CLOSING OPEN INNOVATION

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ABSTRACT: The literature on open innovation has documented how companies expand their boundaries to become more *open*, leaving out how boundaries narrow as open innovation relationships end—the *closing* of open innovation. We explain how open innovation creates new relationships on multiple levels—among firms, individuals, and technologies. Drawing on open innovation and alliance literature, we discuss how the closing of open innovation entails the dissolution of this web of multiplex relationships. We contribute to innovation and strategy literature by explaining how the closing decision is not simply mirroring the initial decision to open up innovation, partly because of evolving interdependencies at multiple levels (firms, individuals, and technologies). Finally, we discuss how closing open innovation relates to new challenges in terms of attention, agency, long-lived interdependencies, and portfolio management that provide new avenues for future research.

KEYWORDS: alliance termination; disintegration; innovation strategy; open innovation closure; relationship dissolution; tie dissolution

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INTRODUCTION

A vibrant literature today argues in favor of open innovation, underscoring the benefits and growing interest in how firms open up their innovation processes to external ideas and paths to market (e.g., Bogers et al., 2017; Chesbrough, 2003b; Chesbrough et al., 2018; Dahlander and Gann, 2010; Dahlander et al., 2021; Lifshitz-Assaf, 2018). Scholars have addressed a broad range of related topics, such as the need for new open business models (Chesbrough, 2006; Saebi and Foss, 2015; Tucci et al., 2016), comparative advantages of open and closed governance forms (Felin and Zenger, 2014), and the use of enabling technologies (Trantopoulos et al., 2017), to mention a few. Such prior work has generated important insights into how firms can navigate an increasingly open innovation landscape of partners and competitors.

Open innovation is "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization's business model" (Chesbrough and Bogers, 2014: 27). Open innovation has also been described as a "modification to the vertically integrated paradigm" (Bogers and West, 2012: 65). It is a paradigm that focuses on purposeful decisions along the innovation process intended to promote the success of a focal firm (Ibid.), and it raises important questions for managers, including if, when, and how a focal firm can benefit from utilizing external sources of innovation, and external paths to market, respectively (Dahlander and Gann, 2010; Granstrand and Sjölander, 1990). Since the birth of the concept, open innovation has focused on how firms can improve their performance. In Chesbrough's 2003 book *Open Innovation: The New Imperative for Creating and Profiting from Technology*, the central thesis was that firms have much to gain from adopting a more open approach to innovation. Chesbrough argued, for example, "No company can afford to rely entirely on its own ideas anymore, and no company can restrict the use of its innovations to a

single path to market" (p. 19). The focus on companies and the link to strategic management was made even more evident in Chesbrough's updated definition, which underscored the intentionality of how firms manage their knowledge flows (Chesbrough, 2006; see also Vanhaverbeke, 2006; West et al., 2014). The research that followed had a similarly strong focus on firms' advantages, challenges, and strategies (e.g., Enkel et al., 2010; Sieg et al., 2010; West and Bogers, 2014).

Open innovation ventures into one of the most central issues of strategic management—the boundaries of the firm. It addresses, for example, horizontal and vertical integration (Leiblein and Miller, 2003), make-or-buy decisions (Pisano, 1990; Poppo and Zenger, 1998), and the relationship between integration, technology, and performance (Chesbrough and Teece, 1996; Leiblein et al., 2002; Teece, 1986). Several considerations impact the appropriate organizational arrangement of the innovation process, including the intellectual property regime (Teece, 1986), the distribution of capabilities (Baldwin, 2012; Chesbrough, 2003), the systemic characteristics of the technology (Baldwin and Clark, 2000; Chesbrough and Teece, 1996), and the cost and incompleteness of contracting (Granstrand, 1998; Williamson, 1999). These considerations are not static, meaning that appropriate organizational arrangements change over time. However, open innovation literature has been preoccupied with documenting how companies benefit from expanding their boundaries (Teece, 2020), forgetting that boundaries narrow as innovation relationships come to an end (for some rare exceptions, see Appleyard and Chesbrough, 2017; Barbic et al., 2021; Granstrand and Holgersson, 2014).

Very little is known about the phenomenon we label *closing open innovation*. Thus, an opportunity presents itself to reconcile some of the fragmentation in the strategic management literature (Leiblein and Reuer, 2020) by connecting open innovation to the literature on alliances, which has long addressed the dynamics and termination of inter-firm

relationships (e.g., Ariño and de la Torre, 1998; Keller et al., 2021; Reuer, 2001; Reuer and Zollo, 2005). We define the closing of open innovation as a termination of a distributed innovation process based on knowledge flows across organizational boundaries. Closing open innovation may refer to canceling a specific open innovation initiative and reducing a firm's general use of open innovation (cf. Granstrand and Holgersson, 2014). In this article, we focus primarily on the closing of specific initiatives. Still, we also want to highlight that the collection of these initiatives constitutes the firm's general open innovation strategy.

We seek to address the nature of the closing open innovation phenomenon, specifically its characteristics, antecedents, and consequences. Or, in layman's terms, how should firms reason when terminating or scaling back on open innovation? Based on previous research, our analytical approach rests on a simple premise: Initiating open innovation creates a new set of relationships among firms (e.g., Chesbrough, 2003), individuals (e.g., Lifshitz-Assaf, 2018), and technological artifacts (Henkel et al., 2013), and closing open innovation changes these relationships, perhaps in hard-to-predict ways. This approach is informed by the alliance literature, especially regarding the instability in inter-firm collaboration but extended with the more granular accounts provided by the open innovation literature.

