UNIVERSITA' DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI "M.FANNO"

CORSO DI LAUREA MAGISTRALE IN BUSINESS ADMINISTRATION

TESI DI LAUREA

EXPLORING THE OPEN INNOVATION PARADIGM IN SMEs: A fsQCA APPROACH IN A SAMPLE OF MANUFACTURING SMEs OF THE VENETO REGION

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ANNO ACCADEMICO 2018 – 2019

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EXECUTIVE SUMMARY

The traditional way of thinking about innovation has been to conduct all R&D and innovation activities in-house, in order to create the best ideas only with internal resources; and then, keep them inside the company, to maintain and preserve the own competitive advantage. However, the reality is now different: increasing demand granularity and shortening product life cycles impose a heavier innovation load on companies. As product portfolios need to be expanded further and market demands new products more often, R&D and innovation require more resources and risk exposure. To address this challenge, collaboration for R&D and innovation emerges as a strategic capability. A newer trend is thus spreading across industries and breaking the old mindset. Chesbrough (2003) has labelled this change as the era of *Open Innovation*. Company innovation strategies have recently been characterized indeed by a tendency towards more openness; with firms increasingly relying on outside information and collaborations to develop new products, services and processes.

The new approach to innovation, at its core, considers going outside the own company boundaries to co-innovate with another organizations, teams or individuals. *Open Innovation* changes therefore how businesses work together by combining internal resources with external ones to boost innovation. Instead of each organization working on its own, they are now open to share information and work jointly. In other words, the new paradigm encourages to connect with outside sources, to get broader pool of talents, to collaborate with others; in order to come up with innovations that an organization could never reach just by itself. Further, investigating the potential benefits deriving from the adoption of this model, a survey conducted by Kpmg (2016) has discovered that companies systematically pursuing collaboration opportunities have a significantly higher rate of commercially successful product launches and nearly twice as much revenue growth than others who don't collaborate.

Due to its relevance, *Open Innovation* has thus developed rapidly as a new wave of research in innovation management, with most insights based on large firms. Indeed, the first evidence of this model were about large high-tech manufacturing companies, such as IBM or Intel, which deliberately implemented this paradigm in their innovation strategy. In contrast, small and medium-sized enterprises have received scant attention in the OI literature; even though several authors recognize its importance. As a matter of fact, the economic relevance of SMEs is unquestionable. For instance, in Europe, more than 60% of private sector jobs are in the SME sector and more than 90% of all businesses are SME (European Commission, 2005).

Also in Italy, small and medium-sized companies are important for the dynamics of the economy; and, especially in the Veneto region, where the majority of local companies are small or medium companies: 94,1% and 5,2% respectively, on the total number of active companies (Apa et al., 2018).

Therefore, on the base of this, in our thesis, we would like firstly to investigate from a theoretical point of view the application of the *Open Innovation* model in SMEs and secondly, we empirically examine, through a quali-quantitative analysis, the innovation performances connected to the recourse of external collaborations for innovation purpose, using a sample of 181 manufacturing SMEs from the Veneto region. Specifically, the thesis is organized as follows. In the next section, we provide a detailed picture of the main theoretical aspects of *Open Innovation*. Afterward, we explore its adoption in SMEs, in order to build an unique and coherent framework of analysis, considering the limited and fragmented academic contributions on the topic of interest. Then, in the third section, we describe our empirical conceptual model, we provide details of our sample, data and measures, before illustrating the results of our analysis conducted with the fsQCA 3.0 software. Then, to conclude, we discuss the empirical results in light of the theoretical background, we underline the contribution of our research to the literature, we discuss the main managerial and policy implications of our study, the possible avenues for future research and, finally, the limitations.

CHAPTER 1: INTRODUCTION TO OPEN INNOVATION

The *Open Innovation* model is generally implemented as a necessary organizational adaptation to changes in the environment (Chesbrough, 2003). In a world of mobile workers, abundant venture capital, widely distributed knowledge and reduced product life cycles, a lot of companies aren't able to afford to innovate on their own and they recur to external sources. Therefore, considering the crucial role of *Open Innovation*, in this chapter, we thus give a clear definition for this paradigm; then, we investigate the environmental factors leading to its adoption; we explore its application areas; we describe which are its main advantages and challenges; and, finally, we consider which are the necessary prerequisites for a company to have, to successfully implement an *Open Innovation* strategy.

1.1 Defining Open Innovation

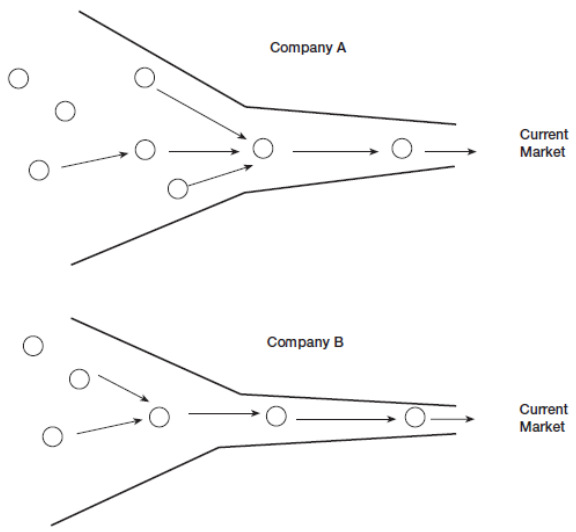
Open Innovation has been described with diverse definitions during the last decade. Chesbrough (2003) introduced this concept based on his research on Xerox PARC as well as on interviews at IBM, Intel and Procter & Gamble; arguing that companies needed innovation strategy which enable innovation flows across the company' boundaries. He explained for the first time this notion referring to a phenomenon of companies making greater use of external ideas and technologies in their own business, and letting unused internal ideas and technologies go outside for others to use in their business. However, it was only after some time that the same author coined a more formal definition of purposive inflows and outflows of knowledge to accelerate innovation internally while also expanding the markets for the external use of innovation. *Open Innovation* is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technologies (Chesbrough, 2006b). In other words, companies can and should rely on internal as well as external resources in their system to develop their technologies and some internal paths may be taken to market to generate additional value. This requires companies open up their fixed boundaries in order to allow valuable ideas to both flow in from the outside to create opportunities for cooperative innovation processes with partners and, flow out for purposes of commercial exploitation. There are therefore outside-in and inside-out movements of technologies and ideas, also known as "technology acquisition" and "technology exploitation" (Lichtenthaler, 2008). The critical conceptual distinction between the prior academic works about innovation and the definition of the *Open Innovation* concept is that these inflows and outflows of knowledge can be purposively managed: companies can create channels to both bring external knowledge into their own systems and to move unused internal R&D outcomes from inside to outside. Moreover, another key difference from the earlier works is the alignment of such innovation strategies to the firm's business model. Chesbrough (2003) explains indeed that *Open Innovation* combines "internal and external ideas into architectures and systems whose requirements are defined by a business model". Following more recent conceptualizations (Chesbrough, 2003, 2006b; Dahlander & Gann, 2010; West & Bogers, 2014), a more complete definition widely adopted in the academic literature for *Open Innovation* is "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization's business model". These flows of knowledge may entail knowledge inflows to the focal organization (using external sources through internal processes), knowledge outflows from the focal organization (leveraging internal knowledge through external commercialization processes) or both (coupling external sources and commercialization activities). Explaining this definition, we can say innovation is linked to the development and commercialization of new or improved products, processes or services, the openness feature is given by the knowledge flows across the permeable organizational boundary and the business model, which may be implicit or explicit, defines how value is created and also how is it captured by the involved organization within the distributed innovation process.

The founding principle of *Open Innovation* is that R&D activities are considered as an open system and valuable ideas can be generated inside or outside the company's boundaries and can go to market from inside or outside the company as well. Hence, external ideas and external paths to market are on the same level of importance as internal ideas and paths to market. Innovation can be driven by multiple sources of knowledge, both internal and external, such as suppliers, research centres, universities, customers, competitors and companies with complementary offerings and, in general, the combination of these allow to deal with costs and risks more effectively while leveraging innovative development. Thus, the adoption of OI may be lead by defensive reasons such as costs and risks reduction and offensive reasons as boosting knowledge and innovation.

Open Innovation is usually counterposed with the so called Closed Innovation Model, which is considered its antecedent and according which companies rely exclusively on their own innovative ideas and R&D activities, thus developing and building their technologies only internally (Chesbrough, 2003). This means that the prior practice and theory of technological innovation highlights the control of innovation inside the firm. To be more specific, in the

Closed Innovation Model, all research projects start in the own company's R&D department so that they can enter only in one way and the projects selected and considered successful only exit in one way through the own company' sales and marketing channels. This means the bundaries of each firm are solid lines since all activities are conducted within each single firm. Firms rely only on their internal technology base for new ideas and only on internal talents to deliver innovation, products are strictly developed internally using in-house R&D and then marked by the same company or by a licensee and, if there are ideas for which the company doesn't have enough skills or which are not in line with company's core interest, they are abandoned (Figure 1.1).

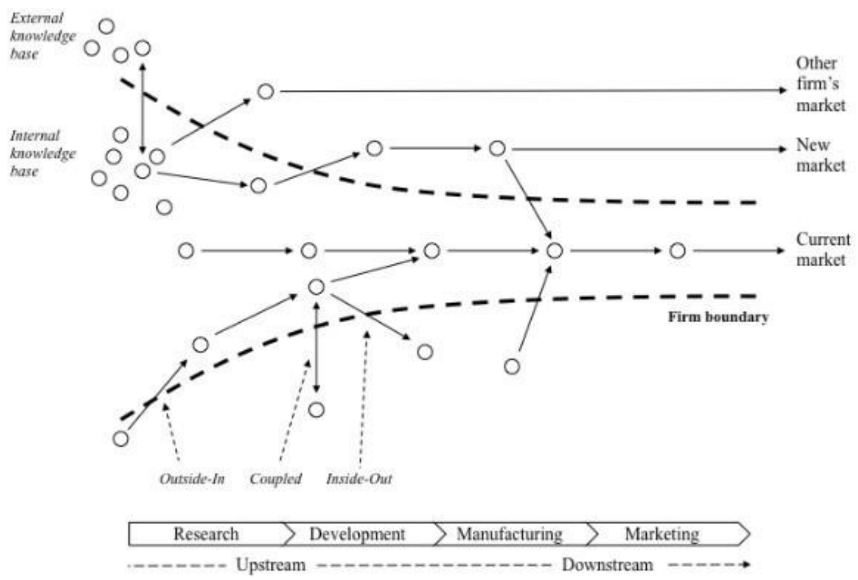
Figure 1.1 - Closed Innovation Model



Source: Chesbrough (2003)

Instead, in the *Open Innovation* Model, companies look beyond the boundaries of their own organization since the knowledge landscape is made up of a flow of internal and external ideas. Projects can be launched either thanks to internal or external knowledge sources and technologies can go to market from inside or outside the company (for example through out-licensing or spin-off venture company). This means companies exploit resources, skills and experiences of external actors but also share their own technology and ideas with other organizations. This external contamination thus changes the logic behind the centralized R&D silos of the Closed Innovation Model. Furthermore, knowledge and technology may follow different paths within and across the boundaries as represented in the Figure 1.2 below (outside-in, inside-out, coupled which will be clarified after). Finally, a recent interpretation defines that the *Open Innovation* model is broadened from upstream R&D to manufacturing and marketing to consider all activities from invention to commercialization in order to create and capture value from ideas and technologies (Chesbrough, 2006b; West & Bogers, 2014).

Figure 1.2 – Open Innovation Model



Source: Chesbrough, 2014

Although in the reality is not a completely fully closed innovation approach because there is more a continuum between the two paradigms, it must be highlighted that the "do-it-yourself" mindset in innovation management is considerate outdated.

1.2 Erosion of the traditional closed innovation model and the birth of the Open Innovation model

After having defined the *Open Innovation* concept, in this section we would like to investigate which are the environmental factors leading from a Closed Innovation Model to an *Open Innovation* system. In particular, we consider the contribution by Chesbrough (2003), who has identified in his book some erosion factors of the traditional Closed Innovation Model. Here below, we present them briefly.

The first one is the increasing availability and mobility of skilled workers. First of all, the supply of educated people has risen a lot since the post-war period. And, in addition, a company may profit from the training and experience of another company by hiring away some of its former employees, or employing consultants used to deal with other firms, without paying in both cases any compensation in return to the other organizations.

The second factor leading to the demise of the traditional model is the rise of the venture capital market. According some researches, there has been an enormous expansion of VC since 1980. Just to mention an example, about $700 million in VC was invested in the US in 1980, reaching more than $80 billion in 2000. Before 1980, although there were start-up companies founded by people leaving large firms, it was difficult for these enterprises to get capital. However, when the venture capital has started to grow it has brought some risk for companies creating their own knowledge with significant commitments to internal R&D. Indeed, laboratory researchers of companies can be now attracted by interesting risk/reward compensation packages to join new start-up firms which large firms barely match.

The third erosion factor is the availability of external options for abandoned ideas. As a result of the combination of the first and second factor (mobility and availability of workers and rise of VC), there is now a new external path to market for dismissed ideas. If a company leaves apart an idea because for instance it is not able to use the research result, workers inside the company could be financed by a VC and commercialize the idea outside on their own.

The fourth and final erosion factor cited by Chesbrough is the increasing capability of external suppliers and the relation with them. If in the past it wasn't simply for companies to find among external suppliers a reliable partner in term of knowledge, experience and financial capital to build the needed materials to create new products; nowadays there are more capable and developed external suppliers that may on one hand facilitate companies with intensive R&D investments to apply the results of the investments in a reduced time. However, on the other hand, since these external suppliers are available to all entrants, there is a pressure on companies with R&D projects sitting on the shelf because these external suppliers may let also other companies move faster as well as serve a wider range of markets. And, as a result of this dynamic, there could be a move out of the unused buffer inventory of ideas and technologies lying on the shelf between research and development, with or without the participation of the company that funded the original R&D.

Thus, all the above mentioned erosion factors (increased mobility of workers, more capable universities, growing access of start-up firms to venture capital) have weakened the traditional Closed Innovation paradigm and changed the conditions under which firms innovate. A wide range of potential research inputs outside a firm has been created and, what before was a closed internal setting (where ideas were originated internally for internal use), it has changed into an open setting (where idea contamination comes both from inside and outside and it may be for internal and external use). Therefore, the landscape of knowledge is different: sources of knowledge have shifted away from the "tall towers of central R&D facilities" toward a "variegated pools of knowledge" distributed across the landscape such as customers, suppliers, universities, national labs, consortia, consultants and start-up firms. Furthermore, the *Open Innovation* paradigm entails a change in the role of the research function: "from knowledge generation to knowledge connection". In contrast to the old model where researchers were used to add knowledge to the company R&D's silos; under the *Open Innovation* Model, researchers should work with knowledge moving in and out of the silos. Therefore, R&D function is organized in order to identify and select available external knowledge, fill itself in the gap of knowledge integrating internal and external sources to create new complex combinations of knowledge and to make profits from selling its research results to other firms. Chesbrough (2003) suggests to companies to leverage the distributed knowledge pools instead of ignoring them to follow only the internal R&D agendas and to avoid inventories of ideas because they might be lost outside if not used with promptness.

The first evidences of the shift toward the concept of *Open Innovation* go back to the 1980s when high tech companies, such as IBM or Intel, in US and Japan, as mentioned by Chesbrough (2003), started to adopt this approach, combined it with internal resources, to face the limitation of the traditional Closed Model. After then, as the globalization increased, the environment started to be more and more competitive and products became more complex, making more risky and more challenging in-house R&D activities, the *Open Innovation* paradigm obtained a growing consideration in other sectors as well. Outsourcing and using external channels to market for the own development has become popular choices (Chesbrough, 2003). Indeed, only few companies may be able to capture the potential of every new finding or have the resources to exploit it (Wolpert, 2002); for instance, it may happen some projects remain incomplete because the internal innovation structure could be exposed to cost cutting or because of lack of internal resources and capabilities, thus resulting in missed opportunities. According to Ikujiro Nonaka (2013), with the previous traditional model, companies placed inside a "black box" the knowledge in order to be stored inside the organization, assuming that knowledge was the source of their superior sustainable performance, that added value, maintained the core competence of the firm and differentiated the firm itself from the other companies. This "black box" strategy worked well during the time of technical innovation since it allowed high return on invested capital by keeping the knowledge secret inside the company. However, since the 2000s, there has been a shift in innovation from products to services, the environment has become more globalized and the customers' needs more complex and, it has developed the need for firms to expand their value chains from a closed and linear system to an open and complex ecosystem; from extraction to inclusion, so that, the *Open Innovation* paradigm describes therefore the innovation process through the firms' boundaries in a more complex business ecosystem.

1.3 Beyond early adopters: Open Innovation in new application areas

As we have seen in the premise above, originally, the concept of *Open Innovation* was coined in relation to the study of large high-tech manufacturing companies, such as IBM or Intel, which deliberately implemented it in their innovation strategy. However, after the release of Chesbrough's book (2003), other companies started to adopt this new paradigm for innovation: P&G, General Mills, Philips, Siemens, Lego, Natura and DSM are only some examples of companies embracing this model. Beyond the early high-tech industry adopters, indeed, *Open Innovation* has begun to spread in other application areas; that we briefly present in this section.

First of all, *Open Innovation* has been linked initially to high-tech context, where companies create new business opportunities based upon external sources in order to realize new technologies. However, to generate new offerings and competitive advantage, there are other paths. For instance, product design, new market insights, customer intimacy and business model innovation are some ways of how firms may grasp the benefits of *Open Innovation* from non-technological factors, which are particularly important in the low-tech environment. Examples of *Open Innovation* are low-tech industries and beyond technological innovation are the cases of Procter & Gamble and Matsushita, which are some low-tech pioneers of inbound *Open Innovation*.

Furthermore, the initial research was focused on large companies adopting the *Open Innovation* model and it was only after that SMEs have been investigated. For instance, in this field, it has been studied that collaborative innovation models are especially relevant for SMEs, which may develop a valuable niche technology buy lack the expertise to bring it to market (Brant & Lohse, 2014). Since this specific application area is particularly interesting for us, we will present a depth analysis about it in the second chapter.

