DOES A FIRM'S OPEN INNOVATION MODE MATTER?

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ABSTRACT: *Open innovation enabled smaller firms to become competitive rivals to multinationals, as it leverages the knowledge and initiatives of external sources and searches outside of firm's boundaries for commercialization opportunities. The aim of this research is to approach open innovation as a multifaceted phenomenon and to address some of the fundamental questions that arise in the literature on open innovation. Such questions include: Do different open innovation modes exist? Does it matter which open innovation mode a firm chooses? Should any specific open innovation dimension receive additional attention? We define the mode of open innovation to be a specific combination of different open innovation dimensions. In seeking answers to these questions, we used quantitative and qualitative research methods and identified four different open innovation modes: open innovators, systems engineering companies, R&D outsourcers, customer-oriented companies. Understanding the contributions of individual open innovation mode and dimension is important for implementing effective decision-making processes. The findings have important implications for CEOs when allocating (scarce) resources to the development of open innovation-related activities.*

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1. INTRODUCTION

The concept of open innovation underscores the importance of a firm searching outside of its boundaries for commercialization opportunities and using external knowledge flows to increase internal innovation activities in order to sustain its competitive advantage (Chesbrough, 2003b). As such, this concept has recently attracted substantial attention among practitioners and academics (Huizingh, 2011). Companies are now searching for new ways to enhance their business strategies and competitive advantage based on the concept of open innovation, i.e., by harnessing external ideas and leveraging in-house research and development (R&D) beyond their current operations (Chesbrough, 2003a).

Open innovation is not a dichotomous phenomenon (Chesbrough, 2003b; Dahlander & Gann, 2010). In fact, it has several distinct dimensions, including collaboration with various partners, customer involvement, venturing, intellectual property (IP) in-licensing,

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and IP out-licensing (Chesbrough, 2003b; van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). A stream of research (e.g. Schroll & Mild, 2011; van de Vrande et al., 2009) has examined the intensity with which companies implement open innovation and based on this identified different open innovation modes. These studies have taken the multidimensional nature of open innovation into consideration and found that there is a trend toward the implementation of open innovation dimensions. We understand the mode of open innovation to be a specific combination of different open innovation dimensions. Lazzarotti, Manzini, and Pellegrini (2010) established a link between open innovation dimensions and a firm's innovation performance, taking into consideration partner variety (the number and type of partners with whom the company collaborates) and phase variety (the number and type of phases of the innovation process open to external collaborations) and identified four different open innovation modes. Moreover, an interesting examination has been carried out by Bianchi, Cavaliere, Chiaroni, Frattini, and Chiesa (2011) investigating the use of different open innovation modes (by mode they define the use of specific open innovation dimension) and their connectedness to different phases of innovation process by bio-pharmaceutical firms.

Although some studies that investigate different open innovation mode already exist, most of them focus on quantitative analysis, without examining deeper meanings behind the identified modes. Our research complements the existing studies by connecting quantitative and qualitative research methods and searching the answers to the questions, such as: Does it matter which open innovation mode a firm chooses (related to firm size and industry)? Why do different firms choose different modes? Should any specific open innovation dimension receive additional attention?

Thus, we aim to contribute to the existing knowledge on open innovation in the following ways. By means of a cluster analysis, we identify different modes of open innovation that are more characteristic of certain firm sizes and industries. Being able to identify these different modes of open innovation may be of great help to innovation leaders who need to prioritize among various open innovation activities when initiating open innovation programs in their firms. By providing an illustrative example of a firm from each open innovation mode, we facilitate managerial decision making in the development of overall innovation strategies and business model innovations. Drawing from an in-depth review of the open innovation literature, we assess the roles and contributions of individual dimensions of open innovation. Based on the semi-structured interviews with the CEOs we identify employee involvement as one of the most important open innovation practices, and provide additional discussion on this topic. Our finding has important implications for CEOs when allocating (scarce) resources to the development of open innovation-related activities.

2. LITERATURE REVIEW AND RESEARCH QUESTIONS

In this section, we summarize existing open innovation literature related to different open innovation dimensions and their corresponding activities, which are the basis for the empirical part of the study. Open innovation involves two important facets: inbound and outbound innovation processes (Chesbrough, 2003b). Inbound open innovation involves dimensions such as external participation, inward IP licensing, external networking, outsourcing R&D, and customer involvement. By contrast, outbound open innovation consists of outward IP licensing, employee involvement, and venturing dimensions (van de Vrande et al., 2009). Each of these dimensions may be implemented through different activities. Table 1 summarizes open innovation dimensions and associated organizational activities becoming an integral part of a firm's innovation strategy. Based on the dimensions and activities presented in the table we propose the following research questions:

Research question 1: Are various open innovation dimensions used in any specific combinations?

Research question 2: How are different modes of open innovation connected to a firm's size, industry and innovation performance?

Research question 3: Should any specific open innovation dimension receive additional attention?

In the forthcoming sections, by conducting different statistical analyses, we aim to provide the grounds for addressing these research questions. In this way, emphasizing the importance of human resources, we can help managers to recognize the rich and abundant opportunities of open innovation and to understand how different dimensions of open innovation may be implemented.

