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Towards a building-block approach for managing open innovation in SMEs

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9th-10th November 2011
Sheffield (UK)

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Key Words: Open Innovation, Building block, SME, CAS

Abstract:

Objectives

The aim of this paper is to give a new perspective of analysis on the recent increasing interest in open innovation in small- and medium-sized enterprises (SMEs). More specifically, the goal of this article is firstly to investigate the fundamental classes of elements which can be considered in managing open innovation. Secondly, it is proposed an approach more tailored to the intrinsic characteristics of SMEs on how to deal with the “era of open innovation” (Chesbrough, 2003).

Prior Work

Due to the scarcity of resources and therefore the need to extend technological competences through alliances or networks, the open innovation approach has always existed in SMEs. However, as many authors have pointed out, much of the literature has regarded open innovation practices in large, high-tech multinational enterprises (Chesbrough, 2003; Kirschbaum, 2005). Only recently the focus has moved toward open innovation in SMEs (Lee et al., 2010; van de Vrande et al., 2009). Even though there is no single best way for doing open innovation (Nambisan & Sawhney, 2007), in the context of SMEs it is preferred an incremental approach, through a step-by-step experiencing (van de Vrande et al., 2009).

Approach

A building-block model is derived by integrating several strands of analysis and taking into account complex adaptive system (CAS), concepts of emergence, adaptability, fit and evolution. Due to the “social” aspects of open innovation (collaborations, alliances, network, etc.) the activity system firstly illustrated by Engeström (1987) is chosen as framework to depict the fundamental classes of elements in the open innovation context.

Results

As confirmed by the literature review, the open innovation process in the context of SMEs must be slow, gradual and in a try & learn logic. In this perspective, the building block model fits in representing the open innovation process in SMEs.

Implications

The building block model identifies the key elements to manage open innovation in SMEs. The parallelism with the activity system contributes to import aspects of the theory of social systems into the open innovation paradigm. From a managerial perspective, a tool is proposed to represent and plan the management of open innovation.

Value

The framework of analysis takes into account the social aspects of open innovation, in a flexible, organized and structured manner. By means of it, the company is supported to build its own open innovation building block model, which is unique and dynamic in time.