Thirdly, *Open Innovation* has been examined at the beginning with reference to the only private sector of the economy. However, in recent years, also the not-for-profit sector has recognized that *Open Innovation* may produce significant benefits for organizations such as charity, NGOs or government agencies (Chesbrough, 2014). For example, WWF has created an incubator where people outside the organization can suggest ideas that would be financed and guided by the organization itself; or, again, a lot of multinationals have decided to collaborate with NGOs to develop new innovative ecosystems. Just to mention an example, in this direction there is Unilever, which has begun to work with the environmental NGO Rainforest Alliance to source its products in a sustainable manner.

Finally, *Open Innovation* has expanded its focus also from product to service innovation. For instance, Chesbrough (2011) has shown how companies in a wide range of service industries may gain from adopting *Open Innovation* practices.

To conclude, it emerges clearly the *Open Innovation* paradigm is right now spread in various fields beside the original one in which it has manifested. Indeed, from high-tech to low-tech industries, from large to SMEs companies, from private to not-for-profit organizations, from technology to service innovation, *Open Innovation* has become relevant in several other application areas.

1.4 Open Innovation approaches

Until now we have given a short overview about the definition of *Open Innovation*, the environmental factors leading to its adoption and its main application areas. Now, we would like to explore the types of *Open Innovation* approaches. Specifically, in literature, it has been classified three types of *Open Innovation* approaches; which are defined according to schools of thought or in term of actors or processes. Below, we describe each one of them.

The first one is the *inbound* approach. This type of *Open Innovation* entails opening up a company's own innovation processes to many kinds of external inputs and contributions (Chesbrough, 2014); for instance through acquiring, a pecuniary inflow of innovation, or sourcing, a non pecuniary inflow of innovation (Dahlander & Gann, 2010); or, in another perspective, through the obtaining, integrating and commercializing phases (West & Bogers, 2014). Hence, in other words, it refers to the use within a firm of external sources of innovation. This implies that the locus of knowledge creation doesn't necessary equal the locus of innovation. For example, a firm may in-licence a technology developed elsewhere and integrating it into its own technology solution (Brant & Lohse, 2014). According to another equivalent definition, this approach is also called *outside-in process*: the know-how of a company is enhanced through the integration of suppliers, customers and external knowledge sourcing. The use of this external knowledge is influenced not only by the characteristics of the external source itself, but also by internal factors such as R&D capabilities and complementary assets. Furthermore, according to a study (Enkel & Gassmann, 2008), it emerges on the base of a sample of 144 companies in 2008 that the main external knowledge sources come from clients (78%), suppliers (61%), competitors (49%) as well as public and commercial research institutions (21%). In addition, a huge part (65%) of expertises derives from non-customers, non-suppliers and partners from other industries. Thus, within this approach, innovation networks are growing in importance as well as new forms of customer integration such as crowdsourcing, customer community integration and the use of innovation intermediaries. To be more specific, there are some mechanisms that facilitate companies to deal with these purposive inflows of knowledge such as scouting, in-licensing IP, university research programs, funding start-up, collaborating with intermediaries, suppliers and customers, utilizing non-disclosure agreements, crowdsourcing, competitions and tournaments, communities and spin-ins or spin-backs (Chesbrough, 2003; 2006a; 2014).

The second type of *Open Innovation* is the *outbound* approach. This requires organizations to allow unused and under-utilized ideas and assets to go outside the organization for others to use in their businesses and business models (Chesbrough, 2014). Alternatively, it can be defined as the transfer of innovative pathways toward the external environment to facilitate other companies to develop and commercialize advancements (Chesbrough & Crowther, 2006). For example, a company may out-licence its product to another firm which can help to further develop the product. Another way to define this approach is *inside-out process*, which stands for making money for instance by selling IP and multiplying technology by bringing ideas outside. When externalizing know-how, the focus is to transfer knowledge outside faster than what could through internal development. Companies adopting this process may have the possibility to enter in new segments of the market through licensing fees, joint ventures, spin-offs. According to the study previously mentioned in the first OI approach, 43% of the sample firms have an in-licensing policy in place while only 36% out-license to externally commercialize their developments (Enkel & Gassmann, 2008). Looking at the company size, it emerges large multinationals are more likely to possess an actively out-licensing policy. The inside-out corporate process is based on venturing activities, new business models such as spin-offs and the commercialization of own technologies in new market called cross-industry innovation. Chesbrough (2003; 2006a) has recognized as specific mechanisms for these outflows of knowledge out-licensing IP and technology, donating IP and technology, spin-outs, corporate venture capital, corporate incubators, joint ventures and alliances (for instance, being a supplier to or costumers of a new project instead of carry out the project internally).

Finally, the third type of *Open Innovation* is the *coupled innovation process.* At the beginning, the original paradigm theorized by Chesbrough was a sequential and linear model which considered only the inbound and outbound approach. However, Enkel at al. (2009) introduced after some time the concept of “coupled” practice, a two-way interaction between firms and innovative actors outside the firm’s boundaries. Therefore, the model started to include non-linear processes such as reverse flows of innovation, feedback loops and reciprocal communications (Bogers & West, 2014). Within the case studies, Procter & Gamble was one of the first to be analysed in connection to such feedback loops. Indeed, it presented a hybrid innovation process; in which, beside the search for the external innovators, there was also a feedback model. This hybrid approach is defined by Chesbrough (2014) as a mix of the inbound and outbound approach merged together since it involves combining purposive inflows and outflows of knowledge to collaboratively develop and/or commercialize an innovation (Chesbrough, 2014). Rather than merely sharing know-how, the companies jointly work by putting together their efforts to create new solutions and expand their knowledge. This could imply for instance a close integration such as a joint venture or an engagement through an innovation competition. In other words, this process refers to co-creation with partners through alliances, cooperation and joint ventures in which give (inside-out process: to bring ideas to market) and take (outside-in process: to gain external knowledge) are fundamental to be able to successfully develop innovation together. To manage these purposively mutual knowledge flows across the organization’s boundaries, there are some specific modes such as joint invention and commercialization activities and strategic alliances, joint ventures, consortia, networks, ecosystems and platforms (Chesbrough, 2014). According to the study already cited before, it has been discovered companies integrate external actors in 35% of all R&D projects (Enkel & Grossmann, 2008) and this percentage noticeably changes according to the category: in the electrical, electronic, IT and other high-tech industries it rises almost to 50% of all R&D whereas in the leather, wood and printing production it goes down to 20% or less. However, the coupled process is spread in all sized-companies. In addition, the external partner is chosen in a different way by different companies: some prefer non-competing actors and technology leaders, others like better word-class universities and others instead opt for local organizations.

1.5 Main forms of Open Innovation: a classification based on the types of changes involved

The main academic contributions have mainly dealt with knowledge flow directions; however, OI modes can also be classified according to the type of changes involved in the adoption and implementation process; namely technological, market and organizational changes. This distinction is based on a paper by Ahn et al. (2015), according which, for instance, every time an innovation is directed towards an existing market (horizontal shift), a certain degree of change (dominantly technological) is involved. Instead, if the implementation concerns an OI mode which also involves a vertical shift, a company has to face changes in both technology and market. This because, in the OI paradigm, firms not only use external technology, but also access to new markets to exploit their internal knowledge in different ways (i.e., IP licensing) or to make new organisations (i.e., M&A or spin-off) to absorb or examine a potentially innovative disruptive technology. Additionally, if a firm needs to establish new organisational structures to deal with any of the modes, there is a further degree of change (organizational).

Thus, Ahn et al. (2015) have proposed a new OI taxonomy (see Figure 1.3) by classifying the OI modes according to the dominant changes involved. Accordingly, "technology-oriented OI" refers to innovation activities, such as in-sourcing and joint R&D, aimed at technological innovation and, therefore, they bring in substantial increase in technology stock. In-sourcing is the fastest way of acquiring technological knowledge, but it does not usually involve a great deal of market and organisational change; while, joint R&D may occasionally entail some degree of organisational changes, but its focus is still on acquiring the necessary technology. "Market-oriented OI", on the other hand, attempts to identify new market needs. Examples are user involvement, open-sourcing, licensing-out; and, this last one may necessitate a certain level of organisational change (i.e., the creation of a new IP division), but the focus of this OI remains still commercialising under-utilised knowledge by generating a new market for it (for instance, by making a new commercialisation route). Last, "organisation-oriented OI" leads to substantial changes in a firm's organisational structure; and, examples of this OI mode are M&A/alliance and spin-off. Therefore, Ahn et al. (2015) have classified OI modes basing on the type of dominant, meant as the highest, core changes involved. For instance, authors have defined open-sourcing as “market-oriented”, since it emphasizes interactions with customers/users; and, M&A and spin-off as “organisation-oriented”, because their adoption involves mainly new organisational practices. However, even though this classification relies upon dominant changes, a higher level of change can include a smaller one. Just to mention some examples, a “market-oriented” OI can include technology changes; and, an “organisation-oriented” OI may involve different sub-level changes such as both technological and market ones, since it is the most complicated mode. Below, we present the classification already described; noting that a single mark denotes a low level of change, while a double mark indicates a high level of change.

Figure 1.3 – Open Innovation classification

	Dominant knowledge flow direction	Changes involved in OI			Dominant core change
		Technology	Market	Organisational structure	
In-sourcing (Licensing-in)	In-bound	✓✓			Technology-oriented
Joint R&D		✓✓			Technology-oriented
User involvement		✓	✓✓		Market-oriented
M&A/alliance		✓	✓	✓✓	Organisation-oriented
Open sourcing	Out-bound	✓	✓✓		Market-oriented
Licensing-out		✓	✓✓	✓	Market-oriented
Spin-off		✓	✓✓	✓✓	Organisation-oriented

Source: Ahn et al., 2015

1.6 Factors driving the advancement of Open Innovation model

In our premise, we have discovered that the *Open Innovation* model is generally employed as a necessary organizational adaptation to changes in the environment (Chesbrough, 2003). Specifically, these circumstances can be conceptualized in the following points:

- Globalization. It facilitates *Open Innovation* since it reduces barriers to international collaborations. Moreover, it simultaneously allows the mobility of skilled labour force with a consequent knowledge distribution; so that firms may work with the best talents independently from the location.
- Product complexity. It has increased to the point companies can’t build everything internally. Together with the tendency to focus on the core competencies, this pushes

firms to search for collaborations in order to get skills and knowledge they don't have and they need to, avoiding the complexity and costs of creating all in-house.

- Industry convergence. Defined as the blurring of technical and regulatory boundaries between sectors of the economy (Brant & Lohse, 2014), it generates new inter-industry segments. And, according to some empirical researches, *Open Innovation* models are most common in sectors marked by technology fusion, globalization and technology intensity (Huizingh, 2010).
- Information and communications technology (ICT). Since it reduces distances between individuals, it allows integration of new actors into the product development process. Therefore, it is possible to easily identify proper partners and to have partnerships across borders. Moreover, ICT advancement and connectivity enables new approaches such as crowdsourcing, innovation competitions and challenges.
- Tradability of intellectual property rights. It makes simpler the exploitation and the sharing of information and investment in innovation. In other words, companies can easily "transfer" knowledge and rights. Further, through IP protection and licensing strategies, it is possible to avoid exclusive appropriation of the results of collaborative efforts while encouraging access to complementary assets for mutual benefit.
- Growth of private venture capital. This facilitates the founding of start-up firms thus increasing the inclination of actors to commercialize inventions originating in enterprises or research centres (Herzog, 2008).

Summing up, globalization, product complexity, industry convergence, information and communications technologies, tradability of intellectual property rights and growth of private venture capital are then some factors driving the advancement of the *Open Innovation* model.

1.7 The value of Open Innovation

At this point of the discussion, it comes in mind a reasonable question about which are the possible benefits a firm can gain if it decides to adopt an *Open Innovation* approach. Therefore, to be aware of them, below we shortly list them.

- Shorter time to market with less costs and risk. Leveraging on external channels of knowledge, skills and technology allows companies to cut costs and to reduce the risk associated to invent everything internally.
- More innovation over the long term. To mention an example, according to a research across industry sectors, innovation performances are significantly improved by an

early integration of suppliers (Brant & Lohse, 2014). Therefore, this explains that having the right to use complementary assets a company doesn't have can stimulate the development of new and better products.

- Increased quality of products and services. Companies can better focus their R&D efforts when integrating downstream and/or upstream feedbacks into their innovative development process. In addition, an *Open Innovation* model allows going beyond the predisposition to do things in the same way they have been done, with a consequent increased probability of producing disruptive innovations.
- Exploitation of new market opportunities. The interaction of different ways of conducting R&D activities, within and also across companies, may facilitate new opportunities to come (Dahlander & Gann, 2010). For instance, firms may be able to enter in markets where their partners are active; while their own share is limited.
- More flexibility. In a rapidly changing environment, *Open Innovation* allows companies to gain flexibility and, in particular, to combine expertises on the base of variable needs. Just to mention an example, a firm may create a specific team of people with different skills and backgrounds dedicated to a specific project and then break it up when it is no more necessary.
- Improved absorptive capacity and innovation processes. An *Open Innovation* approach produces long-term benefits as the knowledge base emerged during collaborations keeps on growing within the firm and as the processes for development improve (Lichtenthaler, 2011). Moreover, it possible to exploit partners' assets such as reputation and investor relationships.
- Monetized spillovers. When part of the R&D efforts aren't exploited in-house, it is possible to use them for new commercial opportunities. For instance, abandoned project may be restarted through or with collaborators. In addition, under the OI model it is possible to spin-off a technology (Chesbrough, 2006b). That is the typical case of universities and research centres that may be willing to create spin-off in order to monetize their R&D investments and to reach the market with their fresh ideas.
- Positive externalities. *Open Innovation* can fuel technological advancement and further development. Companies may be able to expand their technological frontier outward more quickly thanks to the mix of complementary resources and skills. Moreover, they may be able to create more cost-effective solutions and improve their absorptive capacity as knowledge is shared among actors of the innovative network.

1.8 Prerequisites for successful Open Innovation

Once the main benefits of the *Open Innovation* model are presented, it is important to highlight that these advantages may be differently interiorized by firms according to their specific features. Indeed, on the base of the commitment by the firm's leadership, alignment of these innovation strategies to the business model, investments on organizational learning and ability to effectively deal with risks associated to knowledge share, companies may profit from the *Open Innovation* paradigm in different ways. In other words, according some authors, there are some internal characteristics companies possess facilitating a successful *Open Innovation* approach.

The first internal feature is the absorptive capacity that is the ability of a firm to identify and use relevant external knowledge (Bröring & Leker, 2007). Said differently, absorptive capacity refers to a firm's ability to use its own prior related knowledge to recognize, assimilate, and use external information for its own commercial ends (Cohen & Levinthal, 1990). This means companies should have a sufficient absorptive capacity in order to catch valuable external knowledge sources, incorporate it into their internal innovation process and then exploit it (Brant & Lohse, 2014). According to a contribution by Todorova & Durisin (2007), absorptive capacity is characterized as a bundle of five capabilities: recognition, acquisition, assimilation, transformation, and exploitation. So, the only identification and acquisition of external knowledge doesn't imply necessary that companies can incorporate this know-how into their own systems because, in absence of assimilation capacity, even if companies have obtained a good external technology, they can't gain economic value. A research highlights as a matter of fact that absorptive capacity amplifies the benefits of external innovation sourcing both on innovativeness and financial performance and, it also speeds the assimilation of external knowledge and its commercialization (Bogers & West, 2014). To conclude, a firm's absorptive capacity depends on its current level of technological knowledge (Cohen & Levinthal, 1990), which is derived from previous and current efforts in internal R&D; with the logical consequence that it is important for companies to invest in internal research, in order to have it (Brant & Lohse, 2014).

Another element helping an *Open Innovation* strategy to be successful is driving an organizational change. Indeed, it has been noted (Bogers & West, 2014) that organizational culture plays a crucial role in the willingness and ability of a company to successful profit from external sources of innovation. A critical factor is changing organization's corporate strategy and culture, both guided by the firm's leadership, toward an *Open Innovation* approach such as, for instance, defining decision-making processes to manage the results of knowledge share of different actors (Lichtenthaler, 2011) and establishing procedures to integrate the critical information emerged during collaborations into the own internal organization structure (Brant & Lohse, 2014). Indeed, external know-how can be absorbed only when companies are able to change their organizational structure and culture to make easy OI processes (Dahlander & Gann, 2010). For example, focusing on a cultural shift to openness within the firm to avoid the "not invented here" syndrome, that is the unwillingness to use and further improve others' solutions (Lichtenthaler, 2011); develop technical capabilities to assimilate external ideas (Bogers & West, 2014); or again, creating a long-term collaboration where the group is composed both by internal and external actors, to build trust and relationships, in order to encourage partners to share their most valuable skills and expertises (Brant & Lohse, 2014) are only some examples. Moreover, all these changes to implement these innovation strategies should be aligned with the company's business model. It is crucial to avoid that the existing business model of a company may be a limit on how external innovations are obtained, integrated or commercialized (Bogers & West, 2014).

In the end, the third aspect allowing a good implementation of an *Open Innovation* paradigm is having a knowledge management. When adopting an *Open Innovation* model, companies share know-how with partners and this may create a quite considerable uncertainty and risk. Thus, a critical factor is to have an effective knowledge management system that permits companies to engage in selective sharing with partners, licensing some registered and unregistered IPRs, while keeping other information only internally so that the expertise is shared outside the firm in a managed and strategic way.

1.9 Challenges of Open Innovation model

To facilitate a successful adoption of the *Open Innovation* model, beside the main features companies should have, it is important to consider there are also some challenges that should be faced by companies; for instance, to find the right partner, to manage information exchanges, to deal with complexity and risk; and, all of them involve several transactional costs. The first difficulty in *Open Innovation* is the valuation of knowledge since uncertainty may hinder licensing and other technology transactions (Dahlander & Gann, 2010; Enkel at al., 2009). Then, following difficulties are avoiding knowledge leakage and ensuring appropriation. This because there could be the so called appropriation risk meaning that companies may be exposed to misappropriations of their technologies and know-how by others. Hence, when engaging with partners, firms should bear in mind they must simultaneously disclose and protect their technologies; thus contributing without losing control over their intangible assets. To achieve this aim, intellectual asset management practices could be particularly helpful to guide how much to reveal to partners and under which conditions. Registered rights (such as patents) or unregistered rights (like trade secrets) may be used to clarify the ownership and control over resources and expertises that will be shared or transferred to external actors, without being exposed to the risk of free riding. For instance, through cross-licensing of patents, a firm can share its proprietary technology in exchange for the use of others' inventions. Therefore, firms are advised to address IP management as soon as possible in an *Open Innovation* context in order to evaluate the IP position of the partners and to agree on contracts to define how IP will be shared, managed and owned by partners.