The purpose is to initiate a conversation on closing open innovation and to offer advice for future research. Specifically, we discuss the antecedents and consequences of closing open innovation, how it differs from other types of alliance and relationship terminations, and its unique managerial challenges and potential remedies. A core idea is that the decision criteria to open at one point and close at a later point in time are not mirror images. Put differently, it is not necessarily the same predictors that cause a relationship to form that ultimately leads to its demise. Open innovation creates new interdependent relationships on multiple levels—among firms, individuals, and technologies—some of which are not easily

reversed. This makes the decision and process of closing open innovation different and sometimes even more challenging than opening up innovation in the first place.

This paper contributes to the literature on alliances by explaining how relationships terminate at different levels and how interdependencies are created and extended beyond formal termination. The paper also injects the topic of closure into the open innovation literature and provides a new lens for analyzing it in terms of challenges, opportunities, and viability.

WHY OPEN INNOVATION IS CLOSED

There are various reasons why open innovation initiatives are closed. One reason is open innovation failure, which has received limited attention in the literature. Some examples exist, like the termination of an online open innovation community run by an electronics manufacturing company (von Briel and Recker, 2017). In this case, the critical reasons for closing the community were legal and regulatory constraints that prevented a critical mass of contributors from joining it. Without this momentum, top management closed the initiative. Another failure case is Quirky, a well-funded startup with a crowdsourcing model for new consumer product ideas that ultimately could not sustain enough successful products to cover the costs of its operating model (Chesbrough, 2020).

But there are more reasons an open innovation initiative might be terminated. One is that firms that in an early phase benefitted from opening up their innovation processes to gain from distributed value creation and quick innovation diffusion may, in a later stage, gain relatively more from switching (back) to a closed innovation model to improve value capture. This has been observed with Google's development of its various Apps, which all began as open-source projects and were subsequently forked to become proprietary to Google (Appleyard and Chesbrough, 2017). Another reason is that firms engaged in open innovation

may be disappointed with their partners or the related technologies over time, meaning that they need to scale back on the initiative and possibly shift to other partners (Clough and Piezunka, 2020; Granstrand and Holgersson, 2014). Moreover, many open innovation initiatives are temporary from the outset, with more or less fixed closing dates, but may open up for recurring business (Reuer and Ariño, 2007). For example, P&G's Connect and Develop program had over 1,100 collaboration partners, over 600 of which had done multiple collaborations with P&G (Chesbrough, 2020). So, while these temporary collaborations will eventually end, the prospect of a further collaboration likely conditions behavior on both sides at that point.

Further insights into the termination of organizational relationships are found in other fields. For example, research on business relationships has studied relationship dissolution (e.g., Harrison, 2004; Havila and Wilkinson, 2002; Serapio and Cascio, 1996; Tähtinen and Halinen, 2002). This stream of literature has focused primarily on antecedents of dissolutions and typologies or processes (stages) of dissolutions (Tähtinen and Halinen, 2002). It has highlighted the role of social relationships and the lack and asymmetry of social value besides the lack and asymmetry of economic value for explaining why business relationships end (Gassenheimer et al., 1998; Ring and Ven, 1994). On the other hand, cultural differences between partners seem to be positively related to relationship longevity (Park and Ungson, 1997).

Even more relevant here is the vast literature on alliances and other formal agreements, which has gone to great lengths to understand when organizational relationships fall apart. For example, research on alliances and joint ventures has identified several factors that instigate closure (e.g., Madhok et al., 2015; Reuer and Zollo, 2005). One is the level of learning between partners, with opportunistic partners choosing to leave a collaboration when they have gained enough knowledge to continue on their own (Kale et al., 2000; Khanna et

al., 1998). In situations like these, “the leading partner laughs all the way to the bank while the lagging partner is left shouting ‘foul!’,” as Khanna et al. (1998, p. 206) elegantly expressed it. The learning factor has also been identified in other, less-formalized relationships, such as when firms engage with and learn from communities (Appleyard and Chesbrough, 2017; Dahlander and Wallin, 2006). A second factor, often related to inter-organizational learning, is converging capabilities. If partner capabilities converge over time, the partnership eventually becomes obsolete (Nakamura et al., 1996). A third factor is failing to obtain sufficient joint benefits (Sadowski and Duysters, 2008) or failing to meet collaboration expectations (Doz, 1996). A fourth factor is conflict (Ring and van de Ven, 1994; Vasudeva et al., 2020), where differences in cultures and ways of working lead to the relationship’s demise. A fifth factor, less specific to the unique alliance, is increasing industry concentration, which leads to more rivalry between partners. Such rivalry may move partners away from a collaboration (Kogut, 1989). A sixth factor is changing the strategic priorities of the partners, which sometimes means that the partnership is no longer of mutual interest (Reuer and Zollo, 2005). Finally, competition and power impact the risk of relationships breaking down (Baker et al., 1998), as does uncertainty (Gulati and Gargiulo, 1999). In sum, the literature has pointed out many different reasons why relationships come to an end.