Table 1: Description of open innovation activities, their benefits, and organizational activities

Inbound open innovation activities	Benefits	Example
External participation: Equity investments in new or established enterprises in order to gain access to their knowledge or to obtain other synergies (van de Vrande et al. (2009), p. 428).		
• Joint ventures or other similar types of non-equity alliances (Maula, Keil, & Salmenkaita, 2006).	• Provides specific interdisciplinary knowledge and capabilities (Santamaría, Nieto, & Barge-Gil, 2009) and information about potential new technologies. • Facilitates the development of complementary innovations (Maula et al., 2006). • Can help companies to deal with technological uncertainty (van de Vrande, Lemmens, & Vanhaverbeke, 2006). • Joint ventures positively impact patent results, since the high level of formalization delivers extremely thorough contracts that are difficult to obtain through more informal relationships (Santamaría et al., 2009).	Bio-pharmaceutical firms ally with another company (a biotech firm or, more frequently, a large pharmaceutical company) to gain access to complementary resources (e.g., production capacity or distribution channels) needed to commercially exploit a new drug (Bianchi et al., 2011).
Inward IP licensing: Buying or using intellectual property of other organizations, such as patents, copyrights, or trademarks, to benefit from external knowledge (van de Vrande et al. (2009), p. 428).		
• Buying or licensing external IP (Chesbrough, 2003b). • Defining formal, systematic ways of searching for external technology (Chesbrough & Crowther, 2006).	• Helps gain already verified technologies that can facilitate the development of more complex products (Tao & Magnotta, 2006). • Often faster and cheaper to look outside for the supplementary technology than to develop it in-house (Chesbrough & Crowther, 2006).	Nokia has generally outsourced products outside of its core business – for example they bought network elements from SCI, Flextronics Finland, and Elcoteq Networks Oyj because there were no economies of scale for Nokia to produce it by itself, and other firms produced them much more efficiently (Dittrich & Duysters, 2007).

Inbound open innovation activities	Benefits	Example
External networking: Drawing on or collaborating with external network partners to support innovation processes, for example for external knowledge or human capital (van de Vrande et al. (2009), p. 428).		
• Collaboration with individual inventors, high-tech start-ups, academic institutions, spin-offs of large firms (Chesbrough, 2006), consultancies (Tether & Tajar, 2008), or potential competitors (Bergman, Jantunen, & Saksa, 2009; Maula et al., 2006).	• Openness to external sources enables firms to reach ideas, knowledge, and technology from the outside and exploit new innovative opportunities that positively influence a firm's innovation performance (Laursen & Salter, 2006). • By integrating different partners in innovation processes, the organization gains new creativity and know-how (Schroll & Mild, 2011).	P&G pursues several ways of collaborating with different partners. The company organizes events to showcase its most promising technologies and to provide a forum for its partners, researchers, and suppliers to meet; various Internet-based systems facilitate communications and connections, and share data and information among thousands of innovators, researchers, and users across the globe (Dodgson, Gann, & Salter, 2006). Moreover, P&G collaborates with different innovation intermediaries, such as InnoCentive, Yet2.com, and NineSigma (Dodgson, Gann, & Salter, 2005).
Outsourcing R&D: Buying R&D services from other organizations, such as universities, public research organizations, commercial engineers, or suppliers (van de Vrande et al. (2009), p. 428).		
• Collaboration, informal interaction, and discussions between researchers (Fabrizio, 2006) and first-rate individual scientists from other labs worldwide (Chesbrough, 2003b). • Financial support, mentorship, and interaction with PhD students (Chesbrough, 2006; Rohrbeck, Holzle, & Gemunden, 2009).	• Cooperation with research organizations plays an important role in fostering the innovation process (Perkmann & Walsh, 2007). It enables organizations to access new technological and scientific capabilities through the specialized and expert knowledge of scientists (Bishop, D`Este, & Neely, 2011).	Deutsche Telekom collaborates with a university through T-Labs, a University–Industry Research Centre where more than 80 post-doctoral researchers and over 100 Deutsche Telekom employees work on technology and customer-driven innovation. Informal networks of researchers enable Deutsche Telekom to access the worldwide R&D community and the latest technological trends (Rohrbeck et al., 2009).
Customer involvement: Directly involving customers in your innovation processes, for example, through active market research to check their needs, or by developing products based on customers' specifications or modifications (van de Vrande et al. (2009), p. 428).		
• Creation of user innovation community in which users can post, discuss, and review each other's business ideas (Di Gangi & Wasko, 2009). • Developing products based on customers' specifications (van de Vrande et al., 2009). • Providing users with toolkits for the development and testing of prototypes (von Hippel & Katz, 2002).	• Customer involvement can be of a great help when searching for innovative ideas about new or improved products and services, since customers seek products or services that can better address their needs (Chesbrough, 2003b).	Dell has created an online community named Dell IdeaStorm through which users can collaborate with Dell to create or modify new products and services and to share their innovative ideas, which are later reviewed, discussed, and voted upon by the user community (Di Gangi & Wasko, 2009). Lego established a platform by which users can co-create, co-design, and, in the end, also buy their unique models and designs (Piller & Ihl, 2009).

