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Uncovering the micro-foundations of knowledge sharing in open innovation partnerships: An intention-based perspective of technology transfer

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ABSTRACT

In the current dynamic and virtuous flow of knowledge economy, firms are concern about whether to manage innovation centrally or through decentralized business units. Two needs emerge 1. Guaranteeing organizational efficiency and 2. Exploiting effectively market opportunity. This usually implies the integration of knowledge in technology transfer which can be accrued via the knowledge sharing between parties. However, by looking into the technological and social change literature, previous studies were mainly focused on macro-foundation of technology transfer and organizational innovative capabilities with less consideration to the role of psychological precursors of collaborations. Due to this gap, we intended to build a consistent conceptual basis for collaborations and technology transfer practices at the micro level. Therefore, drawing on the theory of planned behaviour (TPB) we propose a micro-foundation model for collaborative innovation and technology transfer.

To test our theoretical arguments, we use data collected from the Community Innovation Survey (CIS) dataset. Hypotheses are tested through both Anova and linear regression analyses. Findings show positive and linear relationships either between our perceived control factors and the intention between technology transfer and intentions.

1. Introduction

Innovation is widely recognized as the main strategic driver of economic growth and development. For such role, the interest of scholars and policy makers for the theme was increasing thus far beyond saying. Nonetheless, the dynamics of innovation systems are still a relevant conundrum, which is way far to be addressed. As a matter of fact, the complex interplay between knowledge flows and the technological paradigm in use is making innovations more difficult to be achieved and more expensive as well. In a nutshell, firms are having hard time when it comes to develop and introduce new products and processes only by themselves. The alternative is to search externally for partners who are willing to put their knowledge as the main stake on the table. Unavoidably, the consequence is that innovation process became an interplay of various parties who combine their knowledge and reduce problems into simple design requirements (Patel and Pavitt, 1997; Scuotto et al., 2017a, 2017b). As Chesbrough (2003) has wisely foreseen already in the early 2000s, this gradually led firms to an open innovation system, which means opening the borders of internal R&D systems toward external sources of knowledge through various kinds of partnership, licensing contracts, alliances and other technology agreements (Hagedoorn and Duysters, 2002; Drayton and Budinich, 2010; Del Giudice and Maggioni, 2014; Carayannis et al., 2018). Generally speaking, a firm's ability to exploit technological opportunities emerging from the environment depends on two main factors: the firm's knowledge-base and its learning process (Cohen & Levinthal, 1989; 1990; Scuotto et al., 2017a; Scuotto et al., 2017b; Carayannis et al., 2017). In this sense, an effective knowledge sharing strategy might positively impact innovative performance (Hansen et al., 1999; Sáenz et al., 2009; Della Peruta et al., 2014; Solima et al., 2016; Soto-

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Acosta et al., 2018). Knowledge reveals itself along with technology transfer, this way directly affecting innovation performances, the application of technologies and the techniques developed in other organizations (Melkers et al., 1993; Nonaka, 1994; Phillips, 2002; Del Giudice et al., 2018a). The integration of knowledge in technology transfer can be accrued via the knowledge sharing between parties, where knowledge sharing occurs as the "activity of transferring or disseminating knowledge from one person, group or organization to another" (Lee, 2004, p. 324), and technology can assume the form of a device – such as tooling, equipment and blue prints – as well as of information – methods and procedures (Teece, 1977). In this sense, several authors describe the technology transfer as a communication process based on knowledge sharing and a mutual exchange (Dahl and Pedersen, 2004; Dahl and Pedersen, 2005). When designing the process of knowledge sharing a firm ought to consider those constraints emerging from the characteristics of the knowledge itself. In fact, knowledge is deemed to occur into two different forms, tacit or explicit, distinguishing by whether it is possible or not to code the knowledge and to what extent.

The tacit dimension of knowledge refers to the interlace between cognitive and technical elements of a person such as experience, opinions, and know-how, which are hard to be isolated and captured in a monistic and codified representation. By contrast, the explicit dimension of knowledge, it is codifiable, and suitable to be articulated and communicated in a symbolic form and/or a natural language (Nonaka and Takeuchi, 1995; Della Peruta et al., 2014).

These two species of knowledge are the fundament for any innovation process (Solima et al., 2016).

Surprisingly, the hard part of any knowledge transfer is not just limited to the sharing of tacit elements. Even explicit knowledge might cause trouble to individuals, mainly related to the lack of familiarity with codifying methods (Marcotte and Niosi, 2000).

Nowadays, innovation evokes an open process which combines these two forms in a virtuous flow. Yet, an open innovation approach connects the process of knowledge exploitation and exploration alongside with technology exploration and exploitation.

This model is based on a dynamic approach in which firms implement both "inside-out" and "outside-in" activities described as inbound and outbound open innovation strategies (Huizingh, 2011; Scuotto et al, 2017b). As the main result, firms are increasingly engaging in global partnerships as a means for recovering external and unique technological inputs (Gatignon et al., 2002; Hauser et al, 2006; Knudsen, 2007; Enkel, 2010; Del Giudice et al., 2018b).

Despite a wide interest in collaborative approaches to innovation from academics and practitioners, many open innovation partnerships fail. For instance, a reluctance to change their mind-set and so move from a closed to an open innovation model is one of the reasons (Hossain et al. 2016). Therefore, this has resulted in discovering the behavioural foundations of open innovation partnerships which is still not so much studied. Chatenier et al. (2010) emphasize the crucial role of people in the process of knowledge creation. Indeed, Gomes et al. (2003) point out that the integration of behaviours and attitudes on the micro level has an important influence on innovation processes.

Furthermore, a decisive issue for firms is whether to manage innovation centrally or through decentralized business units. Two different needs influence this organizational decision: a) the ability to guarantee organizational efficiency, by reducing costs and activating economies of scale, as happens with the creation of specialized research laboratories or the recruitment of expert professionals (Carayannis et al., 2018); b) the ability to guarantee the effectiveness and the best exploitation of market opportunities. This usually implies the decentralization of the company units involved in innovation and a lean set-up of the central organization. The main advantage of decentralization, for example, is the proximity to the market and to customers. This allows the decentralized units to better identify and anticipate opportunities in emerging markets and exploit them deeply. The effectiveness of this approach depends on the willingness and ability of the decentralized business units to share the results with the rest of the company.

By looking into the technological and social change literature, we noted that previous studies were mainly focused on macrofoundation of technology transfer. (Botchie et al. 2018) analysed appropriateness and mechanism of hard and soft technology transfer in fostering economic growth and human capability development in many emerging and developing economies. (Gkypali et al., 2018) explored the relationship between absorptive capacity, export activities, R&D collaboration and performance. More specifically, those authors analysed to what extent internal knowledge creation capacity and R&D collaboration affect innovation and exports. The main finding of the study indicates that absorptive capacity could improve R&D collaborations, innovation and performance. Coherently, (Bresciani et al., 2018) highlighted that building alliances could foster new technologies exploration.

