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CUI BONO? THE SELECTIVE REVEALING OF KNOWLEDGE AND ITS IMPLICATIONS FOR INNOVATIVE ACTIVITY

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Current theories of how organizations harness knowledge for innovative activity cannot convincingly explain emergent practices whereby firms selectively reveal knowledge to their advantage. We conceive of selective revealing as a strategic mechanism to reshape the collaborative behavior of other actors in a firm's innovation ecosystem. We propose that selective revealing may provide an effective alternative to known collaboration mechanisms, particularly under conditions of high partner uncertainty, high coordination costs, and unwilling potential collaborators. We specify conditions when firms are more likely to reveal knowledge and highlight some boundary conditions for competitor reciprocity. We elaborate on strategies that allow firms to exhibit managerial agency in selective revealing and discuss selective revealing's implications for theories of organization and open innovation and for management practice.

> He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me (Thomas Jefferson, letter to Isaac McPherson, August 13, 1813; http://press-pubs.uchicago.edu/founders/documents/a1_8_8s12.html).

Control of valuable resources is one of the most potent sources of competitive advantage organizations can possess (e.g., Barney, 1991; Pfeffer & Salancik, 1978; Teece, 1986). Organizations that control resources enjoy higher rates of survival and exert influence over other organizations in need of those resources. Weaker organizations, in turn, strive to get access to those resources or substitute for them by applying strategies such as partnerships, alliances, joint ventures, mergers and acquisitions, board interlocks, or political action (e.g., Bresser & Harl, 1986; Hillman & Hitt, 1999; Kale & Singh, 2009; Oliver, 1990; Podolny & Page, 1998). Accordingly, organization theory predicts that firms strive to be autonomous whenever they can and engage in collaboration whenever they must in order to access resources and overcome environmental uncertainty (Cook, 1977; Galaskiewicz, 1985).

These considerations are critical to innovative organizations for which knowledge represents the most essential resource (e.g., Grant, 1996; Kogut & Zander, 1992, 1996). Such organizations may hold two types of knowledge related to innovation activity (von Hippel, 1988): (1) solution-related knowledge needed to develop technologies and products and (2) problem-related knowledge about needs they will face in current or future markets. In turn, firms in control of problem- or solution-related knowledge should be able to generate higher rents from innova-

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tion. Thus, they will also be encouraged to protect this knowledge from other organizations through a series of appropriation mechanisms to sustain their favorable competitive position (e.g., Teece, 1986; Winter, 1987). Accordingly, innovative firms are advised to maximize incoming while minimizing outgoing knowledge spillovers (Cassiman & Veugelers, 2002).

Recent empirical anomalies appear to challenge this view. For example, Yang, Phelps, and Steensma (2010) found that coincidental, involuntary spillovers of knowledge by a firm may actually increase the possibility it will receive valuable knowledge in the future. Other studies go even further, indicating the value-accretive potential of strategies in which knowledge is *purposefully* and *strategically* disclosed to the environment. Following such "selective revealing" strategies (Harhoff, Henkel, & von Hippel, 2003; Henkel, 2006b), firms consciously select internally developed knowledge and make it accessible to outside actors, often for free and without contractual requirements. "Open source software" (von Hippel & von Krogh, 2003), where companies disclose the source code of their software products to the general public, who are further allowed to freely modify and independently redistribute the software, represents a particularly salient recent example. Notably, the use of selective revealing in the nineteenth century has already been documented. For example, Allen (1983) discussed information sharing among competitors in the English blast furnaces industry after 1850. While the application of selective revealing strategies today remains relatively rare (CED, 2006), the rising prominence of selective revealing across industries poses a challenge for theories of innovation. In particular, explanations of why firms choose to enact this behavior, how it may be value accretive, under what boundary conditions this behavior may flourish, and how it can be embedded into firms' innovation strategies are scarce. Whereas recent advances acknowledge the deterrence potential of selective revealing (Clarkson & Toh, 2010; Polidoro & Toh, 2011), there is limited research on selective revealing's collaborative aspects (Fosfuri & Rønde, 2004; Henkel, 2006a).