Outbound open innovation activities	Benefits	Example
Employee involvement: Leveraging the knowledge and initiatives of employees who are not involved in R&D by taking their suggestions, enabling them to implement ideas, or creating autonomous teams to realize innovations (van de Vrande et al. (2009), p. 428).		
• Establishing R&D structures that support effective communications among unrelated groups in the company (Dodgson et al., 2006). • Giving rotational assignments to employees (O'Connor, 2005). • Educating the researchers about the business side of innovation and rewarding them for identifying patentable ideas within and outside the firm (Chesbrough, 2003b).	• Employee involvement facilitates creation of innovative ideas about new or improved products/services (van de Vrande et al., 2009) and can bring in useful technology from outside the firm (Chesbrough, 2003b). • Giving rotational assignments require interaction with external partners and collaboration across divisions within the organization, which enable the sharing and borrowing of ideas (O'Connor, 2005).	According to Whelan, Parise, De Valk, and Aalbers (2011), each open innovator should have (as Google has) idea scouts who have broad external networks and the ability to identify potential ideas outside of the company, as well as idea connectors who have strong internal connections and the ability to understand and translate external information to fit internal needs and capabilities.
Outward IP licensing: Selling or offering licenses or royalty agreements to other organizations to better profit from organizational IP, such as patents, copyrights, or trademarks (van de Vrande et al. (2009), p. 428).		
• Outbound licensing of IP, patent pooling, and even giving away technology that stimulates demand for other firms' products (West & Gallagher, 2006).	• Companies can gain additional effects by exploiting their internally generated technologies outside the firm (Gassmann, 2006); this approach maximizes the returns of internal innovation (West & Gallagher, 2006).	In the past Qualcomm manufactured cellular phones and software products, but today it focuses on licensing out its code division multiple access (CDMA) technology and associated chipsets to other cell-phone manufacturers, including Motorola and Nokia (Chesbrough, 2003a).
Venturing: Starting up new organizations, drawing on internal knowledge and possibly also finance, human capital, and other support services from your enterprise (van de Vrande et al. (2009), p. 428).		
• Creation of spin-off companies (Gassmann & Enkel, 2004). • Pursuing new businesses in new industries related to a company's current business or entering new businesses by offering new lines and products (Zahra, 1993).	• Venturing helps organizations to enter new markets and industries (Block & MacMillan, 1995), reach information about future technologies and market opportunities (Chesbrough, 2003b), and provide potential opportunity for innovation breakthrough.	Deutsche Telekom created two spin-out firms Qiro and Zimory (financed by external seed capital as well as by corporate venture capital from Deutsche Telekom) that are developing technology close to its existing business but do not fit well in its innovation strategy (Rohrbeck et al., 2009).

3. METHODOLOGY AND DATA ANALYSIS

In seeking answers to research questions, we used quantitative and qualitative research methods. First, we grouped companies into distinct clusters based on the pattern of open innovation activities they were involved in. We then conducted a statistical analysis, which indicated the relationship between open innovation mode and innovation performance. In order to gain a better insight into our empirical results, we performed a series of semi-structured interviews with CEOs from illustrative firms in each cluster, which were selected based on the results of their distances to cluster centres. The combination of qualitative and quantitative research methods has enabled us to understand the research topic in more detail and, in this way, provide more valuable conclusions for managers.

3.1. Sampling and data collection

The data for the empirical study were gathered via online surveys administered to the CEOs of Italian, Slovenian, and Belgian companies. A random sample of 1,250 Italian companies was compiled from the Amadeus database in October 2012; a random sample of 2,000 Slovenian manufacturing and service firms was compiled in May 2013 from the Business Directory of the Republic of Slovenia (PIRS); and 1,500 Belgian companies were randomly selected from the BELFirst database in June 2013. We received 99 valid responses for Italy (7.9% response rate), 421 valid responses for Slovenia (21.1% response rate), and 173 valid responses for Belgium (11.5% response rate). The total sample was thus comprised of 693 companies from three countries. The sample (presented in Table 2) included a wide range of firm sizes and industries, although the majority operated in the manufacturing, information and communication, and service industries.

Table 2: Sample composition

	Slovenian sample (n = 421)	Belgian sample (n = 173)	Italian sample (n = 99)
FIRM SIZE			
Micro (0-9 employees)	33.3%	11.5%	23.3%
Small (10-49 employees)	46.60%	38.20%	27.30%
Medium (50-249 employees)	11.90%	27.20%	16.20%
Large (250 employees or more)	8.30%	23.10%	33.30%
FIRM INDUSTRY			
Agriculture and mining	2.40%	4.00%	3.00%
Manufacturing sector	34.00%	34.10%	35.40%
Service sector	41.60%	42.20%	41.40%
Construction	9.50%	10.40%	9.10%
Public sector	12.60%	9.20%	11.10%

3.2. Data analyses

We performed a cluster analysis using IBM SPSS Statistics 20. We initially used a hierarchical technique (using Ward's method and squared Euclidean distances) to determine initial solutions for the number of clusters and starting points (i.e., cluster seeds for the non-hierarchical cluster analysis). The basis for the cluster analysis were the open innovation dimensions (inward IP licensing and external participation, outsourcing R&D and external networking, customer involvement, employee involvement, and venturing) measured with a proclivity for open innovation scale developed and validated by Rangus, Drnovšek, and Di Minin (2013). All responses were evaluated on a 7-point Likert scale (i.e., 1 = *strongly disagree*; 7 = *strongly agree*). We reduced the data and built the final dimensions constituting the components for the cluster analysis using summated scales. Innovation performance was measured with Jiménez-Jiménez and Sanz-Valle (2011) measure. The measure asks respondents to evaluate various aspects of a firm's innovation performance over the past 3 years against the major competitors in the industry on a 7-point Likert scale ranging from *much worse than competitors* to *much better than competitors*. Firm size was measured according to the number of employees in the company. We distinguished among five industry sectors (agriculture and mining, manufacturing, service, construction, and public sector). The percentage share of total sales allocated to R&D investments in 2012 was measured on a 6-point scale: 0%; between 0% and 2%; between 2% and 5%; between 5% and 10%; between 10% and 20%; more than 20%.