Previous technological and social change literature was mainly focused on organizational innovative capabilities and organizational antecedents of exploration and exploitation activities, with less consideration to the role of psychological precursors of collaborations (Sarala et al., 2016). To date, the understanding of how these capabilities are created and operate loom as rather poor (Kraatz & Zajac, 2001; Barreto, 2010; Paruchuri and Eisenman, 2012).

For example, few studies analyse the cognitive perspective on international partnerships and its technology transfer effectiveness (Anderson and Tushman, 2004).

By contrast, the study of microfoundations of innovation capabilities might help to clearly identify organizational processes and competencies which support the development of innovation capabilities (Dosi et al., 1988; Eisenhardt & Martin, 2000; Felin et al., 2012).

According to Schneckenberg et al. (2015), innovative capabilities result from specific interactions and interdependencies between microfoundations. Corporate knowledge sharing and organizational learning processes encourage micro foundational sources of innovative capabilities and empower the firm to sustain the corporate advantage.

To the best of our knowledge, studies examining the exploration and exploitation activity at a micro level are also exiguous. Many authors suggest that scholars should pay attention to the individual and team levels of analysis (Gupta et al., 2006; Lavie et al. 2010). Following such lead, the first intended contribution of this research is to build a consistent conceptual basis for collaboration and technology transfer practices at micro level. This highlights the importance of incorporating the perspectives and motivation of firms' decision makers –owner \managers- in a technology transfer process.

Since the main objective of the present study is to analyse antecedents of managers' intentions to collaborate and transfer technology, we draw on the theory of planned behaviour (TPB) (Ajzen, 1991) as a framework to understand social and psychological determinants of individual behaviour. According to TPB an individual's behavioural intention is based on the positive or negative evaluation of behaviour (attitudes), determining the intention to engage or not engage in a behaviour and the perception of the ability to perform a given behaviour (Ajzen, 1991, Armitage and Conner, 2001). The TPB was chosen in this study because it provides an important behavioural perspective of technology transfer. As (Ryan 1982) stated, behavioural intention is a function of the interdependencies of attitudinal and normative variables. According to this perspective, intentions are intended as a useful substitute for explaining behaviour in model applications.

We propose a microfoundation model for collaborative innovation and technology transfer. We focus on the perceived behavioural control. In brief, the perceived behavioural control is presence of some factors that may facilitate or impede performance of the behaviour. As for that, we consider existing collaboration, governance and market factor and intellectual property and licensing-in as factor influencing the perceived behavioural control. We assume that such factors affect

the intention, which is, in our case how firm's goals are perceived and how the value of each collaboration if perceived. Thus, we study how this predict the behaviour, which is, in our case, the implementation of a technology transfer.

To test our theoretical arguments, we use data collected from the Community Innovation Survey (CIS) dataset. Hypotheses are tested through both Anova and linear regression analyses. Findings support our hypotheses at the level of high statistic relevance. As a matter of fact, results show positive and linear relationships either between our perceived control factors and the intention or between technology transfer and intentions.

Unprecedently, our study, extends and novels literature by drawing on the theory of planned behaviour as a mean for revealing the microfoundations of knowledge sharing and technology transfer in strategic innovation partnerships.

For the remainder, the narrative of the paper unties onto five sections: section offers a theoretical background along with the development of current study's hypotheses on technology transfer.Section 2 presents the theoretical model. In this line, the empirical research is built in Section 3.The results are then discussed on the theoretical lens in Section 4 along with research limitations and recommendations for future research.

2. Theoretical background and hypotheses development

2.1. The effectiveness of international technology transfer

Technology is described as one of the most important strategic factors in global competitive environment (Pironti et al., 2018). This is why the relationship between internationalization and technology transfer is assuming an increasing role in the debate about innovation management (Dezi et al., 2018).

International technology transfer (ITT) has been largely studied over the past twenty-five years. Given the inherent complexity of the subject, findings, conclusions and contentions of what we know about ITT are fragmented along various specialties.

According to the pivotal study of, ITT has a horizontal and a vertical component, each with its own constituent elements. On the horizontal dimension, the three base elements in ITT are a home country, a host country, and a transaction. The vertical aspect acknowledges that within the home and host countries, analyses and issues arise that are specific to the nation state, an industry or a firm.

To explain the firms' choice to transfer technology at international level, several researchers have tried to identify the factors influencing an MNC's transfer of its R&D capability. (Hirschey and Caves 1981) reported that the proportion of U.S. MNCs' global R&D outlays that are spent overseas depends positively on the extent to which the MNCs' foreign markets are served by their subsidiaries' local production, the need to adapt the product to local market conditions, and the importance of basic research.

Several studies suggested that acquisition of technology does not automatically lead to the acquisition of technological capabilities (Hagedoorn and Duysters, 2002; Felin et al., 2012).

This means that substantial managerial effort is essential to the acquisition of technological capability (Katz, 1985).

In evaluating the acquisition of a technology, the task of a manager is to find the technology that combines factors of production, usually capital, labour and other factors, to yield maximum revenue and minimal production costs (Pironti et al., 2018). However, according to (Stewart 1977), the managerial choices are influenced by a mix of factors, some of which override the relative factor of cost consideration. As also highlights that managers have engineering objectives and managerial objectives along with profit maximization.

The managerial and theoretical implications of these studies have generated a long tradition of macro perspectives of technology transfer (Bozeman, 2000; Rasmussen and Rice, 2011; Phillips, 2002; Siegel et al., 2007). These studies have their roots in different disciplines such as economics, management, innovation, public policy, strategic management and entrepreneurship. At the macro level this has generated constantly changing perspectives, for example the mechanisms (formal and informal), the measures, the methods, the evaluation and the effectiveness of the technology transfer (Gilsing et al., 2011; Lee and Win, 2004).

2.1.1. Technologies transfer and collaboration strategies

To implement an efficient technology transfer process, firms should collaborate with a large number of actors from outside their organization (Phillips, 2002). Profit-maximization drives firms to cooperate with other organizations whenever it could provide positive economic benefit. A direct economic benefit could be observed, for example, from the reduction of cost of cheaper knowledge acquisition from outside or the reduction on commercialization or time-to-market for new products and processes. At the same time, firms need also to effectively manage the expected returns from exploitation of their innovative ideas (Pironti et al., 2018; Papa et al., 2018). This gives life to the so-called "opening paradox": to create innovations, firms are required to collaborate and become open; at the same time, the commercialization of innovations requires protection to generate economic benefits and, in turn, improve competitiveness (Laursen & Salter, 2014).

This led several studies to analyse the relationship between the technology transfer strategy and the general strategy of open innovation of the company.

Firms that pursue external technology exploitation to commercialize technological knowledge exclusively or in addition to its internal application, prefer outbound innovation strategies (Gassmann & Enkel, 2004; Lichtenthaler, 2009; Ershi et al., 2013). Since these firms focus on the externalization of knowledge with the purpose of bringing ideas to the market faster than what is possible through internal development, outbound innovation strategy could include practices such as out- licensing or intellectual property (Erchi et al., 2013; Gassmann & Enkel, 2004).

