Appendix 2); however, these activities were very general, whereby some practices were broadly defined and the list of open innovation indicators is likely not complete or updated. Owing to this issue, an attempt is made herein to delineate an open innovation survey that can cover several practices including 36 strategies in more detail.

Hence, based on prior studies and extensive research in the area of open innovation, 36 open innovation practices were identified and categorized in three core-processes as per [12]. These three facets of open innovation processes include inbound or outside-in, outbound or inside-out and coupled. The inbound process refers to the purposive inflows of knowledge and regards technology exploration and innovation activities to capture and benefit from external sources of knowledge. Outbound is the process of establishing relationships with external partners with the purpose of bringing ideas to the market faster and commercially exploiting technological opportunities. Finally, in the coupled process companies combine the inbound (gaining external knowledge) with the outbound processes (bringing ideas to market). Moreover, the coupled process refers to co-innovation with complementary partners through structured cooperation such as alliances and joint ventures. Table 1 depicts the 36 practices of open innovation.

Table-1: List of open innovation practices and definitions

	Practices	Definition
O U T S I D E - I N	1- Purchasing	Purchasing licenses, patents or know-how from other firms [12, 29-35].
	2-Acquisition of machinery	Acquisition of new or significantly improved machinery, equipment and software [36].
	3- Licensing-in	Obtaining a right to exploit technologies (IP; patents, copyrights or trademarks) by paying royalties to external partners [7, 12, 30-35, 37].
	4- Venture Capital	Providing money from third party investors such as banks or other financial institutions [7-9, 34].
	5- Customer Involvement	Involving customers in innovation processes [12, 16, 30].
	6- Lead User Involvement	Engaging directly with lead users and early adopters [22, 33, 38].
	7- Employee Involvement	Using knowledge of employees are not employed at the internal R&D department [14, 16, 39, 40].
	8- Consulting	Collaborating with external consultants to acquire new knowledge or consulting external experts to solve the problems of innovation and information sharing [7, 8, 12, 30].
	9- Crowd Sourcing	Making an open online call for a creative idea, problem-solving, evaluation or any other type of business issues, and to let anyone (in the crowd) submit solutions [41-45].
	10- Crowd-funding	Using external finance from a large group of people that provides a very small amount [46, 47].
	11- Out Sourcing (Contract R&D)	Contracting out R&D projects or an internal business process to a third-party organization [16, 37, 48].
	12- Technology Sourcing	Outsourcing a task to a large group of people outside the organization to introduce new technology solutions [49].
	13- Technology Scouting	Assigning part of firm employees to achieve innovations with differentiation characteristics or identifying emerging technologies [50-52].
	14- Mass Customization	Offering to the costumers to personalise (customise) a product online [53, 54].
	15- Learning Journeys	Using learning journeys to pick up important information [51].
	16- Online Portal for Inter Ideas	Using Online portal to inter ideas to allow others outside the company to submit their ideas and innovations [52].
	17- Merger & Acquisition	Buying or combining of different companies and similar entities [25].
	18- Sharing facilities	Sharing facilities with other organizations, inventors, researchers, etc. [55].
	19- Revers engineering	Capturing new information or knowledge through reverse engineering.
	20- Contract research	Providing contract research to other external sources
I N S I D E - O U T	1- Selling	Selling internal technologies (intellectual property; patents, copyrights or trademarks) to the market to better profit from them [12, 19, 37, 56].
	2- Divesting	Divesting or selling of firm units [18].
	3- Licensing-Out	Outward licensing the internal technologies or intellectual property (IP) to other firms to generates revenues in form of licensing payments, instead of direct commercialization [7, 12, 16, 19, 34, 35, 57].
	4- Spin-Off	Starting up new firms drawing on internal knowledge and also with all (or partially) the support from the parent company or organization that may include finance, human capital, legal advice, administrative services, etc. [7, 16, 19, 30, 34].
	5- Spin-Out	Supporting that employees work with own ideas out of your company [7, 19].
	6- Grant Back License	An agreement for the assignment of intellectual property that obligates a licensee to license any improvements made to a licensed technology back to the original technology licensor.
	7- Open Source	Revealing internal technologies without immediate financial rewards for indirect benefits to the company [30, 35, 58].
	8- Corporate Venture Capital	Investing in an external start-up that it does not part of your company.
C O U P L E D	1- Joint research	Joint research with universities or public and private R&D institutes or etc. [19, 34, 37, 48, 59].
	2- Joint development	Joint development with universities or public and private R&D institutes or etc. [19, 34, 37, 48, 59].
	3- Joint Purchasing	It is cooperation between two or more organizations in a purchasing group in one or more steps of the purchasing process by sharing and/or bundling their purchasing volumes, information, and/or resources [60-62].
	4- Joint procurement	Joint procurement means combining the procurement actions of two or more contracting authorities and there should be only one tender published on behalf of all participating authorities.
	5- Joint marketing (Co-Branding)	Refers to any situation where a product is manufactured by one company and distributed by another company and both parties invest in commercialization [63-65].
	6- Joint manufacturing	Joint production of products or goods or services.
	7- External participations	External participation refers to participating in fairs, exhibitions, research consortium, meeting or conferences, which this kind of activities has a mutual propose for companies that can both share and capture knowledge [51, 66-68].
	8- Personnel exchange	Exchanging personnel with other firms to capture information and knowledge [51]

4. Innovation performance

For the purposes of this study, the innovation definition proposed by the OECD's Oslo-Manual (2005) is adopted:

"A firm can make many types of changes in its methods of work, its use of factors of production and the types of output that improve its productivity and/or commercial performance. Innovation can be classified into product, process, services and marketing innovation."

Product innovations represent the utilization of new knowledge or technologies, or can be based on new uses or combinations of existing knowledge or technologies that may include new products offered or improvements to existing products. Product innovation appears to be the most common form of innovation. Process innovation is the implementation of a new or significantly improved production method. This includes considerable modifications to techniques, equipment and/or software [69, 70].

