

# **A framework of intellectual property protection strategies and open innovation**

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## **Abstract**

Adequate management of intellectual property (IP) is critical to sustaining competitive advantage and managing outbound open innovation (OI), which describes the inside-out flows of knowledge and technology. This article presents an IP strategic framework comprising the following strategies: a ‘defensive’ strategy, aimed at avoiding knowledge spillovers and building barriers to competition; a ‘collaborative’ strategy, aimed at collaborating with other organizations and entering new markets; and an ‘impromptu’ strategy, which describes firms protecting their IP without a clear purpose. We investigate the relationships of such IP strategies with outbound OI and innovation performance in 158 Italian firms. Most of them declared an impromptu IP strategy. We found that not having any IP protection strategy can be a barrier to outbound OI and that firms with a defensive IP strategy embraced outbound OI more than those declaring a collaborative IP strategy. Finally, firms with collaborative IP strategies outperformed those with defensive strategies.

**Keywords:** strategy, intellectual property protection mechanism, outbound open innovation, innovation performance, impromptu intellectual property strategy, collaboration.

## 1. Introduction

According to the open innovation (OI) paradigm, firms should be active buyers and sellers of intellectual property (IP) (Chesbrough, 2003a). IP plays a particularly important role in OI and, more specifically, in outbound OI, which describes the inside-out flows of knowledge and technology from one organization to another, for instance, through patent licensing (Dahlander & Gann, 2010). The nature of the link between IP protection and OI is considered somewhat paradoxical (Bogers, 2011), and the two seem to be in contrast with each other (Bigliardi et al., 2020) since IP protection mechanisms (IPPMs) may act as either enablers or disablers of OI (Alexy et al., 2009). Indeed, IP protection may defend an organization from undesired spillovers occurring during its interactions with external subjects; conversely, it may bring rigidities in the interaction process, which can hamper the OI process and its desired outcomes.

Given the complex relationship between OI and IP protection, several authors have explored the topic (e.g., Aloini et al., 2017; Freel & Robson, 2017; Zobel et al., 2017). They studied how the usage of certain IPPMs or IPPM classes (formal, semiformal, and informal)<sup>1</sup> affect firms' openness. However, they obtained a variety of results. Similarly, studies analysing the relationship between IPPMs and performance obtained mixed results (e.g., Andries & Faems, 2013; Brem et al., 2017; Lee et al., 2018; Monteiro et al., 2017; Spithoven et al., 2013; Zhong & Sun, 2020).

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<sup>1</sup> The three classes of IPPMs are often described according to their degree of 'formality': (1) formal or legal IPPMs, including patents, trademarks, and copyrights; (2) semiformal IPPMs, including contracts and agreements between parties; and (3) informal or strategic IPPMs, such as secrecy, product complexity and lead time advantage (Aloini et al., 2017).

The variety of results obtained in previous studies suggests that IPPMs may not be suitable to predict the level and quality of a firm's interactions with other organizations. Indeed, firms experiencing a lack of familiarity with IPPMs may select and use IPPMs in a suboptimal manner (Hall et al., 2013). The same IPPM, such as a patent, used to protect the same invention, could achieve different outcomes in terms of openness and performance according to *how* the firm uses it. For instance, an IPPM could be used to create a barrier to entry for competitors (Heger & Zaby, 2018) or to favour exchanges with external organizations (Chesbrough et al., 2006). Furthermore, firms may protect an invention but then leave it unused, failing to obtain substantial benefits from it (Rivette & Kline, 2000).

Therefore, a common limitation of earlier studies lies in their focus on *which* IPPMs influence OI and performance while they disregard the role of the underlying IP strategy. Instead, we believe that IP strategies are better predictors than IPPMs. An IP strategy should reflect the overall business strategy and allow creating, acquiring, and governing IP, as well as extracting its value (Shaikh & Singhal, 2019).

To the best of our knowledge, studies of IP strategies and OI are scarce (Alexy et al., 2009; Fisher & Oberholzer-Gee, 2013; Reitzig, 2004; Toma et al., 2018), and none of them organically presented how different IP strategies shape firms' capability to leverage and benefit from OI. Such a gap is critical since much of the current literature could lead practitioners to think that a certain mix of IPPMs may be better than another, whereas the very same mix, used with different IP strategies, may achieve dramatically different outcomes.

This article aims to advance the state of the art by proposing a framework to characterize different IP strategies considering the OI literature on the topic. The framework comprises the following three IP protection strategies: the 'defensive' strategy, which aims to avoid knowledge spillovers and build barriers to competition; the 'collaborative' strategy, which

aims to collaborate with other organizations and enter new markets; and an ‘impromptu’ strategy, which describes firms protecting their IP without a predetermined purpose.

Furthermore, we test the framework on a sample of Italian manufacturing firms to investigate (1) how the different IP strategies are adopted by firms, (2) how they are related to firm openness, and (3) how they are related to performance.

According to our findings, most firms declare an impromptu IP strategy. Such a strategy can hamper outbound OI, while firms with a defensive IP strategy are more active in outbound OI than those with a collaborative IP strategy. Finally, the results show that firms with collaborative IP strategies outperform those with defensive strategies.