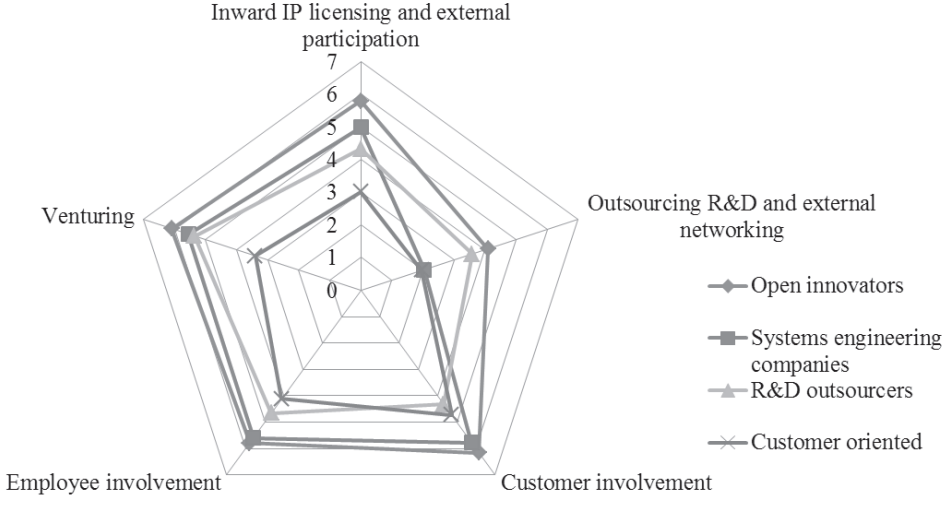
We performed k-means for a range of initial suggestions from the hierarchical technique, taking into account a four-, five-, and six-cluster solution. The final decision for the four-cluster solution was made following the suggestions provided by Hair, Black, Babin, Anderson, and Tatham (2010). We performed an ANOVA test, which supported the significant differences between the variables across the clusters (see Table 3). In addition, significant differences across the clusters were found in terms of firm size (Kruskal–Wallis test = 31.59; $p < 0.001$); on the other hand, the differences related to firm industry were non-significant (Chi-Square = 18.63; $p = 0.116$).

Table 3: Final cluster centres (Mean values) and ANOVA test

	Open innovators ($n = 242$)	Solution implementers ($n = 212$)	R&D outsourcers ($n = 139$)	Customer-oriented companies ($n = 100$)	F ($p < 0.001$)
Inward IP licensing and external participation	5.79	4.99	4.32	3.01	225.43
Outsourcing R&D and external networking	4.10	2.04	3.58	1.96	313.56
Customer involvement	6.15	5.77	4.32	4.73	136.54
Employee involvement	5.79	5.60	4.66	4.12	94.63
Venturing	6.08	5.55	5.35	3.39	220.40

With the cluster analysis, we recognized different modes of open innovation, i.e., a specific combination of various dimensions of open innovation. The results of the cluster analysis presented in the spider web diagrams (Figure 1) suggest that a large majority of the 693 companies included in the analysis were involved with at least one dimension of open innovation. This finding denotes a more general strategic orientation among practitioners to open their innovation processes. With the aim of finding out why firms choose different combinations of open innovation activities, and how effective they are in implementing those open innovation dimensions, we collected additional qualitative data from the CEOs of selected companies. Based on the final cluster centres we identified the top 10 most representative companies from each open innovation mode (i.e. the ones that were the nearest to the centre) and carried out semi-structured interviews with CEOs of two companies per cluster. The goal of the interviews was to obtain deeper understanding of why companies opt to use a specific open innovation dimension, how they perform it, and which benefits and potential barriers are related to these activities.

Fig. 2: Graphical demonstration of the clusters and their performance in terms of the individual dimensions



4. RESULTS

Below we provide results of the findings from semi-structured interviews, further analysis related to open innovation modes and innovation performance and additional discussion on the importance of the employee involvement dimension which was identified as the most vital among selected open innovation dimensions.

4.1. Results of the cluster analysis

Mode 1: Open innovators. The first mode comprised the largest group at 242 firms with the highest percentage of large organizations intensely involved in all aspects of open innovation, such as inward IP licensing and external participation. They build long-term relationships with customers and partners, and heavily involve their employees in the innovation process. Their projects are customer-oriented and customized to meet the customers' requirements. A good example of this mode is the firm with which we conducted an interview. They develop measures and test solutions to improve the quality of products and processes for the manufacturing and service industry. Their approach to open innovation can be illustrated with the following statement: "Openness nourishes the ongoing search for depth, new knowledge, will to change, innovation." They see openness as a way for enhancing the creation of new businesses and the development of new technologies, thereby facilitating relations and the creation of international excellence networks; in turn, such networks design future markets and technology applications.