Whereas, firms that invest in cooperation with stakeholders and integrate the external knowledge adopt an outside- in approach known as inbound innovation strategy. Since ideas are external to the company, technology in- licensing, acquisition or joint development constitute the most cited examples of these approaches (Ershi et al., 2013; Gassmann & Enkel, 2004).

However, firms that enjoy strategic networks and cooperate with members (Gassmann & Enkel, 2004) follow a coupled strategy, combining the outside- in (to gain external knowledge) with the inside- out process (to bring ideas to the market). Besides, other research have addressed the relationship between intellectual property management and the (non-pecuniary, pecuniary, direct and direct) mechanisms of collaboration with the external environment (Henkel, 2006; Nuvolari, 2004; von Hippel & von Krogh, 2003; Dahlander & Gann, 2010).

According to these studies the processes of *revealing* internal resources to the external environment as well as of *sourcing* external ideas and knowledge from stakeholders generally based on non-pecuniary-indirect benefits (Lakhani et al., 2006; Laursen and Salter, 2006b; Allen, 1983; Dahlander & Gann, 2010). While, processes of out-licensing or *selling* products in the marketplace as well as of *acquiring* inventions and input to the innovative process through informal and formal relationships focus on the pecuniary direct benefits (Chesbrough & Rosenbloom, 2002; Lichtenthaler & Ernst, 2009).

Although with regard to the processes of revealing internal resources and sourcing external ideas and knowledge, main disadvantages are related to the difficult to capture the benefits related to technology transfer (Sapienza et al., 2004; Laursen and Salter, 2006b). This supports what (Bayona et al. 2001) assert about firms propensity to collaborate in technology transfer: where there is an high propensity to collaborate in a risk constraint environment rather than in R&D controlling cost situation. (Ahuja 2000) adds that innovation acquisition

activities can limit the maintenance of partners' ties and increase the risk of outsourcing tasks.

Furthermore, Belderbos et al. (2004) point out that the selection of a partner is positively affected by the types of sources of information. Moreover, firms size affects positively domestic cooperation (Santoro et al., 2016; Petruzzelli et al., 2018). Mark and Graversen (2004) further explore antecedents of technology transfer at international level by focusing on R&D cooperation. As Authors point out: if firms employ foreign people they tend to cooperate more with international organizations. R&D cooperation is more common to those firms conducting process innovation; the existence of an R&D department and the presence of skilled researchers also affects positively the probability to cooperate; the ratio of R&D expenditure in basic research as well as the ratio of R&D employees increase the probability of cooperation.

Even though there are a lot of benefits associated with engaging in collaborations, not every decision to participate necessarily leads to successful performance (Wallin & Von Krogh, 2010; Campanella et al., 2017). As the implementation of open innovation in practice is challenging, managers need to pay attention to issues of non-technical nature, such as motivations, knowledge or governance (Wallin & Von Krogh, 2010).

2.2. The microfoundation of international technology transfer: a knowledge base view

Notwithstanding, research has frequently examined the effects of cooperation and strategic partnership on firms competitiveness and innovativeness, a substantial portion of the prior research has been conducted within an organizational analytical framework emphasizing the effects of managerial practices and organizational culture on technology transfer and knowledge sharing (Bartol & Srivastava, 2002; Chen & Huang, 2007; Floyd & Lane, 2000; Carayannis et al., 2014; Felin et al., 2015).

Micro-level based evidence has attracted increasing attention in the management literature and in the field of technological innovation in particular (Felin et al., 2012).

Micro perspectives of technology transfer have focused on a variety of themes and are growing within the field using different perspectives (Albats et al., 2018).

Such studies analysed the use of technology transfer offices (Muscio, 2010), the role cultural differences (Lin and Berg, 2001; Tarba et al., 2017), motivations and communications (Barnes et al., 2002; Plewa et al., 2013) and collaborations (Albats et al., 2018; O'Kane et al., 2017).

Recently, there have been a growing micro level studies aimed to understand better technology transfer through the individual perspective of actors involved in the technology transfer process such as academic entrepreneurs (Bercovitz and Feldman, 2008; Miller et al., 2018) and technology entrepreneurs (Hayter et al., 2017; RezaeiZadeh et al., 2017; Watson and McGowan, 2017; Guerrero et al., 2018).

Despite that, the role of micro-level evidence of technological innovation and social change in interorganizational relationships – such as cross-border strategic partnerships and their relationship to organizational performance – still remains relatively under -investigated in the context of global strategic partnerships (Angwin, Paroutis & Connell, 2015; Paruchuri and Eisenman, 2012; Tarba et al., 2017; Del Giudice et al., 2017).

While scholars and practitioners have acknowledged the critical role that technology transfer and knowledge sharing plays in creating and maintaining effectiveness, surprisingly few empirical studies have examined both the individual antecedents well as their relationship to organizational innovativeness (Alavi & Leidner, 2001; Kogut & Zander, 1996; Yang & Farn, 2009).

Therefore, further micro-level studies are needed to examine the antecedent factors that influence individual behaviour in the technology transfer process, with specific attention to specific technology transfer mechanisms such as licenses and specific individual actors.

2.2.1. A behavioural model for the microfoundations of knowledge sharing and technology transfer in strategic innovation partnerships

Since knowledge sharing has the potential to greatly improve technology transfer, motivating people to contribute knowledge has become a critical issue in research and a major challenge for firms.

For this reason, in recent years, researchers have explored many antecedents and predictors of knowledge sharing in various contexts (Wang and Noe, 2010; Tangaraja et al., 2015) and the nature of sharing relationships has also been documented by other studies (Kim & Lee, 2006; Lin, 2007).

Sharing knowledge is one of the processes in knowledge management (Davenport & Prusak, 1998; Ferreira et al., 2018). It is "the process of transferring knowledge from a person to another in an organization". Knowledge sharing is a deliberate act that makes knowledge reusable by other people through knowledge transfer (Lee & Al-Hawamdeh, 2002; Ferraris et al., 2018).

In spite of the enormous studies on the concept of knowledge sharing, little is known about the effect of individual-level factors on knowledge sharing.

Although many factors influencing the level or amount of knowledge sharing have been found, there is still inadequate empirical evidence available (Wang & Noe, 2010) and the means by which useful knowledge sharing is initiated and realized is left unexplored.