The main contribution to theory offered by this article includes the novel framework comprising the three IP strategies. While two of them directly stem from the OI literature on the topic, the third, which we named impromptu, was quite neglected despite its importance in shaping firms’ behaviour regarding interorganizational collaborations and firms’ innovation performance. Such importance was confirmed by our empirical results, consequently urging future research of the effects of IPPMs on firms’ behaviour (e.g., propensity to collaborate) and outcomes (e.g., innovation and financial performance) taking into account firms’ IP strategies.

## **2. Theoretical background**

Innovation development is a critical source of growth and profitability (Audretsch et al., 2014) that has been traditionally associated with a firm’s internal R&D activities; however, more recently, firms are increasingly drawing knowledge and technologies from external sources (Chesbrough et al., 2006). In this context, both unwanted and voluntary inside-out flows of knowledge and technology must be carefully considered. The managerial literature has a long history of research on unwanted inside-out flows deriving from R&D activities,

referred to as spillovers (e.g., Arrow, 1962; Nelson, 1959). Comparatively, much less attention has been paid to voluntary inside-out flows. According to Dahlander and Gann (2010), the following two types of outbound OI can be identified: ‘revealing’, which entails exposing a firm’s internal resources without immediate financial rewards, and ‘selling’, which describes invention commercialization through selling or licensing.

Firms should be aware of their inside-out flows of knowledge and technologies and protect their IP accordingly. Indeed, ill-protected inventions with good market potential are likely to be imitated by competitors who, free from the associated R&D investments, may propose similar products at lower prices, stealing market shares and compromising the profitability of the invention (Teece, 1986). IP is a primary source of revenue from a licensing activity (Alexy et al., 2009) and a core component of a firm’s structural capital (Barrena-Martínez et al., 2020).

IP protection may enable OI. Indeed, it signals a firm’s expertise (Hsu & Ziedonis, 2013) and attracts potential partners (Alexy et al., 2009). Fisher and Oberholzer-Gee (2013) discussed various ways to leverage IP and collaboration to create value, such as joining standard-setting organizations, complementing others’ products or services, or capitalizing on the innovations developed by independent inventors and customers. Hagedoorn and Zobel (2015) observed that, in an OI context, firms prefer formal contracts rather than engaging in open disclosure and free revealing. Similarly, Veer et al. (2016) proposed that patents, trademarks, and registered designs can mitigate the imitation risk that characterizes R&D collaboration, hence enabling OI. More recently, Toma et al. (2018) discussed how different IPPMs could be used in different phases of the R&D process of a biopharmaceutical firm to leverage different OI practices.

However, IP protection may also impede OI. Some firms adopt a ‘no patent, no talk’ policy, preventing any interaction with external subjects that could put at risk knowledge that

is not already legally protected (Alexy et al., 2009). Furthermore, the use of formal IPPMs can lead to lengthy and costly negotiations (Barchi & Greco, 2018) and even prevent partners from using each other's knowledge and technology, hampering the creation of trust among partners and repelling potential partners (Alexy et al., 2009). Similarly, Monteiro et al. (2017) advanced that knowledge exchange may be incompatible with secrecy, which can disable mutual trust and reciprocity.

Several studies have attempted to quantitatively analyse the link between OI and IP protection. Most of them analysed how the usage of certain specific IPPMs is related to OI (Aloini et al., 2017; Freel & Robson, 2017; Zobel et al., 2017). However, the variety of their methods and results would not allow drawing general conclusions on cause-effect relationships, while IP strategy was not considered in their analyses.

An IP strategy should consider overarching and long-term aspects, including future R&D trajectories and corporate reputation (Reitzig, 2007), such as the spread of the OI paradigm, its risks, and opportunities. In this vein, a recent study emphasized how knowledge sharing practices—which are typical of OI—are supported by knowledge-oriented leaders, who are normally in charge of establishing strategies (Singh et al., 2019). Firms do not need to choose between sharing all knowledge or retaining legal control over it, but they should be selective and choose how and when to waive control (Brunswick & Chesbrough, 2018). This type of selective choice should be driven by a firm's strategy.

Previous studies on both closed and open innovators showed that the corporate approach to innovation shapes how IPPMs are used. For instance, both Xerox (Chesbrough, 2003a) and Procter & Gamble (Sakkab, 2002) were very active in patenting during similar periods, but while the former's closed approach to innovation prevented it from obtaining value from its many internally unused patents, P&G's more open 'Connect and develop' strategy leveraged the firm's IP. The strategic use of IP may even spawn new firms, as happened as a

consequence of IBM's choice to pledge hundreds of its software patents to favour open-source software development (Wen et al., 2016).

Among the few authors mentioning the absence of an IP strategy, Manzini and Lazzarotti (2016) observed how it can lead to costly litigations. However, IP management in companies rarely has a strategic dimension (Fisher & Oberholzer-Gee, 2013; Grzegorzczuk, 2020), which may induce the ineffective use of IPPMs.

### **3. Intellectual property strategic framework**

This article proposes a strategic framework that stems from the OI and strategic management literature. The framework (Figure 1) consists of three IP strategies that are discussed in depth in this section. The three IP strategies are defined according to their different strategic goals.

A firm with a defensive IP strategy will deliberately use its IPPMs to avoid knowledge spillovers and prevent competitors from producing and commercializing its invention. The firm may patent inventions and leave them unexploited, acting as a 'non-practising patent owner'. A defensive firm is anchored to the closed innovation paradigm. Thus, even when it collaborates with external organizations to complement its knowledge and technology, it aims to maintain full ownership and control over its IP and could aim to obtain numerous patents to build barriers to entry for competitors (Heger & Zaby, 2018). Additionally, those firms that proactively intervene to safeguard the future value of their IP by resorting to 'offensive patenting strategies', as described by Shaikh and Singhal (2019), employ the defensive IP strategy.