1. Introduction

Since the open innovation model has been proposed as a new paradigm for managing innovation, much has been said about it. However, literature has mainly regarded open innovation practices in large, high-tech multinational enterprises (Chesbrough, 2003; Kirschbaum, 2005). Only recently the focus of scholars has moved toward open innovation in SMEs. Actually, due to the scarcity of resources and therefore the need to extend technological competences through alliances or networks, the open innovation approach has always existed in SMEs. In these years it has become evident that SMEs can overcome their 'liability of smallness' by opening up their innovation process (Gassmann et al., 2010). Even though organizational and cultural barriers may arise when SMEs start to interact and collaborate with external partners (van de Vrande et al., 2009), it is through alliances or networks that they can extend their technological competencies (Edward et al., 2005). Few studies are available on open innovation and SMEs. Limited to Dutch enterprises, there are exploratory researches that investigate case, trends, motives and management challenges with regards to open innovation and SMEs (van de Vrande et al., 2009), evidencing the differences in collaboration between innovative larger companies and innovative SMEs (van de Meer et al., 2007). Other studies available are more focused on the later stages of the conventional innovation process, the 'exploitation' or commercialization stages (Bianchi et al., 2010; Lee et al., 2010). In particular, Lee et al. (2010) suggest the intermediated network model as an effective way to facilitate open innovation among SMEs, while Bianchi et al. (2010) propose a specific methodology for the identification of viable opportunities for out-licensing a firm's technologies outside its core business. Overall, researches so far have confirmed that open innovation practices are relevant and increasingly applied by SMEs, with a growing presence in business life (van de Vrande et al., 2009; Gassmann et al., 2010). Nevertheless, the few contributions in literature regards only exploratory studies on open innovation and SMEs in Netherlands or studies limited to the final portion of the innovation process, with emphasis on specific methodologies or collaboration modalities. What seems to be missing in literature is a prospective of analysis at a higher level, a general pattern that takes into account how SMEs can approach and manage open innovation practices along the entire innovation process. The aim of this paper is to address this gap by proposing a modular approach, which is flexible and dynamic in time. To address this goal, our research is organized in three different levels of analysis: the organizational layer, the social layer and the open-innovation layer. The importance to consider the innovation and social level of analysis when facing research on innovation and organization is traced in the work of Drazin and Schoonhoven (1996). More specifically, the authors adopt a multilevel perspective and highlight that decisions of an organization regarding undertaking innovation can be subjective to some aspects that lay on the social layer, external to the organizational one. Moreover Drazin and Schoonhoven (1996:1075) raise the issue to develop "models that integrate innovation activities at the micro (organizational) level with macro processes that operate at a social level". According to such perspective, the organizations can be considered as embedded in networks of other organizational actors, that influence the modality and the time in which they engage in innovative activities (Drazin & Rao, 1996). Further, we follow the approach proposed by Fuller and Moran (2001:55) to "embrace a complexity" methodology to deeply understand and analyse the small firm domain. Both these authors propose a model with an emergent multi-layer structure of systems, in which each layer depend upon the lower one for its existence. Simultaneously, each system has a different behaviour from the lower levels, and is understood by different models or theories. This is typical in a complexity methodology, where each layer might be understood as an emergent property of the existence of the system or layer below. Therefore we grounded our analysis merging the multilevel perspective of Drazin and Schoonhoven (1996) and the complexity methodology approach of Fuller and Moran (2001). More specifically we came to the foundations of our building-block approach for managing open innovation in SMEs, which represents the final level of analysis (figure 1), stratifying it on the top of a deep analysis of the organizational and social layers.

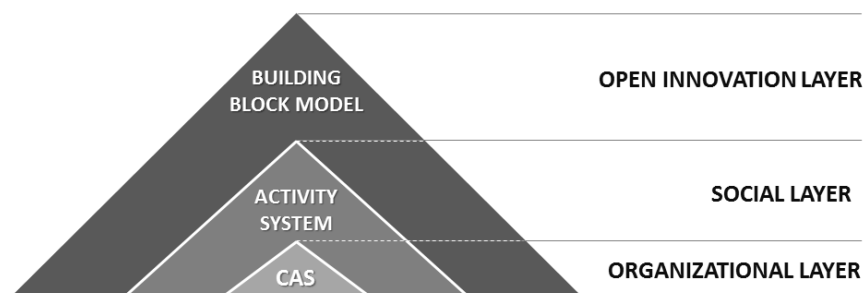


Figure 1. The three layers of analysis in our research

The remainder of this paper is organized as follows. Sections 2 and 3 illustrate a literature review on the organizational and the social layers of analysis, taking into account respectively the theory of complex adaptive systems (CAS) and the Engeström's activity system model. Then, Section 4 illustrates how our research leads to the proposal of a building-block approach, while the methodology is described in Section 5. Section 6 presents the results obtained. Conclusions are drawn in Section 7, where limitations of the study and suggestions for further research are also discussed.