Service innovation can be described as new developments in activities undertaken to deliver a core product and make it more attractive to consumers. Marketing innovation entails the implementation of a new marketing method involving significant changes to product design or packaging, product placement, product promotion or pricing, and is aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales [70]. Another classification of innovation is the distinction between two extreme types – incremental and radical innovation. Incremental innovations build on existing competences in companies and are related to minor technological changes. By contrast, radical innovations accompany fundamental technological changes and can therefore destroy competence [71, 72].

5. Theoretical Framework and Hypotheses

Figure 1 shows the proposed conceptual framework in this study. The framework indicates that the three core processes of open innovation affect the different types of innovation outcome and novelty. This framework also guides the definition of the hypotheses, which are presented later. In recent years, scholars' interest in the relationship between open innovation (OI) strategies and firm performance has increased. The question of how openness influences the capacity of firms to innovate as well as the aptitude to obtain higher economic returns is at the heart of OI research [11, 35, 73].

The effect of various open innovation practices has been widely investigated. It is evident in Table 1 that most scholars have intensely assessed the effect of the outside-in process on innovation performance. However, the effect of the inside-out and coupled processes on performance has been investigated less. The empirical findings highlight that adopting and utilizing open innovation activities can positively influence innovative performance, and also stress the importance of cross-sector cooperation, imitation, and retranslation of existing solutions from other industries to foster innovation performance [74, 75]. According to Li and Vanhaverbeke [76], open innovation strategies can build cooperation with suppliers from neighboring markets and distant industries. Thus, the impact of open innovation strategies on innovation performance can increase.

5.1 Outside-in open innovation

Most prior studies explored relate to outside-in process measured open innovation via different external sources and examine these sources' effect on performance. It seems that firms may advance innovative performance by interacting with different partners, primarily customers, competitors, suppliers and universities. Yuetong and Xiaohui [77] mentioned that open could promote innovation, but open to enterprises of different industries, the impact of different levels of innovation performance. For instance, Belderbos, Carree [78] demonstrated that supplier cooperation focuses mainly on incremental innovations intended to improve productivity performance. Competitor cooperation is instrumental in enhancing incremental innovation and increasing innovative product sales. Additionally, customers and universities are important knowledge sources for firms pursuing radical innovations that facilitate innovative sales growth. According to the results of Faems, Van Looy [79], collaboration with partners from a value chain (customers and suppliers) provides a strong base for the incremental development of existing products and services, whereas collaboration with academic institutions increases firms' ability to drive radical development due to access to new technologies. Tödting, Lehner [80] found that companies that cooperate more often with universities and research organizations introduce advanced innovations, whereas firms that rely more on knowledge links with business services establish less advanced innovations. Chiang and Hung [81] also found that open search depth is positively related to the innovating firm's incremental innovation performance, and that open search breadth is positively correlated with radical innovation performance.

Besides impact on innovation novelty, collaborating with different external sources can affect

different types of innovation. For instance, Inauen and Schenker-Wicki [82] focused on product and process innovations as measures of innovation performance. They found that firms with higher openness (inbound open innovation) towards customers and universities are more likely to increase product innovations. On the other hand, as an indirect output effect, customer and university cooperation increased the percentage share of sales of products developed within the last five years. Furthermore, a more open outside-in process towards suppliers, competitors, and universities leads to greater process innovations. However, openness towards cross-sector companies decreases process innovation performance.

However, only few studies have addressed the effect of open innovation practices on innovation performance. Regarding the effect of the first core process of open innovation, the “outside-in process” on “innovation performance,” [83] discovered that process innovation is largely driven by the acquisition of knowledge “embodied” in machinery and equipment and that cooperation with external agents has no significant effect. In contrast, cooperation seems to be an important strategy to develop new products, although its relevance varies depending on the nature of the partner and sector in which the firm operates. It is, therefore, R&D contracting that appeared to be insignificant in enhancing firms’ innovative performance for either sector categories, suggesting that R&D services outsourced by firms are not aimed at strengthening their innovative capacities. Nonetheless, the results suggest that external knowledge acquisition may promote ideas and supply resources that help firms enhance their innovative performance.

In the context of SMEs, Parida, Westerberg [6] conveyed that four inbound activities are positively linked to at least one aspect of innovation performance and there are no negative associations. They stated that firms which adapting open innovation activities should be able to support incremental and radical innovation outcomes. However, it appears that certain open innovation activities might be more favorable for incremental innovation, whereas others are better suited for generating radical innovation. Regarding product/process innovation, Huang and Rice [84] found that two basic external approaches, namely inter-organizational collaborations (i.e., joint marketing or distribution, joint manufacturing, joint research and development, other joint ventures, licensing agreements, or other forms of collaboration) and technology acquisition have similarly significant effects on each of the two main types of innovation. Also, it seems R&D contracting-out tends have a relatively weaker impact on innovation performance than the others. Moreover, Suh and Kim’s [20] results indicate that technology acquisition and R&D collaboration are positively related to product/service innovation, patenting activity, and process innovation, respectively.

Mazzola, Bruccoleri [73] investigated the effect of 12 inbound, outbound and coupled open innovation practices, (but not aggregate OI processes), particularly on innovation and financial performance. Their results pertaining to the effect of practices related to inbound processes on innovation performance show that supplier collaboration and licensing-in have a positive impact. Acquisition and government collaboration negatively influence innovation performance. However, university collaboration and national public funding do not significantly affect innovation performance. Mina, Bascavusoglu-Moreau [28] categorized open innovation practices into formal and informal activities. They observed that the association of innovation performance as a service integration construct amongst manufacturing businesses is stronger with the degree of engagement in informal activities (non-contractual, such as lead users, open source software, exchanging ideas through submission websites, innovation networks/hubs, sharing facilities) than formal activities (contractual, such as joint R&D, joint purchasing, joint production, co-branding, outsourcing).