FIGURE 1 SHOULD BE PLACED HERE



A firm with a collaborative IP strategy is driven by the OI paradigm and uses its IPPMs purposely to obtain additional streams of revenues (e.g., through licensing), to signal its competencies, and to favour new partnerships. Such a firm manages its IP to advance its business model and profit from it by granting its rivals access to its technology (Chesbrough, 2003a). The collaborative strategy implies a certain degree of conscious and selective revealing (Alexy et al., 2013; Henkel et al., 2014). Indeed, a collaborative firm would purposely choose what pieces of information to share and whether and how to retain legal control of the information (Brunswick & Chesbrough, 2018).

Finally, a firm with an impromptu strategy lacks a clear purpose in the management of its IP and would casually adopt informal or semiformal IPPMs, which are less expensive and complicated than formal IPPMs. In this view, for instance, secrecy can be purposely used in the context of a defensive strategy to avoid knowledge spillovers or could be somewhat spontaneously maintained in the context of an impromptu strategy, without any specific protocol describing which information could be disclosed, when, and to whom.

### *3.1 Strategic goals and sub-strategies*

The three IP strategies are clearly distinguished in two domains. The first, which includes the defensive and collaborative strategies, is the domain of the deliberate strategies, characterised by a clear strategic goal. In both cases, firms will be aware of their portfolio of IP assets and their value (Al-Sharief & Mention, 2013). However, we argue that those characterized by a collaborative strategy will be particularly attentive in evaluating the complementarities with external organizations, the expected benefits that could be drawn from a collaboration with them, and the internal organizational readiness to embrace OI.

The second domain comprises the impromptu strategy, which lacks a clear strategic goal. Firms adopting an impromptu IP strategy will have a limited perspective on their IP assets,

external collaboration opportunities, and internal capabilities to take advantage of such opportunities, hence they will mainly opt for occasional collaborations.

As contextual ambidexterity theory suggests (Gibson & Birkinshaw, 2004), successful firms simultaneously demonstrate alignment (the coherence among the patterns of a business unit) and adaptability (the capacity to reconfigure activities to meet contextual changes). Following the ambidexterity theory, we suggest that firms with a dominant *deliberate* IP strategy may continue to pursue opposite sub-strategies when the context induces them to do so. Large firms with multiple business units may choose to follow a defensive strategy in some contexts and a collaborative strategy in others. However, given the different corporate cultures underlying open and closed innovation (Herzog & Leker, 2010), any firm will be mainly characterized by one of the two IP strategies and maintain a residual interest in the other. This may be driven by other factors, such as the benefits to the corporate image that a declared openness can bring.

Similarly, impromptu firms could inconsistently use defensive or collaborative strategies on different projects, but none would prevail until a clear direction is taken by the governance of the firm.

Transitions from a mainly defensive to a mainly collaborative IP strategy (and vice versa) can occur, since, as suggested by Holgersson et al. (2018), both protective and open IP strategies have possible shortcomings in the long run. For instance, in the case of LEGO, repeated failures in pursuing defensive strategies caused the firm to rethink them and embrace openness (Hunter & Thomas, 2016). Furthermore, changes in a firm's industry can drive the change in IP strategy (Holgersson et al., 2018).

Coopetition, which describes the extent to which two firms are involved simultaneously in collaboration and competition (Bengtsson & Kock, 2000), is either embedded in a collaborative IP strategy or can represent an occasional sub-strategy for a defensive strategy.

In both cases, competitors will carefully choose the information to disclose and make purposeful use of IPPMs (Bouncken et al., 2015).

### *3.2 Firm size*

The defensive strategy is likely to be popular among large firms, which own relevant internal R&D infrastructures and can rely on them for innovation. However, highly innovative smaller firms may be driven by a similar IP strategy, particularly when they specialize in a technological niche such as biotechnology (Gassmann and Keupp, 2007). Indeed, highly innovative small and medium-sized enterprises (SMEs) can be even more aggressive than large firms when defending their IP (Simcoe et al., 2009).

We expect the impromptu strategy to occur frequently among SMEs. According to Kitching and Blackburn (1998), SMEs often simply ignore IP rights, seeing them as unrelated to their innovation activities, while Teece (2007) suggests that the '*failure to proactively monitor and protect know-how and IP is common*'. This was more recently supported by Thoma and Bizer (2013), who found that 64% of their sample did not use any IPPM, and by Eppinger and Vladova (2013), who observed that all of the SMEs they analysed lacked an explicit IP strategy. We do not expect that any large firm will pursue an impromptu IP strategy. Indeed, even in the absence of clear top-down strategic directions on an IP strategy, the rigorous bureaucracy underlying IP management in most large companies could easily be characterized as defensive.

### *3.3 IPPM usage*

Any of the three IPPM classes could be used by firms driven by any of the three IP strategies. However, we expect that different IP strategies will be characterised by slightly different preferences in their usage, according to which IPPMs provide the strongest

protection (the defensive strategy), which favour collaboration (the collaborative strategy), and which are easier to implement (the impromptu strategy).

Thus, defensive firms will particularly favour formal and semiformal IPPMs because they guarantee the strongest legal protection.