Previous studies reveal that people are reluctant to share knowledge. According to, there are several individual factors that inhibit people in sharing knowledge. With specific regard to technology transfer, most relevant factors are: lack of awareness, lack of interaction, lack of trust in people, differences in national culture or ethnic background. Lee and Al- Hawamdeh (2002) identify an additional individual factor that technology transfer: the appreciation of the importance of knowledge. Coherently, several authors analysed the individual factors that enable knowledge sharing. (Awad & Ghaziri 2004) suggest factors like personality and attitude; (Lin, 2007) suggests enjoyment in helping others and self- efficacy; (Zhang and Jiang, 2015) identify learning attitude and personal relationship; and identifies motivations, trust and care. With regard to motivations, several authors theories knowledge sharing behaviour and analyse potential predictor such as intrinsic motivational factors, extrinsic motivational factors and organizational socialization factors (De Almeida, et al., 2016). From the literature, it is evident there are many individual factors that influence knowledge sharing practice. For instance, Ajzen (1991) deems that a complex task can be attempted if the perception of the feasibility is high. In this line, he introduces the theory of planned behaviour (TPB) which describes the individual perception as a leverage of taking an action. Indeed, if the perception is negative even a simple action is blocked. One of the important contributions provided by TPB consists in bringing out the importance of subjective beliefs and not of objective realities as the main determinants of individual behaviour. Beliefs about the outcomes of behaviours create the attitude towards undertaking actions or not; beliefs about how others will react create the perception of having to adapt to external expectations; subject's perceptions of what he can or manages to do, and not his real abilities, limit the field of feasibility. The three types of factors lead to the formation of a behavioural intention. The more favourable the attitude and the subjective norm and the greater the perceived control, the stronger should be the intention of the person to perform the behaviour. Changes in these three factors lead to changes in behavioural intentions. The TPB thus considers individual behaviours in relation to open innovation actions. It is reasonable to assume that the theory of planned behaviour provides an important basis for investigating the individual and group motivations for the implementation of an open innovation oriented behaviour. The TPB theory allows studying factors influencing

individual or group intentions to implement a certain behaviour and can be useful to explain and predict behaviours related to the adoption and implementation of open innovation practices.

Basing on Ajzen (1991) arguments, we build on and extend the span of the TPB by adapting it to explain and predict the microfoundations of knowledge sharing and technology transfer in open innovation partnerships. We focus on the effect of perceived behavioural control and belief on intention and behaviour. The perceived behavioural control "refers to people's perception of the ease or difficulty of performing the behaviour of interest" (Ajzen 1991, p. 183). It is determined by the so-called "non-motivational" factors Ajzen (1991), which are the collection, in a given moment, of resources and opportunities. In our case, we consider a series of specific strategic factors as determinants of the perceived behavioural control. Precisely, we consider:

i the strategy implemented by the firm, labelled as "governance and market." It refers to strategies such as M&A, diversification, refocusing and divestiture, internationalization, globalization, transnational presence;
ii the strategic knowledge resources owned or controlled by the firm directly or through partnerships – with other firms, universities or research institutes -, labelled as "intellectual property and licensing." It refers to industrial design rights, patents, trademarks, European utility models (registration, application, purchase, sale, licensing in or out)
iii the existing strategic partnerships for collaborative innovation, labelled as "types of co-operation." It refers to collaborative innovations with other firms from the same group, with firms from the same sector, with public and private customers, with suppliers.

These strategic factors set the degree of control an individual is confident to exert over his/her ability to actually implement the behaviour. As for the belief, we examine those which are related to above factors, such as the perceived value of each strategic goal (increase/decrease in costs, profits, market share, turnover), whether they are deemed relevant or not.

We assume that the interplay of such factors determines the ability to implement a behaviour. The ability, in its turn, shapes the motivation, which leads to the formation of an intention, and, thus, to the actual behaviour. In sum, having the resources and the opportunities increases the perceived behavioural control. Such sense of control, along with the described belief, let the individual to sense that he/she has the ability to implement the behaviour. This way emerges the individual motivation, which leads to the behavioural intention and predicts the actual behavioural achievement. In our case, the actual behaviour refers to the implementation of a technology transfer.

We retain that:

- Proposition 1. the interaction between perceived behavioural control and belief determines the individual ability to implement a technology transfer and affects individual motivation.

Thus, our hypothesis is that:

Hp1: there is a linear and positive relationship between the implementation of a technology transfer (actual behaviour) and the perception of the positive value of collaborative innovation (motivation).

The model is depicted in Fig. 1.

3. The role of the individual transfer and sharing of technological knowledge

3.1. Research design, sample and method

The aim of the study is to explore the microfoundations of knowledge sharing and technology transfer in strategic innovation partnerships by adapting and extending the TPB. To this end, the unit of analysis is set at individual level. Consistently, we used microdata drawn from the most comprehensive data-set of innovative firms currently available, the Community Innovation Survey (CIS). This dataset is released by the Eurostat. The CIS contains information on innovative activities carried out by firms operating in the European Union. In particular, this dataset includes a broad set of indicators on innovation activities, innovation spending, effects of innovation, public funding, innovation co-operation, sources of information for innovation, main obstacles on innovation activity and methods of protecting intellectual property rights. The CIS is based on a survey distributed throughout the European Union. More precisely, the population of the survey refers to the entire population of firms classified as NACE_R2, for which innovation is the core activity, operating in EU member states and number of ESS member count. The survey specifically consists in a harmonized questionnaire, based on the Oslo Manual, and organized by scales. Respondents, who voluntary choose to contribute, are owners and senior managers from firms.

There are several reasons which led the authors to choose this specific dataset.

First, the CIS is deemed to have a high statistical reliability and validity (Laursen and Salter, 2006). As a matter of fact, constructs and indicators are largely tested by each National Statistics Bureaus and, finally, they are harmonized.

For such reason, numerous scholars in the research field have previously used this dataset (Laursen and Salter, 2006; Frenz and Ietto-Gillies, 2009; Dong and Netten, 2017; Hochleitner et al., 2017).

Also, the dataset is archived in a public repository and it is available on request. This characteristic foster future replications of the study.

Second, the micro-nature of data is consistent with the aim of the research. The CIS is deemed to be subject-oriented (Laursen and Salter, 2006). As for that, this dataset allows authors to directly test perceptions on the value of collaborative innovation and firms' actual behaviour.

Third, European enterprises are an ideal target to test the model because of the many solicitations and incentives to innovation and to collaboration between partners, thanks to programs such as Horizon 2020 and the absence of commercial barriers between Countries. The wealth of monetary incentives, along with governmental policies in support to the cross-fertilization between firms in support of innovation, are supposed to impact the intention by supporting the motivation. In addition, there are abundant programs that fosters technology transfers between firms. According to Bloomberg rating of World's Most Innovative Economies 2019, Europe has 5 out of the ten most innovative Countries in the World: Germany holds the second place, followed by Finland, 3rd, Switzerland, 4th, Sweden, 7th, France, 10th. Generally speaking, this index is intensively populated by European Countries. Apparently, such motives seem to support the idea the European enterprises are an ideal setting to evaluate knowledge transfers between firms.

Consistently, the panel used in current research refers to the entire population of European firms. Data were controlled for normality of distribution and residuals. This type of distribution, typical of large-scale dataset, is consistent with the aim to test the TPB in out specific context. As a matter of fact, TPB testing requires large-scale data to be tested by definition.