Mode 2: Systems engineering companies. The second mode involved 212 firms practicing most open innovation activities with the exception of outsourcing R&D and external networking. This may be because firms in this mode implement solutions that are developed for large customers in B2B markets. These firms tend to be smaller compared to the firms in the first and third modes. An illustrative example of this mode is a small firm developing off-the-shelf, custom-designed digital television solutions. This company actively searches for and teams up with potential partners, and then they jointly develop their product – software. They see open innovation "as a kind of initiative that gathers companies around some innovation topics to communicate openly about what they are doing from an innovation standpoint and potentially develop some joint projects. The main benefits are related to boosting creativity and innovation in the company, gaining new and fresh ideas, achieving faster time to market, and sharing the development costs."

Mode 3: R&D outsourcers. The dominant characteristic of the 139 firms in the third mode, which were predominantly medium-sized companies, was their inclination towards outsourcing R&D and external networking dimension. The mission of the illustrative firm in this mode has always been to create a link between academia and industry. Such firms typically have very well developed R&D activities and are also active in design, quality control, testing and analysis, and consulting. As the interviewee said: "we collaborate with different partners, from researchers to companies and consultancies, with an aim to access the knowledge we miss internally but is essential to the process of solution development."

Mode 4: Customer-oriented companies. The smallest mode was made up of 100 firms that were mostly micro- to small-sized firms characterized by the weakest orientation toward open innovation activities, although they seem to cooperate with their customers to a certain extent. An illustrative example of this mode is a micro-sized company specializing in the development and production of consumer goods. As the firm's CEO stated: "There are several benefits of collaboration with customers, such as direct feedback on the product, customer loyalty, and brand building. Customers who like one brand are willing to help this brand (even for free); to reveal their ideas of improved or new products/services; to spread good words and (unconsciously) promote the brand." The customer-driven strategy may be associated with their size and line of business. Since they focus on the development and production of consumer goods, the experiences, wishes, and needs of the customer matter the most when developing new products. On the other hand, customer involvement is the least risky and cheapest strategy of open innovation, and so smaller companies can afford it.

4.2. The relationship between open innovation mode and innovation performance

In order to evaluate whether meaningful differences exist among a firm's innovation performance and a firm's open innovation mode, we analysed innovation performance. Significant differences across the open innovation modes were found in terms of both innovation performance (Kruskal–Wallis test = 91.51; $p < 0.001$) and the percentage share of R&D investments of total sales (Chi-Square = 57.23; $p < 0.001$). The values of the means and medians for innovation performance and cross-tabs comparisons for R&D investments indicated that the first mode, labelled as "open innovators," tended to have superior innovation performance (median = 5.33), investing more in R&D. "Open innovators" were followed by "systems engineering" mode firms (median = 5.00), "R&D outsourcers" (median = 4.50), and "customer-oriented companies" (median = 4.00). Our findings support the existing notion in the literature that for a firm to excel in innovation performance, it needs to open up in all aspects of the innovation process.

Additionally, when conducting semi-structured interviews with the CEOs an interesting observation was found. They all agreed on the importance of collaboration and external sources for the innovation success, however the strongest emphasis was made on the open innovation dimension related to internal part, i.e. employee involvement. Therefore, we discuss the dimension of employee involvement in more detail below.

4.3. Why is employee involvement important in the process of open innovation?

Although open innovation emphasizes the collaboration and networking with the external partners, the insights from the interviews revealed that employees remain the key component in innovation process. This suggests that business practitioners should include a focus on the development and personal growth of employees in their innovation strategies.

One of the firm's capabilities, which is related to open innovation and important for exploitation of internal and exploration of external resources is absorptive capacity. It facilitates firms to learn from partners, reach information from the outside and transform and integrate it internally (Wang & Ahmed, 2007). Absorptive capacity is defined as a dynamic capability through which a firm identifies, assimilates, transforms and commercially apply the knowledge acquired from the outside (Zahra & George, 2002). In so doing, firms gain firs-mover advantage in exploiting new technologies and thus sustain a competitive advantage (Cohen & Levinthal, 1989).

The absorptive capacity of the employees to identify, integrate, and combine externally acquired knowledge and technology facilitates innovation outcomes, and this absorptive capacity strengthens with increased professional competencies (Knudsen, 2007). Professional competencies of employees can be improved by forming rotational assignments. Different internal and external interactions foster the sharing and borrowing of ideas (O'Connor, 2005). Employee involvement may also be enhanced by establishing and stimulating R&D structures that support effective communication among unrelated groups in the company (Dodgson et al., 2006). Employees can be motivated by establishing reward systems for the identification of patentable ideas within, as well as outside of, the firm's boundaries (Chesbrough, 2003b).

A company has to stimulate all of its employees, not only those involved in R&D, to elicit their ideas for new or improved products/services, and to enable them to implement those ideas (van de Vrande et al., 2009). By according its employees a certain amount of responsibility, decision-making capacity, and freedom, a company may create a more relaxed atmosphere that may in turn lead to fresh, creative ideas and innovations. Giving employees more decision-making capacity motivate them to provide the best possible performance in their job, reflecting in their pride and loyalty towards the organization (Irawanto, 2015).