Firms with a collaborative strategy are expected to resort to any IPPM type, flexibly choosing the IPPM that suits them based on the particular situation. Firms actively engaged in OI have shown a particular interest in using formal contracts (Hagedoorn & Zobel, 2015) and may consider patenting even more than firms engaged in closed innovation (Holgersson & Granstrand, 2017). This suggests that a collaborative IP strategy will make significant use of formal IPPMs, also in the form of joint patents (Delerue, 2018). However, such firms are also likely to use semiformal IPPMs, which typically comprise contracts and agreements between innovation partners such as nondisclosure agreements and joint development agreements (Mehlman et al., 2010), and informal IPPMs, whose implementation is positively associated with collaboration (Aloini et al., 2017).

Finally, as mentioned previously, we expect impromptu firms to be particularly attracted to informal IPPMs since they are less expensive and require less effort to be implemented and to be rarely interested in formal IPPMs. Since semiformal IPPMs can be considered to be between the other two IPPM categories in terms of ease of implementation, we expect their popularity among impromptu firms to be intermediate between the other IPPM categories.

## **4. Hypotheses development**

### *4.1 Intellectual property and open innovation*

As discussed in the literature review, no study has yet analysed how IP strategy is related to OI. Thus, to fill this gap, this article explores the relationships between the three IP strategies and outbound OI, which is the form that is more associated with the strategic use of

IP (Greco et al., 2019). As recalled by Kutvonen (2011), a lack of strategic planning is at the heart of the difficulties encountered by firms that start outbound OI activities. Indeed, traditionally, firms have treated external commercialization of internally developed knowledge and technology on a case-by-case basis (Tschirky et al., 2000). An impromptu IP strategy may bring a firm to neglect most IPPMs and mainly rely on secrecy, which not only hinders, but also abolishes OI (Al-Sharieh & Mention, 2013). Therefore, we argue that firms with impromptu IP strategy protection will also have fewer and less diverse inside-out flows of knowledge than those choosing either collaborative or defensive strategies. Consequently, we hypothesize the following:

Hp.1 Firms with an impromptu IP strategy are less active in outbound OI than those with a defensive IP strategy.

Hp.2 Firms with an impromptu IP strategy are less active in outbound OI than those with a collaborative IP strategy.

Firms with a defensive strategy will engage in outbound OI activities with caution but also with rigorous procedures capable of avoiding undesired spillovers, whereas firms with a collaborative strategy will actively search for external beneficiaries to achieve monetary and nonmonetary benefits (Chesbrough, 2017; Dahlander & Gann, 2010). Therefore, we expect firms with a collaborative IP strategy to be more active in outbound OI than firms with a defensive strategy and hypothesize the following:

Hp.3 Firms with a defensive IP strategy are less active in outbound OI than those with a collaborative IP strategy.

#### *4.2 Intellectual property and innovation performance*

The IP strategy is likely to play a relevant role in determining the firms' performance. To

date, the study of the relationship between IP and innovation performance has drawn the interest of many researchers, who assessed how formal, semiformal and informal IPPMs are associated with innovation performance (e.g., Andries & Faems, 2013; Brem et al., 2017; Spithoven et al., 2013; Stefan & Bengtsson, 2017). However, no study has explored the effect of IP strategies on performance. According to Teece (2007), assiduously developing and protecting IP is at the basis of competitive advantage. Therefore, we would expect that the opposite IP strategy (i.e., superficially developing and protecting IP through the impromptu strategy) is likely to result in worse performance than a defensive or collaborative strategy. Therefore, we hypothesize the following:

Hp.4 Firms with an impromptu IP strategy experience worse performance from outbound OI activities than those with a defensive IP strategy.

Hp.5 Firms with an impromptu IP strategy experience worse performance from outbound OI activities than those with a collaborative IP strategy.

Additionally, the vast literature emphasizing that OI enhances innovation performance (for a review, see Greco et al., 2015) brings us to hypothesize that a collaborative strategy should be associated with better performance than a defensive strategy. Therefore, we hypothesize the following:

Hp.6 Firms with a defensive IP strategy experience worse performance from outbound OI activities than those with a collaborative IP strategy.

## **5. Methodology**

To test the hypotheses of the study, we developed and submitted a survey to a sample of Italian firms. We describe the variables, data, and methods in the next subsections.

### 5.1 Variables of the study

*IPstrategy* is the main independent variable of this study. It can take three values depending on the interviewees' answer when they were asked which of the following sentences best described their firm's IP strategy:

- 'My firm does not have any policy for IP protection, it deploys its internally developed ideas, technologies or knowledge on the market without protection' (*IPstrategy*=0), describing the impromptu strategy;
- 'My firm strongly protects its IP, mainly for defensive purposes' (*IPstrategy*=1), describing the defensive strategy; and
- 'My firm considers IP rights as a strategic resource that can highlight its innovation capabilities and raise the interest of potential partners and the exchange of knowledge' (*IPstrategy*=2), describing the collaborative strategy.

Multiple choices were not allowed to incentivize the interviewees to take a position on the topic and describe the prevalent IP strategy of their firms. The wording of the items aimed at minimizing the social desirability bias.