At the heart of our argument lies a novel appreciation of selective revealing as a strategic mechanism to improve a firm's technological and market conditions. In particular, firms that are part of larger innovation ecosystems—"the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution" (Adner, 2006: 98)—are dependent on the behavior of other actors to achieve positive returns to innovation (see also, for example, Adner, 2012, and Pisano & Teece, 2007). By revealing some of its own knowledge—either in the form of problems or solutions—a focal firm can initiate collaborative relationships with other actors to reshape its competitive environment and improve its access to technologies and markets. In contrast to prevailing approaches to collaboration, these selective revealing strategies may also succeed under adverse conditions of high partner uncertainty and high coordination costs and when known partners are unwilling to collaborate—conditions where (contractual) collaboration previously has been shown to be difficult to initiate (e.g., Casciaro & Piskorski, 2005; Emerson, 1962; Jacobs, 1974). Even if revealed knowledge is merely absorbed and not reciprocated by external knowledge producers in the innovation ecosystem (hereafter simply "externals"), indirect benefits of selective revealing might outweigh the costs for the focal firm. Specifically, if externals take in the revealed knowledge, because of the cumulative, path-dependent nature of knowledge (Nelson & Winter, 1982), their future knowledge production and spillovers will be of higher value to the focal firm. In short, we argue that selective revealing holds the potential to reshape both the active and deliberate as well as the passive and unknowing collaborative behavior of externals in the firm's innovation ecosystem.

To understand when firms selectively reveal their knowledge, we next analyze factors internal and external to the firm that influence this decision, highlighting the particular importance of modularity of resources, existing capabilities, and substitutive threats. Finally, we discuss how firms may embed selective revealing in innovation strategies. When considering the revealing of problems and solutions in conjunction with organizational goals of extending an existing technological trajectory or creating new trajectories (Dosi, 1982; Garud & Karnøe, 2001; Garud & Rappa, 1994), we derive four archetypes of selective revealing: issue spreading, agenda shaping, product enhancing, and niche creating.

Taken together, we discuss situations in which the selective revealing of knowledge may

prove to be beneficial to organizations. In doing so we make several contributions to the management literature. First, we add to ongoing discussions of interorganizational relations (Dollinger, 1990; Gulati, Nohria, & Zaheer, 2000; Oliver, 1990), showing how the strategic disclosure of knowledge allows the focal firm to not only forge new ties to external actors and form coalitions but to also potentially create entirely new knowledge networks. Second, we link our insights to institutional theory (DiMaggio & Powell, 1983; Phillips, Lawrence, & Hardy, 2000) and resource dependence theory (Casciaro & Piskorski, 2005; Pfeffer & Salancik, 1978) by highlighting how selective revealing implies a subtle form of competitor manipulation and thus represents an exercise of power. To explain this mechanism, we introduce the notion of *induced isomorphism*—deliberate strategic action to induce other actors to become more similar to the focal firm, particularly with respect to the production of knowledge. Finally, we contribute to conversations on the organization of innovative activity by discussing the concepts of absorptive capacity (Cohen & Levinthal, 1990; Zahra & George, 2002) and open innovation (Chesbrough, 2003; Dahlander & Gann, 2010; Laursen & Salter, 2006) in light of our theorizing.