1.10 Concluding remarks and research agenda

As we have seen in this chapter, company innovation strategies have recently been characterized by a trend towards more openness, with companies increasingly relying on outside information (Laursen & Salter, 2006). Chesbrough (2003) has labelled this change as the era of *Open Innovation.* Until now, a brief overview about it has been presented. Specifically, we have understood that *Open Innovation* (OI) is a distributed innovation process based on purposively managed knowledge flows across organizational boundaries (Chesbrough & Bogers, 2014). Furthermore, we have discovered the growth of *Open Innovation* has been driven by some factors conceptualized in globalization, product complexity, industry convergence, information and communications technologies, tradability of intellectual property rights and rise of private venture capital. Adopting *Open Innovation* practices may bring some potential advantages to companies; however, to effectively have a successful *Open Innovation* strategy implementation, firms need on one hand to own some specific features and, on the other one, to put attention to some connected challenges. Last, we have observed that *Open Innovation* has become a widely known business strategy in many industries (Dahlander & Gann, 2010). However, the majority of studies have focused on analyzing OI in large and multinational companies; whereas the knowledge of OI in small and medium-sized enterprises is still fragmented. With this regard, in the following chapter of this paper, we attempt to further investigate the *Open Innovation* adoption in SMEs, in order to build a unique and coherent framework of analysis.

CHAPTER 2: EXPLORING OPEN INNOVATION IN SMEs

Open Innovation has been widely studied in connection to large and multinational firms. Only recently, new application fields have been discovered by researchers and, one of the new wave is the relevance and the specific nature of *Open Innovation* in SMEs; as already mentioned in the first chapter. The aim of this section of our thesis is therefore to analyze this specific phenomenon in more detail, since the economic relevance of SMEs is particularly significant; considering that in Europe more than 60% of private sector jobs are in the SME sector, and more than 90% of all businesses are SMEs (European Commission, 2005). In addition to this, a more deeper study of the innovation process in SMEs is justified also by the fact that small firms plays an important role in the innovation landscape, since 30% of the total SME population in the EU27 are innovating in-house (European Commission, 2009); and, a minority of these innovative SMEs collaborate with other organizations (9.5% of all SMEs in the EU27), while a significant part (33.7%) also introduce innovative products, services and processes (European Commission, 2009).

2.1 A brief definition of small and medium-sized enterprise and an introduction to its peculiar nature of innovation

When defining a small medium-sized enterprise, the normal association is to consider SMEs as young technology companies (for instance high-tech start-ups) or new small firms. However, connecting SMEs only to young firms is a bias because the reality is more complex and, beside the young technological start-up firms, it exists also other types such as established SMEs that are at a later organizational lifecycle stage. Thus, with the aim to give a more appropriate description of a SME, we consider the official definition given by the European Commission Recommendations 2003/361/EC (see Figure 2.1). According to this, SMEs are identified by their “smallness”, which is legally defined in term of upper ceiling of number of full-time employees, yearly turnover, and/or annual balance sheet total. In particular, a SME is when it employs fewer than 250 employees. In addition to this headcount ceiling, a firm is qualified as SME if it meets either the turnover ceiling of less than € 50 million or the annual balance sheet ceiling € 43 million; but not necessarily both (European Commission, 2003).

Figure 2.1 – Definition of SMEs

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Source: European Commission

After a brief definition of the SMEs, we present their nature with regard to innovation, which is peculiar and can be explained by the typical characteristics of a small and medium-sized firm. First of all, a myth should be debunked: SMEs, compared to large firms, also have the capacity for innovation (Acs & Audretsch, 1988). Indeed, there has been an increased expenditure in R&D by SMEs: according to a research conducted by the National Science Foundation (2006), the share of SMEs in industrial R&D expenditures in the USA grew from 4.4% in 1981 to 24.1% in 2005. Moreover, not only high-tech and start-ups firms innovate, also low-tech and established SMEs play an important role in the innovation landscape (Santamaría et al., 2009).

Considering the innovation process and models in SMEs, a necessary premise is they are quite different from the ones of large firms because of its particular features. It should be said that SMEs are usually flexible, fast decision makers, quicker in reacting to changing demand, mostly governed by an owner-manager or by a group of partners or by family members, generally own less formalized R&D procedures, and they have material, human, resource constrains; (Chesbrough, 2014) which implies SMEs aren't always able to deal with all the innovation activities inside because of its liability of smallness. As a consequence, innovation in SMEs can show an external and boundary-spanning component. Indeed, some researches points out the importance of external relationships and networks in SMEs (Edwards at al., 2005; Macpherson & Holt, 2007). For instance, it has been studied that young biotechnology SMEs count on strategic alliances to innovate, allowing them to have access to critical resources, expand their knowledge base and build legitimacy and reputation (Chesbrough, 2014). Moreover, it has been discovered that SMEs involved in multiple ties are more innovative than the ones using only one type of tie (Baum et al., 2000); and, SMEs part of both formal and informal networks have a more positive impact on discoveries than others. Indeed, the presence of personal networks (meant as a wide variety of relationships of a member) supports the diffusion of innovation within SMEs (Chesbrough, 2014). However, even though SMEs can rely on these strong external relationships and interpersonal networks, it may occur they don't have the internal capabilities to exploit it because, for instance, they may not have the ability to proactively articulate their needs for external knowledge and, it may happen these social relations turn out to be a barrier to innovation when the SMEs become too dependent upon these relationships (Chesbrough, 2014). To conclude, inter-organizational relationships and networks are important in the innovation of SMEs; however, there is a "paradox" because even if SMEs may have these strong ties, they have difficulties in using these links in the best way (Chesbrough, 2014).

2.2 General overview on the adoption of Open Innovation in SMEs: main strategies and reasons to engage in the Open Innovation model

As already said at the beginning of the second chapter, the application of the *Open Innovation* model presents some differences in SMEs in comparison to large firms; and, this is one of the reasons to explain the importance of studying this new wave of research in the academic literature. To be specific, in large companies the *Open Innovation* paradigm is differently implemented from SMEs, due to the fact that the innovation process of large firms is typically more structured and professionalized; because they are able to formalize their innovation practices, to develop structures for licensing IP, venturing activities and external participations (Chesbrough, 2014). In addition to this, there is also a distinction of the degree of openness on the base of the dimension of the company. Indeed, according some survey-based studies conducted by Drechsler & Natter (2012) it exists as a matter of fact a positive relation between firm size and firm openness, so that, the higher the size of the company, the more is the firm openness. However, even though large companies appears to be more open than SMEs, there are other schools of thought (e.g. Barge-Gil, 2010) highlighting there is an inverted U-shape relationship between firm size and search breadth or, again, even if large companies are more open, SMEs have a higher *Open Innovation* intensity, namely a greater concentration of OI practices (Spithoven et al., 2013).

This recognized high concentration of *Open Innovation* practices in SMEs makes us curios to investigate about them. According to Van de Vrande et al. (2009), these generally include the involvement of network partners, customers and employees; while licensing IP, venturing and participation in other firms are considered unusual activities. Considering the type of approaches, SMEs tend to adopt more inbound *Open Innovation* activities than the outbound ones (Chesbrough, 2014). With reference to inbound mechanisms, they prefer non-monetary activities such as networking and informal knowledge sourcing with respect to complex transaction-based modes like in-licensing or acquisitions. This because the latter are resource intensive and need a lot of expertise and control over several aspects, which SMEs regularly lack (Dahlander & Gann, 2010). In contrast, the outbound approach is less spread; even if some cases of technology-driven and venture-capital backed entrepreneurial firms consider out-licensing of know-how and technologies as a substitute choice for developing a product and then selling it on the market (Chesbrough, 2014). Finally, among SMEs there are a range of varied paths toward *Open Innovation* and, diverse combinations of external knowledge sources are used; so, for instance, some open up only along the value chain, while others seek help from universities and research centres (Chesbrough, 2014). In other words, it means there are different paths of sourcing since small firms have access to different knowledge innovation sources and the value expected in each case may vary significantly (Brunswicker & Vanhaverbeke, 2014).

Till this point, it appears evident the diffusion of *Open Innovation* strategies in SMEs; and, this make us interested in understanding the attractiveness of this model and the reasons for small and medium firms to engage in. To do this, we look at the peculiar characteristics of the small-medium sized companies; which are the specific need for funding and the features of the innovation system. In the particular case of SMEs, the motivations for *Open Innovation* are stronger due to the limited resources. Indeed, for their liability of smallness, they have an incentive to search for alternative options to reach economies of scale, to ensure the provision of support services, to reduce risk, to increase operational flexibility and to market their products (van de Vrande et al., 2009). So far, it has come out, as a matter of fact, that due to their smallness and resource constraints, SMEs aren't able to cover all the innovation activities required to realize a successful innovation and, therefore, innovation in small and medium firms presents almost always an inter-organizational and boundary-spanning component (Brunswicker & Vanhaverbeke, 2014).

2.3 The importance of networks in the Open Innovation model for SMEs

As previously seen, a peculiar role in *Open Innovation* in SMEs is hold by the presence of a variety of formal and informal inter-organizational networks, which can be a driver of innovation performance (Ceci & Iubatti, 2012; Edwards et al., 2005). These networks may be for instance with suppliers, clients, other firms or universities and research centres.

Since innovation in SMEs is hampered by lack of financial resources, few opportunities to recruit specialized employees, small innovation portfolios with the consequence that the risks associated with innovation can't be spread; small firms may need to recur to networks to find missing resources since, sooner or later, due to their liability of smallness, they are confronted with their organizational boundaries (van de Vrande et a., 2009). Therefore, these networks can be used by SMEs to create value in earlier stage of the development process, to extend the technological skills and/or to get access to marketing and sales channels. Such networks are needed on one hand to improve the innovation process and, on the other one, to obtain complementary assets they don't own, in order to capture from external collaborators value they often lack (Chesbrough, 2014). In other words, since small and medium firms lack economies of scale in research, have less access to information and innovation resources to manage the whole innovation process; they are encouraged to collaborate in networks. Therefore, establishing direct or indirect network relations allows to small and medium-sized firms to access to required inputs in the innovation process, including skill accumulation through the combination of complementary skills and collective learning that occurs within networks. In this direction, according to a study conducted by Büchel & Raub (2002), SMEs engage more frequently in informal knowledge networks; and these knowledge networks are often regional initiatives focused on sharing information with a wide range of parties such as start-up firms, incubators, venture capitalists or experts (Collinson & Gregson, 2003). However, it should be stressed there is no universal optimal network structure as it depends on the goals of the network members. The only evidences emerged in literature are that weaker ties should be emphasized during the exploration or idea generation phase; while strong ties are more appropriate for innovation implementation or exploitation. Furthermore, the diversity of network ties bring in small and medium firms additional external resources, allowing to innovate across a broader range of activities. Finally, to conclude, according to Brunswicker & Vanhaverbeke (2014), it is the diversity and combination of innovation sources rather than their total number to be crucial for the success of a firm's sourcing strategy.

2.4 External resources for innovation

As emerged before, SMEs have a wide range of possible relationships, formal and/or informal, they can rely on, when adopting an *Open Innovation* approach. For instance, they could start collaborations with clients, suppliers, competitors, KIBS and/or universities. Since the aim of the collaborations is to develop and sustain the firm's technological capability, the choice of the partner results crucial. Indeed, there are differences among the various partners and these can even influence the type of innovation achieved (Whitley, 2002). Moreover, the external knowledge sources may have a different impact according to the technology intensity of the single firm. For example, sources like universities, research centres and suppliers seem to be more appropriate for pioneering high tech small firms; while demand-oriented SMEs tend to interact mainly with customers and users (Brunswicker & Vanhaverbeke, 2014). As a result of this, developing an appropriate collaboration strategy, to pursue *Open Innovation*, is an important step, that should be evaluated carefully according to the specific needs of the firm and the potential advantages in relation to the potential problems of the selected knowledge source.

Thus, at this point, it appears important to analyse the main academic contributions about searching strategies, each type of collaborator and the expected benefits on a firm's innovativeness. This would be an interesting premise for our next analysis aimed at verifying the impact of the different combinations of these possible collaborations on the innovation performance of small and medium-sized firms.

2.4.1 The role of universities and research centres in SMEs

University-industry collaborations (UIC) are increasing in importance according to the opinion of a lot of policy makers, since they are viewed as a way for firms to capture new opportunities, through valuable incoming knowledge spillovers. Moreover, in the academic contributions, universities and research centres are considered relevant sources for inventive trends and preindustrial knowledge as science may significantly alter the search for inventions (Brunswicker & Vanhaverbeke, 2014)**.** However, according to the Community Innovation Survey (CIS), it emerges that in Europe only a minority of SMEs use universities or research centres as source of information for innovation. Moreover, considering the specific case of our country, according to Colombo & Lanzavecchia (1997, p. 488), "as a knowledge-generating factor, universities and research organizations are less effective in Italy than in the other EU countries". Thus, it comes out a picture of a difficult relationship between universities and small firms, which can be explained both in the perspective of SMEs and universities. First of all, from the company's point of view, SMEs generally lack of absorptive capacity to benefit from academic knowledge (Spithoven et al., 2010). Whereas, from the university's point of view, there is the tendency to prefer larger consortia and longer-term efforts rather than investing in the creation of an interface user-friendly for SMEs (Bodas

Freitas et al., 2013). Further, there are also cultural differences such as the long-term scientific research versus exploitation-oriented research of companies and incompatible reward systems, with universities focusing on publishing and firm protecting results ((Brunswicker & Vanhaverbeke, 2014). Then, in addition to this, to obstacle this kind of relationship, there may be also some barriers, on one hand, for small firms to engage in collaboration with research organizations due to their unawareness of their real requirement and inability to communicate their problems and, on the other hand, for research centres in having experts with specific "techno-economic" capabilities to support SME innovation process (Rolfo & Calabrese, 2003).

Nevertheless, as highlighted in the premise above, even though there may be some obstacles for small firms to collaborate with universities and research centres; in literature, it has been stressed the crucial role that this kind of collaboration has on innovation performance of these firms. For instance, in Zeng et al. (2010), it emerges in Chinese manufacturing SMEs that cooperating with research organizations has a positive association with the innovation performance; due to the fact that such collaborations may bring new knowledge for companies through academic research activities while also providing skilled workforce; supporting and improving in this way the innovation outcomes (Zeng et al., 2010). To confirm this, there is also the research by Apa et al. (2018), based on a sample of manufacturing small and medium-sized firms of the Veneto region and specialized in low-medium technology sector, according which collaborations with universities positively impact SMEs innovation performance. Again, in the same direction, also Ahn, Minshall & Mortara (2015) have discovered that external collaboration with research institutes can contribute positively to performance in a sample of Korean manufacturing SMEs. Therefore, on the base of the above mentioned evidences from the academic world, the impact of university-industry collaboration generally appear to be positively associated to innovation performances of small and medium-sized firms.

2.4.2 Collaborations with KIBS

KIBS, also known as Knowledge Intensive Business Services, are enterprises whose primary value-added activities consist in the accumulation, creation or dissemination of knowledge for the purpose of developing a customized service (Bettencourt et al., 2002; Miles, 2005). In other words, they are consultancy firms offering high intellectual value-added services (Muller & Zenker, 2001); such as design, communication, R&D, ICT and advanced logistics services to their client firms (Di Maria et al., 2012). Therefore, thanks to their services, according to Miles et al. (1995), KIBS support the innovation process of their client firms (facilitator role), transfer existing innovations from one firm to their client firms (carrier role) or initiate and develop innovations in their client firms (source role).

The main advantage of this type of collaboration is that KIBS provide a point of fusion between more general scientific and technological information, dispersed in the economy, and the more local requirements and problems of clients firms. KIBS can be said to function as catalysts who promote a fusion of generic and quasi-generic knowledge, and the more tacit knowledge, located within the daily practices of the firms and sectors they service (den Hertog, 2010). Indeed, KIBS both provide knowledge and innovation for clients companies and acquire knowledge from clients companies. However, it is necessary a strict and continuous interaction between KIBS and clients firms; in order to facilitate KIBS in accelerating production, development and management of knowledge for their customers companies. Eventual physical but also cultural, economical, industrial, institutional or cognitive distance obstacles indeed the exchange of knowledge (Di Maria et al., 2012).

Manufacturing firms appear to be prone to engage in collaborations for innovation purposes with KIBS. As illustrated in Di Maria et al. (2012) KIBS have assumed an increasingly important role in term of creation and transfer of knowledge, innovations and technologies in this sector; since the presence of more and more sophisticated technologies, highly specialized services, global competition and the general tendency to focus on the core competencies has pushed manufacturing companies to search for complementary resources along the value chain and to outsource knowledge intensive services. Indeed, manufacturing companies increasingly outsource not only the production of components, for which they don’t have distinctive skills; but also the management of services ranging from logistics to strategic analysis (Di Maria et al., 2012). The competitive advantage is therefore closely linked to these collaborations on which depend the attributes of their products (consulting, R&D and design), the communication strategy (marketing services) and market positioning (logistics and distribution). Therefore, if the manufacturing enterprise must excel in its core activity based on production, all the support activities may be provided by KIBS; which give the inputs and support often crucial for the success of their clients firms (Di Maria et al., 2012).

Considering some empirical investigations present in literature, the adoption this type of collaboration in the manufacturing sector is associated with positive innovation performance. For instance, according to a contribution by Bustinza et al. (2017), on a sample of 370 worldwide large manufacturing companies, KIBS partnership extends the positive effect of innovation development and increase performance outcomes such as profit and customer satisfaction; thus making KIBS an innovation catalyst. This positive impact on innovativeness is also confirmed in manufacturing SMEs. Focusing on innovation interactions between manufacturing small and medium-sized enterprises and KIBS, the empirical analysis conducted by Muller & Zenker (2001) has shown that French and German manufacturing SMEs interacting with KIBS are more oriented towards innovation than non-interacting firms and that KIBS may be seen as potential co-innovators for SMEs.

2.4.3 Inter-firm collaborations

Inter-firm cooperation is pursued by companies for example to gain sources of know-how located outside their boundaries, to get fast access to new technologies or new markets, to benefit from economies of scale in joint R&D and/or production and to share the risks of activities that are beyond the scope or capabilities of the single firm (Zeng et al., 2010). Generally, the innovative partners for inter-firm cooperation are customers, suppliers, producers, services providers and competitors. According some studies cited by Zeng et al. (2010), these inter-firm cooperations may lead firms to incremental and radical innovations, both through informal arrangements and formal long-term strategic alliances. Due to its evident importance, the role of these inter-firm collaborations has obtained great interest in academic researches. In particular, Zeng et al. (2010), has discovered that the cooperation with customers, suppliers and other firms plays more distinct role in the innovation process of SMEs than horizontal cooperation with research centres and universities. Indeed, in their research, these authors have found that networking activities are primarily based on vertical relationships (customers and suppliers) rather than on horizontal linkages (industry-university). Therefore, considering its relevance, in the next section we will analyze the main points of these vertical relationships in networks.

