Open innovation, ambiguity, and technological convergence

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Abstract

Objectives. *Current paper aims to provide a fresh conceptual framework on the relationship among open innovation, decision ambiguity, and technological convergence. We argue that there is a curvilinear relationship between open innovation and both technological convergence and ambiguity. Contained level of convergence and ambiguity foster open innovation, whilst an excess of them is an impediment to collaboration. Technological convergence further acts as a moderator for ambiguity, in light of the benefits of isomorphism.*

Methodology. *We propose a conceptual framework for open innovation decisions after accurately reviewing the main literature antecedents.*

Findings. *We suggest an inverse u-shaped relationship between open innovation and either ambiguity or technological convergence.*

Research limits. *In future, the theoretical framework proposed by thus study has to be tested with robust and proper statistical techniques on large scale samples.*

Practical implications. *The model offers a heuristic for open innovation decisions under ambiguity.*

Originality of the study. *To the best of our knowledge, the relationship linking open innovation, technological convergence and ambiguity emerges as a literature gap. This study tackles this issue, proposing an interpretation for the analysis of alliances decision in innovation.*

Key words: *open innovation; decision ambiguity; technological convergence; technological diversity; decision making; inverse u-shaped curve.*

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1. Introduction

Some might say: "This whole technology thing... It's kind of complicated." A fact is we are witnessing to a massive digitalization of the overall society, which reshapes the way businesses were traditionally meant. Firms are challenged to innovate continuously. The pace of rivalry is beaten by the hot pursuit of revolutionary and outstanding solutions for matters that are most complex than ever before. In a convergent society with shared matters, there's a request for convergent solutions as well. As far as interactions and interrelations increase, so does the complexity of problems, bringing to an extreme ambiguity of information. Information overload and complexity of problems make to loom more attractive sharing the burden of innovation with other partners and finding alliances; but, at the same time, they are both an undisputed carrier for ambiguity itself. Technological convergence stands in between of open innovation and decision ambiguity. Such a premise underscores the relevance of the topic.

Despite the intricate and intriguing relationship between decision ambiguity, open innovation, and technological convergence, the academic debate is far from offering an appropriate framework which unravels this bundle. By checking in-depth previous literature, it emerges a gap regarding the relationship either between open innovation and ambiguity, or open innovation and technological convergence. Whereas the motivation of this study springs from the self-evident relevance of the topic, its intent is to tackle the recovered gap. So, the underlying research question is: how do these variables deal with each other? Or, put simply, how does open innovation is emphasized by the technology trend to convergence and what happens when information overload and complexity drive an excess of decision ambiguity? From the reasoning around these wonders, a fresh conceptual framework has taken shape. Its aim is to serve as an insight for clarifying the relationship among constructs and to stimulate future research, opening up the road to a new and under-explored route. Beside the academic relevance, the framework can be used by practitioners when deciding if entering or not in a new open innovation project. Observing the raise of technological convergence and open innovation, this study assumes that the first one is a driver for open innovation. The similarities between actors can be used for the selection of partners, and it reduces decision ambiguity. Carrying on innovation jointly requires that partners' technologies must be in line for the mutual exchange of knowledge. Though, at the same time, the effectiveness of the initiative presumes the complementary of resources. At firm level, we assume that open innovation is effective when there are similarities of technologies and diversity of capabilities between partners.

Though, when an innovation is way too complex and far from being realized (due, as instance, to complexity of alliances; information overload; lack of information; asymmetries, poor tools for managing problems arising from incomplete agreements or complexity of relationships), or when technological convergence let other alternatives appearing more pleasing than a mere partnership (as instance, when more value can be extracted with mergers and acquisitions), the chances of open innovation decrease sharply. Bringing all assumptions together, current study proposes an inverse u-shaped relationship between either open innovation and technological convergence or open innovation and ambiguity. As far as technological convergence between partners increases, that's a reason for signing an open innovation settlement. In fact, it can be used as a short-cut or as a heuristic in open innovation decisions. Intuitively, it is a signal that profitable synergies can be implemented and more value can be extracted by the innovation. That reduces the natural ambiguity of both the alliance decision and innovation process, at least for what concerns the technological infrastructure and operational matter. We further assume technological convergence as a moderator factor for decision ambiguity.