Although we know that organizational relationships occasionally fail, a consistent pattern is that relationships are sticky (Seabright et al., 1992). Once a connection is formed, it takes on a life of its own and sustains itself via its history or logic of attachment (Seabright et al., 1992; Stinchcombe 1965). As a result, organizations tend to satisfice and stay in their current collaboration despite other potentially better matches being available. The network surrounding the organization also creates a lock-in to existing collaborations. For example, Polidoro et al. (2011) found that having joint third partners sustains the duration of alliances.

The alliance literature has documented considerable instability in inter-firm collaboration (Ariño and de la Torre, 1998; Madhok and Tallman, 1998; Madhok et al., 2015). For example, joint ventures and other collaborations are often relatively short-lived (Dussauge et al., 2000) but less so when they involve R&D (Kogut, 1989). However, the termination of alliances does not necessarily mean failure but may be natural or even desirable (Reuer, 2001; Reuer and Zollo, 2005). In their study of research alliances among biotech and pharmaceutical firms, Reuer and Zollo (2005) found that most alliances ended for reasons other than failure and often because of changes in strategic priorities. Many alliances are time-bound from the outset. When that is the case, the related agreements are more likely to include provisions for termination (Reuer and Ariño, 2007).

WHAT MAKES CLOSING OPEN INNOVATION UNIQUE

The central role of individuals and technologies in the innovation process makes closing open innovation a unique case of relationship termination. The role, perspective, and importance of individuals in open innovation have been stressed by several scholars (Ahn et al., 2017; Bogers et al., 2018; Dahlander et al., 2016; Lifshitz-Assaf, 2018), inspired by the micro-foundations turn in strategy (Felin et al., 2015). And technological artifacts are of particular concern when closing open innovation because of the interdependencies inherent to technology and technology development and its cumulative and combinatorial nature (Henkel et al., 2013; Somaya et al., 2011). Relationships on individual and technological levels are necessary to consider, besides the relationships on the firm level under which these micro-level relationships between individuals and technologies are formed. This indicates a more multiplex relationship than a formal alliance would suggest. For instance, when the CEO of a midsized technology company decides to open up the R&D lab at below market price to her startup-struggling nephew, the decision—and subsequently the decision to continue or close

the relationship—is undoubtedly embedded in multiplex corporate, technological, and individual considerations.

While the literature on open innovation recognizes the importance of individuals and technologies, the dynamic effects of new inter- and intra-organizational relationships are less understood. We argue that over time, relationships among firms, individuals, and technological artifacts co-evolve in such ways that they pose critical challenges to strategies aimed at scaling back on open innovation, which in the long term may threaten the sustainability of the open innovation model. In the following, we will develop this argument first for technologies and then for individuals.

The importance of technologies and technological relationships

Technology is a central differentiator between closing open innovation and dissolving other types of business partnerships. When technology is involved, long-lasting and complex technological interdependencies evolve across firm boundaries. Technology is expensive to develop, difficult to purchase off-the-shelf, and often proprietary with long-lasting protection through patents or other intellectual property rights (IPRs) (Granstrand, 1999). At the same time, technology is non-rivalrous in use (Stiglitz, 1999), meaning that whenever IPRs do not restrict it, multiple actors can use the same technology simultaneously. These combined characteristics are what make a good case for open innovation. Instead of developing and commercializing expensive technologies uniquely in-house, open innovation can reduce costs and increase revenues from innovation (Chesbrough, 2006; Dahlander and Gann, 2010). However, these technology characteristics also make relationships based on open innovation challenging to dissolve. Due to complementarities between internal and external technologies (Teece, 2018), a firm cannot simply substitute an external technology for another without incurring high costs (cf. Granstrand and Holgersson, 2014; Holgersson et al., 2022).

The role of technology plays out differently depending on the type of open innovation, whether it is outside-in, inside-out, or coupled (Enkel et al., 2009). In outside-in open innovation, external technology is searched, sourced, and integrated by a focal firm to improve innovative performance (Granstrand and Sjölander, 1990; Laursen and Salter, 2006; West and Bogers, 2014). The focal firm may partner with a licensor for existing technology. When ending the partnership, the licensed technology must be substituted, which is challenging if it has been tightly integrated with internal technology (Henkel et al., 2013). The focal firm may also contract with external R&D firms to develop technologies for future products and services (Spithoven and Teirlinck, 2015). Closing such a model means substituting external R&D with internal R&D. For example, Ferrari recently scaled back on its collaborations with Italian design houses, such as Pininfarina, which previously developed exterior designs. Instead, Ferrari recruited architect and designer Flavio Manzoni from the Volkswagen Group to build and lead the new in-house design team.[1] In this case, closing open innovation required a massive build-up of internal capabilities. Similarly, Tesla Motors developed its first vehicle relatively openly, using a design from Lotus, and receiving investment from both Daimler and Toyota in its early years. As the company grew, however, it vertically integrated many aspects of its operations, from vehicle design to batteries to charging networks.

In inside-out open innovation, a focal firm commercializes its technology via external channels to the market (Chesbrough 2003b, 2012). Further development of the idea or technology often occurs outside. This leads to a dependence on external improvements and complements of the focal firm's original technology (Laursen et al., 2017). For example, Tesla opened up its patent portfolio for vehicle charging technologies to others, including

[1] https://www.autocar.co.uk/car-news/industry/inside-ferraris-new-design-studio [Accessed on 8 September 2021]

competitors, to stimulate the adoption of its design as an industry standard. But few competitors adopted it. Sometimes agreements are indefinite in time. It may then be contractually impossible for the focal firm to close a specific open technology. In other cases, material technological artifacts are the main outputs. Contrary to technologies used as intellectual resources, such artifacts are rivalrous in use, which adds to the challenge of closure. For example, open innovation projects in process industries often aim to develop and build pilot plants. An R&D firm conducts much of the development while a manufacturer produces and hosts the pilot plant. Ending such a project may drastically reduce the R&D firm's access to the co-developed pilot plant (Granstrand and Holgersson, 2014).