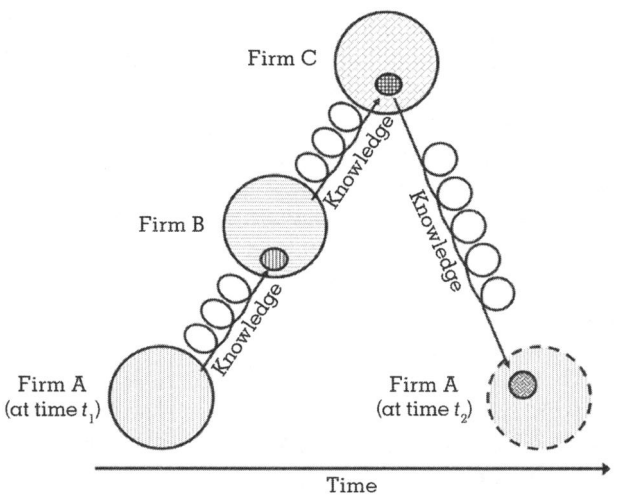
WHY? THE BENEFITS OF SELECTIVE REVEALING

Definition and Representation of Selective Revealing

At its core, innovation is a path-dependent, cumulative activity that involves multiple actors (e.g., Nelson & Winter, 1982). Each actor privately invests in R&D to expand its knowledge base so as to be able to create new or improved products, processes, and services. At the same time, knowledge may "spill over" to competitors, in the sense that competitors, to the disadvantage of the focal firm, gain access to private knowledge. In order to be receptive to spillovers, firms build their absorptive capacity—an ability to recognize the value of externally produced spillovers, to assimilate them, and to apply them inside the firm. Thus, the concept of absorptive capacity helps explain why investment in R&D, even when its benefits cannot be fully appropriated by the focal firm, is sensible because it improves the firm's ability to learn from its environment and use this knowledge to increase innovative activity (e.g., Cohen & Levinthal, 1990). In line with recent empirical insights by Yang et al. (2010) and conceptual work by Agarwal, Audretsch, and Sarkar (2007, 2010), innovative activity may be represented as a dynamic model in which outgoing spillovers, modified and enhanced by different actors along the way, may eventually return to the focal firm. This stylistic representation, shown in Figure 1, provides an intuitive basis to explain the logic behind the selective revealing of knowledge.

Following Henkel (2006b), we define selective revealing as the voluntary, purposeful, and irrevocable disclosure of specifically selected resources, usually knowledge based, which the firm could have otherwise kept proprietary, so that they become available to a large share or even all of the general public, including competitors. Despite its contradiction with established literature emphasizing the protection of knowledge produced in-house, work in this stream has shown that selective revealing may positively affect a firm's innovation and business performance (Stam, 2009; West, 2003) by allowing for outsourcing-like cost cutting (Lakhani & von Hippel, 2003), increasing the diffusion of products leading to beneficial externalities (Varian

FIGURE 1
Innovation As an Iterative, Multiagent System Involving Spillovers



Note: The small circle represents the spillover that is being "passed on." The shading of both the large and small circles symbolizes the varying structure of the respective knowledge.

& Shapiro, 1999), and changing the competitive behavior of others. Focusing on this latter point, Clarkson and Toh (2010) and Pacheco-de-Almeida and Zemsky (2012) separately showed that disclosing internal technology resources may deter rivals from investing in similar ones. Polidoro and Theeke (2012) found that firms publish research results to influence their market positioning, particularly in the face of similar efforts by rivals and under substitutive threats. Finally, Farrell and Gallini (1988) showed that even technology monopolists may gain from selectively revealing their knowledge to rivals when consumers face high adoption cost and are afraid of lock-in.

Thus far, however, the literature has not fully acknowledged the use of selective revealing as a strategic tool and has fallen short of comprehensively explaining the purposeful design and use of strategies embodying selective revealing. For example, while Yang et al. (2010) found that involuntary knowledge disclosure by firms may be beneficial over time, they fell short of conceptualizing spillovers as purposeful, assuming that they occur by chance and suggesting that their "results should not be interpreted as a prescription for encouraging spillovers" (2010: 386). Relatedly, Polidoro and Toh (2011) found that firms choose not to fend off imitators when the threat of substitution is high, particularly in the early stages of development of a technology and when the underlying knowledge is new—raising the question of whether active revealing could allow a further leveraging of these benefits (see also Agarwal et al., 2007, 2010).

Building on these important insights, we propose that selective revealing can best be understood as a strategy aimed at shaping the collaborative behavior of others in the context of innovative activity. Specifically, the two most crucial resources needed for innovative success are (1) knowledge embodied in technology, processes, and routines underlying the firms' products and services and (2) access to the respective product markets (Grant, 1996; Gulati & Singh, 1998; Kogut & Zander, 1992). In turn, a firm can be expected to initiate collaborative relationships with other parties if it *lacks technological know-how* to complete its competitive offering or to increase its potential profits from its products and services by *establishing or improving market access and position*. Accordingly, a focal firm will primarily reveal knowledge selectively in the hope that it will lead others to modify their behavior in such a way that the focal firm improves its access to the technologies or markets required for innovative success. Notably, such a response should not be considered improbable. Externals may decide to reciprocate for a variety of reasons, such as the pure enjoyment of problem solving (Lakhani & Wolf, 2005), status incentives (Jeppesen & Lakhani, 2010), reciprocity (Bonaccorsi & Rossi, 2006), and, of course, downstream financial profit (Henkel, 2006b)—irrespective of whether the reciprocated knowledge is irrelevant (Allen, 1983) or relevant (Henkel, 2006a; Spencer, 2003) to competition.