2.4.4 The role of collaborations with customers and suppliers

As we have just mentioned, collaborations with customers and suppliers play an important role for small companies adopting an *Open Innovation* model. In particular, through vertical collaborations with clients and/or suppliers, firms may gain significant information about new technologies, markets and users' needs (Whitley, 2002) with a great impact on both product and process innovation. Moreover, customer-supplier involvement offers significant advantages such as increased market share, inventory reductions, improved delivery service, improved quality, and shorter product development cycles. Hence, below, we will analyze in depth the most important implications of these relationships for small firms, which commonly use their suppliers and clients as valuable source of technological information.

Considering the cooperation along the upstream value chain with suppliers, Brunswicker & Vanhaverbeke (2014) highlight it allows companies to gain usually technological expertise with the possibility to involve them in their new product development (NPD). Suppliers indeed may be able to give ideas to improve technological solutions or process innovations. So, expressed differently, though a collaboration with suppliers, firms may get their expertise to advance products or create new methods for product improvement (Tsai, 2009). Furthermore, some researchers (among them, Zeng et al., 2010) suggest that this relationship permits companies to reduce the lead times of product development, while improving flexibility, product quality and market adaptability; since, as already said, suppliers are an important sources of information to improve products. Indeed, suppliers have a more comprehensive knowledge about the components required by a firm for its product development. Moreover, supplier's involvement allows firms to identify potential technical problems, with the potential benefits of speeding up new product development and responses to market. Numerous researches have been conducted to analyze the role of suppliers and, the general result is there is a positive impact of the collaboration with suppliers on the innovation performance. For instance, using the French CIS-2 survey, Miotti & Sachwald (2003) have found that there is a positive effect of collaboration with suppliers on the share of innovative product turnover. Also Faems et al. (2005) have discovered that there is a positive association between suppliers and the proportion of turnover linked to improved products analyzing Belgian manufacturing firms; or, again, in a survey of Spanish manufacturing firms, Nieto & Santamaría (2007) have shown a positive link between collaboration with suppliers and the degree of product innovativeness.

Also on the other hand, looking at the collaboration along the downstream value chain with customers and clients, there are some positive implications in the innovation performance of companies. For instance, Zeng at al. (2010) explain that cooperation with clients could be beneficial to develop more novel and complex innovations. In other words, this means that clients and customers as sources of information should be used more frequently by firms when the innovations under development has a higher degree of novelty. This because, according to Brunswicker & Vanhaverbeke (2014), interaction with customers give access to "sticky information" on customer needs, customer context and customer experience so that their involvement may provide new insights into new business opportunities beyond the existing products and markets. In addition to this, it has been also observed that the virtual customer integration into a company's innovation process could provide valuable input for new product enhancements (Zeng et al., 2010). Indeed, cooperating with customers allows companies to better identify market opportunities for technology improvement and to reduce the probability of poor design in the early stages of development; thus increasing the chances of success of new products. Moreover, understanding the needs of potential customers may facilitate firms to obtain new ideas about products (Tsai, 2009). To confirm all this, the study conducted by Faems et al. (2005) has pointed out that collaborating with customers has a positive impact on product innovation performance of Belgian manufacturing firms.

Therefore, summing up, the academic contributions point out the existence of a general positive link between collaborations with suppliers and clients and the innovation performance of small firms. For instance, a case study based on Brazilian SMEs highlights that cooperation with suppliers and customers could promote new product development (Kaminski et al., 2008).

2.4.5 The role of collaborations with competitors

Another *Open Innovation* practice to gain external resources is collaborating with competitors. This phenomenon is also known as co-opetition and, it can be defined as a simultaneous cooperation and competition between firms.

On a base of a research, it has been discovered that over 50% of collaborative relations are between companies within the same industry or among competitors (Gnyawali & Park, 2009). Generally, the collaboration with competitors may happen with the aim of carrying out basic research and establishing standards; and it may be possible when companies face common problems that are outside the competitor's area of influence, for instance pre-competitive research programs or co-production arrangements (Tether, 2002). Through these collaborations, firms involved share technological knowledge and skills with each other; producing in this way a synergic effect on solving their similar issues. According to another perspective of Von Hippel (1987), competitors also collaborate when technological progress may be faster with joint efforts rather than individual ones, when combined knowledge offers better advantages than the single one and, when a unique knowledge doesn't provide any major competitive advantage. However, on the other side of the coin, it should be noticed that, out of the specific context below cited, it may arise some difficulties when cooperating with competitors, especially in relation to the nurture of the inter-firm relations due to the fact that, for instance, joint commitments may be particularly vulnerable to opportunism and they may turn to be problematic if synergies are not easily transparent (Tomlinson & Fai, 2013). Indeed, some risks connected to collaborations with competitors such as the technology leakage to rivals and the loss of control over the innovative process should be considered (Ritala & Laukkanen, 2012).

As a consequence of this, in literature, the impact of this type of collaboration on SMEs innovation performance appears to be ambiguous. On one hand, according to a study conducted by Quintana-Garcia & Benavides-Velasco (2004) and based on a 5 year panel examination of 73 European SMEs in the biotechnology sector, it has been found that co-opetition has a positive impact upon a firm's innovative capacity. Nevertheless, on the other hand, there are also some papers arguing the contrary. For instance, the contribution by Tomlinson & Fai (2013) declares that co-operation with rivals in manufacturing SME has no significant impact upon innovation; whereas, the study by Nieto & Santamaría (2007) shows that collaboration with competitors has a negative impact on the novelty of innovation; and, in the same direction of the last one, there are two papers involving UK SMEs, which also explored the impact of co-opetiton upon innovation (De Propris, 2002; Freel & Harrison, 2006).

2.5 Open Innovation challenges for SMEs

As seen in the previous sections, it is important for SMEs to find partners to collaborate in order to get knowledge and expertise. However, this need implies a dilemma for SMEs because, on the other hand, there is the difficulty faced in finding collaborators and insufficient internal structures to acquire and absorb the required knowledge. According to Chesbrough (2010), small and medium firms face indeed some deficits because they may lack the necessary capabilities to identify, transfer, absorb external knowledge and technologies effectively from outside into their processes.

The first one is the lower absorptive capacity due to the fact that SMEs typically don't have the ability to support dedicated resources and personnel to build structures in order to identify external knowledge (such as technology outposts and university liaison managers).

Then, the second one affecting again the absorptive capacity is the lack of ability in absorbing external ideas and technologies, even when they are initially indentified and transferred. Since external ideas may require a modification in order to be effectively used, it may happen SMEs don’t have employees with the necessary background to understand, absorb and exploit the scientific inventions. Moreover, they may also not have established technical advisory boards that help companies incorporate ideas and technologies into their own processes.

Third, SMEs may be unattractive partners to others because, for instance, they don’t own the resources to provide research funding to support promising academic research or because they often lack an institutionalized and well-structured innovation process.

Fourth, small and medium firms may have difficulties when capturing value due to the fact that they don’t have the market power to benefit from their external sourced knowledge, if not protected by intellectual propriety rights. This may happen because most of SMEs may have a limited ability to profit from intellectual property, since they may lack enforcement power, which furthermore may be also risky. For instance, in the US, the cost for enforcing a patent infringement is typically on average around $500.000 if the value is below $1 million and, this is a higher cost than most SMEs can effort (Chesbrough, 2010). In addition to the cost and risk of legal enforcement, small and medium firms may face often an economic dependence on large companies as they may be their key suppliers or customers; and this may limit their ability to profit from their discoveries. For example, it is not a possible option for most of SMEs which discover a patent infringement by a large company to decide to go to court because this could be dangerous if this large company is its largest customer.

In the following paragraph, we analyze more in detail two of the main challenges of *Open Innovation* for small and medium-sized firms, that are the issue of IP protection and the management of the internal processes when shifting toward this model.

2.6 Intellectual property management in SMEs

One concern for firms engaging in *Open Innovation* is the Intellectual Property (IP) protection. There are two kinds of protection mechanisms: formal, such as patents and trademarks, and informal, such as trade secrets. While large firms may be facilitate to have both types, SMEs face some limits.

According some studies, there is evidence SMEs have difficulties to adopt patents since its maintenance is usually costly and the process to obtain them is complex, with many regulations and procedures. Moreover, since SMEs have limited resources, the cost of patents makes them less attractive. So, small and medium firms tend to prefer more informal IP protection mechanisms, such as speed to market or secrecy rather than formal ones (Chesbrough, 2014). Nevertheless, formal protections are important both to support knowledge sharing in the sense that knowledge transfer is easier as for example patents help to define the IP rights explicitly; and, as signalling devise to demonstrate the technological capabilities. This last point is particularly relevant for SMEs because having a patent is almost a requirement to get any kind of VC funding or for larger firms to be willing to collaborate with the smaller ones. Therefore, formal IP protection not only facilitates knowledge flows, but it may be actually a prerequisite to engage in *Open Innovation*, at the base of negotiations with VCs and potential partners.

However, even if formal IP protection is important, there are some authors arguing that free revealing is also a useful form for some SMEs to overcome their liability of smallness (Chesbrough, 2014). Indeed, SMEs may benefit from selectively revealing some part of their intellectual assets for free usage by others; for instance, in the case of an open source software development or in the pharmaceutical sector, in which freely revealing allows companies to join the larger research community.

As a result of this, there isn’t a one-size-fits-all approach towards IP management since it differs among industries and types of firms. SMEs in the service industry, for example, are much more likely to rely on the speed to market, while SMEs in intensive R&D sectors more regularly engage in patenting (Chesbrough, 2014). Therefore, the role of IP management depends on the contingent factors such as technological environment and the knowledge distribution therein: patents are particularly useful in calm environments where knowledge stays with a few players; whereas in turbulent environments with distributed knowledge more benefits are achieved with free revealing (Chesbrough, 2014). So, to conclude, the IP management is important for SMEs since not only allow to avoid unintended knowledge spillovers, but mostly allow to accelerate and facilitate knowledge exchange and partnership formation.

2.7 Towards Open Innovation: managing internal processes and internal organizational facilitators of openness in SMEs

Once the *Open Innovation* paradigm is adopted, the second concern is to deal with it internally. Indeed, firms face several difficulties when shifting from a closed to an *Open Innovation* approach due to the fact that many companies, including SMEs, rely on a trial and error process rather than on an established organizational practice (Chesbrough, 2014). In particular, in order to be able to manage the transition from closed towards *Open Innovation*, SMEs should firstly understand their internal organizational approach with their systems and routines; to secondly work on some kind of organizational changes, which implies new internal capabilities (Chesbrough, 2014).

The prerequisite for all this is to own the so called absorptive capacity, which we already defined in the first chapter as the ability to absorb external capacity in order to benefit from it (Cohen & Levinthal, 1990), which is in addition built through internal investment in formal R&D. Thus, the presence of formal R&D seems to impact in the ability to profit from *Open Innovation*; however, in small and medium firms, R&D is usually not a formal process. However, going a bit step ahead, even though absorptive capacity is important for successful *Open Innovation,* it is not a complete concept because it explains only how to use external information internally, especially in the inbound approach, without capturing all the dimensions of managing knowledge flows; such as the outbound approach (Chesbrough, 2014). Therefore, recent theoretical contributions by Robertson et al. (2012) have added other capacities for managing these different knowledge processes in *Open Innovation*, which complement the construct of absorptive capacity. Thus, the new capabilities required to apply knowledge and to turn internal and external knowledge into successful outcomes are the “accessive, adaptive and integrative capabilities” (Robertson at al., 2012). Furthermore, these capabilities need a sort of higher order abilities to be guided. These last are the knowledge and innovation management abilities, which work as facilitators for *Open Innovation*. However, in the specific case of SMEs, they are regularly lacking (Robertson at al., 2012). So, to create such knowledge and managerial capabilities, SMEs require new systems, processes and routines; which should be also related to different managerial levels such as the strategic, the operational, the cultural and the network level (Chesbrough, 2014).

Finally, to facilitate and gain from external knowledge sourcing, especially in the case of SMEs, the possession of some internal organizational facilitators is needed. Specifically, these are integrative managerial practices; which implies both strategic and operational elements, for effective and efficient achievement of organizational innovation goals. For instance, these practices should support activities aimed at the identification of external knowledge and future innovation areas, while also integrating internal and external knowledge flows in order to enable firms to launch individual innovation projects. According to Brunswicker & Vanhaverbeke (2014), there are four internal organizational practices that help in this sense. The first one is the long-term innovation investment. Indeed, financial innovation assets are crucial since they give resource slack and allow the firm to engage in riskier innovation projects. Moreover, the internal spending on innovation provides an idea about the internal learning activities and desire to explore. So, it is an important organizational facilitators for external knowledge sourcing since it enables SMEs to build sufficient internal knowledge and may motivate firms to open up to external sources. The second element is the innovation strategy, which supports the identification of future business opportunities and the exploitation of new technologies and also helps to recognize the value of new external information and knowledge. The third one is the innovation development process. The use of formal systems and procedures for NPD are important in innovation management because they help managers to coordinate and integrate the development of innovations in a structured manner. Finally, the fourth and last practice is the innovation project control, which permits firms to measure and manage innovation projects and processes in an efficient, goal-oriented manner in order to turn their innovation potential into value-creating outcomes. Indeed, clearly defined measures and targets for timing, resources and ensuring quality are essential. Definitely, innovation project control helps firms to reconfigure activities, ensures that innovation measures are carried out within budget, on schedule and at a satisfactory level of performance and facilitates external knowledge sourcing as it controls operational activities and the exploitation of both external and internal knowledge.

2.8 Some theoretical observations about Open Innovation performance in SMEs

Our aim of this section is to discuss, from a theoretical point of view, the performance of the application of an *Open Innovation* model in the innovation process of SMEs. We present some general considerations that can be grouped in three categories: degree of openness (OI proxies), impact of individual OI mode and collaboration influence; according to the specific thematic faced in the main academic contributions.

As a premise, the first contributions have identified the effect of openness on firm performance. Laursen & Salter (2006) have defined the search strategy as a proxy variable for a firm's openness by introducing the "breadth" and "depth" search concept as two distinctive dimensions of openness and, on the base of a sample of SMEs in the UK, they have found that small firms which are more open to external sources or channels are more likely to gain higher level of innovation performance; and, in another paper, the same authors (Laursen & Salter, 2014) have further specified there is a concave relationship between firm's breadth of external search and formal collaboration for innovation and the strength of the firms' appropriability strategies. Using the same approach, Chen et al. (2011) have found that the breadth and depth of openness can improve both science-based and experience-based innovation, while Chiang and Hung (2010) have found that breadth affects incremental innovation, whereas depth influences radical innovation. In addition to this, *Open Innovation* also has a significant mediating effect on the relationship between organizational inertia and business model innovation and on the relationship between organizational inertia and firm performance (Huang et al., 2013). Considering a more deeper contribution about the implication on performances, some authors have discovered it exists a curvilinear relationship (inverted U-shape) among SME's *Open Innovation* via external collaboration and innovative efficiency. Indeed, adopting too many OI practices may be risky for SMEs since small firms may not be able to focus on a lot of managerial options simultaneously. For instance, OI adoption implies challenges, such as more managerial choices and difficulties in finding trustworthy partners, which may increase uncertainty levels. Thus, the intensive adoption of OI is preferred to the adoption of too many OI approaches because the first one has more possibilities to contribute to the enhancement of firm performances (Mo Ahn, Mortara & Minshall, 2015).

In the second group, instead, there are authors focusing on the individual effect of each OI mode. According to their contributions, it has been shown the impact of each single OI practice is different on performance. For example, Brunswicker & Vanhaverbeke (2014) have found that not all OI modes are always beneficial in enhancing innovation performance. In this direction, there is also Mazzola et al. (2012), which have examined the effect of twelve different OI modes on financial and innovation performance and have found that the OI effect can be both positive and negative.

Finally, the third group of researchers have studied the effect of collaboration. It should be highlighted that the impact of external collaborations on the innovative performance is different according to the type of partners, with whom small firms decide to work together. For instance, in a survey conducted in the Chinese manufacturing SMEs, it has been pointed out that there are significant positive relationships between inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations on innovation performance of SMEs and, in particular, inter-firm cooperation has the most significant positive impact on the innovation performance of these SMEs. In the same direction, there is also an analysis conducted by Brunswicker & Vanhaverbeke (2014), which has been confirmed the different effect on innovation performances of diverse sourcing choices; namely minimal (no actively interaction with external sources), supply chain (relatively intense interactions with direct customers and suppliers in comparison to other external sources), technology oriented (relatively high degree of interaction with universities, research organizations and IPR experts), application oriented (indirect customers and users as the most important input source in relation to others) and full scope sourcing (heavily interaction with all various of innovation sources); and specifically, they have discovered that full-scope and application-oriented offer direct performance benefits in innovation performances. Moreover, Almirall & Casadesus-Masanell (2010) have simulated the effects of OI in two different settings: where partnerships were fixed or flexible and, they have showed that a high level of openness is associated to better performance, especially in a dynamic environment where firms can freely change their partners. Finally, different innovation modes can be reached with different types of external. For instance, according to Chen et al. (2011), collaboration with universities and research institutes affected science-based innovation; whereas this type of collaboration doesn't influence experience-based innovation, which instead is influenced by value chain partners and competitors.

After a theoretical discussion on the implication of the *Open Innovation* model on innovative performance of small and medium firms, in the next section we will analyse how the innovation performances have been studied from a statistical point of view.

2.9 A review of some selected academic contributions about Open Innovation performance in SMEs

Before introducing our analysis, we would like to provide now a brief overview of the statistical researches already present in the existing literature about the performance impact of *Open Innovation* strategies in manufacturing small and medium firms; in order to understand which are the main objectives and focuses of the studies, types of analysis done, dependent and independent variables used and also, in order to be aware of where our research will fill in. To select the academic contributions, we use a subjective selection method of the most significant reports according to the aim of our discussion. So, we decided to limit our research only to papers discussing the impact of *Open Innovation* practices on innovation performances for manufacturing SMEs (the restriction was done by searching in the scientific database the keywords "open innovation", innovation performance", "manufacturing smes", "cooperative networks") and then we select the most recent publications on the most important economics and business journals for R&D and innovation management. Simultaneously, we also compared our selection with a screening done by Chesbrough (2014) on mapping the field of research on *Open Innovation* in SMEs; to check to have included the main papers in the topic.