Collected data refer to the last available release of the survey. Each release takes place in about 2 and half years. Last survey was started in 2014, released in 2016, and updated in 2018. As stated above, answers are given voluntarily. That means there is the possibility of missing data.

To avoid this problem, we have defined to narrow our data selection only to those Countries and variables for which data are entirely available, thus, excluding at hand Countries with missing values. Selection of valid cases is based on the method of casewise deletion.

Table 1 shows information on the number of firms in our final sample.

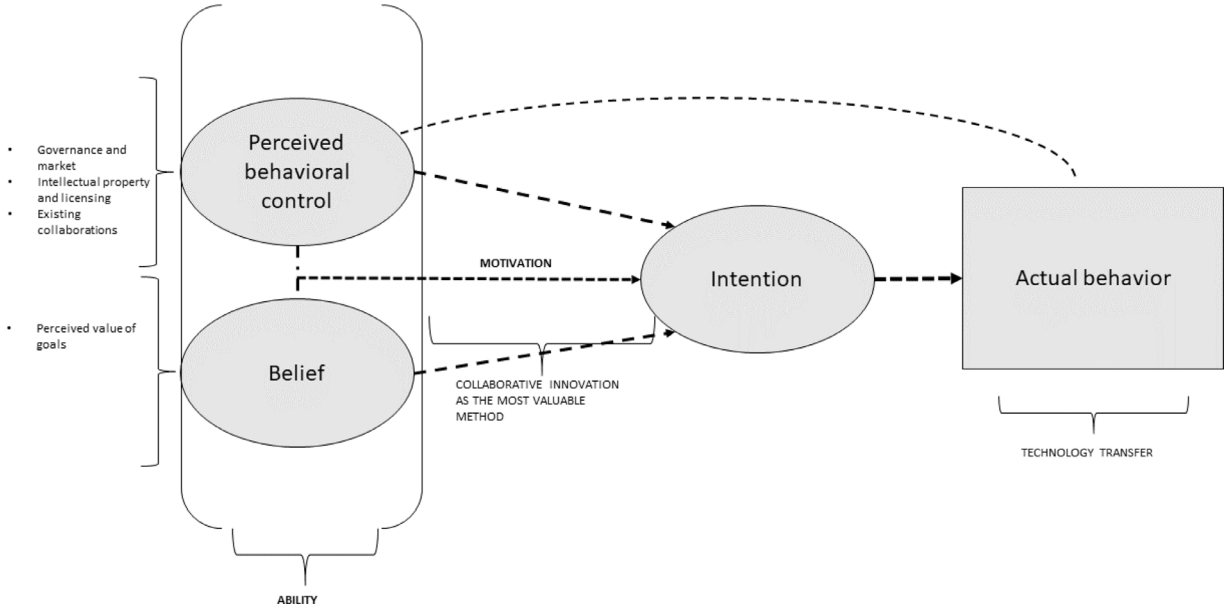

Fig. 1. Authors' adaptation from the Theory of Planned behaviour (Ajzen, 1991, p. 182). Source: Our own elaboration

Table. 1
Population of the sample.
Source: Eurostat, 2018 (last update)

GEO/INDIC_IN	Total number of enterprises in the population in 2014
Bulgaria	3.725
Germany (until 1990 former territory of the FRG)	91.120
Estonia	966
Greece	7.057
Croatia	2.748
Italy	54.458
Cyprus	670
Latvia	1.276
Lithuania	3.300
Hungary	3.764
Malta	367
Austria	9.901
Poland	12.347
Portugal	10.044
Romania	3.645
Slovakia	2.432
Sweden	4.742
Total	212.562

The model was tested by performing a cross-sectional analysis, an analysis in a specific point in time, to check whether a causal effect between variable exists or not, and how powerful it is. Also, the cross-sectional analysis allows to avoid correlation of residuals.

We have measured correlations and applied a three-way ANOVA to test our propositions, whilst the hypothesis was tested by using a linear regression model.

The use of Anova to verify our model is largely justified by prior contribution on TPB (Doll and Ajzen, 1992; Courneya, 1995; Zoellner et al., 2012). Similarly, the use of linear regression is based on the implicit assumption upon which TPB relies (Hankins et al., 2000).

So, first, we test correlations between perceived control and belief, to determine how they interplay. Second, we explore whether perceived control and belief are antecedents of the intention. Finally, we verify the positive and linear relationship between intention and behaviour.

Correlations are useful to gain insights on the interplay between variables. As a matter of fact, we assume that there is an interplay between perceived behavioural control and belief. Such interplay is the antecedents of individual ability and motivation to knowledge sharing and technology transfer. Coherently, we also explore the validity of our model by applying a three-way ANOVA to check whether strategy, intellectual property and existing collaborations influence intention.

The Anova method is extremely popular in this field of research (Chen et al., 2006; Herzog and Leker, 2010).

The three-way Anova (or factorial Anova) is a hypothesis-based test, aimed to examine the effects of three different independent variables on the continuous dependent variable. Thus, we test the effect of each categorical factor on the dependent variable, and the effect of each categorical factor on each other. As the consequence, we test the different null hypotheses (H0) by comparing the means between the groups to determine whether means are statistically and significantly different from each other, as a means to accept the alternative hypotheses (HA).

This way, we assess interrelationships between variables, by comparing multiple groups of factors, and, meeting the three principles of design of experiments which are replication, randomization, and local control.

In the sample, the nominal variable is the Country, while measurement variables are observations per Country, grouped per factor and categories of each factor.

Differently, the linear regression is aimed to verify whether there is a positive and linear relationship between our dependent variable – technology transfer – and the explanatory variable, which is "considering collaboration as the most valuable method to achieve innovation."

As a matter of fact, we hypothesize that the motivation directly determines the intention and predicts the actual behaviour. Consistently with our model, we search for direct effects of the motivation on the actual behaviour.

3.2. Variables

For descriptive statistics, we measure correlations between perceived behavioural control and belief. Basing on the definition provided by Ajzen (1991), we consider a set of strategic factors as a proxy for perceived behavioural control, as shown in Table 2. Such factors directly impact intention, for that they are also the independent variables in the three-way ANOVA test.