At the same time, selective revealing dictates that the firm make available some of its resources. Thus, the resources owned at a point in time determine what the firm can offer to entice others to collaborate. Following von Hippel's distinction (1988), we suggest that the resources the organization should be most inclined to share are problem-related (or need-related) and solution-related knowledge. In the case of *problem revealing*, the company purposefully discloses to its environment current or anticipated future technological problems for which it seeks others' support. For example, firms such as HP and Intel regularly reveal knowledge about problems they are facing internally and future research trajectories they intend to explore in open calls for research (Alexy, Criscuolo, & Salter, 2009; MacCormack & Herman, 2004). Arguments presented under the labels of crowdsourcing and broadcast search advocating the inclusion of large numbers of externals in the solution of technical problems by disclosing these publicly or through intermediaries would also be encompassed by this definition (e.g., Afuah & Tucci, 2012; Jeppesen & Lakhani, 2010).

In contrast, *solution revealing* occurs when the focal firm voluntarily and strategically discloses to its environment knowledge on how to solve a certain problem, as embodied, for example, in a patent, publication, product, or product component addressing a certain need or providing a certain function, to encourage imitation and diffusion. For example, an upstream firm may be willing to share some of the results of its R&D to increase downstream demand for related products (e.g., Harhoff, 1996). Similarly, firms might be willing to contribute upstream knowledge and intellectual property to joint knowledge production efforts in order to attract

more parties to join in quasi-collusive collaboration efforts to ensure the firms' downstream competitiveness (Alexy & Reitzig, in press). IBM made publicly available 500 valuable patents to the open source community in 2005. Followed by several other firms, including Nokia and NEC, this decision was motivated not by altruism but by a desire to sustain and support collective efforts to create and appropriate value from open source software.

Next we look at how selective revealing may be used to entice externals to display active collaborative behavior in situations where other collaboration mechanisms known from the literature rarely apply, thus increasing externals' propensity to grant access to other resources that the firm needs. Subsequently, we examine how selective revealing may reshape externals' generation of knowledge and spillovers so that both are of greater value to the focal firm, even if externals merely use the revealed knowledge but do not collaborate. Put differently, we explain how selective revealing may cause externals to collaborate (1) intentionally and directly as well as (2) unknowingly and indirectly with the focal firm. Uncovering these indirect benefits is relevant because it helps us understand that selective revealing provides benefits even if externals do purposefully change their collaborative behavior toward the revealing firm.

Direct Benefits: Selective Revealing As a Novel Pathway to Collaboration

A large body of literature exists in which scholars argue that firms will try to establish relationships with others when they lack critical resources or are faced with environmental uncertainty (e.g., Casciaro & Piskorski, 2005; Hillman, Withers, & Collins, 2009; Pfeffer & Salancik, 1978). In the context of innovation, scholars have emphasized an increasing disposition to strategically engage in collaborative relationships to overcome such issues (e.g., Arora, Fosfuri, & Gambardella, 2001; Chesbrough, 2003; Phelps, Heidl, & Wadhwa, in press; Powell, Koput, & Smith-Doerr, 1996). In a nutshell, these scholars argue that organizations do not prefer to collaborate but sometimes simply have to—either because technologies and markets crucial to innovative success are (perceived to be) controlled by others, or because of specialization in certain elements of the value chain, as is common, for example, in innovation ecosystems (Adner, 2006; Cook, 1977). Accordingly, firms attempt to strategically design relationships with other actors to secure access to crucial resources and to establish (relatively) predictable environments (e.g., Bresser & Harl, 1986; Gulati et al., 2000; Oliver, 1990).

Conditions limiting the use of traditional modes of collaboration. A variety of formats for collaboration that organizations may choose have been proposed in different bodies of literature, with selective revealing hitherto missing as an option (see, for example, Casciaro & Piskorski, 2005; Hillman et al., 2009; Parmigiani & Rivera-Santos, 2011; Phelps et al., in press). Prevalent arrangements—alliances, consortia, joint ventures, or acquisitions—usually all occur under the shadow of a contract (so as to minimize unwanted spillovers or moral hazard). At the same time, it is clear that firms cannot always successfully use these mechanisms (Ahuja, 2000). We identify three conditions under which traditional collaboration mechanisms fail, and we identify how these may be overcome by applying strategies involving selective revealing. Notably, our intent is not to suggest that selective revealing is a normatively superior approach but, rather, to present it as a novel option when firms *must* collaborate but, according to extant theorizing, can hardly do so.