2. Exploring the organizational dimension of complex adaptive systems (CAS)

A recent and relevant trend in organization theory and strategic management is to consider and apply notations drawn from complexity theory (Dagnino, 2004), in particular regarding complex adaptive systems (CAS). According to Holland (1992), such systems involve great numbers of parts undergoing a kaleidoscopic array of simultaneous interactions, sharing three characteristics: evolution, aggregate behaviour, and anticipation. Levin (1998) defines CAS by three properties these systems have: diversity and individuality of components, localized interactions among those components, and an autonomous process that uses the outcomes of those interactions to select a subset of those components for replication or enhancement. In the work of Kauffman (1993), we can find some pillars of the complexity theory, such as the concept of self-organization and adaptation, spontaneous order and chaos in complex dynamical systems and the dynamics of coevolution. Since the early nineties, when scientists at the Santa Fe Institute conducted simulations in biology and physics (Smith & Stacey, 1997), such systems have been gradually employed in different fields, for example to describe economic, ecological and social systems (Holling, 2001), or human systems, e.g. groups, societies, nations and organizations (Smith & Stacey, 1997). As a result of their characteristics of complexity, self-organization, adaptation to the environment, interaction, non-linearity, coevolution and emergence, the complex adaptive systems have proved to be suitable to describe dynamic and evolutionary processes in organization and management science. Anderson (1999) proposes them to study new organizational models, while Brown & Eisenhardt (1998) see companies strategic change in turbulent and highly competitive markets through the lens of complexity theory. Among other main contributions of CAS models in management, Volberda & Lewin (2003) focus on the co-evolutionary dynamics within and between firms, Dagnino (2004) applies the approach of complex systems to the resource- and capability-based theory by an integration to the network level, Tilebein (2006) studies CAS as a theoretical perspective to approach efficiency and innovation and McCarthy et al. (2006) view the new product development as a CAS ruled by three levels of decision making, in-stage, review, and strategic. Particularly noteworthy for our research are the articles by Fuller & Moran (2001), and Dooley (1997): the first because it analyses SMEs dynamics through the lenses of CAS, suggesting how this theory is a plausible field for the study of the dynamics of such enterprises, and the latter because it introduces the concept of *schema* – even though limited to the organizational systems – built by *building blocks*, that change under complexity theory rules.

In this paper, the level of SMEs' organizational systems (figure 1) is analysed through the lens of complex adaptive systems. In particular, the framework we propose takes into account the concepts of self-organization and coevolution, in which reside aspects of emergence, adaptability and fit. As stated in literature, self-organization takes place only in presence of open systems that import energy from the outside (Prigogine and Stengers, 1984). A dissipative structure reaches an organized state if it is maintained far from thermodynamic equilibrium, through energy that is constantly injected into the system. So, in the context of open innovation, organizations can be seen as dissipative structures maintained by external agents, such as new partners, suppliers, consultants and experts, who inject new sources of energy to the organization. In natural systems, the order is observed under a set of rules that explicates how connections between agents at a certain period of time may influence connections in a following period of time (Anderson, 1999). In the same way, also from an organizational point of view the exchanges between agents can be seen as governed by rules, that are usually formalized by contracts. As regards coevolution, in a complex adaptive system, "agents coevolve with one other, because changes in the distribution of behaviours among agents change individual fitness functions, and such shifts in turn alter behaviours" (Anderson, 199:223). So evolution of most effective organizations resides in strategies that lie at the edge of the chaos, with strategic equilibrium that is obtained over time by combining frequent small changes in an improvisational way (Brown and Eisenhardt, 1998). In the light of open innovation, where opportunities that come from external agents are mediated by managerial choices, it is appropriate the perspective of Volbrenda & Lewin (2003), that illustrate how co-evolutionary models have the premise that adaptation and selection are not orthogonal but are interrelated forces, and change is not the outcome of managerial adaptation or environmental selection, but rather the combination of intentionality and environmental effects. It is possible to notice how central for the organizational systems level is the role of agents. In particular, as pointed out by Dooley (1997), agents interacts with other agents, which are the building blocks of the CAS, accordingly to schema, that may change under complexity theory rules. The agents first scan their external environment, and then develop schema that represent interpretative and

action rules. Such schema can evolve through random or purposeful mutation, combination with other schema, or acquisition of other building blocks (Dooley, 1997). All these aspects are taken into consideration in the framework we propose.