Perceived goals are indeed considered as a proxy for belief (Table 3)

Table. 2
Independent variables – perceived behavioural control.
Source: Our own elaboration

Factor	Categories
Governance and Market	Enterprises that have merged with/take over another enterprise
	Enterprises that have sold/closed/outsourced tasks or functions
	Enterprises that are part of an enterprise group
	Enterprises that are part of an enterprise group and have a foreign head office
	Enterprises for which the largest market in terms of turnover is the other EU, EFTA and/or EU-candidate countries
	Enterprises for which the largest market in terms of turnover is the local or the regional market
	Enterprises for which the largest market in terms of turnover is the national market
	Enterprises for which the largest market in terms of turnover is all other countries than EU countries, EFTA or EU-candidate countries
	Enterprises that sell goods and/or services in other EU, EFTA or EU-candidate countries
	Enterprises that sell goods and/or services in the local or the regional markets
Intellectual property and licensing	Enterprises that applied for a patent
	Enterprises that registered a trademark
	Enterprises that applied for a European utility model
	Enterprises that applied for a patent, a European utility model or that registered an industrial design right or a trademark
	Enterprises that licensed out or sold a patent, industrial design right, copyright or trademark to another enterprise, university or research institute
	Enterprises that licensed in or bought a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute
	Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute
	Enterprises that applied for a patent or an industrial design right
	Enterprises that applied for a patent or registered a trademark
Types of cooperation	Enterprises co-operating with other enterprises within the enterprise group
	Enterprises co-operating with competitors or other enterprises of the same sector
	Enterprises co-operating with clients or customers from the private sector
	Enterprises co-operating with clients or customers from the public sector
	Enterprises co-operating with suppliers of equipment, materials, components or software
	Enterprises for which cooperation with other enterprises within the enterprise group is the most valuable method

In the three-way ANOVA, intention is the dependent variable.

Though, in the final regression test, intention become our independent variable, while actual behaviour is the dependent variable.

We consider perception of the value of collaboration as a proxy for intention. As a matter of fact, as previously specified, considering collaboration as the most valuable method to achieve innovation is the main motivation for implementing a technology transfer and for engaging in strategic partnerships.

In our case, actual behaviour refers to technology transfer. Thus, we consider the number of firms that "licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research" as a proxy for technology transfer. Intention and behaviour proxy variables are shown in Table 4.

3.3. Findings

The correlation statistic is aimed to explore the interplay between perceived behavioural control and belief. See Table 5 for main results.

As the correlation table clearly indicates, our proxy variables for belief and perceive behavioural control interplay intensively.

With regard to proposition 1, that means the combination of pre-existing and non-motivational strategic factors interplays with individual perceptions of the value of goals, determining the ability to pursuit the intended behaviour.

The second test is aimed to verify whether such factors are drivers of the motivation, and, thus, contribute to the formation of the intention. Table 6 shows results of the three-way ANOVA. Apparently, findings allow to reject the null hypothesis (first type error) and accept the alternative hypothesis (second type error). Consequently, results of the three-way ANOVA seem to support our proposition.

The means appear significantly heterogeneous and all assumptions for Anova are verified: dependent variables are measured at interval level, independent variables consist of independent groups, observations are independent<, there are no significant outliers, dependent variables are approximately normally distributed, there is homogeneity of variances.

The sample was also controlled for residuals and for normality of distribution.

Finally, the linear regression test is aimed to verify that intention predicts the actual behaviour. In a nutshell, that means the intention and behaviour are the same. In our case, they both are measured through implemented technology transfers. So, we consider the motivation as the very trigger of the action. Considering collaborations as extremely valuable for innovation is the main motivation underlying our model. Tables from 7 to 11 show results of the linear regression tests. In general, results of the analysis largely support our hypothesis:

Table. 3
Individual belief.

Factor	Categories
Perceived Goals	Enterprises considering a decrease in costs highly important
	Enterprises considering a decrease in costs not relevant
	Enterprises considering an increase in market share highly important
	Enterprises considering an increase in market share not relevant
	Enterprises considering an increase in profit margins highly important
	Enterprises considering an increase in profit margins not relevant
	Enterprises considering an increase in turnover highly important
	Enterprises considering an increase in turnover not relevant

Table. 4
Dependent variables.

Factor	Categories	Proxy
Technology transfer	Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	Actual behaviour
Perception of the value of collaboration	Enterprises for which cooperation with other enterprises within the enterprise group is the most valuable method	Motivation and Intention
	Enterprises for which cooperation with competitors or other enterprises of the same sector is the most valuable method	
	Enterprises for which cooperation with clients or customers from the private sector is the most valuable method	
	Enterprises for which cooperation with clients or customers from the public sector is the most valuable method	
	Enterprises for which cooperation with suppliers of equipment, materials, components or software is the most valuable method	

technology transfer is linearly and positively related with perception of the value of each collaboration type. Albeit each relationship is verified at a significant level, only four out of the five relationships have an adjusted R-squared greater than 0,8. By contrast, it seems that how senior management perceive collaboration with competitors has a lower impact on the probability of a technology transfer.

According to above findings, technology transfer is directly triggered by individual motivation. In other terms, belief and perceived behavioural control directly influence the individual motivation and intention, thus, indirectly impacting actual behaviours. The interplay between non-motivational and motivational factors predict future behaviour by shaping the individual intention. In our case, non-motivational factors (strategy, existing collaborations, intellectual properties) determine a positive managerial mindset toward collaborative innovation and knowledge sharing, thus, they are a moderator factor for technology transfer. Apparently, the influence of such non-motivational on technology transfer is strong.

4. Discussion

Our model uncover the microfoundations of technology transfer by describing the process and the mechanisms of intention formation. Our results support that perceived behavioural control along with belief determine the ability to implement a plan and shape individual motivation. We guess that such factors contribute to individual awareness, giving the lead for future actions.

As the self- awareness theory (Duval and Wicklund, 1972; Williams, 1985), the social exchange theory (Redmond, 2015) and the personality theory (Weinberg & Gould, 1999) conceptualized, factors which closely affect knowledge sharing and, in turn, technology transfer are: interpersonal trust, individual attitude, perceived benefits/costs and individual self-efficacy.

Mutual interpersonal trust is necessary for knowledge sharing to take place within and across firms. Individual attitudes have both direct and indirect effects on knowledge sharing (see, for e.g., Lin, 2007). Perceived benefits are positively related to knowledge sharing. Meanwhile, perceived costs have a negative effect on knowledge sharing (Wang and Noe, 2010). Finally, self-efficacy in the ability to share knowledge should influence knowledge sharing (Lee et al., 2007)

This has increase the capacity of a firm to go beyond their boundaries to exploit and explore new knowledge. Organizations need to move from an environment that is closed to views and reactive to one that is open to views, proactive and focused on collectiveness and collaboration (Boateng, 2011; Cunningham and Link, 2015; Nicotra et al., 2017; Usai et al., 2018).

Fey and Birkinshaw (2005) state that a higher degree of openness enhances a firm's performance when it comes to bringing new ideas to the market. Openness constitutes a key strategic decision for managers (Drechsler & Natter, 2012) and there is no optimal way to execute a unique style. This is because the approach will be shaped by external conditions and the organizational culture of the firm (International Chamber of Commerce, 2015). Today the decision to collaborate is incentivized by the possibility of accessing the human capital resources of complementary companies (Rothaermel & Boeker, 2008).

As emerged from our findings several individual factors could affect the willingness of people to collaborate, influencing the decisions about the collaboration depth, the type of partners, the management of the intellectual property rights and the knowledge to share.

The motivation of firms to engage in cooperation with other firms and organizations has been identified within different internal and external perspectives in fields such as economical, production, organizational, marketing and especially in knowledge sharing and product/process development (Sakakibara, 2003; Wognum et al., 2002; Bayona et al., 2001).