The first academic contribution we have selected comes from Spithoven, Vanhaverbeke & Roijakkers (2013) and addresses how small and medium-sized enterprises use OI practices and how the resulting benefits differ from those of large companies. To capture the effect of OI practices on innovative performances in SMEs and large firms, the authors used two distinct innovative performance measures as dependent variables that are the market launch of a new product/service (dummy variable with value 1 if the firm introduced an innovation on the market during the period considered and value 0 if the firm didn't launch any innovative products or services) and the turnover resulting from this innovation. They avoided to use patent activity as a key indicator for innovation embracing the thesis suggested by Laursen & Salter (2006) according which patenting behaviour depends on the specific sector and is often related to the size of the firm since large companies tend to patent more than smaller ones. Instead, to examine whether OI practices in SMEs have a different impact on firm performance compared to large companies, the authors followed adopted as explanatory variable a composite indicator capturing four categories of OI activities: the search for external of innovation (divided in market sources, institutional sources and other available sources), the acquisition of external R&D (acquisition of ready-made products/services by third parties, acquisition of processes by externals, outsourcing of R&D activities, acquisition of innovative externally developed machinery and acquisition of external knowledge through licenses or other contracts), the use of collaborative innovation partners (clients, suppliers, competitors, consultants and private R&D organizations, universities, public research organizations) and the exploitation of available IP protection mechanisms (patents, industrial designs, trademarks, copyrights). Since all OI practices are equally important, they were rescaled between a minimum value of 0, meaning there was no use of them, and a maximum value of 10, implying they were all used. Moreover, they added a set of commonly used control variables when studying OI that are group membership, R&D intensity, internationalisation and type of industry. So, with the selected variables, they conducted a quantitative analysis through a regression model based on the Community Innovation Survey 2006 in Belgium and, the main finding of their research highlight that SMEs launch fewer new products/services to the market than large companies, but the share of turnover generated from these products/services is nearly equal to that of large firms.

The second paper we consider is by Brunswicker & Vanhaverbeke (2014) and it is an exploration of different inbound sourcing strategies and internal managerial facilitators of *Open Innovation* in SMEs, based on a quantitative study on firm-level data of European SMEs. In their analysis, the authors firstly conceptualized five types of external knowledge sourcing strategies namely minimal (no actively interaction with external sources), supply-chain (relatively intense interactions with direct customers and suppliers in comparison to other external sources), technology-oriented (relatively high degree of interaction with universities, research organizations and IPR experts), application-oriented (indirect customers and users as the most important input source in relation to others) and full scope sourcing (heavily interaction with all various of innovation sources). Secondly, they examined the performance impact of each sourcing strategy; and, in the last step, they looked at how different sourcing strategies relate to different internal organizational practices for innovation (meant as long-term innovation investment, innovation strategy processes, innovation development processes and innovation project control). Since in our discussion the focus is on OI performances, we only consider the investigation made by the authors on the effect of the sourcing choice on innovation performance and we skip the estimation of the relation between external knowledge sourcing and internal organizational practices. So, to study the potential performance impact of each sourcing strategies, they used a regression analysis. In particular, they used as independent variables the categorical variables describing the firm's sourcing strategy (minimal, supply-chain, technology-oriented, application-oriented and full scope sourcing) and, as dependent variables, they consider two dimensions of innovation performance that are innovation success (measured as percentage of innovation projects meeting launch targets) and income from innovation (measured as share of income from new products/services not older than three years). In addition to this, control variables were also used to account for firm's age and size, innovation effort and industry groups. The analysis run by the authors highlight that engaging in external knowledge sourcing can improve innovation performance in the two dimensions of success of launching an innovation and the appropriation of financial value from new products/services. In particular, they identify two sourcing strategies, full-scope and application-oriented, offering performance benefits in the two dimensions above. Moreover, this analysis complement prior academic works, focused only on the number of external knowledge sources, because it suggests the nature of sourcing matters.

The third analysis we present is by Zeng, Xie & Tam (2010) and it is an empirical explanation of the relationships between different cooperation networks and innovation performance of small firms. Before explaining their analysis, it should be highlighted that, in this paper, authors follow a different definition for SME with respect to the one we have provided at the beginning of the chapter. In particular, they used the American Small Business Administration (SBA)'s definition of SME, which considers as cut-off for the size firms having fewer than 500 employees. Then, the analysis was conducted through the technique of structural equation modelling (SEM) and based on a survey to 137 Chinese manufacturing SMEs. Structural equation modelling is a multivariate statistical technique, which is broken up into one part consisting in the measurement model, which reduces observed variables to a smaller number of latent factors, and a second part consisting in the structural equation model, which defines causal relationships among these latent factors. The latent factors in this model are inter-firm cooperation (identified by customers/client, suppliers, competitors/rivals as observed variables), cooperation with government agencies (innovation service departments, information service departments and supervision service departments as observed variables), cooperation with intermediary institutions (observed as technology intermediaries, technology market, industrial associations and venture capital organizations), cooperation with research organizations (universities, research institutions and colleges/technical institutes as observed variables) and innovation performance (measured using three indicators: proportion of annual turnover of new products, new products index and modified products index). The result of the study of these causal relationships shows up there are significant positive relationships between inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations and innovation performance of SMEs, of which inter-firm cooperation has the most significant positive impact on the innovation performance of SMEs. Surprisingly, the result reveals that the linkage and cooperation with government agencies don't demonstrate any significant impact on the innovation performance of SMEs. Finally, these findings confirm that the vertical and horizontal cooperation with customers, suppliers and other firms plays a more distinct role in the innovation process of SMEs than horizontal cooperation with research institutions, universities or colleges, and government agencies.

A fourth paper by Tsai (2009) is considered in our discussion. Even if the sample is not only about small-medium sized firms, we decided to include in the review since the methodology the author used in his research was quite interesting and a bit different from other ones in the formulation of the variables. This research examines the impact of different types of partners of collaborative networks on product innovation performance and how these relationships are influenced by the absorptive capacity of a firm; using a sample of companies from the Taiwanese Technological Innovation Survey jointly conducted by the National Science Council and the Ministry of Economic Affairs in 2002. The models, estimated by OLS-based hierarchical regression and further explored by firm size and industry type, contain as dependent variable the product innovation performance, as independent variables four types of collaboration with different partners (including suppliers, customers, competitors, research institutes and universities) and, as moderating variable, the absorptive capacity, which is measured by dividing the firm's total expenditures on in-house R&D activities and training programs for technological activities in the past three years by its total number of employees in a current year. Moreover, to eliminate or reduce the bias from cofounding effects, controls about industry dummies, firm size, labour quality, inward technology licensing and subsidiary (multi-nationally) dummy are included. To be more specific, the dependent variable, namely product innovative performance, is measured by innovative productivity as the sales generated by new products per employee (i.e. the ratio of sales attributed to new products divided by the total number of employees). These sales include technologically new or technologically improved products introduced to the market within the past three years. With reference to this, the author has explained not to use the volume of new products sales because it would be correlated with firm size. Instead, each of the independent variables were constructed by the product of two variables: one is a dummy which takes value from 0 to 1 if the firm is engaged in collaboration with a specific type of partner and, the other one indicates the relative importance (high, medium, low) of collaboration with this partner, that is how close is the relationship. Some interesting findings of the research are: firstly, absorptive capacity positively moderates the impact of vertical collaboration on the performance of technologically new or improved products; secondly, absorptive capacity negatively affects the relationship between customer collaboration and the performance of marginally changed products; thirdly, absorptive capacity negatively affects the relationship between collaboration with research organizations and the performance of technologically new or improved products.

The fifth research we present is by Ahn, Mortara & Minshall (2015) and it studies the impact of *Open Innovation* on firm performance, on the base of survey data from Korean innovative SMEs. The model contains a dependent variable about performance, and two independent variables about *Open Innovation* and collaboration partners (studied in two separated models). The performance variable is a three year-average value measured by three indicators: sales, new product development and relative market share. Instead, to measure *Open Innovation*, two binary variables about breadth and depth (meaning how many OI modes are used and how intensely) were included. Speaking about the variable for collaboration partners, authors have specified it in term of collaboration with other firms, customers/clients, affiliated firms, consultancy/intermediaries, universities, research institutes and, it was also explored how broadly and intensively a firm collaborate with external partners, in order to capture the frequency and the intensity. Finally, to avoid biased results, authors decided to control for the internal investment in R&D (since it is an important indicator in generating and absorbing knowledge), firm size (because abundance of resources is a critical factor for innovation), firm age (due to the fact that the age of a firm may influence innovation), government support (as public funding may encourage networking and interactions) and market turbulence (since a competitive setting may be a strong driver for change). According to the quantitative analysis run, the study shows that broad and intensive engagement in OI and cooperation with external partners are positively associated with firm performance; technology and market-oriented OI modes (joint R&D, user involvement and open sourcing), involving relatively low level of changes, can positively contribute to performance enhancement; and, innovative SMEs benefit from working with non-competing partners, such as customers, consultancy/intermediaries and public research institutes.

Lastly, the final paper we include in this section is by Tomlinson & Fai (2013) and it explores the relationship between innovation (both product and process) and types of co-operation along the vertical supply chain and horizontally with competitors. This has been done through a multi-scalar and multi-dimensional analysis, in order to capture both the scale and the various dimensions of collaboration and, to assess whether the strength of co-operative ties advances innovative capability among SMEs. Based on a survey of UK manufacturing small and medium-sized companies, the authors have executed a hierarchical multivariate regression, where the dependent variable (innovation, which is a composite measure that captures both product innovation – in term of the number of new product lines introduced – and process innovation – as the number of changes/improvement to existing product lines) was first regressed on the control variables (firm size, R&D expenditure, sales revenue growth, industry dummy) and, then, the model was supplemented with the predictor variables (buyer co-operation, supplier co-operation, competitor co-operation). This executed analysis puts in evidence that the strength of cooperative ties within the value chain are important facilitators for SME's innovative capability (hence SME's innovative activity benefits from good, close dyadic relations within the supply chain), being true this for both product and process innovation; whereas, co-operation with rivals appears to have no significant impact upon innovation.

To conclude, for the sake of simplicity, we present below in the following Table 1 a small summary of the main contributions above discussed.

Table 1 – Review of the main academic contributions about OI performance in SMEs

Author(s)	Objective and focus of the study	Type of analysis and data source	Dependent variables	Independent variables
Spithoven, Vanhaverbeke, Roijakkers (2013)	Investigation on how OI dimensions impact the innovative performance of SMEs in comparison to large companies	Quantitative analysis conducted with a regression model based on the Community Innovation Survey 2006 in Belgium. Data includes 967 firms from manufacturing industries	Two indicators: 1. Performance in terms of the introduction of new or significantly improved products/servic es to the market 2. Performance in term of share of turnover resulting from innovative product/service development	Composite indicator capturing four categories of OI practice measures: 1. Search for external sources of innovation 2. Acquisition of external R&D 3. Use of collaborative innovation partners 4. Exploitation of available IP protection mechanisms
Brunswicker, Vanhaverbeke (2014)	Exploration of different inbound sourcing strategies and internal managerial facilitators	Quantitative study on firm-level data of European SMEs executed through a regression model. The	Two dimensions: 1. Innovation success: percentage of innovation projects meeting launch	Categorical variables describing a firm's collaborating strategy: 1. Minimal 2. Supply-chain

	of Open Innovation in SMEs	sample includes 1.411 firms from seven industry sectors across Europe and selected through a survey elaborated by the authors	targets 2. Income from innovation: share of income from new products/services not older than three years	3. Technology-oriented 4. Application-oriented 5. Full scope
Zeng, Xie, Tam (2010)	Analysis of the relationship between cooperation networks and innovation performance of SMEs	Quantitative study using the structural equation modelling technique and based on a cross-sectional survey by authors to 500 Chinese manufacturing SMEs	Three indicators: 1. Proportion of annual turnover of new products 2. New products index 3. Modified products index	Cooperation network with: 1. Inter-firms 2. Government agencies 3. Intermediary institutions 4. Research organizations
Tsai (2009)	Examination of the impact of collaborative networks on product innovation performance with absorptive capacity as moderating factor	Quantitative analysis conducted with a hierarchical regression approach and based on a sample of 753 Taiwanese manufacturing firms coming from the Taiwanese Technological Innovation Survey database	1. Product innovative performance: the ratio of sales attributed to new products divided by the total number of employees	Product of two variables indicating: 1. Collaboration with a specific partner (suppliers, customers, competitors, research centres and universities) 2. Intensity of the collaboration (high, medium, low)
Ahn, Mortara, Minshall (2015)	Examination of the impact of *Open Innovation* on firm performance, based on	Quantitative analysis through a regression model on 306 Korean manufacturing SMEs. Data	Three year-average value measured by three indicators: 1. Sales 2. New product development 3. Relative market	Two variables studied in two separated models: ▪ Open Innovation specified as: 1. Breadth

	Korean innovative SMEs	were collected through a survey using the database of the Korean small and medium business administration (SMBA)	share	2. Depth ▪ Collaboration partners specified in term of: 1. Types of partners 2. Breadth 3. Intensity
Tomlinson, Fai (2013)	Exploration of the relationship between innovation (both product and process) and types of co-operation	Quantitative study run with a hierarchical multivariate regression on a sample of 371 SMEs in UK manufacturing collected through a questionnaire of the authors	Composite measure capturing: 1. Product innovation (number of new product) 2. Process innovation (number of changes/improvement to existing product)	Co-operation variables: 1. Buyers 2. Suppliers 3. Competitors measured in term of contribution to product and process innovation

Source: own elaboration

CHAPTER 3: ANALYSIS ON A SAMPLE OF MANUFACTURING SMEs IN THE VENETO REGION

After the theoretical discussion presented in the second chapter about the main implication of *Open Innovation* in small and medium-sized enterprises; in this section, our core objective is to study the innovation capacity of a sample of manufacturing SMEs of the Veneto region, especially in relation to the recourse to external resources. To do this, first we define the hypotheses of our study and the research methodology; then, we describe the sample and the model we construct; and, after having conducted the analysis, we discuss the theoretical and practical implications of our research, the limitations of our model and finally we propose further possible research avenues in the field of interest.

3.1 Hypotheses definition

As we have seen in the previously chapters, small and medium-sized firms may adopt an *Open Innovation* strategy; for instance, recurring to external collaborations for innovation. However, even though companies use a systematic approach with the simultaneous adoption of different external collaborations for innovation, existent academic contributions have devoted little attention to explore the dynamics among several combinations of collaborations; focusing instead on the outcomes associated with the types of collaboration taken in isolation. Indeed, as we have reported in the review presented at the end of the second chapter, the main quantitative examinations already conducted are regression analyses. Therefore, the purpose of our research is to fill this gap and to investigate if there are one or more configurations of external collaborations for innovation leading to high innovation performances. In other word, we would like to find out which combinations of collaborations better influence the firm's innovation performance. Furthermore, we also desire to check which are the core and peripheral elements in achieving the desired outcome. Hence:

RQ1: Are there one or more combinations of external collaborations for innovation that lead to high innovation performance of small and medium-sized manufacturing firms?

RQ2: Which are the essential elements for the realization of a high innovation performance and which are instead the elements supporting the outcome but not essential?

3.2 Research methodology: data collection and survey design

To run our analysis, we got the sample of a previous study by Apa et al., (2015) about a research project, in collaboration with Unioncamere Veneto and the University of Padua, and focused on investigating the innovation capacity of small and medium-sized enterprises of the Veneto region. The data were collected through a questionnaire addressed to 181 companies operating in the manufacturing sector in Veneto; considering that the reference population was made up of 5.166 manufacturing small firms in Veneto (at 01/01/2015), with a dimension between 10-250 employees, and registered in the AIDA database (Bureau Van Dijk).

This sample was drawn from a stratified sampling procedure. Firstly, the researchers divided the entire population into different subgroups (or strata) according two variables, namely dimension of the firm (number of employees) and access to regional public funding for innovation. To be more specific, it has been considered four classes of firm size based on the number of workers (10-19, 20-49, 50-99, 100-249) and two classes of access to public support (yes or not). Secondly, the researchers randomly selected the final subjects proportionally from the different strata, till the achievement of a prefixed number of observations per each subgroup. In particular, through this simple random sampling method (implying that every firm has an equal chance to be selected), they drew companies from each stratum in order to reach a minimum sample size of 200 SMEs. However, since some responses were missing, the number of observations dropped to 181 firms.

Once obtained the sample, a survey was conducted through the administration of a structured questionnaire with the CATI (Computer-Assisted Telephone Interviewing) procedure, in order to investigate SME’s innovation activities over the years 2012-2014. In particular, telephonic interviews with entrepreneurs and general directors of the firms were done in the period between 01/12/2015 and 31/01/2016. To collect data, a structured survey (see Appendix 1) has been used. This one was composed by 40 items and included five sections of questions about main firm’s characteristics, innovation outputs, internal firm’s activities and resources for innovation, external resources for innovation and public support for innovation. In particular, the respondents were asked to indicate the age of their firm, the number of total employees, exports percentage on total turnover, eventual participation in a group, type of innovation achieved (specified in term of product, process, marketing and organizational innovation), percentage on turnover connected to innovations introduced, use of intellectual propriety rights, number of employees in R&D department, internal activities aimed at introducing innovation, eventual collaborations with external partners (specified in term of formal/informal collaboration, type of partner, efficiency achieved according to their perspective) and, finally, recourse to public funding for innovation. To perform our analysis, however, we use only a part of this survey; namely, the information about the types of collaborations adopted and the data about innovation performances.

3.3 Empirical setting: some considerations about the Veneto region

As previously said, our thesis is based on data on SMEs located in the Veneto region; an empirical setting particularly interesting for its peculiar characteristics.

According to Apa et al. (2018), Veneto is a region in which the role of SMEs is strong on the local economy. Definitely, the majority of local companies in Veneto are small or medium companies (94.1% and 5.2% respectively, on the total number of active companies); and, the medium size is becoming an increasingly influential strata (Apa et al., 2018).

Second, a lot of manufacturing firms, mostly specialized in low-tech manufacturing, are present in the Veneto region: from 2015, according to the evidences given by Apa at al. (2018), employment in manufacturing made up 38.7% of the total employment of the region.