3. Exploring the social dimension of open innovation through activity system

As is known, open innovation means that valuable ideas can come from inside or outside the firm, and in the same way can go to market from inside or outside the company (Chesbrough, 2003). Companies have to increasingly team up with other firms outside their boundaries in order to innovate, confronting critical and complex choices about whom to join forces and how to share power with (Pisano & Verganti, 2008). In particular, the role of collaboration networks for challenging open innovation has been widely investigated: Vanhaverbeke (2006) highlights the importance of analysing inter-organizational networks, enhancing the role of external network management. The importance of inter-firm networks is also illustrated by Dittrich and Duysters (2007), with regard to technology networks for strategic repositioning under situations of change. Pisano and Verganti (2008) suggest four ways to collaborate, to be chosen accordingly to the typology of governance and the participation of the members. More generally, the open innovation paradigm provides an opportunity to investigate the governance structures of open innovation and the ways to collaborate with external partners. For this reason, in order to depict the fundamental classes of elements of the second level of our analysis, the layer of social and collaborative processes in the context of SMEs (figure 1), we propose in this paper the 1987 Engeström's model of activity system (figure 2). Engeström's work sets its origins in the work of Russian psychologists Vygotsky (1896-1934) and Leont'ev (1978), who in their activity theory deeply analysed the phenomenon of activity and mediation artefacts. This model describes the relationship between a *subject*, the *community* with whom the subject collaborates with and the *object* of the activity in which subject and community are engaged. Central to the activity system is the concepts of mediating factors: the subject and the activity's outcome are mediated by *instruments* or *tools*, *rules* have a mediating role between the subject and the community, while *division of labour* mediates the relationship between community members and the activity's object (Engeström, 1999).

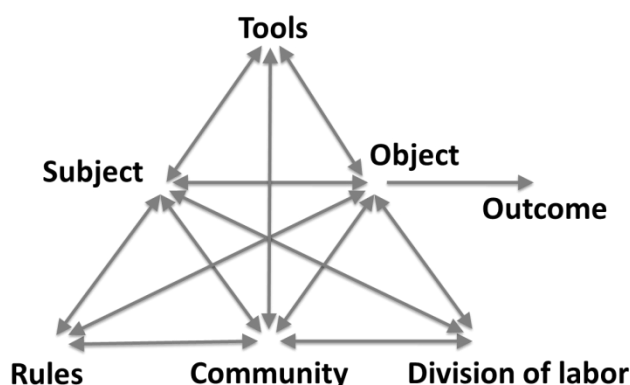


Figure 2. Activity system (Engeström, 1987)

Since it was illustrated for the first time, the activity system has been used to examine various types of collaboration, such as the management of experts in rapidly changing sectors (Blackler et al., 1999), the analysis and evaluation of activity learning in virtual communities (Henri et al., 2003), and the collective development in open-source communities (Hemetsberger et al. 2008). Due to its social aspects, this model appears suitable to represent the backbone of our framework for illustrating the collaborative process in the context of SMEs through open innovation practices. Even though the Engeström's representation might appear static, actually, the activity theory approach emphasizes that incoherencies and tensions are integral elements of the activity system, providing the possibility for a collective development or a reconfiguration of the system itself (Blackler et al., 1999). Furthermore, this model looks suitable also to study pattern of collaboration in complex organizations, which typically are more difficult to see and represent because they are loosely connected, emergent, abstract and contestable (Blackler et al., 2000:282). For these reasons, the analysis of organizations is more satisfactory if considering overlapping activity systems, or "activity networks"

(Blackler et al., 2000:282). In this way, organizations can be described as a general activity system that can be decomposed in a network of activity systems at lower levels.

4. Towards a building block approach

Combining the Engeström’s model of activity system with the concepts of open innovation and CAS previously illustrated, we now propose our framework for managing open innovation in SMEs. The core elements of the activity system represent in this research the social building blocks of open innovation (figure 3): SMEs are the *subjects* of our study, and to approach open innovation practices, they must open to the outside to start some collaborations with external partners, who represent the *community* in our context. The collaboration that arises between the subject and the community is aimed to reach a common *innovation goal*, and it is governed by rules that mediate the activities between them. Furthermore, the opportunity to use some *tools for innovation* and the specification of *roles* within the partners - the *division of labour* - facilitates the entire innovation process. From complex adaptive systems, we maintain the centrality of agents, which in this case are represented by the SMEs, and by the communities with whom they collaborate with, such as companies, suppliers, consultants, experts, and others. As in CAS, agents interact under specific rules. The principles of auto-organization, adaptation and fit are taken into consideration to propose a schema that is not static, that changes according to the influences of the interactions between agents, and coevolve in a combination of managerial intentionality and environmental effects (i.e. government policies at local/regional/national level).