Therefore, for the purpose of this study, open innovation is defined as diverse strategies for innovation based on cooperation with a range of stakeholders. This study elaborates on the research question of whether the outside-in open innovation practices have a positive impact on a firm’s innovation performance. Thereby, of particular interest is the relationship between the first core process of open innovation, or the “outside-in process,” and measures of “innovation performance.” In existing research, innovation measurement has been addressed in several ways by different authors [85, 86]. As mentioned earlier, the following indicators are considered for measuring the dependent output “innovation performance” variable: product, process, services, and marketing innovations as well as radical and incremental innovation. Hence, the following research hypotheses are proposed regarding the outside-in process:

- H1: Outside-in open innovation activities lead to a higher number of the firm’s product innovations.
- H2: Outside-in open innovation activities lead to a higher number of the firm’s process innovations.
- H3: Outside-in open innovation activities lead to a higher number of the firm’s services innovations.
- H4: Outside-in open innovation activities lead to a higher number of the firm’s marketing

innovations.

H5: Outside-in open innovation activities lead to a higher number of the firm's radical innovations.

H6: Outside-in open innovation activities lead to a higher number of the firm's incremental innovations.

5.2 Inside-out open innovation

Inside-out open innovation practices are increasingly considered to be strategic activities by firms, which can yield profit from their own innovations without investing in complementary assets [73]. In addition to the financial benefits involved, several strategic benefits can be accrued from pursuing an inside-out open innovation strategy. Also, non-monetary incentives guide a firm to open its boundaries toward outbound processes [87], such as reputation. Firms may choose this strategy when they have strong development and commercialization departments but no branded products in the target market [17]. They can indirectly benefit from partnership through an enhanced brand or through the strategic position of their partner. Setting industry standards presents another strategic benefit that can be of particular importance to firms' long-term success [88]. Moreover, the commonly acknowledged non-monetary objective for external knowledge exploitation is to gain access to another company's technology portfolio [89].

Nevertheless, outward of external knowledge also presents the risk of negative effects on innovation performance [90, 91]. For instance, managers who decide to license out their IP or divest knowledge assets surely increase short term profits and meet analysts' expectations and resist to stakeholders' pressure; but in a long range horizon, a firm's internal innovation processes could be negatively affected [89]. From a long-term perspective, these practices may weaken the specific R&D capabilities of a firm, leading to inferior innovation performance.

As mentioned earlier, most previous studies adopt external sources of knowledge (partners) to measure open innovation and concentrate on the outside-in process. This is owing to the fact that for measuring inside-out open innovation processes, researchers should use open innovation practices to measure inside-out core-processes. Nonetheless, few studies focus on outbound practices and examine their effect on innovation performance. For example, Inauen and Schenker-Wicki [17] stated that inside-out open innovation strategies (licensing-out, open-source innovation, participation in other companies, sales and/or divestment) have a significant impact on innovation performance and are more likely to create radical innovations that could be of critical importance to R&D managers. Their findings also indicate that an intensive participation strategy will yield better process innovation performance and companies that employ closed innovation are more likely to exhibit superior product innovation performance.

According to Mazzola, Bruccoleri [73], among three outbound practices only out-licensing has a positive impact on innovation performance; the other two practices, namely external technology commercialization and divesting, do not have considerable effect. Ebersberger, Bloch [92] measured three core processes of open innovation practices with four breadth dimensions (sourcing, search, protection and collaboration). The protection dimension is related to the inside-out process and when disentangling the breadth of open innovation practices, a robust pattern across countries points to the highly significant correlation between protecting the breadth of companies and their ability to innovate. It was asserted that open innovation practices have a strong impact on both the capacity for novel innovation and actual innovation performance.

However, as mentioned in the introduction, our study proposed whether firms' use of open innovation practices enhances their different types of innovation performance. The following hypotheses are proposed for the second open innovation core process on innovation performance:

H7: Inside-out open innovation activities lead to a higher number of the firm's process innovations.

H8: Inside-out open innovation activities lead to a higher number of the firm's process innovations.

H9: Inside-out open innovation activities lead to a higher number of the firm's services innovations.

H10: Inside-out open innovation activities lead to a higher number of the firm's marketing innovations.

H11: Inside-out open innovation activities lead to a higher number of the firm's radical innovations.

H12: Inside-out open innovation activities lead to a higher number of the firm's incremental innovations.

5.3 Coupled open innovation

The coupled process refers to co-innovation with complementary partners through structured co-operation such as alliances and joint ventures [73]. Co-operation is usually characterized by a profound interaction between parties over a longer period of time [93-96]. This interaction tends to result in an intensive exchange of knowledge and a process of mutual learning [21, 97] leading to context-specific and implicit knowledge. The benefits of co-operation are seen in competitive position improvement and risk minimization, but not development time reduction [12]. A significant number of scholars have investigated the relationship among R&D inter-firm collaboration/co-operation and innovation outcomes [20, 28, 37, 73, 98]. Fey and Birkinshaw [37] results signify that external contracting usage negatively impacts R&D performance. Suh and Kim [20] stated that inter-firm networking is not significantly related to any of the three types of R&D performance (product, service, process). However, Nieto and Santamaria [86] indicated that technological collaborative networks, R&D and manufacturing alliances among others, are of crucial importance in achieving a higher degree of novelty in product innovation. Besides, the empirical findings by Lau, Tang [98] show that product co-development like joint product design, joint process engineering, and joint production operations with suppliers improve performance and are mediated by product innovation. Mazzola, Bruccoleri [73] also studied the three coupled open innovation practices and found that co-patents and manufacturing alliances seem to influence innovation performance contradictorily, whereas co-patents have a positive impact and manufacturing alliances a negative influence. The adoption of R&D alliance is not significant with respect to innovation performance.