Similarly, we suggest that some ambiguity adds value to the project.

Thus, small levels of technological convergence and ambiguity are a carrier of value in open innovation. An excess of both of them lead the alliance to be useless or impossible.

Ambiguity can increase after a bearable level for reasons such as: the presence of more valid alternatives stemming from technological convergence, as M&A; the project is way too complex

(including for those reasons linked to incompleteness of agreements); the poor relatedness among businesses, which eventuality implies that the transaction could add poor or no value to the corporation. When ambiguity growths after tolerable levels, a new heuristic takes the place of the first one: open innovation is no longer a business, because it doesn't worth the trouble. In this case, further technological convergence are useless for open innovation matters, and the curve slope decrease sharply.

The paper is structured as follows: after explaining the theoretical background, authors introduce the original framework for open innovation decisions under technological convergence and ambiguity, discussing how it extends and novel the theory through acknowledging different explanations. The last section details future research questions and developments for the area of study; it also presents some hints for the practical implementation of the novel framework, restating authors' concluding remarks in the last section.

2. Open innovation and technological convergence

Paraphrasing Chesbrough (2006), in such information-rich world, solipsism in innovation can no longer be afforded. In lieu of closed R&D, the new open innovation paradigm entails openness of firms boundaries toward external partners (Chesbrough, Vanhaverbeke, and West, 2006).

Thus, open innovation can be intended as a means for carrying the innovation process jointly with other actors. Enkel, Gassmann, and Chesbrough (2009) distinguish three core processes in open innovation: the outside-in; the inside-out; and the coupled process, according to the locus of knowledge and innovation. Not only high-tech industries can benefit from the paradigm of open innovation; the span of its usefulness embraces also mature industries and other traditional sectors (Chesbrough and Crowther, 2006). Similarly, the size of firms undertaking open innovation practices seems to be not an actual matter, since even SMEs are used to it (Van de Vrande, *et al.*, 2009).

The main factors which have facilitated the diffusion of open innovation are the information and communication technologies, whose role was of enabling the exchange of distributed sources of information (Dodgson, Gann, and Salter, 2006).

For this reason, some authors have seen open innovation as a matter of technology transaction (Lichtenthaler, 2008).

Profitably, Gassmann, Enkel, and Chesbrough (2010) categorizes approaches to open innovation into different perspectives: a) the spatial perspective, focused on the globalization of innovation; b) the structural perspective, interested in R&D outsourcing; c) the user perspective, which studies the involvement of users in innovation process; d) the supplier perspective, for what the mark is posed on supplier integration within companies innovation process; e) the leveraging perspective, which underscores the relevance of the relationship between the created technology and issues related to intellectual property; f) the process perspective, g) the tool perspective, whose locus is enabling tools for participating actors; h) the institutional perspective; which studies the knowledge spillovers, with and without compensations; i) the cultural perspective, focused on innovative mindset of actors.

The reason why open innovation arose so explosively deserves some in-depth considerations. Chesbrough (2004) addresses the question in terms of technological and market uncertainty, in the early-stage of the innovation project: relying on some external sources of knowledge could be of help for the firm to enhance its performances.

In the author's view, open innovation is seen as a means to harnessing collective creativity (Chesbrough, 2007).

Another stream of literature links the rise of open innovation to the recognition of the role of communities in technological and social innovation diffusion (West and Lakhani, 2008), and in particular to the advent of open source software communities (Urban and Von Hippel, 1988): such events led to interfirm cooperation for the creation of innovative ecosystems.

Cooperative ecosystems are aimed both to gather heterogeneous knowledge useful for the

development of innovation and to share the uncertainty and risk of the overall project.

Although open innovation might seem a panacea for curing different pains, there are some issues to be solved for the creation of a cooperating ecosystem: one is technology related; the other one is relationship-related.