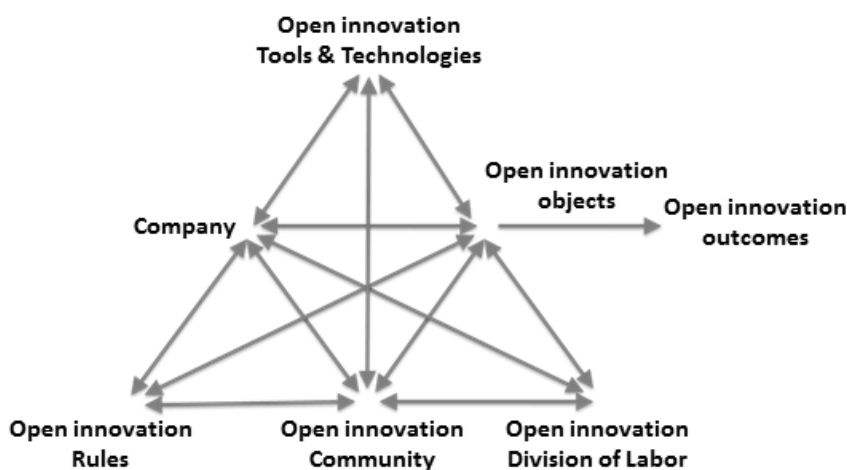


Figure 3. The activity system in the context of open innovation

5. Methodology

Previous works on open innovation practices were already conducted by some of the authors of this paper (Bernardi & De Toni 2008; Carignani, Andriani and De Toni, 2008; De Toni, Biotto and Carignani, 2010), and helped to reinforce the theoretical background which lies behind the framework here proposed. In order to populate the activity system model with the elements of open innovation, we performed the following process: first, a deductive approach, based on recent literature review, allowed to obtain the key elements of each building block. Then, such elements have been validated through an inductive approach, comparing them with data from interviews, in order to set the foundations of our framework on reality. So, to develop the elements, we firstly considered some of the most recent and important contributions in the literature on open innovation: Enkel, Gassmann & Chesbrough (2009); Rohrbeck, Holzle and Gemunden (2009); Elmquist, Fredberg and Ollila (2009); van de Vrande et al. (2009) and Huizingh (2011). Such authors have been selected for their focus on the practices of open innovation. Along with these contributions, it was also considered a previous study regarding the impact of technology transfer services on open innovation approaches (Bernardi & De Toni, 2008). From all these works, it was extracted a list of elements, shown in table 1, which represent the foremost alternatives for each building block. In two cases it was maintained the distinction of the phases of the process of open innovation, as typically are seen in literature, the *outside-in*, *inside-out* or *coupled process* (Enkel et al., 2009; Rohrbeck et al. 2009). To properly categorize the building blocks, some elements were grouped in subclasses: *tools and technologies* were subdivided in ICT technologies, R&D services,

methodologies and financial supporting tools, *rules* were grouped in IPR (intellectual property rights), motivational, cultural and social rules, while for the *division of labor* it has been decided to stress the differences between the type of collaboration which outline the organizational design and boundaries of the firm, and the business models and the innovation roles.