Consequently, on one hand collaboration/co-operation might increase the probability of generating new ideas successfully, thus increasing innovation performance, but at the same time, it may substantially limit the firm's ability to appropriate the value of such activities [73, 99]. The following are proposed:

- H13: Coupled open innovation activities lead to a higher number of the firm's product innovations.
- H14: Coupled open innovation activities lead to a higher number of the firm's process innovations.
- H15: Coupled open innovation activities lead to a higher number of the firm's services innovations.
- H16: Coupled open innovation activities lead to a higher number of the firm's marketing innovations.
- H17: Coupled open innovation activities lead to a higher number of the firm's radical innovations.
- H18: Coupled open innovation activities lead to a higher number of the firm's incremental innovations.

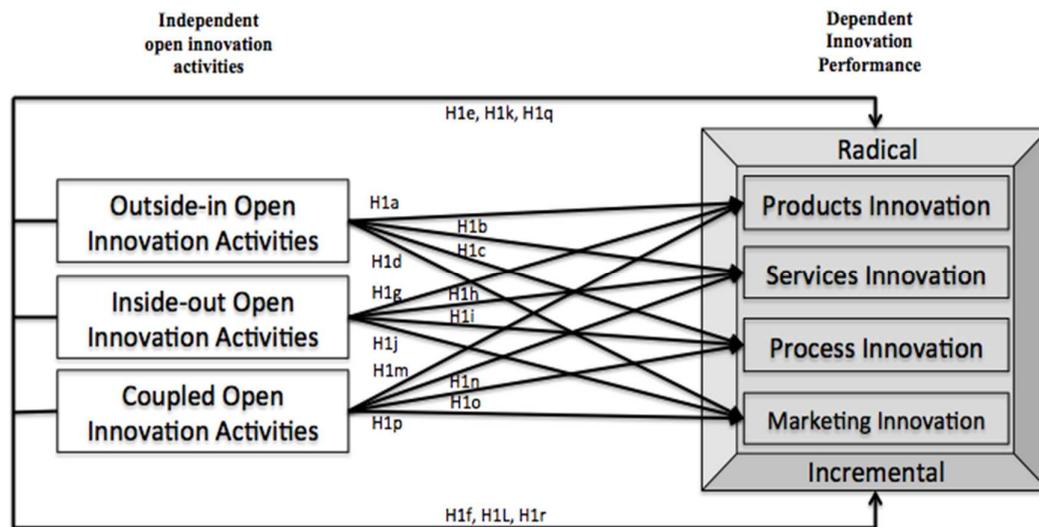


Figure 1: Conceptual framework

6. Conclusion

Following an extensive systematic review of prior empirical studies, several gaps have been identified. Most studies mainly focus on investigating the effect of inside-out open innovation processes but the other two core processes of open innovation have been overlooked. Moreover, open

innovation has been measured with external sources of knowledge to estimate only how much open innovation was adopted but additional details are lacking with respect to the different kinds of open innovation activities firms engage in, to what extent and in what way they do so. To bridge these gaps, this paper was started with the research question. As a result of the literature review, a conceptual framework was developed in this study, which identified and categorized 36 open innovation practices and their impact on different types of innovation. Literature from open innovation domains is drawn on, to establish a framework as a guide for further research and practice.

For practitioners – particularly board members, CEOs, CIOs, and those leading R&D and innovation functions at senior and middle management levels – the framework offers insight into open innovation practice effectiveness in large and SME firms. Practitioners will have a better understanding of open innovation effectiveness and how open innovation can be applied to improve firm performance. This would help managers understand when it might be appropriate to seek out open innovation. Given such insight, policy makers and government leaders can attempt to provide fresh strategies for improving innovation.

For researchers, the framework clarifies the contributing practices of open innovation in three core processes and its impact; it provides opportunities for researchers to validate and test the framework. Validation results will further contribute to knowledge in innovation management and its role in corporations.

Appendix 1: Literature analysis of empirical researches on open innovation and firm performance

No	Outside-in	Inside-out	Coupled
1	Belderbos et al (2004) \$	Lichtenthaler (2008)	Fey & Birkinshaw (2005) ①
2	Fey & Birkinshaw (2005) ①	Lichtenthaler (2009) \$	Nieto & Santamaria (2007) ①
3	Faems et al (2005) ①	van de Vrande et al (2009)	Lin & Wu (2010) \$
4	Laursen & Salter (2006) ①	Chiaroni et al (2009)	Faems et al (2010) \$
5	Belderbos et al (2006) \$	Ili et al (2010)	Lau et al (2010) ①\$ *
6	Knudsen (2007) ①	Mortera et al (2010)	Ebersberger et al (2010) ①
7	Nieto & Santamaria (2007) ①	Belderbos et al (2010) \$	Tsai et al (2011) ①
8	Lichtenthaler (2008)	Ebersberger et al (2010) ①	Huang & Rice (2012) ①
9	Drechsler & Natter (2008)	Schroll & Mild (2011a) ①	Mazzola et al (2012) ①\$*
10	Aschhoff & Schmidt (2008) ①\$*	Schroll & Mild (2011b) ①	Suh & Kim (2012) ①
11	Svetina & Prodan (2008) ①	Cosh & Zhang (2011)	Sisodiya et al (2013) ①\$*
12	Chiaroni, Chiesa, & Frattini (2009)	Bianchi et al (2011)	Mina et al (2014) ①\$*
13	Poot, Faems, & Vanhaverbeke (2009)	Filippetti (2011) ①	
14	van de Vrande et al (2009)	Tsai & Liao (2011) \$	
15	Kang & Kang (2009) ①	Inauen & Schenker- Wicki (2012)	
16	Vega-Jurado et al (2009) ①	Abulrub & Lee (2012)	
17	Lichtenthaler & Ernst (2009) ①	Mazzola et al (2012) ①\$*	
18	Tsai (2009) ①	Esbjerg et al (2012)	
19	Belussi et al (2010) ①	Bagherinejad & Darjazini (2013)	
20	Ili, Albers, & Miller (2010)	Hung & Chou (2013) \$	
21	Spithoven, Clarysse, & Knockaert (2010)	Chesbrough & Brunswick (2014)	
22	Mortera et al (2010)		
23	Belderbos et al (2010) \$		
24	Grimpe & Kaiser (2010) ①		
25	Hung & Chiang (2010) \$		
26	Chiang & Hung (2010) ①		
27	Tian & Feng (2010)		
28	Hwang & Lee (2010) ①		
29	Lau et al (2010) ①\$*		
30	Lin & Wu (2010) \$		
31	Ebersberger et al (2010) ①		
32	Un et al (2010) ①		
33	Lazarrotti et al. (2010) ①		
34	Lee et al. (2010) ①\$*		
35	Huang (2011) ①		
36	Filippetti (2011) ①		
37	Schroll & Mild (2011a) ①		
38	Schroll & Mild (2011b) ①		
39	Schweitzer et al. (2011) ①		
40	Cosh & Zhang (2011)		