An estimation of the outbound OI activities of the firm is needed to identify how IP strategies are related to outbound OI (Hp.1, Hp.2, and Hp.3). Furthermore, since outbound OI activities most likely positively affect innovation performance (Greco et al., 2019), a variable describing them is needed as a control variable to test the relationship between IP strategies and performance. The variable *outbound* is measured through a question that asks whether, between 2013 and 2015, organizations in the six categories of suppliers, customers, competitors, consultants and private R&D, universities, and government and public research institutions benefited from the firm's inside-out flows of knowledge to a high, average, or low level or whether they did not employ them at all. We associate the answers to scores of 3, 2,

1, and 0, respectively, and summed the scores for each organization category using a similar approach as earlier studies that analysed Community Innovation Survey (CIS) questionnaires.

To assess the performance of the firms (the dependent variable in Hp.4, Hp.5, and Hp.6), we resorted to the degree of agreement (on a four-point Likert scale) with the sentence ‘*On average, the external use of your firm’s knowledge increases its sales derived from new products or services*’ (*outbound\_revenues*), which aims to target the specific economic benefit that can be drawn from outbound OI.

Following earlier studies (e.g., Clausen, 2013), we estimate the variable *absorptive capacity* as the sum of three items. We asked the interviewees whether they strongly disagree, disagree, agree, or strongly agree (on a scale from 0 to 3) with the following statements: the firm invests in (1) internal R&D, (2) the recruitment of highly qualified employees, and (3) the training of its employees. The interviewees were also allowed to answer ‘I don’t know’ to the three questions, in which case the variable would be set to missing. The resulting *absorptive capacity* variable takes values between 0 and 9.

Other control variables include the following:

- firm *size*, which takes the value 0 for companies with 1 to 9 employees (microenterprises), 1 for 10 to 49 employees (small), and 2 for 50 to 249 employees (medium-sized);
- firm *age*, which takes the value 0 for companies up to 3 years old, 1 for 4- or 5-year-old companies, 2 for companies between 6 and 9 years old, and 3 for companies older than 10 years;
- the technology level of the firm’s sector (*tech*), which takes one of four values (1, low-tech; 2, medium-low tech; 3, medium-high tech; and 4, high tech) according to the Eurostat classification of manufacturing industries (Eurostat, 2017); and
- the receipt of public subsidies provided at a local, national or European level, which were measured with three binary variables (*localfunds*, *nationalfunds*, and *europeanfunds*,



respectively) that take the value of 1 if the firm benefited from funds from the corresponding source in the triennium and 0 otherwise.

Table 1 shows the descriptive statistics of the variables of the study.

TABLE 1 SHOULD BE PLACED HERE

### *5.2 Data*

We submitted the survey to 2474 firms, corresponding to the population of manufacturing firms based in three Italian provinces with similar socioeconomic characteristics for which valid contacts were available. The geographical zone chosen to conduct the analysis is populated by manufacturing firms that often compete on a national and international scale, which induces them to collaborate with external subjects. Furthermore, the entrepreneurs of the zone are often unfamiliar with IP protection mechanisms, which makes it likely to observe firms active in OI while adopting an impromptu IP strategy.

The firms that did not promptly respond to the survey received two follow-up emails and one phone call. The respondents were in most cases entrepreneurs or managers (73%); other respondents included senior employees operating in innovation-related units or other employees. We obtained a total of 158 valid answers, of which 47.5% declared an impromptu strategy, 12% declared a defensive strategy, and 40.5% declared a collaborative strategy. Sixty-two percent of the firms in the sample are microenterprises, 29% are small-sized firms, 8% are medium-sized firms and 1% are large firms. Since a social desirability bias may exist, our results probably offer a lower bound for the actual share of firms using an impromptu IP strategy. No clear patterns can be identified when analysing different size classes according to the IP strategies.

### 5.3 Methods

We tested the hypotheses of the study through two statistical approaches.

Hp.1, Hp.2, and Hp.3, which aim to explore the relationship between *IPstrategy* and *outbound*, are tested through standard linear regressions. Notably, the *outbound* distribution is similar to a normal distribution (a Shapiro-Wilk test cannot reject the null hypothesis).

Hp.4, Hp.5, and Hp.6, which focus on the relationship between *IPstrategy* and *outbound\_revenues*, are tested through ordered probit regressions, which extend univariate-ordered probit models (Greene & Hensher, 2010) and are used to analyse ordered categorical dependent variables.

In both cases, we control for heteroscedasticity by using robust standard errors and tested additional models to check robustness.

## 6. Results

### 6.1 IP strategy and outbound OI

Table 2 shows the regression models used to test Hp.1, Hp.2, and Hp.3. The table includes a baseline model (Model 0) and two equivalent regressions that show the relationship between *outbound* and *IPstrategy*. Model 1a describes *IPstrategy* using the impromptu strategy reference category, while Model 1b uses the defensive strategy as a reference. Since variance inflation factors are on average 1.64 (maximum 2.43), multicollinearity is controlled.

The results show that a defensive IP strategy is more associated with *outbound* than either an impromptu strategy (Model 1a) or a collaborative strategy (Model 1b). Additional regression models were tested for robustness purposes on different measures for outbound OI to confirm the results. The first result supports Hp.1, which suggests that firms with an impromptu IP strategy are less active in outbound OI than those with a defensive strategy;

however, Hp.2, which compares impromptu and collaborative strategies, is not supported by the findings.

Surprisingly, we obtain the opposite result than that hypothesized in Hp.3, since firms with a defensive strategy appear more active in outbound OI than firms with a collaborative strategy.