Table 1. Building block elements for managing open innovation in the context of SMEs

MAIN CLASSES	BUILDING BLOCKS FOR MANAGING OPEN INNOVATION	AUTHORS								
		Enkel, Gassmann and Chesbrough (2009);			Rohrbeck, Holzle and Gemunden (2009)			Bernardi and De Toni (2008)	Elmquist, Fredberg and Ollila (2009)	van de Vrande et al. (2009)
		outside-in process	inside-out process	coupled process	outside-in process	inside-out process	coupled process			
Subject	SMEs	X	X	X				X	X	X
Object/goal	Problem solving							X		
	Knowledge development (gain external knowledge)	X		X				X	X	X
	New product development				X	X	X			
	Transferring ideas to the outside environment - bring ideas to market		X	X				X	X	
	Technology exploitation		X	X				X	X	X
	Technology exploration	X		X				X	X	X
Open innovation community								X		
	Clients	X						X		X
	Commercial research institutions	X						X		X
	Communities							X	X	
	Competitors	X						X		X
	Complementary partners			X						
	Consultancies	X						X		
	Consumers			X						X
	Customers	X			X			X		X
	Employee (not in R&D)							X		X
	Lead users			X				X		
	Non-customers	X								
	Non-suppliers	X								
	Partners from other industries	X		X				X		X
	Public research institutions (universities or research organizations)	X						X		X
	Suppliers	X						X		X
Tools and technologies								X	X	
ICT technologies	Innovation intermediaries (web platforms)	X							X	
	External database							X		
R&D Services	Technology transfer services							X		
	R&D services from other organizations								X	
Methodologies	Foresight/creative workshop						X			
	Forums (with executives, experts, etc.)						X			
Financial supporting tools	Equity investments									X
Rules										
IPR	In-licensing policy (e.g. Buying patents); inward ip licensing	X						X	X	X
	Out-licensing policy; Outward IP licensing		X							X
	Contracts, NDA									
	Licenses or royalty agreements		X							X
	Patents, copyrights or trade marks									X
Motivational rules	Rewards, incentives									
Cultural rules	Cultural issues								X	X
Social rules	Norms, regulations							X		
Division of labor										
Organizational design and boundaries of the firm	Crowdsourcing	X						X		
	Mass customization, and customer community integration	X						X		
	Joint ventures		X	X						
	Alliances			X						
	Cooperation			X				X		
	Peer production			X				X		
	Research alliances - academic				X			X		
	Complex research projects				X					
	Value chain alliances						X			
	Test market					X			X	
	Creation nets								X	
Business models	Spinoffs		X							
	New ventures		X		X					X
	Corporate venturing activities		X		X					
	Spin-outs (external commercialization of internal R&D results: technologies, products or services)		X			X				
Innovation roles	Promoters	X	X	X						
	Lead users			X				X		
	Knowledge provider									X
	Technical service providers							X		X
	Funders (i.e. venture capitalists, business angels, investors)								X	
	Generators								X	
	Innovation brokers								X	
	Network organizer (gatekeeper)								X	

Parallel to the development of the table, in order to get more insights on the attitude of SMEs towards open innovation (table 2), a series of events have been exploited. These events – twenty interviews, six focus groups, ten visits to firms and a workshop – were performed within the COLLECTIVE Project (see Acknowledgements) during the period February-May 2010, with an overall participation of more than 40 SMEs from various European countries, belonging to different industrial sectors. During the work sessions, many aspects of open innovation practices have been discussed from the subjects involved. These events helped in refining our conceptual model with information gathered directly with the SMEs and experts. During the focus groups, a brainstorming session was conducted: SMEs were invited to answer to the trigger question "How will European SMEs innovate products, services, processes, business models in 2015?". Their answers led to broad discussions on economical, technological, scientific, social and political aspects related on open

innovation. Interviews were conducted in six European countries, addressing directly the SMEs with structured questionnaires, while the visits to firms represented a fruitful occasion to meet different professional profiles. The workshop has seen the participation of three high-profile innovation experts as speakers. From all these events, it emerged that the topics of major interest for SMEs are the IPR management, with special attention to the roles of patenting nowadays, the incentives and motivations systems that should bring SMEs to communicate and collaborate, the need for a reduction of the distance with the sources of research and information, and an easier access to the funding for innovation. These considerations validated most of the key elements that are depicted in table 1.