First, firms will often need to go beyond currently accessible partners to get access to the technologies and markets they need for innovative success. However, in a context of *high partnering uncertainty*, firms may simply be unaware of who the right partner is, or they may face prohibitively high search costs identifying that partner (Gulati, 1998; Gulati & Gargiulo, 1999; Jacobs, 1974). Notably, this problem may be bidirectional—externals that would be willing to collaborate may simply not be aware of the focal firm's issue.

Second, even if firms know the right partners, traditional methods of cooperating suggested by the literature may simply be *too costly to establish or coordinate* (e.g., Dollinger, 1990; Gulati & Singh, 1998; Henkel & Baldwin, 2011). While the logic of how this may apply to acquisitions or joint ventures is intuitive, a brief elaboration is required for alliances. Importantly, coordination costs associated with their formation and management can reasonably be assumed to increase nonlinearly. Thus, if firms

require multiple partners to bring a technology to the market successfully—for example, if they need to form a coalition to legitimize a certain technology (Dodgson, Gann, & Salter, 2007; Garud & Rappa, 1994)—it is likely that the costs associated with the creation of a plethora of bilateral alliances will substantially decrease the value of this option. Also, the fuzzy boundaries of knowledge and the paradox of disclosure pose difficult challenges when assembling partnerships (Arrow, 1962).

While consortia may present a way to mitigate some of these concerns, they have been shown to be much less effective when potential collaborators are competitors in product markets (Branstetter & Sakakibara, 2002), leading to the third issue: even under the condition that the firm is aware of a limited and accessible set of collaboration partners, these potential partners may be *unwilling to collaborate*. Most notably, in a situation where an external party controls access to the technology and/or market desired and the focal firm has little or no bargaining power, incentives to collaborate for the supposed partner are limited, suggesting that a collaborative tie is unlikely to form (Casciaro & Piskorski, 2005). Regarding collaboration by competitors of similar resource endowment in consortia, Branstetter and Sakakibara (2002) summarized a debate in the industrial organization literature stating that efficiency gains from such endeavors may well be eaten up in subsequent market competition.

These conditions should be particularly prominent in innovation-related contexts, where technological uncertainty and incomplete appropriability increase the salience of high partner uncertainty, high coordination costs, and potential partners' unwillingness to collaborate. Finally, these three conditions might also be interlinked. For example, a focal firm might already be collaborating with another firm and hope to extend this relationship to access a technology or market to foster another innovation. However, for competitive reasons the partner firm might be unwilling to comply (the third condition), forcing the focal firm into a novel search for alternative partners (the first condition) and subsequent contracting (the second condition).

We suggest that selective revealing may be an appropriate strategic move that may allow firms to partially overcome these impediments to attain access to technologies and markets.

Overcoming partnering uncertainty. To address the problem of unawareness of partners, the disclosure of knowledge is a clear signal of the intent to collaborate with externals—a nontrivial precursor of actual collaboration (Kogut & Zander, 1996). By selectively revealing, the firm is reducing the preexisting information asymmetry about (1) whether or not it is looking for a collaboration partner and (2) which attributes these partners should hold, thereby encouraging fitting external actors to respond to the signal (see Spence, 1973). In so doing, selective revealing provides a solution to the basic nested problem of establishing common ground for collaboration to emerge (Puranam, Singh, & Chaudhuri, 2009). Thus, selective revealing will often represent an open invitation to externals to collaborate (even if the firm knows exactly who the potential collaborators might be). This is clear for both problem revealing (e.g., through crowdsourcing) and solution revealing (as shown in the earlier IBM patents example).

In addition, selective revealing may drastically reduce the search cost for external actors by allowing firms to cast a wider net in their quest for collaboration partners. This holds not only for the potential number of externals that may be reached but also for their scope. Specifically, the open invitation given through selective revealing may be received by externals active outside the space in which the organization traditionally searches for collaboration partners, which may be particularly effective in supporting the focal firms' innovative efforts (Afuah & Tucci, 2012; Jeppesen & Lakhani, 2010). For example, Afuah and Tucci (2012) described how problem revealing in the form of crowdsourcing may allow firms to drastically expand the limits of local search. With respect to solution revealing, Jeppesen and Molin (2003) articulated how software firms instigated the development of extensions to their products by voluntarily and strategically disclosing parts of their products. We thus posit the following.