Both technologies and relationships can cause an ambiguity problem in open innovation decision. As instance, some studies find that the cost of alliances for technology diversity in portfolio can exceed the benefit of alliances themselves (Faems, *et al.*, 2010).

The technology-related issue can be further qualified as a matter of technology diversity/homogeneity between open innovation partners; or as a matter of technology diversity within the portfolio of the firm.

We refer to these types of issues as the technological convergence matter. Thanks to convergence, cross-partners similarities in technology are helpful for open innovation.

Convergence has been defined as "the blurring of boundaries between industries by converging value propositions, technologies and markets" (Brorong, 2010, p. 273). Convergence is said to be technology driven, thanks through sharing among partners.

It creates new interfaces (Brorong, 2010); it is a source of corporate advantage (Christensen, 2006); and it is distinct from market convergence (Gambardella and Torrisi, 1998).

Thus, convergence refers to a trend in technology and in technology platforms (Malhorta and Gupta, 2001; Pennings and Puranam, 2001).

Despite the relevance of the technological trend to convergence, few antecedent contributions focus on how this affects open innovation dynamics.

Among exceptions, some scholars investigate exploitation oriented alliances in technological convergence and the mobile industry (Lee, *et al.*, 2008); and open innovation alliances between food and pharmaceutical industries (Broring, 2013).

3. Decision ambiguity

Uncertainty is a central concern in decision making studies. There are two types of uncertainty, one that can be associated to probabilities and one that is unknown (Elssberg, 1961). The latter is fundamentally a driver of ambiguity. Specifically, ambiguity occurs when there are information biases and equivocal messages, factors which lead to misinterpretations of events. Strategic ambiguity (Eisenberg, 1984) is related to conflicting goals.

Traditionally, the organizational theory and the role theory explain that ambiguity occurs in a coping behavior by the role incumbent, as a mechanism of defense (Rizzo, *et al.*, 1970).

Consistently with the aim of our study, we find that similarities and approximation are intended as a way to solve ambiguity (Slowinski and Vanderpooten, 2000).

The most famous models studying this matter have an econometric approach and embrace the theory of expected utility, which met a great favor among scholars, so far.

The theory of expected utility is based on the assumption of ambiguity aversion (Ghirardato and Marinacci, 2002).

Decision ambiguity is a central concern in behavioral decision theory. It refers to the individual capability of ordering preferences and making decisions consistently. It is "a subjective variable which determines the decision maker's confidence in his probability estimates" (Becker and Brownson 1964, p. 62).

So far, ambiguity has been seen as depending mainly on information (Ellsberg 1961). Precisely, ambiguity is caused by missing or unreliable information (Frisch and Baron 1988). More recently, behavioral scholars extended this approach, explaining the relevance of contextual and personal factors in decision ambiguity. Thus, ambiguity it is not only linked to an objective matter of information, but also to individual biases and the way people process information, when making their judgments.

In general, an individual suffers from different biases in the act of making a judgment. A locus of the literature is the status quo bias (Samuelson and Zeckhauser 1988, Kahneman Knetsch and

Thaler 1991, Fernandez and Rodrik 1991, Ritov and Baron 1992, Kim and Kankanhalli 2009), which causes "that people prefer a previously chosen option over others" (Muthukrishnan 1995, p. 98). Scholars address this bias to different psychological causes, such as sunk costs, regret avoidance, cognitive misperception, and feeling of control. This kind of bias stems as a source of ambiguity. Another source of ambiguity is the confirmation bias.

Muthukrishnan (1995) argues that ambiguity can stem from the decision environment: experience and belief crystallization can simultaneously cause ambiguity and confidence, due to confirmatory bias. Einhorn and Hogarth (1988) criticize models based on the expected utility theory, pointing out that they are based on explicit gambles, whilst ambiguity in real world is inherently different because of the impact of the context and the effect it has on the payoff of a future prospect. Similarly, March (1987) explains the limits of utility-based models invoking the ambiguity of choices.