Table 2 – Data synthesis of focus groups, interviews, visits to firms and workshop

	Events data synthesis (period February – May 2010)							
	Quantity	Participants	Innovation experts	SMEs	non-SMEs	Other organizations	Industrial sectors	European countries
Focus groups	6	25	2	22	-	1	15	5
Interviews	20	-	-	18	-	2	10	6
Visits to firms	10	10	-	3	2	2	4	5
Workshop	1	20	3	3	-	-	-	8

6. Results

Table 1 illustrates some of the main building blocks for managing open innovation practices in SMEs, considered with their key elements, which have been identified and mapped in the table according to the authors who have analysed them. SMEs are the subjects of our investigation. Among the most important goals, we find some that are typical of open innovation, such as the technology exploitation, technology exploration, and the transferring of ideas to the outside environment, and others that are relevant in any context, such as the necessity of problem solving, the knowledge and new product development. The open innovation communities are widely investigated, starting from actors closer to the SMEs, for example the members of the supply chain, up to external agents further from the usual collaborations of the firms. Among the innovation tools, in particular we highlight the importance of innovation intermediaries, that is a topic of interest in open innovation but not widely investigated in this paper. The subject and the community collaborate under a set of rules, that may be social, cultural, motivational or regarding intellectual property rights (IPR) issues. A central relevance has the system of rewards and incentives for the collaboration, that should take into account the motivations of the actors and the practices for managing IPR. The division of labour regards in general the roles covered by the agents involved in open innovation processes, and in a broader vision also the organizational design and boundaries of the firm and the business models can be taken into consideration. Many of these aspects have been discussed and validated during the workshop, focus groups and interviews. All of the elements of the tables represent the building blocks of our model, that can be reconfigured in the activity system and combined differently according to the characteristics and the innovation goals of each SMEs, thus creating a model of innovation that is dynamic and unique for each company. An example of the application of the model is represented in a scenario of open innovation illustrated in figure 4. As it is possible to notice, our model represents the innovation strategy at a high and a low level of analysis, by simply “zooming-in” the framework. When going into details, the framework is decomposed in a network of activity systems, that represents how innovation is managed in order to reach three different goals (i.e. “idea-generation”, “technology exploration” and “transferring ideas to the outside environment”). For each of them, the key building blocks are specified, taken from table 1, to illustrate the open innovation practices taken under consideration.