The region is then emblematic for the importance of networks (based on a long tradition of industrial districts). Indeed, the economy of Veneto is characterized by several industrial districts; meant as conglomerates of more SMEs, in a specific and restricted territory, specialized in different stages of product development within one or related industries and, where innovation processes are realized recombining knowledge acquired via the diverse collaborations (Apa et al., 2018).

Finally, Veneto is among the most developed regions in Europe in terms of employment rate and GDP per capita. Additionally, according to the Regional Innovation Scoreboard Report European (2017), it is a quite innovative, with a rank of Moderate Plus Innovator; whereas, De Marchi & Grandinetti (2017) define it among the top 5 regions in the country. Nevertheless, the region is also a case of innovation “without research” (Colombo & Lanzavecchia, 1997), because of its low public and private investments in R&D. To confirm this, according to Apa et al. (2018), R&D expenditure in the business and public sector in

Veneto are lower than the average of the regions defined as leader in the European Regional Innovation Scoreboard Report (see Table 2).

Table 2 – Normalized scores per indicator and relative results of the Veneto region compared to the country and the EU

Factor	Data	Normalized score	Relative to	
			IT	EU
R&D expenditures public sector	0.39	0.397	79	73
R&D expenditures business sector	0.73	0.331	98	73
Non-R&D innovation expenditures	±	0.345	±	±
Product/process innovations	±	0.582	±	±
Marketing/ org. Innovations	±	0.494	±	±
SMEs innovating in-house	±	0.619	±	±
Innovative SMEs collaborating	±	0.186	±	±
Sales new-to-market/firm innovations	±	0.445	±	±
Regional Innovation Index 2017	--	0.360	--	--

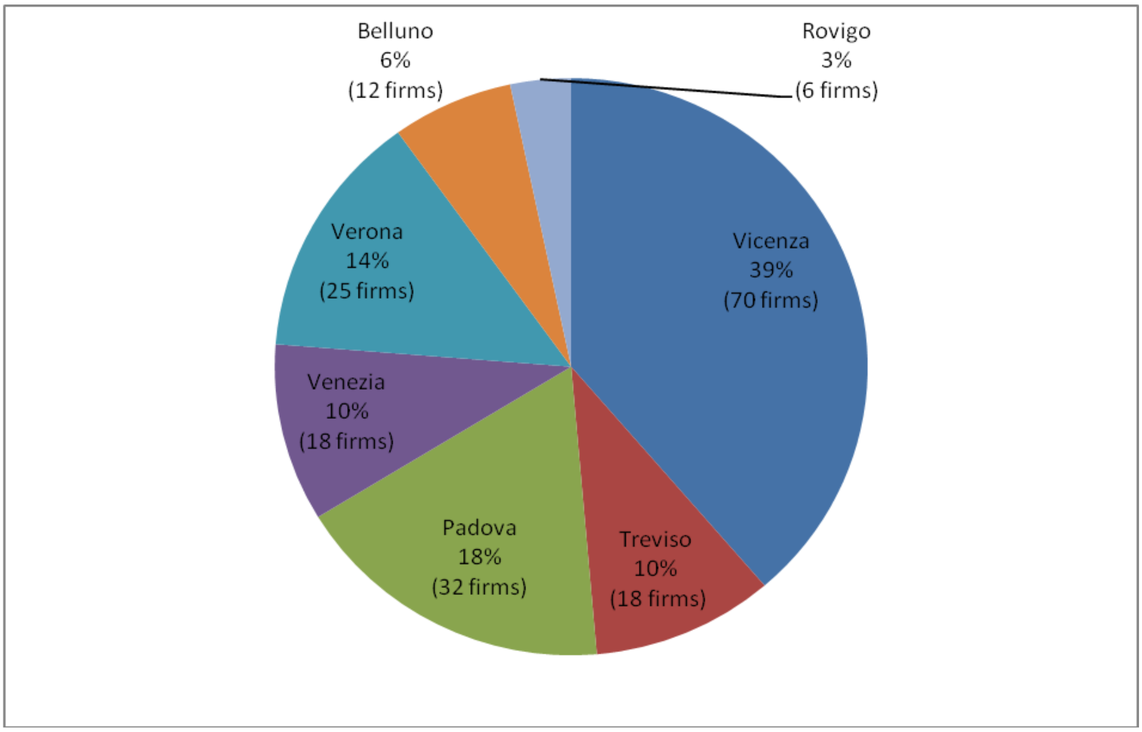
Note: ± Relative-to-EU scores are not shown as these would allow recalculating confidential regional CIS data.

Source: own elaboration based on European Regional Innovation Scoreboard Report (2017)

3.4 The sample

On the base of the responses obtained from the questionnaire mentioned above, that we consider to gather the data for our analysis; the interviewed companies of the sample are mostly located in the Veneto region and, mainly in the province of Vicenza (39%), Padova (18%), Verona (14%), Treviso (10%) and Venezia (10%), with a small minority located in Belluno and Rovigo (see Figure 3.1).

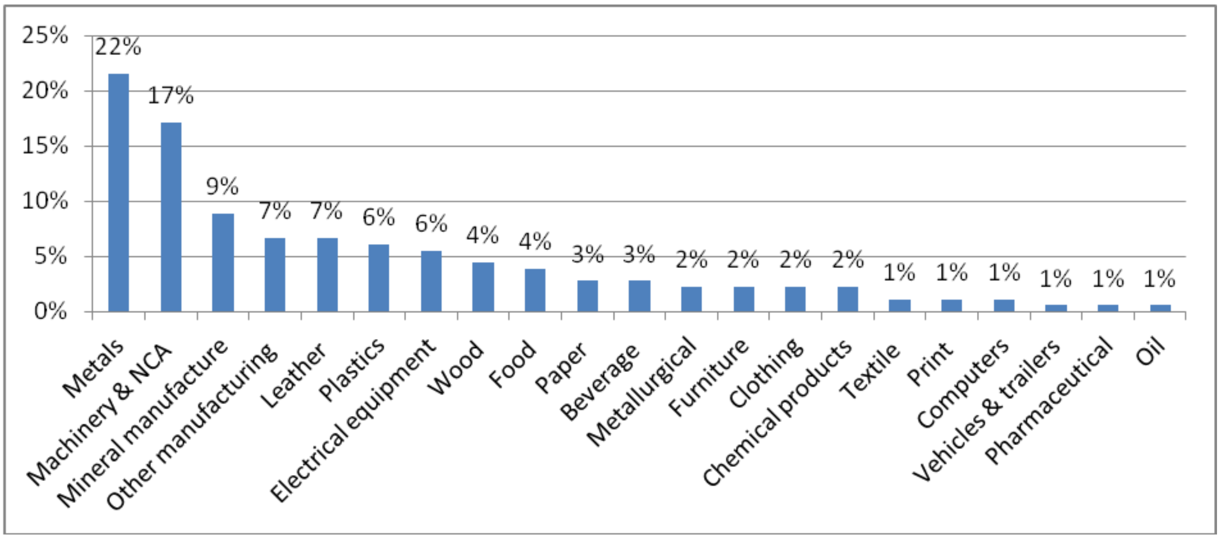
Figure 3.1 – Geographical distribution of firms per provinces in percentage



Source: own elaboration

To identify the sectors in which the companies of our sample operate, we use the first two number of the ATECO code; which is an alpha-numeric classification of Italian business activities. If we look at Figure 3.2, representing the distribution of data by sector, we can observe that 21 different sectors have been identified. The biggest deviation is on the metals sector (22%) and, following, by percentage, we find the machinery and NCA appliances (17%). Five sectors identified as mineral manufacture, other manufacturing, leather, electrical equipment and plastics are between 9% and 6%; whereas, all the others and 4% or below. Moreover, referring to some previous observations about our same dataset carried out by Apa et al. (2016), according to the European classification of technology intensity of industries, in our sample only 2% of the firms belong to high-tech industries; while, considering together high-tech and medium-high tech industries, the percentage rises about to 27%. The rest of the companies are therefore in the medium-low or low-tech industries; thus representing well the peculiar characteristics of the Veneto region, mostly specialized in low-tech manufacturing.

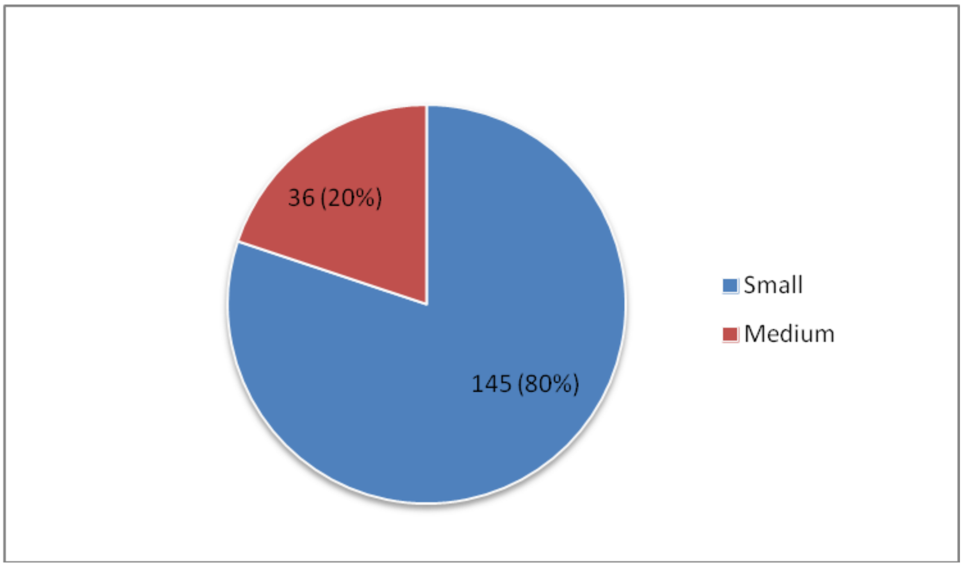
Figure 3.2 – Distribution by sector of the companies



Source: own elaboration

Considering the dimension of the companies, the sample is made up of small and medium-sized enterprises (see Figure 3.3). Specifically, according the definition of SME introduced in the second chapter, the majority of the companies (80%) are small firms since they don't have more than 50 employees and, among these, a very small part (6 out of 181, that is barely a 3%) has only 10 employees. Then, the remaining 20% of the total companies in the dataset are medium-sized (between 50-250). Also in this case, the firm size considered in the sample is quite good representative of the structure of most of the companies in Veneto (as seen before 94,1% small and 5,2% medium).

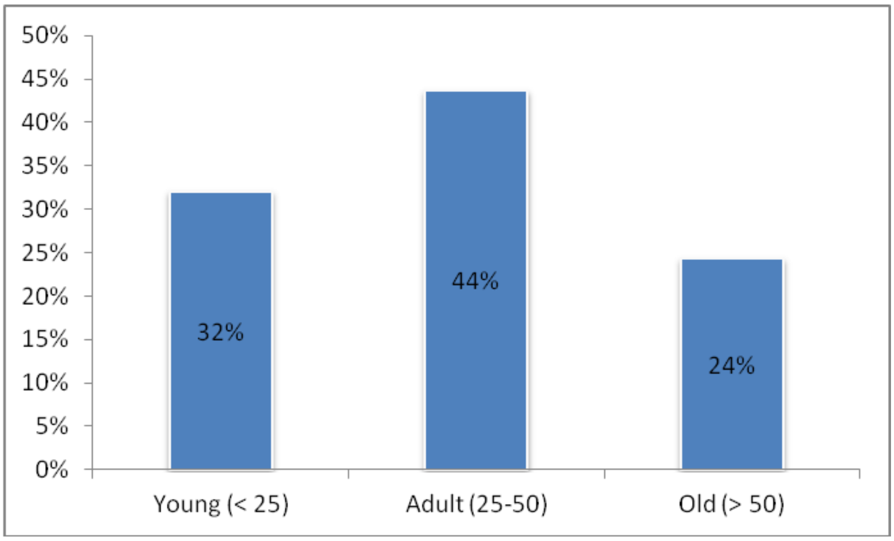
Figure 3.3 – Company size



Source: own elaboration

Dividing then the sample, with a subjective criterion, in three categories of age (see Figure 3.4), respectively young the firms with less than 25 years, adult the ones between 25 and 50 years old, and old the ones with more than 50 years, the sample of 181 companies collected is composed mainly of adult (44% of the total sample), followed by young (32%) and last, old companies (24%).

Figure 3.4 – Company age



Source: own elaboration

Now, we focus our attention on the core objective of our analysis, that is studying the innovation capacity of the companies in our sample. For a first understanding of the types of innovation introduced by the firms in the sample, we adopt the classification used in the CIS (Community Innovation Survey), according which innovations can be product, process, marketing and organizational innovations. On the base of the responses collected (see Table 3), it emerges a high propensity for innovation in the companies of our sample: 91% of them has introduced at least one of the four types of innovations above mentioned in the period 2012-2014. In particular, the most spread typology of innovation introduced is the product innovation (83.4%), followed by process innovation (74.6%), organizational innovation (70.2%) and marketing innovation (56.3%).

Table 3 – Types of innovations introduced

Type of innovation introduced	Number of firms to introduce it	Over a total number of firm	Percentage
Product	151	181	83,43%
Process	135	181	74,59%
Organizational	127	181	70,17%
Marketing	102	181	56,35%
Note: multiple choice answer in the questionnaire			

Source: own elaboration

To better understand the innovation process, we consider now some descriptive statistics about the recourse to internal and external resources for innovation.

First, to evaluate the entity of internal resources dedicated to innovation, we consider the number of internal employees dedicated directly to R&D projects. Since small firms may have R&D employees working only in the R&D department, even though of limited dimension, or working also for other organizational functions, we classify the companies of our sample according to: firms not having employees dedicated to innovation, firms with employees dedicated to R&D projects even if without a specific R&D department and firms having employees dedicated to innovation in a specific R&D department. On the base of the evidence we got, 89.1% of the companies has employees working for innovation projects and, of these companies, only 33.9% has a structured R&D department; whereas, 55.2% of the companies doesn't have a structured R&D department. Only 10.9% of the companies in our sample owns neither a specific R&D department nor workers dedicated to innovation activities (see Table 4). Considering instead activities aimed at stimulating creativity and new ideas generation (for instance brainstorming, training or prototyping), according Apa et al. (2016), in firms without dedicated employees to innovation and without a R&D department, they are almost totally absent; in firms with a structured office for R&D projects, they are frequently adopted; whereas, in firms with workers specialized in R&D project but without a R&D department, the percentages are more contained.

Table 4 – Internal resources dedicated to R&D

Internal resources for R&D	Number of firms	Percentage
No dedicated employees, no R&D office	19	10,9%
Dedicated employees, no R&D office	96	55,2%
Dedicated employees, with R&D office	59	33,9%
Total	174	100%
Note: 7 firms didn't answer to this question		

Source: own elaboration based on Apa et al. (2016)

Second, following the *Open Innovation* model and considering the recourse to external resources for innovation (see Table 5), the survey has shown the companies of our sample use for innovative purposes mainly collaborations with suppliers (59.67%) and with clients (67.96%); then, there are the collaborations with KIBS (39,78%); whereas, competitors and universities collaborations are less spread (16.57% and 17.68%, respectively). This result is in line with the literature (i.e., Zeng et al., 2010) suggesting that cooperation with customers and suppliers plays a more distinct role in the innovation process of SMEs than horizontal cooperation with research centres and universities, since there may be matching problems in relation to different cultural background, namely long-term scientific research versus exploitation-oriented research of companies (Brunswicker & Vanhaverbeke, 2014). On the other hand, considering instead the competitor collaboration, the authors Ritala & Laukkanen (2012) highlight that there may be possible threats of technological knowledge leakage, to hamper this relation. Then, referring to the preferred type of form of collaboration (see Table 6), in our sample emerges that in the cases of supplier and university collaborations, the formal form is preferred to the other ones; while, with competitors and clients, informal collaborations are the most used. Finally, to conclude, recalling some evidences presented in the paper by Apa et al. (2016), the totality of firms with a R&D department and the almost totality (98%) of the ones without a structured R&D office but with dedicated employees to innovation collaborate at least with one type of the indicated partners in the survey (suppliers, costumers, competitors, universities and research centres); suggesting therefore that for these companies the investment in internal resources for innovation and the use of external sources are not substitute but rather complementary choices. On the contrary, firms without R&D department and dedicated employees to innovation declare to collaborate for innovation purposes for 42% thus, making partially valid the internal-external substitution logic.

Table 5 - Recourse to external sources for innovation

Type of partner	Number of firms using it	Over total number of firms	Percentage
Collaboration with suppliers	108	181	59,67%
Collaboration with competitors	30	181	16,57%
Collaboration with clients	123	181	67,96%
Collaboration with universities	32	181	17,68%
Collaboration with KIBS	72	181	39,78%
Note: more than one option was possible in the answer to this question			

Source: own elaboration

Table 6 – Forms of collaboration for innovation in numbers

Forms of collaboration	Suppliers	Competitors	Clients	Universities	KIBS
Only formal	65 (60,2%)	5 (16,7%)	22 (17,9%)	12 (37,5%)	30 (41,6%)
Only informal	20 (18,5%)	16 (53,3%)	34 (27,6%)	14 (43,8%)	31 (43,1%)
Both	23 (21,3%)	9 (30,0%)	67 (54,5%)	6 (18,7%)	11(15,3%)
Collaborate	108 (100%)	30 (100%)	123 (100%)	32 (100%)	72 (100%)

Source: own elaboration

Finally, we highlight that considering the innovation breadth, meant as the average number of the types of innovation (product, process, organizational, marketing) in the considerated period 2012-2014, in our sample it emerges a clear difference between firms with R&D department (with an average of 3.7) and firms without R&D office, both with and without dedicated employees to innovation projects (2.6 as average). This evidence thus appears in line with the role of absorptive capacity: SMEs having a formal internal R&D department are more positively associated with innovation performance connected to collaborations (here, in term of the average number of types of innovations) than SMEs having only people dedicated to R&D without a structured department or even without R&D people and department. Academic contributions explain this happens because if a firm lacks absorptive capacity (approximated here with the presence of a structured R&D department to indicate the internal R&D efforts of a company) may have problems in assimilating any externally acquired technological knowledge; whereas, if a firm has it, the acquisition of the partners' knowledge is facilitate (Tsai, 2009); since, as a matter of fact, absorptive capacity amplifies the benefits of external innovation sourcing on innovativeness (Bogers & West, 2014).