In coupled open innovation, firms combine the outside-in and inside-out models to develop innovations jointly and bring them to market (Enkel et al., 2009). Such partnerships create strong ties between technologies from different firms. There is no clear differentiation between pure developers and commercial innovators, and all parties contribute to development and commercialization. For example, in open-source software, firms, organizations, and individuals contribute to the same software, often under the agreement that developments must be licensed openly under the same terms (Fitzgerald, 2006; O'Mahony, 2003; West and Gallagher, 2006). In telecommunications standards, firms bring their technologies into the standard, agreeing that others will be allowed to use them under fair, reasonable, and non-discriminatory (FRAND) terms (Bekkers and West, 2009; Holgersson et al., 2018). Again, taking a specific technology away from such an open innovation obligation may be contractually impossible.

Technology impacts costs and challenges in closing open innovation. But technology may also trigger closure. For example, as a firm successfully accumulates technological competence from outside-in or coupled open innovation, the relative advantage of staying open is reduced (e.g., Appleyard and Chesbrough, 2017; Kale et al., 2000). In contrast,

incentives to keep innovation open are low when open innovation fails to develop the expected technological results. Finally, when technological complexity increases—with growing interdependencies between internal and external technologies—the growing coordination costs of open innovation may lead firms to close it. This happened to Ferrari before bringing the development of exterior design back in-house. Supercars had become very complex, with a tight connection between the exterior's aerodynamics and the underlying platform's technology. To stay competitive, Ferrari needed to shorten the communication distance between the exterior design developers and the rest of the engineering team.

The importance of individuals and personal relationships

The individual level was featured in Chesbrough's 2003 book when he argued that an increased supply of highly educated and mobile individuals was a vital force behind open innovation. Since then, the function, motives, and capabilities of individuals have become critical areas of interest in open innovation research (e.g., Ahn et al., 2017; Alexy et al., 2013; Chatenier et al., 2010; Dahlander et al., 2016; Dahlander and Wallin, 2006; Henkel, 2009; Rangus and Černe, 2017; Salter et al., 2014, 2015).[2]

We as a community have paid less attention to the individual level in closing open innovation, although a few examples exist, primarily in the literature on user and online communities (e.g., Kane et al., 2014; Shah and Nagle, 2020). For example, a study of the online co-production community formed around the Wikipedia page on autism found that changes in production focus happened as a result of members joining and leaving the community, rather than members taking on new roles (Kane et al., 2014). In other words,

[2] Still, some note that the individual level and the "human side" of open innovation has yet to receive due attention (Bogers et al., 2018; Gassmann et al., 2010).

relationship termination on an individual level was necessary to maintain a sufficient degree of innovation and thus to remain open on the community level. The authors of the study concluded that contributors, even those with a history of making significant contributions, may have to leave as the community evolves—but that an option to return remains if the community needs align with their skill set. User communities, though, are not necessarily representative of the typical product user or firm; instead, they are often made up of enthusiasts, tinkerers, and amateurs (von Hippel, 1988). A key feature of user communities is the unrestricted entry into and exit from the community, which differs significantly from how firms operate (Kane et al., 2014; Shah and Nagle, 2020). Another essential feature of online and user communities is that community members' contributions, entry, and exit are outside the direct control of the firms interacting with the community (Argyres and Zenger, 2012; Dahlander and Wallin, 2006; Zenger et al., 2011).

Firms that pursue open innovation depend heavily on a few key individuals. For example, studies of gatekeepers—individuals that hold the keys to the door that connects the outside with the inside—have a long history in the innovation literature (Allen, 1977; Katz and Tushman, 1981; Tushman and Katz, 1980). These individuals are well-positioned to appropriate rents at the nexus of knowledge flows (Laursen and Salter, 2020). For example, Laursen and Salter suggested that exposure to outside opportunities may propel employees to leave the firm. In that way, openness on the organizational level might threaten the sustenance of individual-level relationships should key individuals decide to jump ship. In other words, individual and organizational relationships are not necessarily aligned. Individuals can keep relationships that are detrimental to their firm or refuse to collaborate while there is indeed a good reason for the company to drop or extend the collaboration. For instance, Piezunka and Grohsjean (Forthcoming) used data from the video game industry to

show that inter-organizational relationships shape personal relationships and that individuals gain from collaborations by enhancing career prospects while the organization can lose.

The literature on social capital and networks has also provided clues to the antecedents and effects of closing open innovation. For open innovation to prosper, close personal relationships that cross firm boundaries are often needed. These relationships are manifested in shared language and meaning that allow individuals to engage in complex problem-solving despite being in separate organizations. On the flip side, such close ties can also lead to relational and cognitive lock-in, inhibiting both the dissolution of current relationships and the formation of new ones (Maurer and Ebers, 2006;, Ring and Ven, 1994). For example, in a study of new biotechnology firms, Maurer and Ebers (2006) found that these relational and cognitive lock-ins constrained organizational members' ability to sever old ties. But severing old personal ties can also have quite immediate firm-level effects. For example, studies in the advertising industry found that the exit of client managers increased the likelihood of dissolution of ties with advertising firms (Broschak, 2004), but that intra-organizational structure and multiplexity of advertising firms improved retention (Rogan, 2014).