The past decade has seen a wave of studies on partnerships, joint venture and strategic alliances (e.g. Austin and Seitanidi 2012a,b). However, the role of individuals and how their actions can effect on the effectiveness of collaborative efforts remained underexposed. An organization's pursuit of a specific course of action is a reflection of the experiences, and motives of its managers (Hambrick & Mason, 1984; Finkelstein & Hambrick, 1996).

For example, it has been pointed out that managers' perceptions of alliance-related issues influence their willingness to enter into alliances (Larson, 1992). More generally, the strategic behaviours or actions of organizations are influenced by the characteristics or background of decision-makers in an organization (Hambrick & Mason, 1984) such as their extent of prior experience with specific behaviours.

4.1. Research limitations, academic relevance and practical insights

According to the theory of planned behaviour (TPB) (Ajzen, 1991), individual's behavioural intention is a function of his/her positive or negative evaluation of the behaviour (attitudes), social pressure to engage or not engage in a behaviour (subjective norm), and perceptions of ability to perform a given behaviour (perceived behavioural control). Attitudes are developed from the viewpoint, which individuals hold about the object of their evaluation. Managers form viewpoints or beliefs about cooperation and partnership by associating them with certain attributes, such as shared trust and achievement of an organizational goal. Each of those managerial evaluations motivates the manager to attain a specific outcome, such as entering into a joint venture or a strategic alliance. This means that managers will act on the basis of their own perceptions of the benefits.

Applying open innovation may speed up and enhance a firm's innovation processes (Chesbrough et al., 2006). These processes entail a significant amount of external knowledge exploration and exploitation (Chesbrough, 2003; Van de Vrande et al., 2006). The ability to explore and exploit knowledge has become a key resource in society and the utilization of knowledge is one of the main characteristics in the new paradigm (Chesbrough et al., 2014). Buganza and Verganti (2009) state

Table. 5
Correlation statistic.

	Enterprises considering a decrease in costs highly important	Enterprises considering a decrease in costs not relevant	Enterprises considering an increase in market share highly important	Enterprises considering an increase in market share not relevant	Enterprises considering an increase in profit margins highly important	Enterprises considering an increase in profit margins not relevant	Enterprises considering an increase in turnover highly important	Enterprises considering an increase in turnover not relevant
Enterprises considering a decrease in costs highly important	1							
Enterprises considering a decrease in costs not relevant	0,959899315	1						
Enterprises considering an increase in market share highly important	0,998879847	0,960080304	1					
Enterprises considering an increase in market share not relevant	0,994703021	0,971897906	0,992591011	1				
Enterprises considering an increase in profit margins highly important	0,976842565	0,892044039	0,973101991	0,970749564	1			
Enterprises considering an increase in profit margins not relevant	0,885939921	0,972725235	0,890149269	0,898286255	0,773698014	1		
Enterprises considering an increase in turnover highly important	0,995441182	0,939050744	0,994326384	0,990463713	0,99111412	0,846959174	1	
Enterprises considering an increase in turnover not relevant	0,961507967	0,998645878	0,961788259	0,971240842	0,891049505	0,974899263	0,938697098	1
Enterprises that have merged with/take over another enterprise	0,961237958	0,988025778	0,961436457	0,963598316	0,888941534	0,967234181	0,935128746	0,989473636
Enterprises that have sold/closed/ outsourced tasks or functions	0,92149941	0,806974669	0,914839422	0,910578715	0,977632639	0,659118362	0,950948143	0,802994827
Enterprises that are part of an enterprise group	0,939485722	0,930471844	0,947161977	0,948835282	0,893702619	0,890777475	0,927675825	0,931017816
Enterprises that are part of an enterprise group and have a foreign head office	0,726869185	0,611389782	0,745126619	0,720757867	0,785485878	0,49712285	0,768832091	0,601271016
Enterprises for which the largest market in terms of turnover is the other EU, EFTA and/or EU-candidate countries	0,763905374	0,796547222	0,774539979	0,740575281	0,644703573	0,836618925	0,721111516	0,796799661
Enterprises for which the largest market in terms of turnover is the local or the regional market	0,991177695	0,964953353	0,99239425	0,995151429	0,967712233	0,892805422	0,98949275	0,963251045
Enterprises for which the largest market in terms of turnover is the national market	0,936710126	0,845151678	0,935150532	0,934214378	0,981622212	0,710875322	0,965124916	0,83952582
Enterprises for which the largest market in terms of turnover is all other countries than EU countries, EFTA or EU-candidate countries	0,418306418	0,322879501	0,417307994	0,359471272	0,383254366	0,299326405	0,403633428	0,322726262
Enterprises that sell goods and/or services in other EU, EFTA or EU-candidate countries	0,989401948	0,944361492	0,991593526	0,987196215	0,978417717	0,86067041	0,993695696	0,941280173
Enterprises that sell goods and/or services in the local or the regional markets	0,974438024	0,980569751	0,979270565	0,978730229	0,919405901	0,942927736	0,960700453	0,979153368
Enterprises that registered an industrial design right	0,967055558	0,88360205	0,96441585	0,966862582	0,988425483	0,768543873	0,97934772	0,883452821
Enterprises that applied for a patent	0,904845091	0,786715996	0,89980907	0,900955022	0,972805568	0,630774973	0,939196143	0,78098323
Enterprises that registered a trademark	0,982063681	0,905769618	0,97816858	0,978085162	0,990936246	0,800241867	0,988168414	0,907876032
Enterprises that applied for a European utility model	0,889505134	0,768589469	0,88135072	0,884622295	0,963528355	0,606368157	0,925067636	0,763109538

(*continued on next page*)

Table. 5 (*continued*)

	Enterprises considering a decrease in costs highly important	Enterprises considering a decrease in costs not relevant	Enterprises considering an increase in market share highly important	Enterprises considering an increase in market share not relevant	Enterprises considering an increase in profit margins highly important	Enterprises considering an increase in profit margins not relevant	Enterprises considering an increase in turnover highly important	Enterprises considering an increase in turnover not relevant
Enterprises that applied for a patent, a European utility model or that registered an industrial design right or a trademark	0,964830241	0,87099895	0,959709846	0,960536379	0,995354463	0,745569019	0,980292874	0,870970346
Enterprises that licensed out or sold a patent, industrial design right, copyright or trademark to another enterprise, university or research institute	0,93731305	0,831684503	0,932603193	0,93356603	0,985337325	0,69337438	0,959918643	0,830044235
Enterprises that licensed in or bought a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,983101328	0,920286059	0,979927046	0,982038586	0,984262309	0,823579131	0,98526141	0,921606025
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,975789302	0,900360682	0,971916915	0,974301464	0,991031557	0,790286854	0,984184921	0,900617
Enterprises that applied for a patent or an industrial design right	0,737371674	0,561190689	0,729759302	0,726853352	0,862711618	0,36326013	0,793937517	0,553958776
Enterprises that applied for a patent or registered a trademark	0,732201343	0,547900102	0,72499722	0,717472093	0,857408407	0,350580171	0,788416848	0,542366884
Enterprises co-operating with other enterprises within the enterprise group	0,862315299	0,739067331	0,867905952	0,852915064	0,924486515	0,602865612	0,896857622	0,73404981
Enterprises co-operating with competitors or other enterprises of the same sector	0,933641729	0,868032119	0,942001169	0,922678604	0,921067943	0,803339364	0,93292935	0,87640352
Enterprises co-operating with clients or customers from the private sector	0,853803651	0,710636171	0,858289635	0,840690901	0,923960945	0,567242567	0,889884198	0,710620637
Enterprises co-operating with clients or customers from the public sector	0,809447576	0,658705748	0,812572287	0,802440821	0,898102772	0,500402092	0,853739057	0,654981899
Enterprises co-operating with suppliers of equipment, materials, components or software	0,936432915	0,869204114	0,945935343	0,924371335	0,927681203	0,800621842	0,939537333	0,876068053