3.5 fsCQA: a brief description

In our research, we apply a fuzzy-set qualitative comparative analysis (fsQCA). This is an analytic technique introduced by Ragin in 1987 which allows to find some combinations of explanatory variables, called causal condition, influencing the results of another dependent variable, called outcome. Therefore, it is appropriate to use when studying how causes combine to bring about outcomes (Ragin, 2000). These causal patterns are then studied through set-subset relationships between degree of membership in the outcome set and membership in the set of a particular combination of causal conditions through Boolean Algebra. Hence, according to Ragin (2000), measurement occurs both in terms of presence/absence (1/0, crisp sets) of the causal condition and in terms of the degree of membership in the set (values between 0 and 1, where the value 0 indicates the full non-membership whereas the value 1 stands for the full membership).

As highlighted by Apa & Sedita (2017), fsQCA supplements conventional correlation analysis, such as the regression model, due to three main advantages: causal complexity, asymmetry relationships and equifinality. This means that, as described by Galeazzo & Furlan (2018), fsQCA first assumes conjunctural causation, according which the analysis consider the combined effects that a variable could produce not trying to estimate its standing alone contribution. Second, fsQCA assumes equifinality, which means that different configurations of attributes may bring to the same outcome. Moreover, by allowing that multiple, equally effective, sets of attributes lead to the desired outcome, fsQCA enables to distinguish which attributes are relevant and how they combine to achieve the result (Galeazzo & Furlan, 2018). Finally, fsQCA allows for asymmetrical relations, for instance the fact that a configuration is associated with the outcome of interest doesn’t imply that the absence of the same configuration explains the lack of the outcome. Therefore, it follows that the use of set-subset connections in fsQCA qualifies for a more nuanced understanding of the links between attributes and expected outcomes than conventional methods that use correlation analysis.

Thus, on the base of the advantages above presented, this methodology appears useful in investing the combination of conditions and pathways that lead to a performance (outcome) and, this is particularly relevant in the *Open Innovation* field because OI practices involve complex relationships among the variables of interest. Moreover, due to the cost of conducting surveys about OI practices in SMEs, it is difficult to obtain a large and complete dataset and, therefore, a quantitative method can't always be applied. On the other hand, a case study research, based on small samples, permits in-depth studies but the results can be difficult to generalize. Thus, in this situation QCA provides a middle ground between statistical large-N-studies and case study analysis (Apa & Sedita, 2017).

The application of the fsQCA analysis requires a process of four steps, namely data calibration, analysis of necessary conditions, truth table analysis and truth table minimization; that we now briefly discuss below.

The first step is data calibration, needed to transform variables into fuzzy set scales of degrees of membership. According Ragin (2000), this means specifying three qualitative anchors: the threshold for full membership, the threshold for full non-membership and a crossover point of maximum ambiguity regarding membership (for more details, see the section about variables specification). To calibrate the measures and translate them into set membership ones, Ragin (2009) suggests to use a combination of standards based on social or scientific knowledge or on the knowledge acquired by researchers in the field. However, when no external criterion can be employed, more sample dependent methods can be used, such as percentiles of the distribution of the standard measure (Campagnolo & Cabigiosu, 2015).

Going on, the second step is the analysis of the necessary conditions; which are conditions that must be present for the outcome to occur, even though their presence doesn't guarantee the occurrence of the outcome. Hence, the first thing is to check if there are some causal conditions that could be considered necessary conditions and then drop them from the truth table procedure (Apa & Sedita, 2017); which is essentially an analysis of the sufficient conditions (Ragin, 2009). Conventionally, a condition is necessary if its consistency score exceeds the threshold of 0.9 (Ragin, 2006).

Then, the third step is the generation of a truth table, to test the sufficient conditions. This truth table has 2^k rows, where k is the number of causal conditions used in the analysis. Each row of this table shows a specific combination of the causal conditions and, the full table lists all possible combinations.

In order to find the best combination, the fourth step is the truth table minimization, which aims to reduce the number of possible combinations by using an algorithm based on Boolean algebra, to identify a set of simplified combinations. The lines of the truth table are reduced by taking into consideration all the combinations that can be associated with at least two firms (column number), following a minimum consistency-level criterion. Consistency, in this case, refers to the degree to which cases correspond to the set-theoretic relationship expressed in a solution. A consistency of 1.0 means that a specific configuration has no contradictions, while lower values imply an imperfect relationship between the configuration and the outcome. Following Apa & Sedita (2017), in order to consider a subset of relationships as relevant, we use a consistency threshold of 0.75. As explained by Ragin (2009), after the minimization, this last step of the procedure produces three solutions: a "complex" solution (which is often hardly reduced in complexity and therefore it isn't considered) and then, a "parsimonious" solution and an "intermediate" solution (which instead are both used in the data analysis).

In the next section, we explain the analytical procedure of the application of the fsQCA method in our model. To perform this analysis, we use the fsQCA 3.0 software.

3.6 Analytical procedure of our analysis

As already said, our research relies on the fsQCA methodology to examine the configurations of external collaborations for innovation associated with successful innovation outcomes. Indeed, the fsQCA analysis is the most appropriate technique to capture the relationship that different combinations of collaboration configurations have with innovative performance. This because this method uses a configurational approach to explore a phenomenon (here, innovation performance) by breaking it into its causal conditions (here, external collaborations for innovation); so that, these conditions allow us to understand how collaboration configurations are connected together to gain high innovation outcomes. Therefore, taking into account the data collected with the survey, we consider the following analytical procedure briefly described to estimate our model.

1. First step is the definition of the variables. As outcome (dependent variable) we set the innovation capacity; whereas, as the causal conditions (independent variables) we consider the types of collaborations differently combined.
2. Second step is the variable calibration. The variables represented by the collaborations adopted are calibrated with numbers 0 (meaning no collaboration) and 1 (staying for

collaboration); while the innovation variable is calibrated with values from 0 (full non membership) to 1 (full membership).

3. The calibrated variables are tested with the "Necessary Conditions" command and, afterward, they are used to create the truth table through the "Truth Table" algorithm.
4. The final step consists in the minimization of the results of the truth table. This gives three outputs: the complex solution, not useful for our analysis, and then the parsimonious and intermediate solutions, which underline which are the core elements and which are the peripheral ones in each combination.

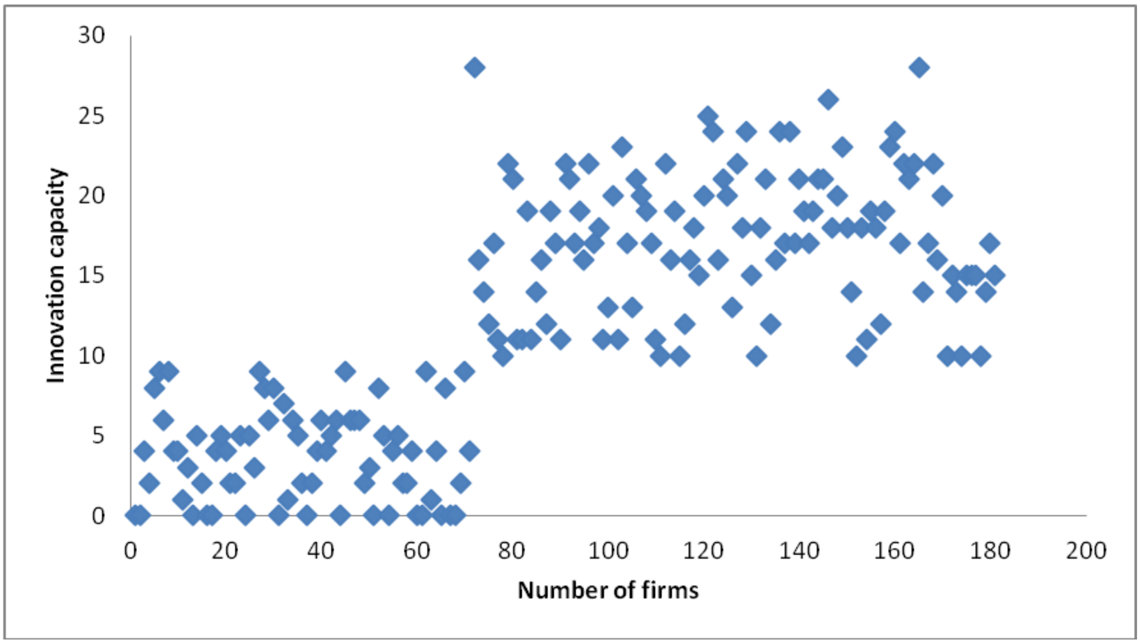
3.6.1 Variables definition

First of all, in the survey we consider to gather data, to assess innovation, it has made reference to the definition given by the OECD (2005) and used in the Community Innovation Survey; according which there are four types of innovation: product innovation (a good or service that is new or significantly improved), process innovation (a new or significantly improved production or delivery method), marketing innovation (a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing) and organizational innovation (a new organizational method in business practices, workplace organization or external relations). In the questionnaire, the interviewed firms have thus self evaluated the introduction of the four above mentioned categories of innovation in a 0-7 scale. With the aim to define our innovation outcome (dependent variable), we use therefore these answers coming from the questions of the survey asking the innovation intensity on a 0-7 scale for each typology of innovation and then, we sum up these four variables to create a single innovation variable, indicating the overall level of innovation for each firm. This measure, called innovation capacity, can assume values from 0 to 28.

To be specific, we avoided to use information from the survey about patent activity as a key indicator for innovation performance embracing the thesis suggested by Laursen & Salter (2006), and followed also by Spinthoven et al. (2013); in order to reduce eventual biases, since patenting behaviour is sector dependent and is often related to the size of the firm, with the consequence that large companies tend to patent more than smaller ones.

In addition to this, to gain more insights about our dependent variable, we also plot its values in Figure 3.5; and, as it is possible to see in the graph below, it emerges a non linear distribution with two major clouds of points: one in correspondence to low innovation capacity and one associated to a medium-high innovation capacity. In the sample of SMEs we are considering, therefore, it appears a polarized behaviour towards a minimal *Open Innovation* strategy and, on the opposite, a behaviour towards an articulated one.

Figure 3.5 – Distribution of the innovation capacity variable



Source: own elaboration

This result make us curious to investigate a bit more about these two clouds of points and see if they could be explained by a relation between the innovation capacity and the number of collaborative ties; that is, if a lower innovation capacity is associated with less collaborations and, on the other hand, if a medium-high innovation capacity is related with more collaborations for innovation purposes. So, in order to check it, we have run a correlation analysis (see Appendix 2) through R software and, according to the results, we have discovered that there is a positive correlation (0.56) between the two variables. Through a Pearson test, we have also verified the significance of this indicator and we have found that it is relevant: the p-value was equal to 2.2e-16 and, given it is lower than 0.05, we rejected the null hypothesis (which indicates a non-correlation between the two variables).

Finally, speaking about the causal conditions of our model (independent variables), we have chosen to define them as different combinations of the types of collaboration for innovation, which have been detected in the survey as collaborations with suppliers, clients, universities, KIBS and competitors.

3.6.2 Variables calibration

The fsQCA methodology at this point requires the variables calibration. To transform the dependent variable "innovation capacity" into a fuzzy variable, with values ranging from 0 to 1 (mirroring the degree of membership of this variable into a subset), we consider a sample dependent method. this because, as explained in the previously section about the fsQCA methodology and, in particular, with reference to the discussion carried out by Campagnolo & Cabigiosu (2015), more sample dependent methods about the distribution of the variable can be used, when it is not possible to apply an external combination of standards based on social or scientific knowledge. Therefore, we decide to look at the mean minus the standard deviation of the distribution for the full non-membership threshold (value 4), the mean for the crossover point (value 12), and the mean plus the standard deviation for the full membership threshold (value 20). Below, we report the above mentioned statistics about the distribution of the innovation capacity variable (see Table 7) and the calibration method used (Table 8).

Table 7 – Descriptive statistics for our outcome variable

Variable	Mean	Std. Dev.	Minimum	Maximum	N cases	Missing
Incapacity	11.9337	7.657447	0	28	181	0

Source: own elaboration

Table 8 – Calibration method used

Calibration method for our outcome variable: innovation capacity		
Mean minus standard deviation	Mean	Mean plus standard deviation
12-8=4	12	12+8=20

Source: own elaboration

Finally, considering the causal conditions (independent variables) of our model, as previously seen defined as different combinations of collaborations with suppliers, clients, universities, KIBS and competitors, we have chosen to calibrate each one with number 0 (when there is no collaboration) and with number 1 (in presence of collaboration).

3.6.3 True table construction & minimization

With the calibrated variables, we have then analysed the presence of necessary conditions; and, we have found that none of the types of collaborations exceeds the acceptable consistency level of 0.90, as suggested by Ragin (2006). Therefore, the next step is creating the truth table (see Figure 3.8) for sufficiency, from the fuzzy data, through the "truth table" algorithm. First, the innovation capacity is set as outcome and the five types of collaborations as causal conditions. The resulting table elaborated through this algorithm includes all the possible combinations of conditions and also specify the number of cases in which a certain configuration is found (see column "number" in the figure) and the consistency measure (column "raw consist."), indicating the proportion of cases that display the outcome. These two indexes are particularly important among the others because they are used to minimize the truth table. As explained in Ragin (2017), the aim is firstly to develop a rule for classifying some configurations as relevant and others as irrelevant, based on the number of cases. Therefore, we select 2 observations as the cut-off for the minimum number of cases to be present and, consequently, we eliminate the rows with less than 2 cases. Then, the second step suggested by Ragin (2017) is to distinguish configurations that are consistent subsets of the outcome from those that are not; by determining a consistency threshold. As explained in the section about the fsQCA methodology, we follow Apa & Sedita (2017) and we set a minimum consistency value of 0.75. Hence, in the column "inncapacity", for all the combinations with a consistency level that doesn't meet the defined consistency threshold, we put a 0; whereas, we classify all combinations with consistency equal or above 0.75, with 1, meaning that these last ones are cases in which the outcome is consistently found.

Figure 3.6 – Truth table

suppliers	kibs	competitors	clients	uni	number	inncapacity	raw consist.	PRI consist.	SYM consist
1	0	0	1	0	41	0	0.446585	0.331270	0.418466
1	1	0	1	0	26	0	0.710769	0.659420	0.801762
1	0	0	0	0	21	0	0.291429	0.160271	0.196676
0	0	0	0	0	20	0	0.074000	0.050256	0.051579
1	1	0	1	1	12	1	0.772500	0.751592	0.827655
0	0	0	1	0	10	0	0.368000	0.281818	0.326316
1	1	1	1	0	8	1	0.830000	0.817204	0.883721
1	1	0	0	0	8	0	0.267500	0.127976	0.158088
1	1	1	1	1	5	1	0.930000	0.924731	1.000000
1	0	1	1	0	5	0	0.700000	0.663677	0.755102
0	1	0	1	0	5	0	0.748000	0.702830	0.856322
1	0	1	1	1	4	0	0.492500	0.421652	0.490066
1	0	0	1	1	4	0	0.615000	0.554913	0.657534
1	1	1	0	1	3	1	0.766667	0.736842	0.844828

Source: own elaboration

3.7 Presentation of our results

From the truth table, through the "Standard Analysis" command, we obtain three solutions: a complex, a parsimonious and an intermediate solution. As already mentioned, only the parsimonious (representing the core elements essential for the realization of the outcome) and the intermediate (indicating the peripheral elements which support the outcome but are not essential) solutions can be interpreted. Consequently, we consider only these two types of solution and we exclude the complex one from the discussion we are going to present.

The analysis of the intermediate and parsimonious solutions thus allows building a table that summarize the results, where each column represents a combination of causal conditions leading to the specified outcome. Through the use of symbols, different results are indicated:

- The black large circle stays for the presence of a certain element as core condition, meaning an element that is essential to achieve a high level of the selected indicator of performance. These core conditions are those that are part of both the parsimonious and intermediate solutions (Apa & Sedita, 2017).
- The black small circle stays for the presence of a peripheral condition, meaning an element that is present in the combination and support the core conditions. These peripheral conditions are those that are eliminated in the parsimonious solution and thus are only present in the intermediate solution (Apa & Sedita, 2017).
- The white crossed circle represents the absence of an element, meaning that an element must be absent from the combination in order to reach high levels of the chosen performance indicator (Apa & Sedita, 2017).
- The absence of symbols means that the element can either be present or not in the combination, without any impact. It indicates a "*don't care*" situation, since the causal condition doesn't really affect the realization of the outcome (Apa & Sedita, 2017).

For each of the solution provided, the procedure further indicates the consistency index (measuring the degree to which solution terms and the solution as a whole are subsets of the outcome), the solution coverage (assessing the proportion of membership in the outcome that is explained by the complete solution), the row coverage (computing the proportion of membership in the outcome explained by each term of the solution) and, finally the unique coverage (which measures the proportion of membership in the outcome explained solely by each individual solution term).

Here below we report the fsQCA results of the five types of collaborations tested as causal conditions for the achievement of a high innovation capacity, chosen indicator for the innovation performance. Furthermore, we also run the fsQCA analysis performed with the same causal conditions as before but, this time, leading to bad innovation performance. The results show asymmetric causality, since the combinations of external collaborations for innovation purposes yielding to successful performance differ from the one associated with bad performance. Moreover, considering in more detail the configuration path that lead to bad innovation performance, no external collaborations should be implemented; thus implying that the *Open Innovation* paradigm is a valid approach in improving the innovation capacity of SMEs. However, since the results of this analysis present only the consistency above the threshold of 75%, while the coverage is around 20% so, below the threshold of 25%, we report these findings in Appendix 3.

At this point, therefore, we will consider only the findings leading to high innovation performance; which we will discuss here below.

Table 9 – fsQCA results

High Innovation Performance			
Configuration	C1	C2	C3
Universities	●	●	
Clients	•		•
Suppliers	•	•	•
Competitors			
KIBS	●	●	●
Consistency	0.818823	0.868750	0.868461
Raw coverage	0.152114	0.075948	0.123374
Unique coverage	0.101300	0.025134	0.072560
Overall solution consistency		0.816429	
Overall solution coverage		0.249809	

Source: own elaboration

Table 9 shows the results of our fuzzy-set analysis and identifies three "equifinal" combinations of causal conditions; meaning that one can substitute the other to obtain the same result, in this case, a high innovation performance. Furthermore, from a statistical point of view, all the solutions displayed can be considered both valid and significant, since all solutions together present an overall consistency above the threshold of 75% and an overall coverage around the threshold of 25% (Schneider & Wagemann, 2012).