4. A conceptual model for open innovation decision under technological convergence and ambiguity

4.1 The open innovation decision model

Current model analyzes the decision whether to choose open innovation or not, according to two dimensions: technological convergence and ambiguity. Technological convergence depends on structural factors. We define decision ambiguity as an information-related issue which causes biases in individual's judgments. In particular, decision ambiguity occurs when an individual can express only vague probabilities for a future event to happen and it stems from an extreme uncertainty.

This kind of ambiguity causes the impossibility to frame future prospects correctly, so that any decision is repealed, delayed or utterly avoided.

Decision makers base their judgments on short-cuts; thus, they use the presence of similarities with partners for strategic alliances as a heuristic for making the decision. In short, they rely on some degrees of approximation of the information.

Basing on this logic, the presence of cross-partners similarities in technologies are a reason why to engage in open innovation alliances. Precisely, we refer to technological convergence as an approximation for substantial cross-partners similarities.

In this light, technological convergence emerges as a driver for open innovation and a moderator factor for ambiguity. To some extent, technological convergence is an approximation of a certain isomorphism.

One problem in open innovation is how to choose and to set alliances for profiting from the innovation and avoiding transaction costs. Thus, the presence of similarities allows a better exploitation of synergies among partners. Most of all, technological homogeneity between partners increases the absorptive capacity of the firm. Absorptive capacity is " the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128) and it is critical for the innovative performance of firms.

Even though a certain degree of isomorphism among different partners is rather desirable; nonetheless, an excess of that frustrates the benefits from taking advantage of the external and diverse knowledge in open innovation. In fact, the value creation in open innovation spurs from capturing the external knowledge and turning it into novel products and services (Chesbrough 2003; Inauen and Schenker-Wicki 2011). Thus, the firm targets also some technology diversity.

As a consequence, small increasing quantities of technological convergence between partners facilitates open innovation, moderating the ambiguity related to both operational issues and the inbound of external knowledge.

Though, an excess of technological convergence is pointless, because no new and diverse knowledge valuable for the innovation process can be brought by the partner.

In the last case, the firm might consider alternative strategies, as instance as M&A and different kinds of alliances, such as equity alliances.

Considering a dynamic perspective, we draw on the concept of the value of waiting for the evolution of the relationship between the technological convergence and decision ambiguity over time (Bernanke 1983, McDonald and Siegel 1986, Pindyck 1986, Majd and Pindyck 1987, Ingersoll and Ross 1992, Bowman and Hurry 1993). In the short run firms can observe some degrees of technological convergence between the partners and them, so they rely on this observation as a short-cut for making a timely open innovation decision. The similarity further moderates the perceived ambiguity in intuitive individuals. In sum, technological convergence is a valuable information, which allows the individual to solve the ambiguity dilemma whether the partnership will be successful or not in terms of synergies.

More rational thinkers prefer to wait until they gain further useful information. Information are generally valuable for avoiding or mitigating transaction costs. They are also useful to understand the feasibility, marketability, and profitability of the innovation. Thus, in the long run, the ambiguity of the prospect is assumed to be solved. In this case, the effect of the technological convergence on ambiguity is exhausted. Moreover, the isomorphism between partners can either be kept or melt over time, whether on purpose or not. Descriptions of the three constructs adopted in current model and their measures are expressed in Table 1.

Tab. 1: Constructs' definition

Construct	Description	Measures
Open innovation	"open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation, respectively" (Chesbrough, 2006, p. 2)	Openness of firm's borders. Openness is defined by the breadth and the depth. Breadth " is defined as the number of external sources or search channels that firms rely upon in their innovative activities" and depth " is defined in terms of the extent to which firms draw deeply from the different external sources or search channels" (Laursen and Salter 2006, pp. 134-135)
Technological convergence	Technological convergence is the degree of technological, resource and knowledge relatedness between partners.	The entropy measure can be used as a proxy for detecting cross-similarities between partners and resource relatedness (Orlando et al. 2017).
Decision ambiguity	"Ambiguity is a type of uncertainty resulting from the decision maker possessing vague information about the chances of various events occurring" (Yates, and Zukowski 1976, p. 19)	According to Ellsberg (1961), it is possible to distinguish a high ambiguity from a low ambiguity, basing on the availability and reliability of informations.