41	Gronum & Verreyne (2011)		
42	Hu & Chen (2011)		
43	Tsai & Liao (2011) \$		
44	Tsai et al (2011) ①		
45	Winkdrum (2011) ①		
46	Zhao & Liang (2011) ①		
47	Yuetong & Xiaohui (2011) ①		
48	Bianchi et al (2011)		
49	Inauen & Schenker-Wicki (2011) ①		
50	Chen et al (2011) ①		
51	Knudsen & Morensen (2011) ①		
52	Mention (2011) ①		
53	Abulrub & Lee (2012)		
54	Terstriep & Lüthje (2012) ①\$*		
55	Howells et al (2012) ①		
56	Parida et al (2012) ①		
57	Macdonald et al (2012)		
58	Idrissia et al (2012)		
59	Huang & Rice (2012) ①		
60	Todtling et al (2012) ①		
61	Mazzola et al (2012) ①\$*		
62	Aslesen & Freel (2012) ①		
63	Lasagni (2012) ①		
64	Esbjerg et al (2012)		
65	Suh & Kim (2012) ①		
66	Scott & Chaston (2012) ① □		
67	Salge et al (2012) \$		
68	Huang & Rice (2012) ①		
69	Tomlinson & Fai (2013) ①		
70	Bagherinejad & Darjazini (2013)		
71	Hung & Chou (2013) \$		
72	Sisodiya et al (2013) ①\$*		
73	Brunswick & Vanhaverbeke (2013) ①		①=Innovation Performance
74	Fitjara & Rodríguez-Pose (2013) ①		\$= Financial Performance
75	Chesbrough & Brunswick (2014) ①		*= Financial & innovation Performance
76	Mina et al (2014) ①\$*		

Appendix 2: Literature analysis of empirical researches measuring open innovation with two methods

No	External Source of Knowledge	Activities	ESK & Activities
1	Belderbos et al (2004)	Fey & Birkinshaw (2005)	Ili et al (2010)
2	Faems et al (2005)	Lichtenthaler (2008)	Schroll & Mild (2011a)
3	Belderbos et al (2006)	Lichtenthaler (2009)	Schroll & Mild (2011b)
4	Laursen & Salter (2006)	Lichtenthaler & Ernst (2009)	Cosh & Zhang (2011)
5	Nieto & Santamaria (2007)	van de Vrande et al (2009)	Filippetti (2011)
6	Knudsen (2007)	Vega-Jurado et al (2009)	Abulrub & Lee (2012)
7	Aschhoff & Schmidt (2008)	Chiaroni, Chiesa, & Frattini (2009)	Huang & Rice (2012)
8	Drechsler & Natter (2008)	Mortera et al (2010)	Esbjerg et al (2012)
9	Svetina & Prodan (2008)	Lin & Wu (2010)	Chesbrough & Brunswick
10	Poot et al (2009)	Huang (2011)	
11	Kang & Kang (2009)	Tsai & Liao (2011)	
12	Tsai (2009)	Tsai et al (2011)	
13	Belussi et al. (2010)	Bianchi et al (2011)	
14	Hung & Chiang (2010)	Inauen and Schenker- Wicki (2012)	
15	Chiang & Hung (2010)	Parida et al (2012)	
16	Faems et al. (2010)	Mazzola et al (2012)	
17	Spithoven et al. (2010)	Suh & Kim (2012)	
18	Ebersberger et al (2010)	Scott & Chaston (2012)	
19	Belderbos et al (2010)	Bagherinejad & Darjazini (2013)	
20	Grimpe & Kaiser (2010)	Hung & Chou (2013)	
21	Un et al (2010)	Sisodiya et al (2013)	
22	Lau et al (2010)	Mina et al (2014)	

23	Lee et al (2010)		
24	Lazzarotti et al (2010)		
25	Tian & Feng (2010)		
26	Hwang & Lee (2010)		
27	Inauen & Schenker-Wicki (2011)		
28	Mention (2011)		
29	Hu & Chen (2011)		
30	Gronum & Verreyne (2011)		
31	Windrum (2011)		
32	Yuetong & Xiaohui (2011)		
33	Zhao & Liang (2011)		
34	Knudsen & Morensen (2011)		
35	Schweitzer et al (2011)		
36	Huang (2011)		
37	Chen et al (2011)		
38	Terstriep & Lüthje (2012)		
39	Howells et al (2012)		
40	Macdonald et al (2012)		
41	Idrissia et al (2012)		
42	Todtling et al (2012)		
43	Salge et al (2012)		
44	Aslesen & Freel (2012)		
45	Lasagni (2012)		
46	Huang & Rice (2012)		
47	Tomlinson & Fai (2013)		
48	Brunswicker & Vanhaverbeke (2013)		
49	Fitjara & Rodríguez-Pose (2013)		