In combination, these studies have highlighted the importance of considering formal alliances and individual relationships in tandem, even though accessing such systematic data can be challenging. Although not necessarily visible, personal relationships can be incredibly strong and hard to break. For example, when they investigated academic collaboration, Dahlander and McFarland (2013) found a strong case for path dependence. This resulted from people's tendency to stick to the ties they had already established at the expense of better potential matches. The results are consistent with literature arguing that personal ties persist and, once formed, take on a life of their own, giving rise to organizational path dependence and inertia (March and Simon, 1958; Stinchcombe, 1965).

These findings suggest that decisions and beliefs at the individual level may initiate, sustain, and close open innovation in a way that can be in line with or outright against the strategy of the firm. These multiplex relationships create interdependencies that are more difficult to manage than purely managing an alliance. Yet precisely how these relationships play out is largely unknown.

MANAGERIAL CHALLENGES IN CLOSING OPEN INNOVATION

At this point, we may ask ourselves if closing open innovation is a phenomenon that raises relevant questions for managers. We argue that closing open innovation is related to several managerial challenges—and opportunities. We address four related areas identified in the literature on open innovation and alliances by linking the closing of open innovation on the firm level to relationships on the individual and technological levels. First, only when closure is considered can firms start actively managing their more extensive portfolio of open innovation initiatives to support their business model and strategy. Second, closing open innovation economizes on the limited attention of the firm's managers and employees. Third, open innovation creates long-lived interdependencies that must be managed during and after closure. Finally, we highlight how closing open innovation can be prepared and the difference between managing closing proactively and reactively.

Closing to optimize the portfolio of open innovation initiatives

In recent years, the literature on alliances has expanded into the domain of alliance portfolios (e.g., Jiang et al., 2010; Lavie and Miller, 2008). A core insight of the portfolio approach is that one must consider more than a single alliance and pay attention to the collection of alliances. This literature has underscored the diversity of the partners, resources, and countries they represent and how they connect to a company's performance (Cui and

O'Connor, 2021; Jiang et al., 2010), as well as the set of different alliances a firm already engages in (Wuyts and Dutta, 2014).

Most of this literature has considered how adding new ties change portfolios, even if some work has considered how ties are deleted and alliances closed (Ghosh and Klueter, 2022; Hernandez et al., 2015; Polidoro et al., 2011). For example, in mergers and acquisitions, acquiring firms can pursue "network synergies" by eliminating redundant ties it shares with the target firm (Feldman and Hernandez, Forthcoming; Hernandez and Shaver, 2019). At the same time, the partners of the target firm may decide to discontinue their relationships due to a merger or acquisition, although these situations are not well-understood. The work on alliance portfolios strongly suggests that a portfolio approach with a closing component is needed for open innovation. However, when importing the portfolio concept, scholars are reminded that innovation relationships differ from how relationships are usually portrayed in the alliance literature. In particular, in terms of relationship complexity—open innovation is more than formal alliances (e.g., see the bibliometric analysis on open innovation research by Randhawa et al., 2016). As Powell et al. (1996:120) reminded us, formal agreements (e.g., alliances) represent "the tip of the iceberg—it excludes dozens of handshake deals and informal collaborations, as well as probably hundreds of collaborations by our company's scientists with colleagues elsewhere." Indeed, innovation literature has long been concerned with looking below "the tip of the iceberg" and examining relationships that not only include firms but also encompass individuals, communities, or even technologies. The types of partners and partnerships relevant to innovation scholars are diverse—many open innovation relationships are not purely dyadic relationships between two partners that mutually enter an agreement. For instance, open innovation can involve working with a community where members self-select into the collaboration, implying an *a priori* lack of information about the partner. This makes it challenging to plan *ex ante* about what will

happen at the end of a relationship. These features make it cumbersome to manage a more "untamed" portfolio than a typical alliance portfolio. For example, companies may be left in the dark about crucial innovation relationships their employees are embedded in. Portfolio management is central since open innovation initiatives and closing such initiatives require attention from managers, developers, and other employees of the firms. To this, we turn to now.

Closing as a means of managing attention

The attention-based theory of the firm has convincingly argued that attention is a finite resource. Information consumes attention (Ocasio, 1997), and there are limits to the number of relationships an organization can hold. Empirical research has found diminishing returns to the number of external search channels for innovating firms (Laursen and Salter, 2006), and as Koput's (1997) simulation showed us, attention should play an essential role in the consideration of relationships. There may be a specific carrying capacity before the marginal benefits of adopting a new relationship diminishes or even turns negative (Duysters and Lokshin, 2011).

These observations have been somewhat overlooked in the open innovation literature. Suppose the number of ties and types of partners consume attention, and there is an upper limit. In that case, closing open innovation becomes an important mechanism to reallocate attention to more productive ends. Logically, closing a relationship increases attention to other existing relationships *and* finding more productive matches. However, inertia and logic of attachment suggest that organizations stick to relationships even when they don't deliver on their promises. Closing a relationship can also be attention-grabbing and highlight what has been going wrong inside the firm. We remember negative events more than positive ones (Taylor, 1991). Keeping the relationship at low intensity (though still consuming attention)

may thus protect managers from being associated with a failure. The critical message for open innovation is that closing a relationship may be a prerequisite for opening up a new one, but that it is hard to break away from the inertia of an established connection. In that regard, setting criteria for when and how relationships can be evaluated can help avoid over-commitment to existing unproductive relationships.