5. DISCUSSION

The aim of our research was to contribute to a deeper understanding of how aspects of open innovation are implemented in companies and ascertain their role in specific open innovation mode. We began with a systematic overview of the possible dimensions of open innovation, the specific benefits of those dimensions, and illustrative presentation of their implementation. In so doing we have aimed to help managers to recognise the rich and abundant opportunities of open innovation. We continue with cluster analysis on a large cross-cultural and cross-industry sample of companies based on their involvement with specific dimensions of open innovation. In so doing we presented diverse modes of open innovation that may be implemented by firms related to their industry focus and size. Although previous studies already introduced different modes of open innovation, our study complement existing research by providing deeper inferences related to identified modes. Being able to identify these different modes of open innovation may help innovation leaders when initiating open innovation programs in their firms.

The results of the cluster analysis indicated that there are different modes of open innovation that may be implemented by firms related to their industry focus and size. Significant differences among the modes of open innovation were found only in terms of firm size, which is in line with the existing literature (e.g. van de Vrande et al., 2009).

Overall the results emphasize a general trend among companies to open up their innovation processes and provide further evidence for existing findings in the literature (e.g. Schroll & Mild, 2011; van de Vrande et al., 2009). In particular, our results suggest that the larger the size of the company, the higher the probability that such a company is involved in several aspects of open innovation. Our results, therefore, support and refine the findings of van de Vrande et al. (2009) who suggested that companies more inclined toward closed innovation are more likely to be small and to involve customers in their innovation process to a certain extent. The results also indicate that the firms in the first open innovation mode, i.e. open innovators (which open up in all aspects of the innovation process), exhibit higher innovation performance. Therefore, managers should strive to stimulate as many open innovation activities as possible. As one interviewee in this study said: "It doesn't make any sense to develop technology internally, if external partners do this better and cheaper." However, researchers and managers still have a hard time finding the right balance between open and closed behaviour (Van der Meer, 2007).

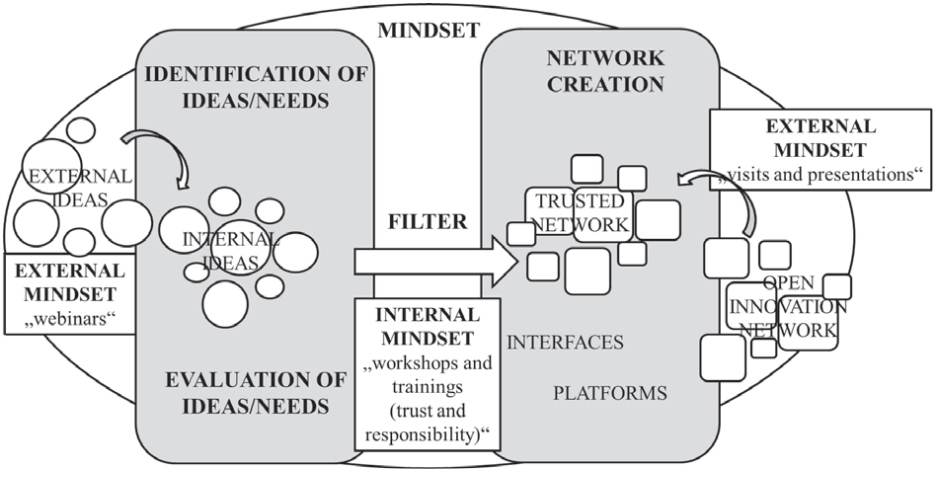
Nevertheless, this does not imply that small companies are by nature closed. The evidence on the implementation of open innovation among small and medium sized enterprises revealed that more formalised open innovation practices such as IP licensing, venturing, and external participation are employed only by a minority because they require financial investments, formalised contracts and a structured innovation portfolio approach to manage the risks (van de Vrande et al., 2009). Based on our interviews with the CEOs, we have been able to provide guidelines for the successful implementation of open innovation. An important aspect emphasized by the interviewees is establishing the right proportion of ideas initiated externally. One CEO noted that "each customer has its own wish (and idea of improved product/service) and when striving to satisfy all of them you can find yourself in a circle of constant improvements, which can be costly and time consuming. Instead of focusing on promotion, marketing and development you spend precious time for improvements which may in turn often satisfy only a minority of potential customers." Therefore, business practitioners should find a balance between accepted and rejected ideas. We suggest companies develop a system for idea assessment that will show which ideas may bring the anticipated outcome and which do not offer sufficient benefit (e.g., because of high assimilation and developmental costs, etc.). As showed by Salter, Ter Wal, Criscuolo, and Alexy (2014) there may be negative effects of too much openness caused by the integration and approval costs managing collaboration with a large number and type of external sources.