TABLE 2 SHOULD BE PLACED HERE

### *6.2 IP strategy and performance*

Table 3 shows the regression models used to test Hp.4, Hp.5, and Hp.6. The table includes a baseline model (Model 2) and two equivalent ordered probit regressions that show the relationship between *outbound\_revenues* and *IPstrategy* with respect to the impromptu strategy (Model 3a) and the defensive strategy (Model 3b). There is no statistically significant evidence in support of Hp.4, which expected worse performance for firms adopting an impromptu strategy than those adopting a defensive strategy, while Hp.5, which suggested a worse performance than firms adopting a collaborative strategy, is supported. In line with Hp.6, we find that the collaborative strategy is more associated with *outbound\_revenues* than the defensive strategy. Such results are confirmed using different methodological approaches, including ordered logit regressions and linear regressions.

TABLE 3 SHOULD BE PLACED HERE

## **7. Discussion**

This article contributes to the literature by proposing a novel framework to describe three key strategies for the management of IP. While two, the defensive and collaborative strategies, follow the earliest studies of the OI literature (Chesbrough, 2003b, 2003a) and the

hundreds of articles that followed, the third, the impromptu strategy, gathered surprisingly little attention in the literature. The widespread open vs. closed dichotomy gained much of the scholars' attention while this important topic was ignored. Indeed, we found a pre-eminence of the impromptu strategy in our sample, which underlined the lack of strategy in the management of IP (e.g., Eppinger & Vladova, 2013; Kitching & Blackburn, 1998; Teece, 2007).

The following open questions stem from this result: Which microfoundational factors determine the dominance of an impromptu strategy (e.g., managers' education or attitude; firm's age, intellectual capital, industry, or interorganizational relationships; or other contextual factors)? Which factors favour the transition from one strategy to another? How relevant are the IP strategies in determining the firms' success? Are firms with an impromptu IP strategy also more likely to lack an overall business strategy? To what extent do firms that declare a certain IP strategy act consistently with that strategy?

In addition to the definition of the three IP strategies, this article reveals how these strategies are linked with the interactions among organizations and with the resulting performance. The following subsections discuss our results.

### *7.1 How is IP strategy linked with outbound OI?*

The firms involved in outbound OI activities seek pecuniary and nonpecuniary benefits (Dahlander & Gann, 2010; Greco et al., 2019; Kutvonen, 2011). Such firms may either accidentally encounter an occasion to allow the external use of their internally developed knowledge and treat such a casual occasion on a case-by-case basis (Tschirky et al., 2000), or they may be more aware of the risks and opportunities of outbound OI and build a strategy, if not a business model, accordingly. While case-by-case logic seems strongly related to the impromptu strategy introduced in this article, having an IP strategy forces firms to take a position. Ideally, firms with a defensive strategy would know the opportunities of outbound

OI but fear its negative consequences and primarily want to protect their knowledge.

Conversely, firms with a collaborative strategy would be more aggressive, primarily willing to receive the benefits of outbound OI at the cost of knowledge spillovers.

This article shows that a defensive strategy is more associated with outbound OI activities than the impromptu and collaborative strategies. These results suggest that a defensive IP strategy can enable the inside-out flows of knowledge and technology by reducing the risk of imitation, which—as observed by Veer et al. (2016)—is associated with interorganizational collaboration and can be mitigated by formal IPPMs. Indeed, even though firms with a defensive strategy need to disclose their knowledge to effectively conduct outbound OI activities, they maintain control of the risk of imitation, which, according to Bigliardi and Galati (2016), is among the main knowledge barriers to OI. Our results are in line with Hagedoorn and Zobel’s study (2015), which showed that firms prefer using formal contracts in their OI activities rather than engaging in open disclosure and free revealing, and with Drechler and Natter’s article (2012), whose results suggested that stronger IP protection increases the likelihood of opening the innovation process.

### *7.2 How is IP strategy linked with performance?*

In line with the expectations, we found that a collaborative strategy is more effective than a defensive strategy. The result seems supported by a recent study of innovation projects, which found that the majority of successful projects derived from outbound OI activities were characterized by selective waiving of control of IP, rather than a more closed IP strategy (Brunswick & Chesbrough, 2018). The positive role of a collaborative strategy adds to the literature emphasizing how OI enhances innovation performance. The result is even more interesting if we consider that the collaborative strategy outperforms the defensive strategy, although the latter is likely to increase outbound OI more than the former (as discussed in Subsection 7.1). Indeed, while a defensive strategy can create more connections with other

organizations than a collaborative strategy, the latter strategy seems more effective to leverage the connections and enhance performance.

We would have expected an even stronger difference with respect to the impromptu strategy. Instead, the results differ from those obtained by Thoma and Bizer (2013), who found that firms that do not protect their IP in any way are much less innovative than others. Such a difference might be justified since an impromptu strategy does not necessarily coincide with not using IPPMs at all. Therefore, the case-by-case logic characterizing the impromptu strategy may return comparable results to those achieved by firms with a defensive strategy and slightly worse than those with a collaborative strategy.

## **8. Conclusions and future developments**

Firms are challenged to choose whether and how their knowledge should be protected (Brunswick & Chesbrough, 2018). This study of how IP strategies are associated with outbound OI and performance contributes to theory, policy making, and practice.

### *8.1 Contribution to theory*

Three key contributions to theory derive from this manuscript.