> *Proposition 1a: The higher the level of partnering uncertainty perceived by an organization needing to collaborate, the more likely it will consider selective revealing over other mechanisms to induce collaborative behavior.*

Overcoming coordination costs. Selective revealing may significantly reduce contracting costs as potential partners can self-select to accept the open offer to collaborate, which replaces costly bilateral negotiations and largely eliminates unsuccessful contracting. Also, selective revealing mandates neither formalized nor contractual collaboration (Spencer, 2003). In addition, its fixed setup costs may be discounted over a potentially limitless number of collaborations. The reduction of coordination costs is a necessary condition to benefit from the expansion of the scope of partner search described above. This does not mean that no contracting exists; however, it is usually delayed until after it is clear that the collaboration can be successful. For example, companies in many sectors engage in problem revealing by publicly disclosing the problem on their website (Alexy, Criscuolo, & Salter, 2012). In such scenarios companies may often not need to negotiate with externals since these may submit their ideas for free because of motivations other than financial reimbursement (e.g., Lakhani & Wolf, 2005). However, if negotiations have to take place, the revealing firm may, compared to other modes of collaboration, know better whether an external suggestion actually solves its problem (Lakhani, Jeppesen, Lohse, & Panetta, 2007) and may also have higher bargaining power because of the increased search scope and resulting availability of alternate solutions.

At the same time, selective revealing positively impacts the three Cs of collaborative activity—complementarity, compatibility, and commitment (Kale & Singh, 2009). Externals who self-select to respond to the selectively revealing organization will also signal information about themselves. First, externals should only self-select into collaboration if they possess complementary knowledge and use compatible processes. Because selective revealing creates transparency about the revealing firm's collaboration goals (i.e., the expected contribution of joining parties), externals should only decide to partake in the exchange if these goals are perceived as beneficial (Emerson, 1962; Jacobs, 1974). Notably, however, even free-riding may generate indirect benefits for the revealing firm.[1] Second, the specific action that represents the externals' self-selection decision may be interpreted as a signal of commitment. In many cases the focal firm will be able to observe the response of the externals. From that the focal firm may evaluate the externals' level of commitment by looking at such factors as the level of resource commitment or its reversibility. Third, the same method may allow the focal firm to judge the capabilities of externals. Consider again the earlier HP and Intel example. Following the open call, university researchers will self-select into responding, generating two key benefits. First, the firm will receive, for free, a large number of proposals depicting the current level of progress of research in the problem area and the possible range of approaches to solving the problem. Second, it can handpick and fund or hire those individuals whose suggestions it deems most economically or strategically viable to begin the joint exploration of identifying problem solutions—that is, those with the highest levels of complementarity, compatibility, and commitment.

Finally, the irrevocability of selective revealing instigates trust as problems of moral hazard are minimized (Farrell & Gallini, 1988; Gulati & Sytch, 2007). In doing so, trust may eventually become an enabler for more intense and higher-value information exchange between the parties (e.g., Gulati, 1998). Notably, this would also suggest that selective revealing could instigate subsequent more in-depth relationships between firms (such as joint ventures or alliances). Consider again the example where IBM disclosed 500 patents. This not only led several other firms to follow IBM but also paved the way for joint investment into the creation of a dedicated venture tasked to protect these firms' selective revealing efforts against nonpracticing entities such as patent trolls. In summary, we posit the following.

> *Proposition 1b: The higher the level of coordination costs perceived by the organization needing to collaborate, the more likely the organization will consider selective revealing over other mechanisms to induce collaborative behavior.*

Overcoming unwillingness to collaborate. Selective revealing offers two options to address the issue of powerful actors who are unwilling to collaborate. Generally, the most compelling mechanisms to reduce dependence on a power-

[1] We extend this point in the section titled "Indirect Benefits: Selective Revealing As a Pathway to Reshape External Knowledge," below.