5.1 Implications for practitioners: Strategies for the effective implementation of open innovation dimensions

In order to better understand the pathways toward the successful implementation of open innovation and the challenges confronted by an innovating company during the implementation process, we build on the observations made during the semi-structured interviews. For example, Ms. Lucia Chierchia, Open Innovation Manager at Electrolux Group indicated that the first step to successful open innovation implementation is the definition of the strategic areas of the company for which they want to scout solutions. This is followed by the process of idea filtering and evaluation. In her view, "the key challenge of open innovation is the creation of synergies between people inside and outside the company." So, the implementation of open innovation should start with the identification of an open innovation network – that is, the network of partners outside of the trusted network of the company (i.e., the network of long-standing partnerships with known and trusted associates). However, the foundation for the successful implementation of open innovation is the establishment of the open mindsets of internal and external participants. The human centeredness posture of the open innovation process is key to successful open innovation implementation; still, there is a law of inertia connected with open innovation processes, precisely, the Not Invented Here (NIH) syndrome (favouring internally-developed solutions over externally-developed, although the latter one may be better) and the IP paradigm. (People specifically in R&D are convinced that innovation should be related to patenting.) Therefore, companies need to invest in activities that nurture open mindsets. For example, firms can stimulate the open innovation mindset of employees by offering workshops and training, establishing trust and reliability among employees, giving employees space to explore the open innovation and make decisions on their own, refraining from pushing employees into bounded and constrained thinking processes, presenting successful stories, and, in this way, showing that innovation is not necessarily invention; innovation does not require control of IP, but rather is the creation of new value for customers and consequently new value for the company. On the other side, open innovation mindsets should also be promoted externally, for example through free webinars and presentations of good practice for external partners.

Based on our quantitative and qualitative analysis the first thing firms have to establish for open innovation to flourish is a culture which stimulate employee involvement in innovation processes. After that we suggest several steps to be followed when implementing open innovation: (a) identify potential internal and external ideas for new or improved products/services; (b) evaluate these ideas based on three criteria (consumer opportunity, business opportunity, alliance viability); (c) create a network of partners (not only a trusted network, but also an open innovation network of new, unknown partners that has to be enlarged continuously); and most important (d) facilitate human centeredness by stimulating open mindsets internally and externally. The main steps for the successful implementation of open innovation are presented in Figure 2. Since the model base on the additional interviews carried out in the second part of the research we present it as a recommendation and needs further testing before we can generalize it.

Fig. 2. Steps for successful implementation of open innovation.



Adapted from Lucia Chierchia, Open Innovation Manager at Electrolux Group

5.2. Limitations and future research

Although our study has provided an extensive overview of open innovation and broad evidence for the separate aspects of this phenomenon, it has several limitations. The research was based on the use of cross-sectional data, which limits the understanding of the development and implementation of open innovation over longer periods of time. Longitudinal data may provide evidence as to how this phenomenon evolves over time. The study included three European countries; however, due to smaller sample sizes in Italy and Belgium, the study joined the three samples into one, not taking into account the specificities of each nation. Future research may incorporate larger samples to test the proposed research questions, as the samples of Italy and Belgium in this study were marginal. Encompassing greater international context and distinguishing among countries may provide some additional insight into the evolution of open innovation. Moreover, as stated in the previous section, the model presented in Figure 2 is only a potential model for successful implementation of open innovation and needs further testing and development. The inclination of smaller companies towards closed innovation presents an interesting avenue for future research which may search answers to the questions on how to overcome the barriers related to the lack of financial and human resources of smaller companies to execute more open innovation activities. Our research indicated the importance of the human centeredness for open innovation processes; nevertheless, more evidence is needed on this aspect. Therefore, an intriguing opportunity for future research could be an examination of the competencies that business practitioners need in order to effectively implement and lead the open innovation process, as well as the abilities employees need in order to understand the process and its complexities. More evidence is needed on the

training of employees (i.e., how to train and motivate employees to overcome the NIH syndrome and to establish trust) and understanding the importance of open innovation.