Attention is unevenly distributed in organizations. Divisions, groups, and individuals all have different foci, even though they may work together toward the same goal. One organizational relationship may completely consume the attention of one individual but not others in the same organizational unit (cf. Ghosh and Klueter, 2022). As a result, the closing of an organizational relationship may affect individuals differently. Attention is freed up for some, while others are unaffected. In other words, attention-deprived relationships may be because of a few overloaded individuals acting as bottlenecks. The signal received by management may be that innovation partners complain or drop out. And management can respond by throwing resources and manpower behind the project or closing the relationship altogether. Both strategies can be highly ineffective from an attention perspective. Without a careful analysis of what needs more attention and from whom, generic resources may even worsen the situation by stealing additional attention away from critical individuals. And it may very well be that the attention problem is with the partner organization. Such attention problems in dyads and networks are inherently challenging to manage.

These challenges become even more complicated when relationships have both formal and informal components. As management closes an organizational relationship—for performance reasons, strategic reasons, etc.—their influence does not necessarily extend into the informal and personal relationships that often form in longer-term innovation projects. Therefore, for some individuals, closed relationships may still consume attention. Clearly, a micro-foundational understanding of closing open innovation is needed (Felin et al., 2015).

Attention is not only required by project managers and top management. Significant inputs are often required from support functions in the organization for the upkeep of open innovation collaboration. Yet all too often, these support functions, including procurement, HR, finance, and legal, are not given any additional resources to provide these inputs, resulting in resource congestion and backlogs (Chesbrough, 2020). One implication of our analysis here is that these functions' importance will increase once the organization entertains considerations of closing or terminating relationships.

Closing entails managing long-lived interdependencies

Open innovation leads to interdependencies that make closing a delicate matter. Thompson (1967) distinguished between three types of interdependence: (1) *pooled*, where units contribute to the same overall output but are not dependent on input from others, (2) *sequential*, where the output of one unit is the input of another, and (3) *reciprocal*, where there is sequential *and* cyclical interdependence. Since open innovation involves different partners where interdependence is often reciprocal, coordinating open innovation becomes challenging.

Interdependence between partners can be akin to alliances (e.g., Reuer, 2001; Reuer and Zollo, 2005) and other forms of formalized, firm-level relationships such as explicit contracts and license agreements (Chesbrough, 2003a) and joint ownership of resources (Serapio and Cascio, 1996). Partners enter contracts in mutual agreement, and contracts can relax some interdependencies, lower costs related to uncertainties, and prepare partners for closure (Granstrand and Holgersson, 2014; Laursen et al., 2017; Serapio and Cascio, 1996). The challenge for open innovation is that there are multiple interdependencies between actors at different levels and with other goals that can be misaligned (Staudenmayer et al., 2005). For example, a firm can depend on a community of open-source software. In open-source

software, we often intend projects to endure indefinitely (in time), preventing any organization from unilaterally closing the development. This means that some decision rights for the firm are revoked. If the firm decides to step back from the open-source project, their employees may still want to continue their work, distracting attention away from other obligations.

Open innovation can also result in interdependencies between technological artifacts, but these interdependencies can be relaxed proactively by making appropriate design choices. One such design choice is modularizing the technological architecture, separating between "open" and "closed" components (Henkel et al., 2013; Holgersson et al., 2022; Weiblen and Chesbrough, 2015). By doing so, interdependences are limited, and costs of possible *ex post* invent-arounds are lowered. Again, the management and termination of these personal, technological, and contractual relationships are contingent upon the recurrence of the relationship.

Sometimes there are interdependencies between individuals and technologies. Imagine two organizations beginning to collaborate and a dedicated person becoming responsible for bringing this to fruition. This person would gain bargaining power and status from open innovation, where they basically "own" and control the relationship with the external world (Laursen and Salter, 2020). One anonymous case we recently studied involved a single inventor who collaborated with a chemical engineering firm to develop new process technology for the chip manufacturing industry. As the technology became increasingly promising—and eventually sold as pilot plants to a few customers in Europe—disagreements between the inventor and the engineering firm arose about the rights to the inventions and compensation. As a result, the collaboration quickly halted. The technology was still developing at that stage, and the inventor's knowledge was critical for the R&D project to continue successfully at the customers' pilot plants. The inventor was willing to step in as a

consultant to the customers to see his technology successfully put into use. Still, such initiatives were effectively killed due to disagreements with the engineering firm. These disagreements included individual-level issues, such as a perceived lack of appreciation for his contribution from the engineering firm's management, and firm-level issues, such as contractual disputes. In another anonymous case involving two pharmaceutical companies, the collaboration between the two ended. Scientists were asked to stop collaborating, but the informal relationships between scientists were sticky and continued despite the firms' interest in shutting them down.