First, this article presents an IP strategic framework describing the following three key strategies under the lenses of the OI literature: defensive, collaborative, and impromptu.

While the defensive strategy leverages the closed innovation paradigm and the collaborative strategy leverages the OI paradigm, the impromptu strategy describes firms that use their IPPMs without a clear orientation. The three categories could serve as a basis for future research linking IP strategy to firms' characteristics, behaviour, and performance.

Second, the analysis of the declared IP protection strategies in a sample of Italian firms showed that most firms operate without an IP strategy. This very relevant but neglected

cluster of firms offers much space for future research to understand (1) which factors could lead them to embrace an either defensive or collaborative IP strategy, (2) under which circumstances such transition could be fruitful or harmful, and (3) what the long-term outcomes of an impromptu IP strategy may be.

Third, our study confirmed that IP strategies are likely to impact firms' propensity towards outbound OI and the resulting sales. Hence, future studies of IPPMs should not ignore the strategies underlying them and further explore the link between IPPMs, IP strategies, OI, and performance.

### *8.2 Contribution to policy making*

Since firms with an impromptu IP strategy are less likely to engage in outbound OI, public policy should support them towards a more informed approach to the opportunities of IP protection, including an appropriate understanding of the different degrees of formality that can be selected. Thus far, our results show that public subsidies are often not associated with either outbound OI or the resulting performance, showing a potential issue that should be addressed.

### *8.3 Contribution to practice*

This study informs managers about the importance of choosing and pursuing an IP strategy to achieve better results in terms of outbound OI and performance. Those managers willing to increase the inside-out flows of knowledge and technology with different categories of partners could opt for a defensive strategy, while the managers that want to improve the sales stemming from such inside-out flows could more fruitfully choose a collaborative strategy.

### *8.4 Limitations and future developments*

We acknowledge that this study is affected by several limitations. First, we analysed a specific sample of Italian firms. Second, we did not investigate the different formal, semiformal and informal IPPMs used by the firms, and therefore we could not control for this. Further studies may replicate our research and integrate it with a more in-depth analysis of IPPMs. Third, our study relies on the perceptions of the interviewees on their firms' IP strategy, which may not always coincide with the actual IP strategy, either due to imperfect information about the firm's IP strategies or due to response and social desirability biases. Fourth, to offer a clear perspective on firms' perceived IP strategies, we used a single item to describe them. Hence, we encourage future research on the definition of multiple items that could more reliably describe IP strategies. Finally, the results of regression analysis can be influenced by the unbalanced characteristics of our sample with respect to the three IP strategies.

Future studies could determine which of the three strategies better addresses the needs of firms under different circumstances (e.g., firm size or innovativeness) and could contribute to better defining the characteristics of the three IP strategies and to analysing their impact on pecuniary (e.g., share of sales from innovative products) and nonpecuniary (e.g., increase in knowledge or access to new markets) outcomes. Future research could reveal the necessary and sufficient conditions that determine favourable outcomes in terms of OI or performance, for instance, resorting to qualitative comparative analysis, which is increasingly popular in management studies (e.g., De Crescenzo et al., 2020; Seny Kan et al., 2016; Xie & Wang, 2020).



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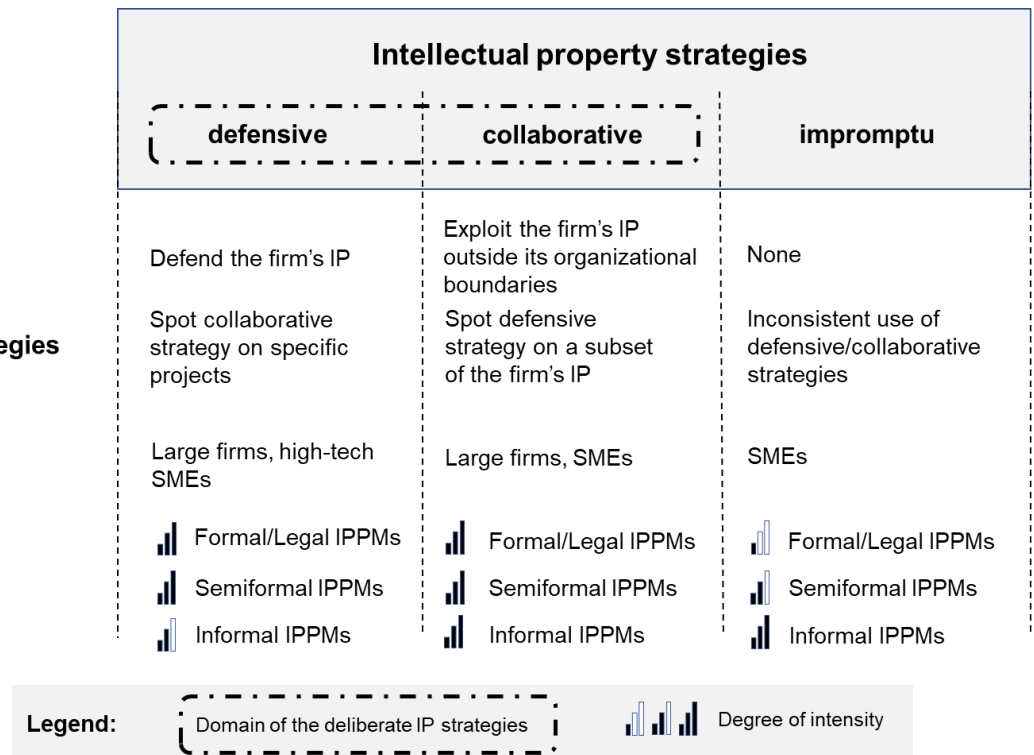
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**Figure**



*Figure 1. The intellectual property strategic framework*

## Tables

Table 1. Descriptive statistics of the variables. Notes: <sup>[CIS]</sup> describes a variable constructed from questions analogous to those in the CIS.