REFERENCES

1. Damanpour, F., R.M. Walker, and C.N. Avellaneda, 2009. Combinative Effects of Innovation Types and Organizational Performance: A Longitudinal Study of Service Organizations. *Journal of Management Studies*. 46(4): 650-675.
2. Lichtenthaler, U., 2009. Outbound Open Innovation and Its Effect on Firm Performance: Examining Environmental Influences. *R&D Management*. 39(4): 317-330.
3. Doloreux, D., 2004. Regional Innovation Systems in Canada: A Comparative Study. *Regional studies*. 38(5): 479-492.
4. Love, J.H., S. Roper, and J. Du, 2009. Innovation, Ownership and Profitability. *International Journal of Industrial Organization*. 27(3): 424-434.
5. Geroski, P., S. Machin, and J. Van Reenen, 1993. The Profitability of Innovating Firms. *The RAND Journal of Economics*. 198-211.
6. Parida, V., M. Westerberg, and J. Frishammar, 2012. Inbound Open Innovation Activities in High-Tech Smes: The Impact on Innovation Performance. *Journal of Small Business Management*. 50(2): 283-309.
7. van der Meer, H., 2007. Open Innovation - the Dutch Treat: Challenges in Thinking in Business Models. *Creativity and Innovation Management*. 16(2): 192-202.
8. Chesbrough, H., 2003. The Era of Open Innovation. *Sloan Management Review*. 44(3): 35-41.
9. Chesbrough, H., 2006. The Era of Open Innovation. *Managing innovation and change*. 127(3): 34-41.
10. Chesbrough, H., W. Vanhaverbeke, and J. West, 2006. *Open Innovation: Researching a New Paradigm*. Oxford university press.
11. Gassmann, O., E. Enkel, and H. Chesbrough, 2010. The Future of Open Innovation. *R&D Management*. 40(3): 213-221.
12. Gassmann, O. and E. Enkel, 2004. Towards a Theory of Open Innovation: Three Core Process Archetypes. In the Proceedings of R&D management conference. pp: 1-18.
13. Bryman, A., 2008. *Social Research Methods*. Oxford university press New York, NY.
14. Chesbrough, H. and A.K. Crowther, 2006. Beyond High Tech: Early Adopters of Open Innovation in Other Industries. *R&d Management*. 36(3): 229-236.
15. Chiaroni, D., V. Chiesa, and F. Frattini, 2010. Unravelling the Process from Closed to Open Innovation: Evidence from Mature, Asset-Intensive Industries. *R&D Management*. 40(3): 222-245.

16. van de Vrande, V., et al., 2009. Open Innovation in Smes: Trends, Motives and Management Challenges. *Technovation*. 29(6-7): 423-437.
17. Inauen, M. and A. Schenker-Wicki, 2012. Fostering Radical Innovations with Open Innovation. *European Journal of Innovation Management*. 15(2): 212-231.
18. Lichtenthaler, U., 2008. Open Innovation in Practice: An Analysis of Strategic Approaches to Technology Transactions. *IEEE Transactions on Engineering Management*. 55(1): 148-157.
19. Chesbrough, H., 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Publishing Boston, MA.
20. Suh, Y. and M.-S. Kim, 2012. Effects of Sme Collaboration on R&D in the Service Sector in Open Innovation. *Innovation: Management, Policy & Practice*. 14(3): 349-362.
21. Lane, P.J. and M. Lubatkin, 1998. Relative Absorptive Capacity and Interorganizational Learning. *Strategic management journal*. 19(5): 461-477.
22. Von Hippel, E., 1988. *The Sources of Innovation*. Oxford University Press New York, NY.
23. Chesbrough, H., 2004. Managing Open Innovation. *Research-Technology Management*. 47(1): 23-26.
24. Marinova, D. and J. Phillimore, 2003. Models of Innovation. *The international handbook on innovation*. 44-53.
25. Herzog, P. and J. Leker, 2010. Open and Closed Innovation—Different Innovation Cultures for Different Strategies. *International Journal of Technology Management*. 52(3): 322-343.
26. DeBresson, C. and F. Amesse, 1991. Networks of Innovators: A Review and Introduction to the Issue. *Research policy*. 20(5): 363-379.
27. Zhou, L., W.-p. Wu, and X. Luo, 2007. Internationalization and the Performance of Born-Global Smes: The Mediating Role of Social Networks. *Journal of International Business Studies*. 38(4): 673-690.
28. Mina, A., E. Bascavusoglu-Moreau, and A. Hughes, 2014. Open Service Innovation and the Firm's Search for External Knowledge. *Research Policy*. 43(5): 853-866.
29. Fu, X. and H. Xiong, 2011. Open Innovation in China: Policies and Practices. *Journal of Science and Technology Policy in China*. 2(3): 196-218.
30. Schroll, A. and A. Mild, 2011. Open Innovation Modes and the Role of Internal R&D: An Empirical Study on Open Innovation Adoption in Europe. *European Journal of Innovation Management*. 14(4): 475-495.
31. Drechsler, W. and M. Natter, 2008. Open Innovation - Management Trend with Impact? An Empirical Investigation of Antecedents, Drivers and Performance Outcomes. In the Proceedings of Goethe University Frankfurt.
32. Acha, V., 2008. Open by Design: The Role of Design in Open Innovation. In the Proceedings of Tanaka Business School, Imperial College London.
33. Laursen, K. and A. Salter, 2006. Open for Innovation: The Role of Openness in Explaining Innovation Performance among U.K. Manufacturing Firms. *Strategic Management Journal*. 27(2): 131-150.
34. Eirma, 2004. *Technology Access for Open Innovation*. Working Group Report. Paris. 63
35. Dahlander, L. and D.M. Gann, 2010. How Open Is Innovation? *Research Policy*. 39(6): 699-709.
36. Filippetti, A., 2011. Innovation Modes and Design as a Source of Innovation: A Firm-Level Analysis. *European Journal of Innovation Management*. 14(1): 5-26.
37. Fey, C.F. and J. Birkinshaw, 2005. External Sources of Knowledge, Governance Mode, and R&D Performance. *Journal of Management*. 31(4): 597-621.
38. Riggs, W. and E. Von Hippel, 1994. Incentives to Innovate and the Sources of Innovation: The Case of Scientific Instruments. *Research policy*. 23(4): 459-469.
39. Van Dijk, C. and J. Van Den Ende, 2002. Suggestion Systems: Transferring Employee Creativity into Practicable Ideas. *R&D Management*. 32(5): 387-395.
40. Van de Ven, A.H., 1986. Central Problems in the Management of Innovation. *Management science*. 32(5): 590-607.
41. Yang, J., L.A. Adamic, and M.S. Ackerman, 2008. Crowdsourcing and Knowledge Sharing: Strategic User Behavior on Taskcn. In the Proceedings of ACM. pp: 246-255.
42. Kleemann, F., G.G. Voß, and K. Rieder, 2008. Un (Der) Paid Innovators: The Commercial Utilization of Consumer Work through Crowdsourcing. *Science, Technology & Innovation Studies*. 4(1): 5-5.
43. Ribiere, V.M. and F.D.D. Tuggle, 2010. Fostering Innovation with Km 2.0. *Vine*. 40(1): 90-101.
44. Howe, J., 2008. *Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business*. Crown Publishing Group New York.
45. Author, Year. Innocentive. Com (a).Harvard Business School Case, 608-170