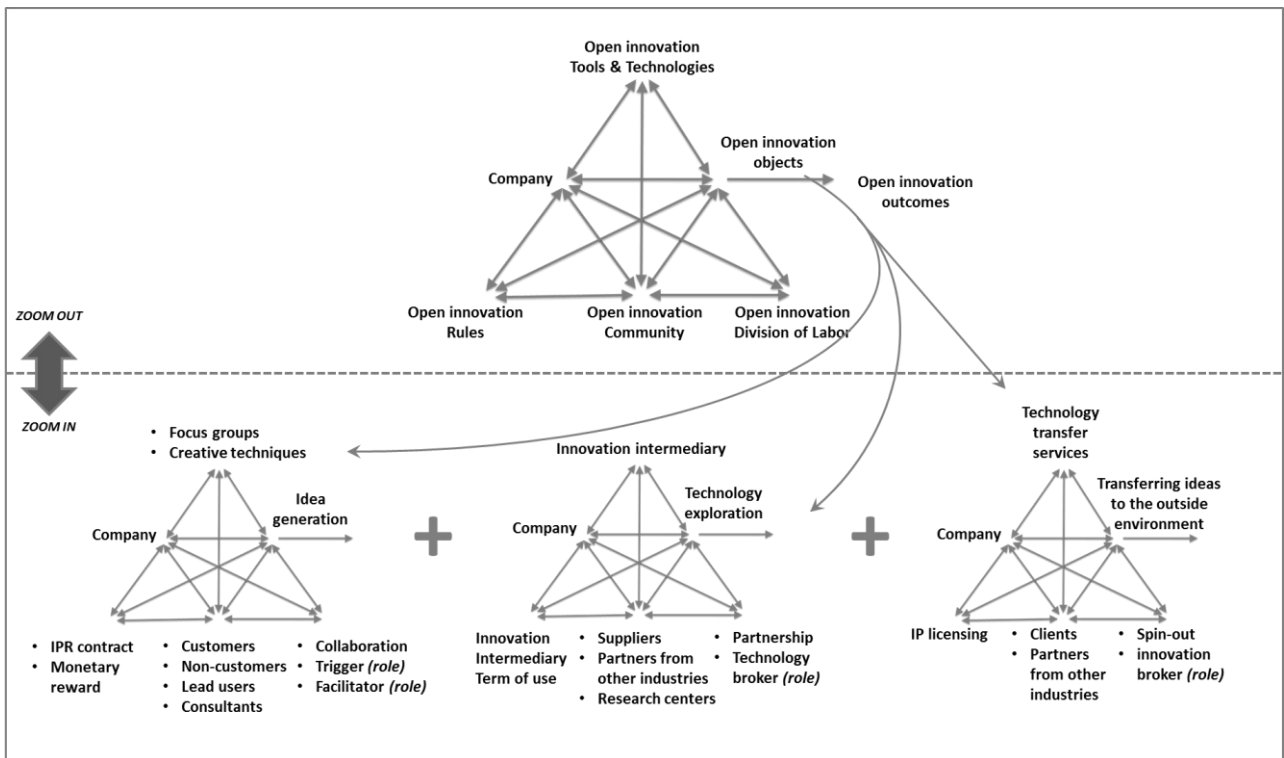


Figure 4. Example of the application of the model to a scenario of open innovation.

7. Conclusions

Open innovation in the context of SMEs has recently started to find some relevance in literature, encouraging the discussion on this topic. What seems to be missing is a 'cookbook', a framework of analysis that may help managers and practitioners to decide how to deploy open innovation practices (Huizingh, 2011). This paper attempts to recover this gap, by proposing a modular approach for managing open innovation in SMEs. The model is made by reconfigurable building blocks taken from the Engeström's theory of activity system (1987). The entire framework considers some core concepts of the complex adaptive systems, such as auto-organization, coevolution and interactions between agents and external environment, which are all seen through the lenses of open innovation. Considering that there is no single best way for doing open innovation (Nambisan & Sawhney, 2007), our model allows a gradual approach, by giving the opportunity to choose the most appropriate elements within each building block in order to reach some specific innovation goals. The framework proposed is customizable and 'open': new elements can be added according to the characteristics of each SMEs, in order to fit any innovation requirement. In this perspective, the model proposed is flexible and dynamic in time, and it appears coherent with a step-by-step experiencing, that is preferred in the context of SMEs (van de Vrande et al., 2009) and in a trial & error approach, which is typical in the context of open innovation (Gassmann et al., 2010). From the academic point of view, this paper contributes to the debate on open innovation, in particular by addressing the context of SMEs. From a managerial perspective, the building block model works as a tool to plan and manage open innovation practice, and in this way can be considered as a support for their adoption. The main limitation of this work is that the research is explorative in nature, and lacks of a multiple case studies analysis.

Acknowledgements

The research leading to these results has received funding from the European Community's Seventh Framework Programme managed by REA-Research Executive Agency <http://ec.europa.eu/research/rea> ([FP 7 - SME 2008 - 2]) under grant agreement n° [243593], project COLLECTIVE - Emerging communities for collective innovation: ICT Operational tool and supporting methodologies for SME Associations. For details, see www.collective-project.eu. The authors thank and acknowledge the Milan Chamber of Commerce, Industry, Craft Trade and Agriculture, the Confederation Generale Des Petites And Moyennes Entreprises, the Economic Chamber of Macedonia, the Association of Polish Aviation Industry, the Footwear Technology

Centre of la Rioja, Campus Srl, Techin Sp.Z.o.o. and University of Ljubljana for their support in the development of the events.

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