Preparing for closing

Acting for closure of open innovation is related to completely different causes and effects than *reacting to closure*. Agency—or who initiates closure—matters. Opening up innovation means opening up for a multitude of opportunities and risks. The exact evolution of an open innovation initiative is difficult to forecast—much more so than in an ordinary buyer-seller relationship simply because open innovation, above all other uncertainties, also includes uncertainty about technological progress. In open innovation, many things can lead an agent to initiate closure. Some open innovation initiatives are limited in time from the outset, albeit often with contractual options for extension. Sometimes open innovation even comes as an intermediary step in a well-planned process of disintegration (Granstrand and Holgersson, 2013). But when closure is unplanned, firms may still choose to step back from their open innovation engagements for various reasons, which we discussed above.

The main argument here is that there are multiple levels of relationships in open innovation, and consequently, multiple levels of relationships are impacted by closure. As argued above, relationships develop between firms (Chesbrough, 2003b), individuals (Bogers et al., 2018; Dahlander and Wallin, 2006), and technologies (Henkel et al., 2013; Laursen et al., 2017; Staudenmayer et al., 2005). When closing open innovation, relationships on one

level may (need to) endure even when other types of relationships are terminated. Such complexity makes collaborators stay relatively long in collaborations involving R&D (Kogut, 1989). But it also creates much friction if an actor unilaterally closes its open innovation.

Because agency matters, firms engaging in open innovation take actions both *to enable closure*, as instigators of termination, and *to protect against closure* initiated by others. Relevant measures include technology design choices, contracting, pricing, and developing substitute technologies. For example, firms modularize their technological architectures (Baldwin and von Hippel, 2011; Staudenmayer et al., 2005) and separate the joint (open) technological module from their closed technology to reduce risks related to partner closure—and to enable future closure initiated by themselves (Henkel et al., 2013). By this type of modularization, firms can efficiently replace an open module with another one if need be—i.e., the design choice turns the closing of a technological module into a decision independent from the other modules and the longevity of a more prominent supporting project.

Contractually, license agreements are designed to secure access to future improvements, even after collaborative activities end (Laursen et al., 2017). Safeguarding future access to technological advances is a central enabler of closure since collaboration sometimes leads partner capabilities to converge (Nakamura et al., 1996). In such settings, partners are more likely to develop competing and proprietary improvements of joint technologies after a closure. If this is not adequately dealt with in the contracting phase, it may efficiently lock firms out of future modifications of their own technologies (Granstrand and Holgersson, 2014; Laursen et al., 2017). Similarly, multilateral agreements in telecommunications standards require participants to make their standard technologies available for everyone under FRAND (but not free) terms, partly to reduce the risk of opportunistic behavior and patent holdups (Holgersson et al., 2018; Lemley and Shapiro, 2006). In software, this is

sometimes taken one step further. In open-source licensing, it is common to include clauses stipulating that derivative works must be licensed under the same free and open terms as the original software. This contractual setup enables an expanding amount of open-source code related to the original software (e.g., O'Mahony, 2003; von Krogh et al., 2012), efficiently limiting the possibilities for closure of the technology itself. However, other open-source licenses permit the derivative products to remain proprietary. This is notably true of Linux, where derivatives like Amazon Kindle or Samsung's Tizen remain proprietary.

Another activity that enables and protects against closure is substitute R&D. In learning races (Kale et al., 2000; Khanna et al., 1998), opportunistic actors can eventually take knowledge from a collaboration and develop a substitute technology in order to relax their dependence on its partners. There might be multiple reasons, including financial ones, if an external technology provider is compensated based on sales (Granstrand and Holgersson, 2014). By extending this argument, it is safe to assume that agency in closure is often related to opportunism. However, the opposite is also true. Sometimes preparing for closure is done only to safeguard against opportunism. For example, we have witnessed how startups with core technologies being licensed from a partner have spent time and resources developing in-house substitutes precisely because of the risks of having a core technology licensed from the outside. In such situations, a technological substitute can mean the difference between life and death for the startup if the external partner acts opportunistically by limiting or conditioning access to the licensed technology (e.g., Lemley and Shapiro, 2006).

Pricing can safeguard against opportunistic closure. And it is not so much about the price level but how the compensation scheme is designed. Suppose we return to the above example of a learning race. In that case, a simple change in the compensation scheme may turn incentives in favor of remaining open instead of closing open innovation. One such change that reduces opportunism in learning races is to shift some of the compensation (from a

technology user to a technology provider) from sales-based running royalties (*ex post*) to up-front royalties (*ex ante*) (Granstrand and Holgersson, 2014). This, however, increases risks related to opportunism for the technology user since it enables shirking by the technology provider *ex post.*

A final observation is the difference in how closure can be enabled or inhibited depending on the formality of the open innovation engagement. The alliance literature has covered termination in formal terms, focusing on a firm-level contractual decoupling at the end of a partnership. In these settings, protection from opportunism can be contracted, albeit incompletely. Both parties enter into an agreement and can design for the end. In an informal relationship—and innovation often have strong informal components—this is not the case: most scientists do not discuss what will happen in advance should they stop their informal collaboration. The individual tie then just withers: it is not terminated. Such a situation may provide a managerial challenge because of the technological relationships fostered by scientists' individual-level relationships. The involved firms may need to manage closure even in these cases, but without access to some of the contractual tools introduced above.