Variable	Type	Obs.	Mean	Std. Dev.	Min	Max
IPstrategy	Categorical independent variable (0, impromptu strategy; 1, defensive strategy; 2, collaborative strategy)	158	0.93	0.94	0	2
outbound_revenues	Ordinal dependent variable (1, strongly disagree; 2, disagree; 3, agree; 4, strongly agree)	133	3.11	0.59	1	4
outbound	Discrete independent and dependent variable	158	6.23	3.23	0	17
aborptivecapacity	Discrete control variable	137	9.08	1.55	5	12
size	Ordinal control variable (0, microenterprise; 1, small; 2, medium; 3, large)	158	2.14	1.16	0	3
age	Ordinal control variable (0, < 3 years; 1, 4-5 years; 2, 6-9 years; 3 >10 years)	158	0.20	0.40	0	1
localfunds	Binary control variable <sup>[CIS]</sup>	158	0.13	0.33	0	1
nationalfunds	Binary control variable <sup>[CIS]</sup>	158	0.06	0.24	0	1
europeanfunds	Binary control variable <sup>[CIS]</sup>	158	2.44	0.89	1	4

	Ordinal control variable	158	0.93	0.94	0	2
tech	(1, low-tech sector; 2, medium-low tech sector; 3, medium-high tech sector; 4, high-tech sector)					

Table 2. Linear regressions on outbound. Notes: \*  $p < 0.1$ , \*\*  $p < 0.05$ , and \*\*\*  $p < 0.01$ .

Variable	Model 0 (baseline)		Model 1a		Model 1b	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
<i>IPstrategy</i> (wrt impromptu)						
defensive strategy			2.43***	0.71		
collaborative strategy			0.81	0.57		
<i>IPstrategy</i> (wrt defensive)						
impromptu strategy					-2.43***	0.71
collaborative strategy					-1.63**	0.77
<i>absorptivecapacity</i>	0.80***	0.20	0.77***	0.19		
<i>size</i> (wrt 1-9)						
10-49	0.36	0.65	0.42	0.63		
50-249	-1.22	1.14	-1.21	1.13		
> 249	2.34	3.15	1.67	2.77		
<i>age</i> (wrt < 3 years)						
3-5 years	-0.98	1.18	-1.07	1.08		
6-10 years	0.20	0.79	0.48	0.80		
> 10 years	-0.19	0.72	-0.04	0.69		
<i>localfunds</i>	0.11	0.67	0.31	0.71		
<i>nationalfunds</i>	1.86**	0.78	1.60*	0.83		
<i>europeanfunds</i>	1.09	1.33	1.05	1.32		
<i>tech</i> (wrt low-tech)						
Medium-low tech	-0.77	0.73	-0.76	0.72		
Medium-high tech	-0.56	0.72	-0.37	0.73		
High tech	-1.44*	0.85	-1.76**	0.83		
	<i>AIC</i> 696.38		<i>AIC</i> 690.18			
	<i>R-squared</i> 0.27		<i>R-squared</i> 0.32			
	<i>Observations</i> 137		<i>Observations</i> 137			

Table 3. Ordered probit regressions on *outbound\_revenues*. Notes: \* p<0.1, \*\* p<0.05, and \*\*\* p<0.01.

Variable	Model 2 (baseline)		Model 3a		Model 3b	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
<i>IPstrategy</i> (wrt impromptu)						
defensive strategy			-0.50	0.4		
collaborative strategy			0.42*	0.24		
<i>IPstrategy</i> (wrt defensive)						
impromptu strategy					0.50	0.40
collaborative strategy					0.92**	0.39
<i>outbound</i>	0.03	0.04	0.04	0.04		
<i>absorptivecapacity</i>	0.24**	0.10	0.24**	0.11		
<i>size</i> (wrt 1-9)						
10-49	0.06	0.29	0.06	0.29		
50-249	-1.08**	0.49	-0.93**	0.46		
> 249	-1.44*	0.82	-1.37**	0.64		
<i>age</i> (wrt < 3 y)						
3-5 y	-0.06	0.58	-0.14	0.60		
6-10 y	-0.21	0.38	-0.36	0.37		
> 10 y	0.04	0.38	-0.01	0.36		
<i>localfunds</i>	-0.35	0.29	-0.49	0.31		
<i>nationalfunds</i>	0.15	0.36	0.15	0.37		
<i>europeanfunds</i>	1.66***	0.50	1.77***	0.53		
<i>tech</i> (wrt low-tech)						
Medium-low tech	-0.66**	0.33	-0.65*	0.34		
Medium-high tech	-0.34	0.31	-0.31	0.33		
High tech	-0.84	0.58	-0.73	0.57		
	<i>AIC 211.44</i>		<i>AIC 208.7</i>			
	<i>Pseudo R-squared 0.14</i>		<i>Pseudo R-squared 0.17</i>			
	<i>Observations 119</i>		<i>Observations 119</i>			