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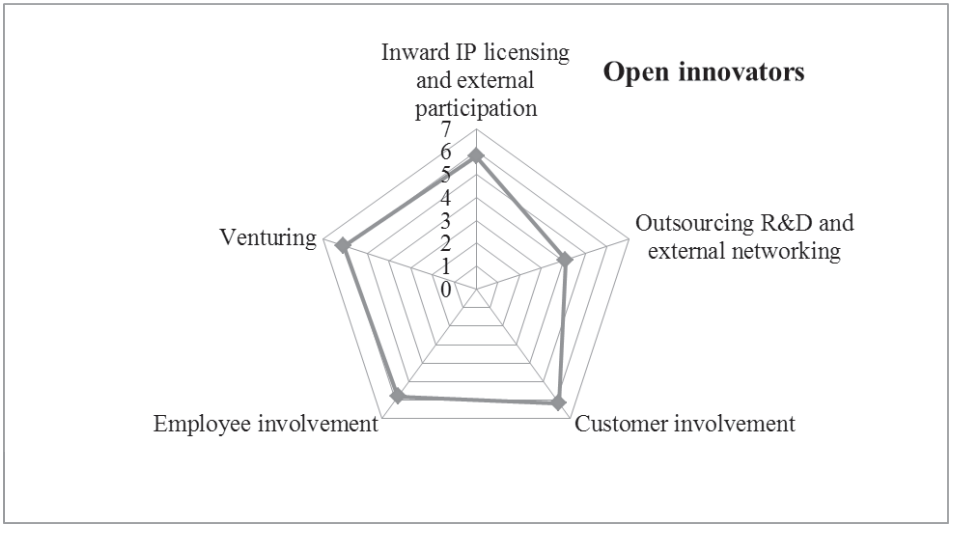
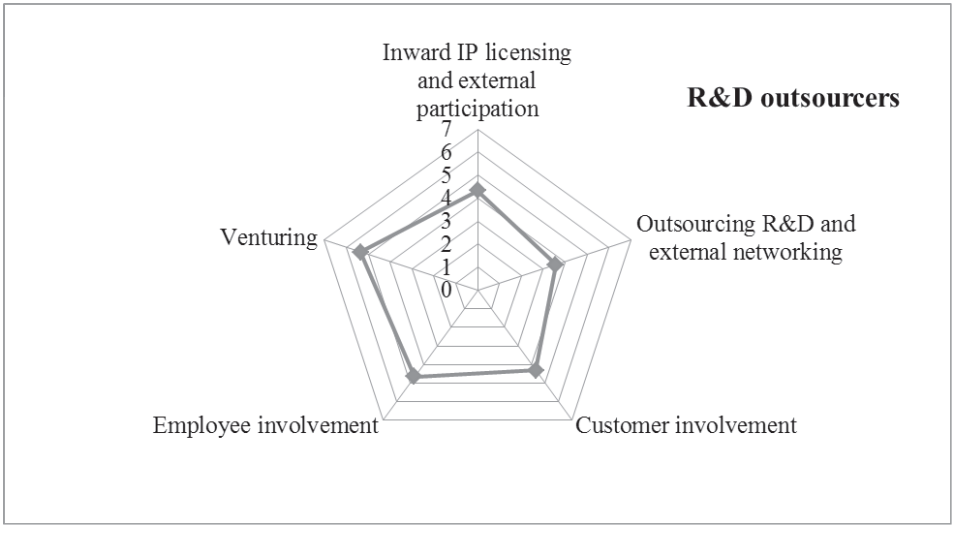
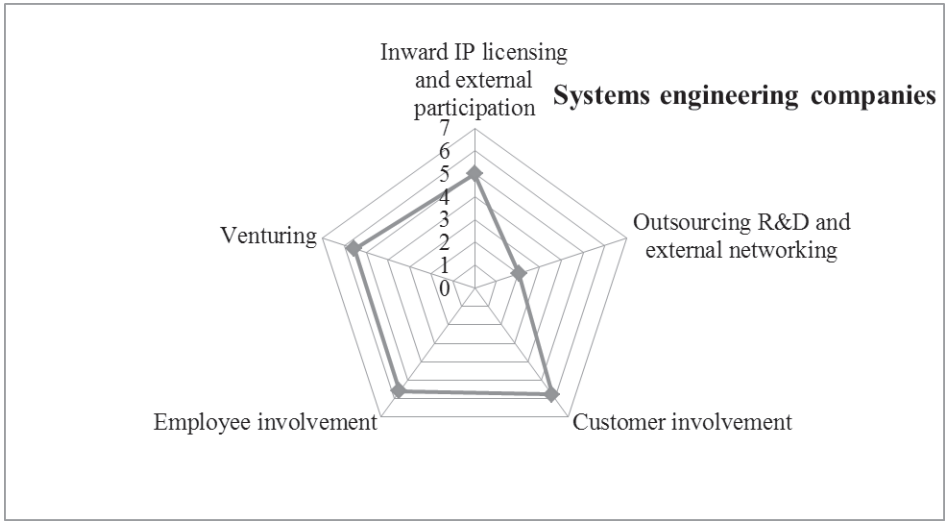
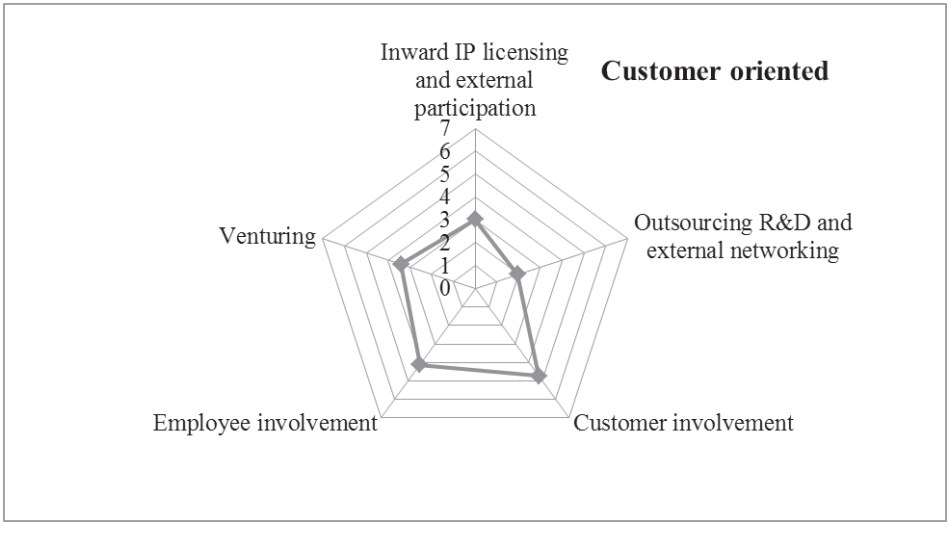
APPENDIX: Graphical demonstration of each cluster and its performance in terms of the individual dimensions






Systems engineering companies
Inward IP licensing and external participation
Outsourcing R&D and external networking
Customer involvement
Employee involvement
Venturing
0
1
2
3
4
5
6
7


Customer oriented
Inward IP licensing and external participation
Outsourcing R&D and external networking
Customer involvement
Employee involvement
Venturing
0
1
2
3
4
5
6
7