ful actor are the identification of alternate sources of supply and the formation of a coalition (Cook, 1977; Jacobs, 1974). Formally, how to achieve the first goal follows the argument of how selective revealing widens the search for partners. As to the second goal, selective revealing might represent not only an invitation to *collaborate with* the focal firm but also one to *collude against* another firm or even a network of firms. Per Polidoro and Toh (2011), firms decrease their efforts at deterring imitation when faced with a threat of substitution. However, the substitution threat not only applies to the focal firm but to all firms following the same technological trajectory (Dosi, 1982)—that is, to all potential imitators. Since these firms face similar incentives regarding which technology trajectory they want to see emerge victorious but have idiosyncratic resource endowments for their commercialization, selective revealing by one actor may initiate reciprocal actions by others facing the same competitive issues. It is clear how this logic applies to the IBM patents example, which has as its "targets" competitors such as Microsoft and nonpracticing entities. Yet this strategy is clearly not limited to software. For example, as part of its Merck Gene Index, Merck disclosed all human gene sequences into a public database. The goal of this initiative was to entice similar others to join Merck in preventing an upstream input to pharmaceutical products being monopolized by actors specializing in this space (Pisano & Teece, 2007). We thus propose the following.

> *Proposition 1c: The higher the level of unwillingness to collaborate perceived by an organization needing to collaborate, the more likely the organization will consider selective revealing over other mechanisms to induce collaborative behavior.*

Indirect Benefits: Selective Revealing As a Pathway to Reshape External Knowledge

At the same time that selective revealing may influence the intentional collaborative behavior of externals, we further argue that it may also have a subtle yet important impact on how these externals generate knowledge that may lead them to *unintentionally exhibit collaborative behavior*. Importantly, we maintain further that this effect should be present irrespective of whether or not externals reciprocate with collaborative behavior, as long as they merely *use* the knowledge that the focal firm has released. Put differently, the cost of revealing might already be outweighed by indirect benefits of selective revealing, which *always* accrue if the selectively revealed knowledge is absorbed. These benefits originate from changes to how users of the selectively revealed knowledge generate knowledge themselves and the voluntary and involuntary spillovers (Winter, 1987) they produce.[2] In the following section we focus our arguments on situations in which the selectively revealed knowledge is only used by externals who then free-ride and do not give back knowledge actively in return. If they did, then all effects described in the following should be present to an even stronger degree.

Why should selective revealing have an impact on the knowledge, and particularly the spillovers, that organizations taking in the revealed knowledge produce? To be able to answer this question, we first need to look at what constitutes the value of externally held knowledge, namely whether it objectively addresses a need of the firm (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998)—that is, its *content compatibility*—and whether it exhibits *structural compatibility* with the firm's existing body of knowledge—that is, an overlap in its categorization of knowledge (e.g., according to certain scientific disciplines) and the language used to describe it (e.g., Grant, 1996; Lane & Lubatkin, 1998). In turn, content compatibility represents the objective maximum value of externals' knowledge (and of the spillovers they produce voluntarily or involuntarily), and structural compatibility predicts the costs of absorption. Thus, selective revealing by the focal firm will produce indirect benefits if it can influence others in such a way that their production of knowledge and spillovers generated in this process are of improved structural or content compatibility.

Effects on content compatibility. When firms engage in problem revealing, as argued above,

[2] Notably, further benefits may exist for the revealing firm. For example, von Hippel and von Krogh (2003) maintain that revealing in itself brings benefits such as learning, which may outweigh its total cost. Furthermore, we point to the literature discussed above on the deterrence effect of revealing.

this is likely to facilitate the development of solutions by others. Even when externals are unwilling to freely share their solutions with the focal firm as voluntary spillovers, their involuntary spillovers will exhibit increased content compatibility, because externals will still be basing their production of knowledge on the needs of the focal firm. Thus, the mere use of the released problem-related knowledge by a sufficiently large number of externals, even if these do not actively reciprocate, may create externalities that lead the focal firm to see its original problem sufficiently lessened or even solved entirely.