CONCLUSION AND OPPORTUNITIES FOR FUTURE RESEARCH

The open innovation literature has flourished, focusing on how opening expands the space of relationships. As a research community, we have been excited to document new forms of open innovation and how different types of relationships emerge. As a result, the study of *closing* relationships has taken a back seat. But what happens to open innovation after the relationships are in place? What are the antecedents and consequences of closing open innovation? It is indeed timely to address how closing open innovation raises new questions for open innovation. While focusing on closing may be seen as giving up on open innovation, nothing could be further from the truth. Open innovation has grown into a centerpiece of

almost any innovation strategy, and as a result, it can no longer be treated as a minor activity of some renegade firm. As open innovation is becoming the norm, research needs to focus on the entire life of the phenomenon, from inception, expansion, and finally, closing.

The starting point for this paper was that the open innovation literature had been overly focused on opening innovation and had not considered the closing of open innovation, even though most open innovation initiatives eventually end. The imagery we want to establish is that closing open innovation is a means to open other, potentially more fruitful, collaborations—and that closing is a natural and necessary part of sustainable open innovation practice. A proverb often attributed to Alexander Graham Bell goes, "when one door closes, another opens." With this metaphor in mind, we can start asking if the right door is being closed, whether it is closed at the right time, and how the door can be closed most effectively. These questions differ from what we as a community have investigated so far but are well in line with recent developments in open innovation literature, for example, studies of open innovation failures and costs (Chesbrough, 2020; Dahlander et al., 2021) and the few studies that have addressed some aspect of closing open innovation (Appleyard and Chesbrough, 2017; Barbic et al., 2021; Granstrand and Holgersson, 2014).

Innovation processes rely on the creativity of the human mind to pursue technological progress. But these innovation processes are not confined to a single individual or individuals belonging to a single organization (Chesbrough, 2003). What signifies open innovation is that individual and technological relationships are centerstage, on top of, and embedded in organizational-level relationships. In this paper, we contribute to strategy literature in which alliance termination has been widely studied but with less granularity. One strength of open innovation scholarship is its fine-grained investigation of boundary-spanning innovation processes, with a particular concern for managing such processes, often using in-depth case studies (e.g., Lifshitz-Assaf, 2018). Bringing this knowledge into the strategy domain

contributes to a better understanding of the idiosyncrasies of R&D alliances and innovation relationships and why and how they are initiated and terminated (in line with moves to unpack relationships in the alliance literature, see, e.g., Reuer and Ariño, 2007).

A central argument in our paper is that the decision to close is not simply mirroring the decision to open up innovation. Yet, managing closure is conducive to successful openness. Any collaboration consumes attention, and closing can redirect efforts to more productive ends. However, we know from related literature that collaborations take on a life of their own, and people and organizations stick to collaborations even if there are better potential matches (Dahlander and McFarland, 2013; Seabright et al., 1992). Closing a collaboration can be seen as an admittance of failure, leading to unproductive collaborations lingering on the back burner. While some of these insights are known from related literature, there are added complications previously overlooked. The alliance literature has probed the underlying reasons formal alliances fall apart. But open innovation is more than formal R&D alliances; it includes handshake agreements and informal collaborations, which implies a broader palette of endings than alliance terminations. Cross-level interdependencies also exist, for example, where two scientists would like to continue to collaborate even after a formal breakdown of an alliance or where a conflict between two teams from different firms leads to the demise of a formal collaborative agreement between the firms. This broader palette of collaborations suggests that the company is situated in an intricate web of relationships. Such "structural embeddedness" (Polidoro et al., 2011) makes it difficult to foresee what will happen if one relationship breaks down.

The fact that this paper addresses the topic of closure does not mean that the case of closure is closed. One of the paper's main contributions is highlighting a promising avenue for future research. For open innovation research, a particular question is how individual open innovation initiatives—and the relationships built within them—fit into a more

extensive portfolio of innovation projects guided by firm strategy and the interdependent processes of opening and closing innovation (Appleyard and Chesbrough, 2017). With this perspective, building solid relationships between firms, individuals, and technologies within individual projects is not always unilaterally positive for long-term firm-level performance, at least unless it is matched with plans for how to break up these relationships if need be. Indeed, a new focus on closure exposes the intricate web of relationships that innovation creates. As we have seen, innovation projects are embedded in a multitude of constantly evolving relationships that enable and constrain the path from idea to successful commercialization. Considering closing open innovation should bring open innovation literature in a direction that investigates the portfolio of different innovation projects, with varying degrees of openness, maturity, and complementarity. It should also direct open innovation research to consider longer time horizons. We have focused too much on how companies get into open innovation and too little on how they follow through. We know innovation is a long-term game where time, persistence, entry, and exit matter. It's time for open innovation research to acknowledge that.

For strategy research, explicitly including the role of individual and technological relationships with more or less formality has much to add to the extant research on alliance terminations and the related literature on integration and disintegration (Pisano, 1990). Individual relationships (Dahlander et al., 2016), technology architecture (Henkel et al., 2013), and contractual relationships (Granstrand and Holgersson, 2014; Laursen et al., 2017)—sometimes in conjunction (Baldwin and Henkel, 2015)—all provide additional clues about and explanations for why innovation alliances are maintained or terminated and condition the process of closure.

Open innovation is thriving as literature, community, and management practice. To ensure the continued success of open innovation, we believe research needs to empirically

examine and theorize along a longer path of the open innovation journey. Acknowledging that most relationships end, be they individual, organizational, or technological, is an essential next step for open innovation research. To truly reach the promise of openness, we also need to embrace the closing of open innovation.

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