46. Belleflamme, P., T. Lambert, and A. Schwienbacher, 2011. Crowdfunding: Tapping the Right Crowd. C.f.O.R.a. Econometrics, Belgium.
47. Ordanini, A., et al., 2011. Crowd-Funding: Transforming Customers into Investors through Innovative Service Platforms. *Journal of Service Management*. 22(4): 443-470.
48. Abulrub, A.-H.G. and J. Lee, 2012. Open Innovation Management: Challenges and Prospects. *Procedia-Social and Behavioral Sciences*. 41: 130-138.
49. Sloane, P., 2011. The Brave New World of Open Innovation. *Strategic Direction*. 27(5): 3-4.
50. Wolff, M.F., 1992. Scouting for Technology. *Research Technology Management*. 35(2): 10-12.
51. Ili, S., A. Albers, and S. Miller, 2010. Open Innovation in the Automotive Industry. *R&D Management*. 40(3): 246-255.
52. Rohrbeck, R., 2010. Harnessing a Network of Experts for Competitive Advantage: Technology Scouting in the Ict Industry. *R&D Management*. 40(2): 169-180.
53. Piller, F., 2009. The Future of Open Innovation. In the Proceedings of. pp: 21-24.
54. Piller, F.T., 2004. Mass Customization: Reflections on the State of the Concept. *International Journal of Flexible Manufacturing Systems*. 16(4): 313-334.
55. Chesbrough, H. and S. Brunswicker, 2013. *Managing Open Innovation in Large Firms*. Fraunhofer Verlag.
56. Chesbrough, H., 2007. Why Companies Should Have Open Business Models. *MIT Sloan Management Review*. 48(2): 22-28.
57. Lichtenthaler, U. and H. Ernst, 2007. External Technology Commercialization in Large Firms: Results of a Quantitative Benchmarking Study. *R and D Management*. 37(5): 383-397.
58. West, J., 2007. Value Capture and Value Networks in Open Source Vendor Strategies. In the Proceedings of IEEE. pp: 176-176.
59. Contractor, F.J., C.S. Kim, and S. Beldona, *Interfirm Learning in Alliance and Technology Networks: An Empirical Study in the Global Pharmaceutical and Chemical Industries*. 2003, Elsevier Science: Boston, MA. p. 493-516.
60. Schotanus, F. and J. Telgen, 2007. Developing a Typology of Organisational Forms of Cooperative Purchasing. *Journal of Purchasing and Supply Management*. 13(1): 53-68.
61. Lambe, C.J., R.E. Spekman, and S.D. Hunt, 2002. Alliance Competence, Resources, and Alliance Success: Conceptualization, Measurement, and Initial Test. *Journal of the academy of Marketing Science*. 30(2): 141-158.
62. Hendrick, T.E., 1996. Purchasing Consortiums: Horizontal Alliances among Firms Buying Common Goods and Services: What? Who? Why? How? Center for Advanced Purchasing Studies.
63. Grossman, R.P., 1997. Co-Branding in Advertising: Developing Effective Associations. *Journal of Product & Brand Management*. 6(3): 191-201.
64. Kumar, P., 2005. The Impact of Cobranding on Customer Evaluation of Brand Counterextensions. *Journal of Marketing*. 1-18.
65. Leuthesser, L., C. Kohli, and R. Suri, 2003. Academic Papers $2 + 2 = 5?$ A Framework for Using Co-Branding to Leverage a Brand. *The Journal of Brand Management*. 11(1): 35-47.
66. Howells, J., R. Ramlogan, and S.L. Cheng, 2012. Universities in an Open Innovation System: A Uk Perspective. *International Journal of Entrepreneurial Behaviour and Research*. 18(4): 440-456.
67. Gronum, S. and M.-L. Verreynne, 2011. Open Innovation in Australian Small Firms: When Should We Collaborate? In the Proceedings of Swinburne University of Technology. pp: 1079-1091.
68. Cosh, A. and J.J. Zhang, 2011. Open Innovation Choices: What Is British Enterprise Doing? Centre for Business Research.
69. Oke, A., G. Burke, and A. Myers, 2007. Innovation Types and Performance in Growing Uk Smes. *International Journal of Operations & Production Management*. 27(7): 735-753.
70. Oslo, M., 2005. Guidelines for Collecting and Interpreting Innovation Data. 2005. A joint publication of OECD and Eurostat, Organization for Economic Co-Operation and Development. Statistical Office of the European Communities.
71. Green, S.G., M.B. Gavin, and L. Aiman-Smith, 1995. Assessing a Multidimensional Measure of Radical Technological Innovation. *Engineering Management, IEEE Transactions on*. 42(3): 203-214.
72. Tushman, M.L. and P. Anderson, 1986. Technological Discontinuities and Organizational Environments. *Administrative science quarterly*. 439-465.
73. Mazzola, E., M. Bruccoleri, and G. Perrone, 2012. The Effect of Inbound, Outbound and Coupled Innovation on Performance. *International Journal of Innovation Management*. 16(06): 1-27.