Source: our elaboration

The strength of technological convergence can be expressed in terms of homogeneity/diversity of technologies as well as knowledge and resources between partners. The degree of relatedness can be expressed by the entropy measure.

Differently, decision ambiguity is quite the fleeing variable.

Several factors impact on decision ambiguity. Knowledge, culture, belief and values as well as personal characteristics of the individual are all variables affecting the decision making process.

Thus, we can only say that ambiguity is high or low, depending on information matters.

The model assumes a curvilinear relationship between constructs. Open innovation is the dependent variable, whilst technological convergence and ambiguity, which are pre-existent, are the independent ones.

In sum, open innovation requires some ambiguity and technological convergence. They are both carriers of value when contained. The first makes open innovation more rewarding, the second increases the absorptive capacity of firms. These conditions explain the positive side of the curve.

Technological convergence further allows to keep ambiguity within bearable levels, so it is a moderator variable. Though, an excess of both of them impact negatively on open innovation for different reasons. In case of excess technological convergence, that means the chances of the inbound of heterogeneous capabilities are poor. In case of excess ambiguity, the decision is impossible. These two conditions explains the negative side of the curve.

4.2 An inverse u-shaped interpretation for the relationship among open innovation, ambiguity and technological convergence

Consistently with the logic early described, we further clarify open innovation as an inverse u-shaped curve of technological convergence and decision ambiguity.

The open innovation model is depicted in Figure 1 and 2.

For small increasing quantities of technological convergence between partners (Figure 1, section a-b), the probability of open innovation alliances increases as well. Such convergence intensifies the expected utility of open innovation. In fact, convergence is assumed to improve absorptive capacity of firms.

In this case, technological convergence has also a moderator impact on decision ambiguity, because it is used as a heuristic for the choice. Though, when technologies between partners match perfectly, the isomorphism between them could impact negatively on the expected utility of open innovation.

In the latter case, open innovation becomes a negative function of technological convergence (Figure 1, section b-c). The utility of the firm to engage in the open innovation partnership depends also on the possibility to capture an external, scarce and specific knowledge. Thus, open innovation requires some degrees of knowledge diversity between partners, otherwise the firm prefers to pursue the innovation by itself, in a closed mode.

Our model is based on three main underlying assumptions:

i. the absorptive capacity of the firm is a positive function of technological convergence;
ii. open innovation alliances are a positive function of knowledge diversity between partners.
iii. innovative performance of the firm are a positive function of knowledge diversity between open innovation partners.

Consistently, we express the following hypotheses:

I. Hp1: technological convergence between partners is a moderator factor for decision ambiguity;
II. Hp2: open innovation is curvilinearly related to technological convergence;
III. Hp3: expect utility of open innovation is a positive function of small increasing quantities of technological convergence;
IV. Hp4: expected utility of open innovation is a positive function of the value capture of external specific knowledge.
V. Hp5: expected utility of open innovation is a negative function of knowledge homogeneity (perfect isomorphism);
VI. Hp6: technological convergence is a negative function of the knowledge diversity between partners.
VII. Hp7: expected utility of open innovation is a negative function of an excess of technological convergence between partners.

In sum, there is a trade-off between technology convergence and knowledge diversity which explains the u-turn in the relationship. The firm has to balance the degree of structural similarities and knowledge diversity between partners when designing its portfolio of technological innovations.

The relationship between open innovation and decision ambiguity can be described similarly: open innovation is also an inverse u-shaped function of ambiguity.

In fact, the open innovation decision has option-like characteristics: the greater is the ambiguity the greater is also its value, and, hence, its expected utility. Ambiguity increases uncertainty and, then, risk of the initiative. As far as uncertainty and risk increase, so does the expected reward of the open innovation initiative.