Table. 6
Three-way ANOVA.

Origin of the variation	Sum of squares	Degrees of freedom	Mean square	*F*	*P*	*F* sig
Rows	1,23E + 09	15	82189911	28,97644	1,53E-55	1,690247
Columns	2,35E + 08	28	8401412	2,961958	1,33E-06	1,503235
Error	1,19E + 09	420	2836439			
Total	2,66E + 09	463				

Table. 7
Linear regression 1 – with one-tailed *t*-test with a = 0,05 and $^{**}p < 0,05$.

	Coefficient	Standard error	*T*-test	Sig	< 95%	>95%	< 95,0%	> 95,0%
Intercept	165,8808	56,76759	2,922103	0,010513	44,88352	286,878	44,88352	286,878
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,257472	0,031188	8,255379	5,84E-07	0,190996	0,323949	0,190996	0,323949

Rmultiplot = 0,90; Adjusted Rsquared = 0,80

Table 8
Linear regression 2 – with one-tailed *t*-test with a = 0,05 and $^{**}p < 0,05$.

	Coefficient	Standard error	*T*-test	Sig	< 95%	>95%	< 95,0%	> 95,0%
Intercept	61,14124	47,74032	1,280704	0,219746	-40,6148	162,8973	-40,6148	162,8973
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,109161	0,026229	4,161883	0,000835	0,053256	0,165066	0,053256	0,165066

Rmultiplot = 0,72; Adjusted Rsquared = 0,50

Table 9
Linear regression 3 – with one-tailed *t*-test with a = 0,05 and $^{**}p < 0,05$.

	Coefficient	Standard error	*T*-test	Sig	< 95%	>95%	< 95,0%	> 95,0%
Intercept	80,30434	54,39827	1,47623	0,160566	-35,6428	196,2515	-35,6428	196,2515
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,267934	0,029887	8,964995	2,06E-07	0,204232	0,331636	0,204232	0,331636

Rmultiplot = 0,92; Adjusted Rsquared = 0,82

Table 10
Linear regression 4 – with one-tailed *t*-test with a = 0,05 and $^{**}p < 0,05$.

	Coefficient	Standard error	*T*-test	Sig	< 95%	>95%	< 95,0%	> 95,0%
Intercept	0,764445	12,48348	0,061237	0,951979	-25,8435	27,37235	-25,8435	27,37235
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,04556	0,006858	6,64291	7,84E-06	0,030942	0,060179	0,030942	0,060179

Rmultiplot = 0,85; Adjusted Rsquared = 0,73

Table 11
Linear regression 5 – with one-tailed *t*-test with a = 0,05 and $^{**}p < 0,05$.

	Coefficient	Standard error	*T*-test	Sig	< 95%	>95%	< 95,0%	> 95,0%
Intercept	307,718	89,01704	3,456844	0,003522	117,9827	497,4533	117,9827	497,4533
Enterprises that licensed in/out or bought/sold a patent, industrial design right, copyright or trademark owned by another enterprise, university or research institute	0,379301	0,048906	7,755641	1,26E-06	0,275059	0,483542	0,275059	0,483542

Rmultiplot = 0,88; Adjusted Rsquared = 0,79

that firms who are able to rapidly access new knowledge and integrate it into their current processes will most likely be able to achieve competitive advantage.

This can be achieved by interacting with the external environment through collaborations, which enable firms to create, develop and sustain inter-organizational relationships, which in turn may facilitate finding solutions and ideas that they would not find by themselves (Erfors, 2004). Firms that are adopting this approach must adopt new organizational mechanisms and strengthen the capacity not only to identify and assimilate new external knowledge but also to develop the capabilities to convert knowledge acquired from outside into action within the organization (Ardito and Messeni Petruzzelli, 2017). The key to effective use of knowledge in innovation is that knowledge has to be shared across functional or organizational boundaries (Gibbons, 1994), and hence, an understanding of how knowledge sharing occurs and what factors may enhance or hinder knowledge sharing is necessary.

Subsequently, knowledge sharing comes to play a central part in determining the success of open innovation practices. In line with this, Boer (2005) states that knowledge sharing is indispensable in order to obtain a collective outcome from collaboration in an open innovation environment. Moreover, knowledge flows through the people in the innovation network (International Chamber of Commerce, 2015). (Chesbrough, 2012) also acknowledge this fact by stating that one has to move people in order to move knowledge. Thus, innovation is a social process and it is only through the people that participate in collaborations that firms can achieve the benefits of innovation (Carayannis et al., 2012). Boer (2005) further declares that the participants should share knowledge, since it is their part of responsibility in such collaborations, but it does not always happen in reality.

Since knowledge sharing by and large is a relational process it is of interest to investigate what factors may affect knowledge sharing from the participants' perspective by a qualitative approach. In this way, the present research can be extended with a deep perspective on micro-level roles. It can be also improved by looking into each country and exploring their differences. A cross- cultural analysis can be employed to analyse this phenomenon (Cooke et al., 2019).

However, it is important to note that knowledge sharing does not refer to a static transmission of knowledge. Rather, it should be seen as an iterative process, or a transformation of knowledge from one part to another. A fundamental assumption is that the participants represent a central role in the sharing of knowledge. On this regard, it may be interesting collecting more data, including emerging countries as well. Actually, these countries are more and more brought in international collaborations to exploit advanced knowledge. Indeed, one of the biggest reasons for the actors to get involved in open innovation collaborations is to get access to external knowledge. In order for external knowledge to be created it is of paramount importance that the actors are willing to contribute with their knowledge to the collaboration.

CRediT authorship contribution statement

Veronica Scuotto: Conceptualization, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **Orlando Beatrice:** Formal analysis, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Cillo Valentina:** Conceptualization, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **Melita Nicotra:** Formal analysis, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Leonardo Di Gioia:** Resources, Software, Writing - review & editing. **Massimiliano Farina Briamonte:** Resources, Software, Writing - review & editing.

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