74. Gassmann, O. and M. Zeschky, 2008. Opening up the Solution Space: The Role of Analogical Thinking for Breakthrough Product Innovation. *Creativity and Innovation Management*. 17(2): 97-106.
75. Herstatt, C. and K. Kalogerakis, 2005. How to Use Analogies for Breakthrough Innovations. *International Journal of Innovation and Technology Management*. 2(03): 331-347.
76. Li, Y. and W. Vanhaverbeke, 2009. The Effects of Inter-Industry and Country Difference in Supplier Relationships on Pioneering Innovations. *Technovation*. 29(12): 843-858.
77. Yuetong, H. and L. Xiaohui, 2011. The Influence of Openness to Innovation Performance. In the *Proceedings of Ieee*. pp: 6-9.
78. Belderbos, R., M. Carree, and B. Lokshin, 2004. Cooperative R&D and Firm Performance. *Research Policy*. 33(10): 1477-1492.
79. Faems, D., B. Van Looy, and K. Debackere, 2005. Interorganizational Collaboration and Innovation: Toward a Portfolio Approach*. *Journal of Product Innovation Management*. 22(3): 238-250.
80. Tödting, F., P. Lehner, and A. Kaufmann, 2009. Do Different Types of Innovation Rely on Specific Kinds of Knowledge Interactions? *Technovation*. 29(1): 59-71.
81. Chiang, Y.H. and K.P. Hung, 2010. Exploring Open Search Strategies and Perceived Innovation Performance from the Perspective of Inter - Organizational Knowledge Flows. *R&D Management*. 40(3): 292-299.
82. Inauen, M. and A. Schenker-Wicki, 2011. The Impact of Outside-in Open Innovation on Innovation Performance. *European Journal of Innovation Management*. 14(4): 496-520.
83. Vega-Jurado, J., A. Gutiérrez-Gracia, and I. Fernández-de-Lucio, 2009. Does External Knowledge Sourcing Matter for Innovation? Evidence from the Spanish Manufacturing Industry. *Industrial and Corporate Change*. 18(4): 637-670.
84. Huang, F. and J. Rice, 2012. Openness in Product and Process Innovation. *International Journal of Innovation Management*. 16(4).
85. Becheikh, N., R. Landry, and N. Amara, 2006. Lessons from Innovation Empirical Studies in the Manufacturing Sector: A Systematic Review of the Literature from 1993–2003. *Technovation*. 26(5): 644-664.
86. Nieto, M.J. and L. Santamaría, 2007. The Importance of Diverse Collaborative Networks for the Novelty of Product Innovation. *Technovation*. 27(6): 367-377.
87. Kutvonen, A., 2011. Strategic Application of Outbound Open Innovation. *European Journal of Innovation Management*. 14(4): 460-474.
88. Lichtenthaler, U., 2008. Integrated Roadmaps for Open Innovation. *Research Technology Management*. 51(3): 45-49.
89. Lichtenthaler, U., 2005. External Commercialization of Knowledge: Review and Research Agenda. *International Journal of Management Reviews*. 7(4): 231-255.
90. Arora, A. and A. Fosfuri, 2003. Licensing the Market for Technology. *Journal of Economic Behavior & Organization*. 52(2): 277-295.
91. Fosfuri, A., 2006. The Licensing Dilemma: Understanding the Determinants of the Rate of Technology Licensing. *Strategic Management Journal*. 27(12): 1141-1158.
92. Ebersberger, B., et al., 2010. Open Innovation Practices and Their Effect on Innovation. *International Journal of Innovation and Technology Management*. 1-22.
93. Fritsch, M. and R. Lukas, 2001. Who Cooperates on R&D? *Research policy*. 30(2): 297-312.
94. Pisano, G.P., 1990. The R&D Boundaries of the Firm: An Empirical Analysis. *Administrative Science Quarterly*. 35(1): 153-176.
95. Littler, D., F. Leverick, and D. Wilson, 1998. Collaboration in New Technology Based Product Markets. *International journal of technology management*. 15(1): 139-159.
96. Hagedoorn, J., 1993. Understanding the Rationale of Strategic Technology Partnering: Nterorganizational Modes of Cooperation and Sectoral Differences. *Strategic management journal*. 14(5): 371-385.
97. Hamel, G., 1991. Competition for Competence and Interpartner Learning within International Strategic Alliances. *Strategic management journal*. 12(S1): 83-103.
98. Lau, A.K.W., E. Tang, and R. Yam, 2010. Effects of Supplier and Customer Integration on Product Innovation and Performance: Empirical Evidence in Hong Kong Manufacturers. *Journal of Product Innovation Management*. 27(5): 761-777.
99. Ring, P.S. and A.H. Van de Ven, 1994. Developmental Processes of Cooperative Interorganizational Relationships. *Academy of management review*. 19(1): 90-118.