Thus, for small increasing levels of ambiguity, the expected utility of open innovation increases as well (Figure 2, section a-b).

However, individual risk aversion prevails for extreme levels of ambiguity and uncertainty: the decision maker prefers to avoid an excess of risk.

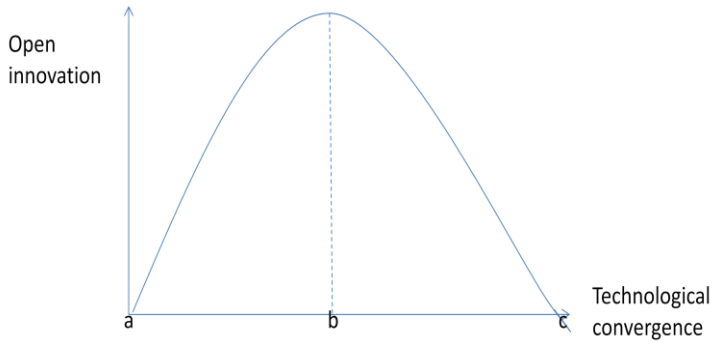
In the latter case, open innovation becomes a negative function of decision ambiguity (Figure 2, section b-c).

These hypotheses are in line with the traditional risk-reward theory, the security capital market line assumptions, and the financial option theory, for what uncertainty increases the value of options.

Thus, we express the following hypotheses:

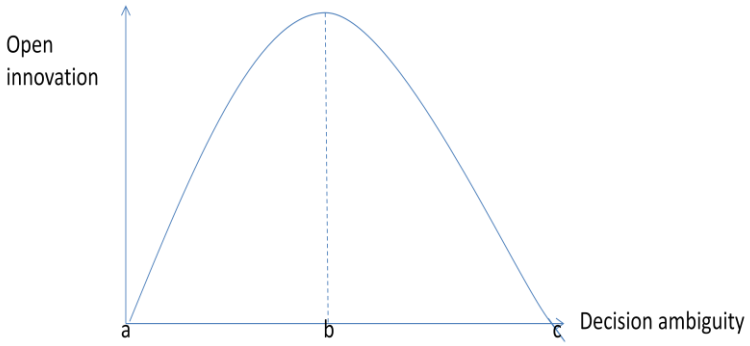
VIII. Hp8: open innovation is curvilinearly related to ambiguity;
IX. Hp9: expected utility of open innovation is a positive function of small increasing quantities of ambiguity;
X. Hp10: ambiguity is positively related with uncertainty;
XI. Hp11: extreme ambiguity is positively related with uncertainty aversion;
XII. Hp12: expected utility of open innovation is a negative function of extreme ambiguity.

Fig. 1: Open innovation and technological convergence



Source: our elaboration

Fig. 2: Open innovation and decision ambiguity



Source: our elaboration

The inverse u-shaped relationship between open innovation and ambiguity, and, specifically, the negative side of the curve (b-c) depends on the fact that excess ambiguity negatively impacts on collaborations. In other terms, some ambiguity is implied in open innovation and it positively affects the value creation. However, when decisions are extremely biased by ambiguity itself, there are poor collaboration chances. This type of ambiguity is characterized by an extreme difficulty when defining the probabilities of future events, so that transaction costs overtake the benefits of the collaboration.

As instance, there can be ambiguity with regard the marketability of innovation (e. g. due to individual acceptance; infrastructural readiness; network effects, etc..). An example can be the development of the 3G technologies. The technologies itself was developed during eighties. However, it took almost two decades for the technology to be market-ready. Its adoption, and the later diffusion, depended on the absorption capabilities of mobile manufacturers In fact, mobile industry made a later adaptation to 3G technology. Players, such as Nokia, Motorola, Samsung and others had delayed the adoption, which, finally, was done after a collaborative innovation promoted by groups of players altogether.