Observing the different configurations leading to high innovation performance, we can note the presence of core, peripheral and "don't care" conditions for each one. Specifically, the first configuration indicates universities and KIBS as core elements, suppliers and clients as peripheral conditions, while the competitor variable is not relevant. Then, the second configuration includes three elements: universities and KIBS again are the core conditions, whereas suppliers collaboration is the only peripheral one. All the other variables are "don't care" conditions. Finally, the third configuration shows as core condition the presence of collaborations with KIBS; as peripheral elements, the collaborations with suppliers and clients; and, as "don't care" conditions, all the others variables.

From the analysis of these results, a strong evidence to small and medium-sized companies emerges: in order to achieve a higher innovation performance, external collaborations for innovation purposes can't be only pursued with suppliers (solution 2) or, in alternative, with suppliers and clients (solutions 1 & 3), since they are peripheral conditions (supporting the outcome but not essential to it); but rather complemented with KIBS (solution 3) or KIBS and universities (solutions 1 & 2). Moreover, when comparing the different configurations, we also discover that collaborating with KIBS is a core condition in common to all the three configurations; meaning therefore that this type of collaboration is essential to reach high innovation performance. Collaborations with universities, instead, appear as a condition that matters but that is not indispensable (since they are not present in all the three configurations). Finally, with regard to competitors, they are represented in all the three cases as a "don't care" causal condition; hence, neither their presence nor their absence leads to the outcome of interest.

Therefore, our findings highlight that, when innovating, the collaborations along the value chain act as a support and make possible the interest to innovate. This because suppliers, on one hand, may provide their expertise to advance the components required by a firm (Tsai, 2009); while, clients, on the other hand, may allow companies to better identify technology improvement giving information about their needs (Brunswicker & Vanhaverbeke, 2014). However, on the base of our findings, what it is necessary to reach high innovation performances, it the presence of horizontal collaborations. In particular, KIBS are a central condition to our outcome of interest, since they are present in all the three configurations;

whereas, collaborations with universities matter, but they are not crucial since they are a core condition in only two cases. This particular positive impact of KIBS and universities is in line with the literature. Indeed, Muller & Zenker (2001) have shown that SMEs interacting with KIBS are more oriented towards innovation than non-interacting firms; while, according to Brunswicker & Vanhaverbeke (2014), collaborations with universities and research centres are seen as a way for firms to obtain inventive trends and preindustrial knowledge, as science may significantly alter the search for inventions. The importance, but not the necessary presence of universities collaborations to reach successful innovation performances can be explained by the fact that there is still a difficult relationship between universities and small and medium-sized firms. Indeed, as described in the second chapter, to obstacle this kind of relationship, there may be some barriers: on one hand, for SMEs since they generally lack of absorptive capacity to benefit from academic knowledge (Spithoven et al., 2010); and, on the other hand, for research centres since they normally tend to prefer longer-term efforts rather than investing in the creation of an interface user-friendly for SMEs (Bodas Freitas et al., 2013). Whereas, the essentiality of KIBS emerged in our analysis can be explained by the contribution of den Hertog (2010); which has declared that KIBS provide a point of fusion between more general scientific and technological information, dispersed in the economy, and the more local requirements and problems of their clients firms; therefore, functioning as catalysts who promote a fusion of generic and quasi-generic knowledge, and the more tacit knowledge, located within the daily practices of the firms and sectors they service. Finally, with regard to competitors collaborations, as already said above, it emerges they are a "*don't care*" condition since they don't really affect the realization of the outcome. Again, this result appear in line with the academic contributions; according which competitors collaborations have an unclear impact on innovation performance because, on one hand, they may permits companies to gain technological knowledge and skills when carrying out basic research outside the competitor's area of influence, for instance in pre-competitive research programs or co-production arrangements (Tether, 2002); however, on the other hand, they may present some difficulties, especially in relation to the risks of technology leakage (Ritala & Laukkanen, 2012). Indeed, in the empirical explorations, its impact is ambiguous: only in the biotechnology sector there is evidence of a positive impact on innovation performance (Quintana-Garcia & Benavides-Velasco, 2004); whereas, in the manufacturing sector – that is the one of our interest – Nieto & Santamaría (2007) have found a negative impact, while Tomlinson & Fai (2013) have pointed out a no significant impact of co-operation with rivals upon innovation.

CONCLUSIONS

Our research has attempted to deepen understanding the relationship between *Open Innovation* strategies and innovation performance in small and medium-sized enterprises; referring in particular to a sample of 181 manufacturing SMEs in the Veneto region. Since the existing studies in innovation management literature limit their analysis on exploring the effect of each single external collaboration for innovation purposes on innovation performance through regression analyses, and fail to capture the interdependencies among multiple *Open Innovation* configurations of external collaborations for innovation purposes; the aim of our investigation has been to fill this gap. Specifically, the originality of our work was to investigate if there were one or more combinations of external collaborations for innovation leading to high innovative performance and, then, which were in the configurations the core and peripheral elements in achieving the desired outcome.

To perform our analysis, we have used the fsQCA method. This has allowed us to move beyond classical statistical analyses, which normally take in isolation the effect of each single *Open Innovation* collaboration on the innovation performance, and rather check if there are diverse configurations of external collaborations for innovation purposes, which differently combined, lead to a high innovation performance in SMEs. Therefore, in this way, our research has provided a theoretical contribution to the innovation management literature by offering an alternative exploration to the open debate on the relationship between *Open Innovation* strategies and innovation performance. Indeed, thanks to the configurational approach we have adopted, firstly, we were able to understand how different combinations of external collaborations causally interact among each other and lead to different performance outcomes; and, secondly, to point out whether relationships among external collaborations for innovation purposes were characterized by complementarity, additive, substitution or suppression effects.

On the base of the results obtained from our analysis, vertical collaborations are supportive, but not essential in the contribution to high innovation performances; since horizontal collaborations with KIBS are the discriminating factor to successful innovation outcomes. Hence, this means that the innovation model of manufacturing SMEs in the Veneto region is based on the role of intermediaries and, in particular, on the presence of collaborations with KIBS. Therefore, from these findings, it follows that managers should pay attention on resource allocation because a high innovation performance doesn't depend on the adoption of the whole sets of external collaborations for innovation purposes, but rather on the implementation of only few specific collaborations. Furthermore, our results also provide a useful guideline for policy makers. Specifically, since the collaboration for innovation purposes between SMEs and KIBS appears a central condition to obtain high innovation performances, more policy in favour of this linkage should be made. Finally, since from the fsQCA analysis it has also emerged that the role of universities matters and, since this type of collaboration is one of the less adopted according to the descriptive analysis of our data, another valid suggestion for policy makers is to try to put emphasis on facilitating the collaboration with them.

Nevertheless, our study has also some limitations; which however could represent interesting opportunities for future new researches. The first one is that our empirical results are derived from a sample of SMEs in the Veneto region; therefore, our data are geographically bounded and findings might be region-specific. Future studies could use samples of SMEs from other Italian regions to test and extend the generalizations of the findings at country level. Then, a second limitation is connected to the fact that we studied small and medium-sized firms in Veneto operating in a specific sector (manufacturing industry). Nevertheless, the objective of our research was to illustrate *Open Innovation* practices of small and medium firms in Veneto specifically in this sector. However, future papers may conduct a comparative analysis with other sub-populations of SMEs from other sectors, to gain more insights. Further, referring to the method used in our analysis, it should be said that some of the fuzzy set procedures are based on selections made by the researchers who conducts the analysis (for instance, the decision of the calibration method); for that reason, some interpretational biases must be acknowledged. Then, it should also be highlighted that the fsQCA methodology is constrained in the number of causal conditions it can include. Therefore, future studies might add contingent factors influencing firms' context (for instance internal organizational facilitators of openness) to the investigation of configurations in *Open Innovation* collaborations. Finally, in light of the fact that in our analysis it has been shown that suppliers and clients are a support while KIBS are a core condition to reach high innovation performance, a future qualitative survey could investigate whether the role of suppliers and clients is connected to innovation according to a only problem solving logic (i.e. supporting the everyday working routine for improvements) and, whether SMEs prefer relying simultaneously also on partners external from the value chain to introduce instead radical innovations.

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APPENDIX A

Questionnaire about SME's innovation (in Italian)

Sezione 1: Caratteristiche dell'impresa

Nell'ambito di un progetto di ricerca finanziato dalla Regione Veneto - Sezione Ricerca e Innovazione in collaborazione con Unioncamere Veneto, il Dipartimento di Scienze Economiche e Aziendali dell'Università di Padova sta effettuando una ricerca sulla capacità innovativa nelle imprese medio-piccole della regione, con l'obiettivo di valorizzare il loro contributo all'economia regionale ed evidenziarne le specificità e le eventuali criticità, così da supportare la definizione di politiche regionali più attente e adatte. Il responsabile della ricerca è il prof. Roberto Grandinetti, ordinario di Economia e Gestione delle imprese e già responsabile scientifico di progetti a supporto della definizione di politiche regionali presso la Direzione Ricerca e Innovazione della Regione Veneto, affiancato dalla prof.ssa Silvia Rita Sedita e dalle dottoresse Roberta Apa e Valentina De Marchi.

* Anno di costituzione

2. Numero di addetti dell'impresa

Fine 2011

Fine 2014

3. Indicare la % degli operai (generici e specializzati) sul totale degli addetti nel 2014:

4. Indicare la % di esportazioni sul fatturato nel

Fine 2011

Fine 2014

* 5. La sua impresa fa parte di un gruppo?

Si

No

6. La sua impresa è la capogruppo

Si

No

7. Se la sua impresa NON è la capogruppo, dov'è localizzata la capogruppo
Italia
Estero

Sezione 2: Output dell'innovazione

8. Nel triennio 2012-2014, in che misura avete introdotto i seguenti tipi di innovazione, avendo in mente il settore in cui opera l'impresa? (in una scala da 0= nullo a 7= elevata)

Innovazioni di processo: processi di produzione, metodi di distribuzione, sistemi di logistica, attività di supporto ai processi di produzione concernenti la gestione degli acquisti, le attività di manutenzione, la gestione dei sistemi informatici e amministrativi, le attività contabili.

Innovazioni organizzative: sistemi di gestione della fornitura, di gestione della conoscenza, lean production, metodi di organizzazione del lavoro, certificazioni

Innovazioni di marketing: nuove pratiche di commercializzazione, nuove politiche di prezzi, nuove tecniche di commercializzazione, nuovo confezionamento dei prodotti

	0	1	2	3	4	5	6	7
di prodotto (anche in relazione ai servizi che lo integrano)	○	○	○	○	○	○	○	○
di processo	○	○	○	○	○	○	○	○
organizzative	○	○	○	○	○	○	○	○
di marketing	○	○	○	○	○	○	○	○

9. Rispetto alle innovazioni introdotte nel triennio 2012-2014, quanto l'innovazione ha contribuito alla riduzione degli impatti ambientali? (in una scala da 0= nullo a 7= elevato)

	0	1	2	3	4	5	6	7
PRODOTTO	○	○	○	○	○	○	○	○
PROCESSO	○	○	○	○	○	○	○	○

10. Le innovazioni di prodotto o servizio introdotte nel triennio 2012-2014 hanno riguardato:

- Prodotti o servizi nuovi (o significativamente migliorati) per il mercato di riferimento dell'impresa
- Prodotti o servizi nuovi (o significativamente migliorati) solo per l'impresa

11. Qual è la percentuale di fatturato del 2014 relativa a prodotti/servizi nuovi o significativamente migliorati rispetto al mercato di riferimento:

introdotti nel triennio2012- 2014	
introdotti nel triennio 2009- 2011	

12. Rispetto alle innovazioni introdotte nel triennio 2012-14, l'impresa è ricorsa ai seguenti strumenti di tutela della proprietà intellettuale?

Registrazione di un marchio

Registrazione di brevetti

Registrazione di disegni o

modelli Segreto industriale

13. Indicare con quale intensità sono state svolte nel triennio 2012-14 le seguenti attività di marketing per la PROMOZIONE delle innovazioni di prodotto (in una scala da 0= assente, a 7= elevato sviluppo)?

	0	1	2	3	4	5	6	7
Campagne di lancio tradizionali (mass media)								
Comunicazione via Sito web								
Direct marketing (telemarketing, mailing list ...)								
Strumenti di interazione con il cliente online (social network, community, blog)								
Campagne di lancio non convenzionali (guerrilla, flash mob gadget, pop-up store)								
Partecipazione a fiere								

Sezione 3: Risorse e attività INTERNE per sviluppare l'innovazione

14. Nel 2014, quanti addetti dell'impresa si occupavano di innovazione e in che reparto?

Addetti dedicati in modo esclusivo in un reparto di R&S: n

Altri addetti che si occupano di innovazione: n

15. Rispetto alle innovazioni introdotte nel triennio 2012-2014, quale delle seguenti attività avete svolto al vostro interno, anche solo parzialmente?

Ricerche e test di mercato

Prove tecniche su prodotto

Prototipazione

Test di qualità dei prodotti

Altre attività specificatamente legate all'innovazione

16. Rispetto alle innovazioni introdotte nel triennio 2012-2014, l'impresa ha svolto al suo interno una delle seguenti pratiche per stimolare la creatività e la generazione di nuove idee?

Sessioni di brainstorming

Forme di rotazione del lavoro dei dipendenti

all'interno dell'impresa Incentivi (finanziari e non)

ai dipendenti per lo sviluppo di nuove idee

Attività di formazione dei dipendenti volte allo sviluppo di nuove idee e di soluzioni creative

Sezione 4: Risorse ESTERNE per sviluppare l'innovazione

17. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato CON ALTRE IMPRESE DELLO STESSO GRUPPO?

Non faccio parte diun gruppo

Non ho collaborato

Collaborazioni Formali (contratti)

Collaborazioni Informali

Entrambe

18. Dove sono localizzate LE ALTRE IMPRESE DELLO STESSO GRUPPO con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto	
Italia	
Estero	

19. Quanto sono state efficaci le collaborazioni con LE ALTRE IMPRESE DEL GRUPPO per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

◯ 0

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

◯ 6

7 ◯

20. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato con FORNITORI DI MATERIE PRIME, SEMILAVORATI E COMPONENTI, E PRODOTTI FINITI?

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

21. Dove sono localizzati I FORNITORI DI MATERIE PRIME/SEMILAVORATI E PRODOTTI FINITI con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto	
Italia	
Estero	

22. Quanto sono state efficaci le collaborazioni con I FORNITORI DI MATERIE PRIME/SEMILAVORATI, PRODOTTI FINITI per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

○ 0
○ 1
○ 2
○ 3
○ 4
○ 5
○ 6
○ 7

23. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato con i FORNITORI DI MACCHINARI E APPARECHIATURE?

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

24. Dove sono localizzati I FORNITORI DI MACCHINARI E APPARECCHIATURE con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto

Italia

Estero

25. Quanto sono state efficaci le collaborazioni con I FORNITORI MACCHINARI E ATTREZZATURE per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

- 1
- 2
- 3
- 4
- 5
- 6
- 7

26. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità collabora con I FORNITORI DI SERVIZI (CONSULENTI, STUDI DI PROGETTAZIONE ETC.)?

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

27. Dove sono localizzati I FORNITORI DI SERVIZI con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto

Italia

Estero

28. Quanto sono state efficaci le collaborazioni con I FORNITORI DI SERVIZI per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7

29. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato con ALTRE IMPRESE DELLO STESSO O DI ALTRI SETTORI (COMPETITOR O NO)?

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

30. Dove sono localizzate LE ALTRE IMPRESE con cui l'impresa collabora per l'innovazione ? (indicare la percentuale %)

Veneto	
Italia	
Estero	

31. Quanto sono state efficaci le collaborazioni con LE ALTRE IMPRESE per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7

32. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato con I CLIENTI?

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

33. Rispetto alle collaborazioni con i clienti, si tratta di (sono possibili più risposte):

Consumatori

Clienti industriali

Clienti istituzionali (pubblico)

Distributori o intermediari commerciali

34. Dove sono localizzati I CLIENTI con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto	
Italia	
Estero	

35. Quanto sono state efficaci le collaborazioni con I CLIENTI per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

◯ 1

◯ 2

◯ 3

◯ 4

◯ 5

◯ 6

7 ◯

36. In relazione alle innovazioni introdotte nel triennio 2012-2014, con quale modalità ha collaborato con LE UNIVERSITA' E LE STRUTTURE DI RICERCA PUBBLICHE

- Non ho collaborato
- Collaborazioni Formali (contratti)
- Collaborazioni Informali
- Entrambe

37. Dove sono localizzate LE UNIVERSITA' con cui l'impresa ha collaborato per l'innovazione? (indicare la percentuale %, somma=100)

Veneto

Italia

Estero

38. Quanto sono state efficaci le collaborazioni con LE UNIVERSITA' per le attività d'innovazione dell'impresa (in una scala da 0= nullo, a 7= elevata)?

- 1
- 2
- 3
- 4
- 5
- 6
- 7

39. Rispetto alle collaborazioni per l'innovazione con l'Università, in quali forme collaborate? (sono possibili più risposte)

Progetti di ricerca congiunti

Consulenze con docenti /dipartimenti (anche non formalizzate)

Stage

Dottorati industriali

Didattica (Premi di laurea, Borse di studio, assegni di ricerca)

Sezione 5: Risorse l'innovazione

40. Rispetto alle innovazioni introdotte nel triennio 2012-2014, l'impresa ha usufruito di qualche forma di sostegno pubblico? Se sì, qual è stata la rilevanza ai fini dell'innovazione introdotta (in una scala da 0=non rilevante a 6=molto rilevante)?

	Utilizzo	Efficacia
Finanziamenti regionali e locali		
Finanziamenti statali o di altre istituzioni italiane		
Finanziamenti Europei		
Altre forme di sostegno pubblico (non finanziarie)		

41. Informazioni generali AIDA

Nome Azienda	
Codice fiscale	
Nome intervistato	
Carica ricoperta	

42. Intervistatore

R

V

APPENDIX B

Correlation between innovation capacity and number of collaborations

```
        Pearson's product-moment correlation

data:  x and y
t = 9.0984, df = 179, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.4536907 0.6545103
sample estimates:
      cor
0.5623362
```

APPENDIX C

fsQCA results leading to bad innovation performance

Bad Innovation Performance	
Configuration	C1
Universities	⊗
Clients	⊗
Suppliers	⊗
Competitors	⊗
Kibs	⊗
Consistency	0.926000
Raw coverage	0.206951
Unique coverage	0.206951
Overall solution consistency	0.926000
Overall solution coverage	0.206951