We further describe the elasticity of open innovation decision as a cross function of ambiguity and technological convergence. This expression models the moderator role of technological convergence on ambiguity. Usually, some convergence moderates the negative effect of ambiguity and uncertainty, determining a negative cross-elasticity effect.

Cross-elasticity can be expressed in the following manner:

$$e_{ATC} = {}^{\partial A}/_{A} \Big/ {}_{\partial TC}/_{TC}$$

Where e_{ATC} is the cross-elasticity of decisional ambiguity; A is the intensity of ambiguity; and TC is the degree of technological convergence. This expression explains how the perceived level of ambiguity changes as far as the level of technological convergence varies. In sum, it is the sensitivity of ambiguity to technological convergence.

The elasticity measure is negative, e(A')<1, when A= A'. However, when there is an excess ambiguity ($\bar{A}$), the moderator role of technological convergence is nullified and the ambiguity function becomes un-elastic to technological convergence.

$$A = \bar{A} \;\Rightarrow A = a - bTC \;\wedge b = {}^{\partial A}/_{\partial TC}$$

In fact, when the individual assigns far too many probabilities to an event and cannot choose one, any decision is impossible. Thus, in this case, further technological convergence is useless. That said, two very close and similar partners, in technological terms, cannot solve the ambiguity

dilemma, because they own a similar knowledge.

This expression is also useful to determine the maximum level of ambiguity that can be carried in open innovation decisions.

5. Managerial and practical relevance

As antecedent scholars suggest, it is of importance to create a conceptual framework which allows to understand how open innovation can add value in knowledge intensive processes (Enkel, Gassman and Chesbrough, 2009). Such processes are markedly characterized by ambiguity. In business ecosystems, the technological convergence among actors can help balancing the value creation with value capturing (Chesbrough, 2007). Since judgments on the value of open innovation can be biased by false negative results (Chesbrough, 2004), new metrics for the correct evaluation of open innovation initiatives may help firms salvaging value. This situation occurs when the innovation path in unknowable and the decision is harnessed by extreme uncertainty, which causes ambiguity. Ensley and Pearce (2001) state: "The true ambiguity may lie in the direction of the cohesion- conflict relationship, as it could be reciprocal" (Ensley and Pearce 2001, p. 147).

The value capture also depends on the risk of the initiative: sustainability of risk can determine the decision to innovate and may drive the choice between closed and open innovation.

Antecedent studies on the relationship between open innovation and ambiguity are surprisingly scant. Current paper make an early attempt to fill this gap. Second, the model offers a useful heuristic for open innovation decision. The uncertainty linked to innovation can cause ambiguity in the mental account of the decision maker, who experiences biases in determining the probability of the innovation future prospect. Besides, decision ambiguity can also depend on cohesion matters, such as transaction costs and principal-agent issues.

As a short-cut for the success of the partnership, the decision maker can evaluate the technological homogeneity between them. Some degrees of homogeneity are a sign of possible and profitable synergies. Though, an excess of that inhibits the possibility to capture external knowledge, valuable for innovation. Thus, in case of technological convergence, the firm might benefit from the open innovation strategy, as a way to reinforce its competitive posture. Open innovation creates entry barriers, determining a lock-out for new entrants and for rivals, who are not aligned to technological standards.

6. Concluding remarks and suggestions for future research

The increasing technological convergence can foster open innovation. Future research should investigate how open innovation can be used for complex and social innovations. After reviewing the literature, we propose a conceptual model for the open innovation decision, in function of technological convergence and decision ambiguity. We argue there is an inverse u-shaped relationship between open innovation and technological convergence, and between the first and ambiguity. An excess of technological convergence becomes useless when ambiguity is too extreme, so that other alternatives loom more profitable.

This study opens up to other research questions. To mention some of them, first, how absorptive capacity is linked to technological convergence in open innovation? Second, how can we frame the decision ambiguity of open innovation alliance? Third, does ambiguity of open innovation lead to a preference for a closed approach? Moreover, since our conceptual model hasn't been tested empirically, scholars might provide robust statistical testing on large scale samples.

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