This logic similarly applies to solution revealing. Here the nonreciprocated use of the released solution is identical to the choice of an imitation strategy by externals, or free-riding. However, even free-riding may often be strictly beneficial to the focal firm. For example, Pacheco-de-Almeida and Zemsky (2012) showed how competitors switching from innovation to imitation strategies may convey time-related advantages to the focal firm. And in case externals choose to employ the revealed knowledge as an ingredient in their own innovative activity, this means they will become more closely aligned with the technological path of the focal firm. Thus, future spillovers by externals taking in the revealed knowledge will have higher content compatibility with the focal firm. As we elaborate below, these externals will also partake (to some degree) in the focal firm's technological path so that they become potential supporters for a focal firm's attempt to create or displace technological standards or dominant designs and legitimize new technologies or markets. This is consistent with scholars who argue that in the face of a substitutive threat, firms should change their evaluation of strategies encouraging imitation (Polidoro & Theeke, 2012; Polidoro & Toh, 2011). Thus, we propose the following.

> *Proposition 2a: The more the focal firm seeks to influence the content compatibility of externals' knowledge, the more likely it will consider engaging in selective revealing.*

Effects on structural compatibility. The use of selectively revealed knowledge should further affect the structural compatibility of future knowledge production by these externals. In short, when taking in the revealed knowledge, the external has to bear the cost of translation. Externals that want to work on a disclosed problem will need to assimilate this problem to match their own language and structure for knowledge (Kotha, George, & Srikanth, in press). Should they intend to solve it, they will further have to produce an output that is structurally compatible with the problem originally revealed (Jeppesen & Lakhani, 2010), for which they would need to adjust their knowledge production processes (Grant, 1996; van den Bosch, Volberda, & de Boer, 1999). In turn, this may permanently increase the structural compatibility of their knowledge production with the focal firm (Cohen & Levinthal, 1990; George, Kotha, & Zheng, 2008; Grant, 1996; Gulati & Gargiulo, 1999).

The argument for solution revealing is analogous: the revealed knowledge taken in becomes an input to the external's own R&D and is assimilated and adapted. However, in this absorption process, it is likely that the knowledge will retain some of its original language and structure. Through its own absorption process, the external firm will familiarize itself with the original structure and language of the voluntary spillover and keep some of it as its own (e.g., Dyer & Singh, 1998; Lane & Lubatkin, 1998), particularly when reusing the external knowledge with little to no modification (Fleming, 2001; Kogut & Zander, 1992) or when external knowledge is generally preferred to internal knowledge (Menon & Pfeffer, 2003). Eventually, as shown by Yang et al. (2010), this increased structural compatibility will lead to a rise in the focal firm's ability to profit from incoming spillovers. We thus posit the following.

> *Proposition 2b: The more the focal firm seeks to influence the structural compatibility of externals' knowledge, the more likely it will consider engaging in selective revealing.*

Effects on technological trajectories. Technological trajectories (e.g., Abernathy & Utterback, 1978; Dosi, 1982) play a central role in innovation ecosystems (e.g., Adner, 2012). They are best understood as a socially constructed frame of reference that informs organizations of what a technology can and cannot do, how it should be physically embodied, and how it can be evaluated by all players in the field (e.g., Garud & Rappa, 1994; Powell et al., 1996). Early on, a tech-

nological trajectory is solely sustained by the beliefs of those exploring it, and huge uncertainties exist on all dimensions. Multiple trajectories will be competing to address the same market need until the emergence of a socially accepted evaluation system that selects a dominant design. Conversely, once a technological path is established, relative certainty exists over technology and markets (Dosi, 1982; Garud & Rappa, 1994). Yet because of the cumulative nature of knowledge, organizations will find themselves locked into a certain path (Garud & Rappa, 1994; Nelson & Winter, 1982). Accordingly, when the innovative activity of organizations aims at *extending existing paths*, we would expect that the need for collaborative behavior will mainly originate from problems of technological specialization or the wish to expand into different market segments. Conversely, organizations intending to *create new paths* will need to shape their technological and market environment to eliminate as many unfavorable possible future trajectories as possible.

The greater the number of externals who commit to a certain trajectory—and its content, structure, and language—in a given knowledge domain, the more beneficial it is for other actors to also convert to this trajectory and facilitate efficient cooperation (Grant, 1996; Kogut & Zander, 1992), necessitated by increased interconnectedness and mutual dependence (Gulati & Sytch, 2007; Kotha et al., in press). In this context, selective revealing may allow the firm to induce externals to align their technological trajectories and knowledge production processes so that they become analogous to the focal firm, with higher structural and content compatibility. Providing valuable knowledge will increase imitation, which should precipitate both greater convergence toward the focal firm's technological trajectory and the generation of complements and second-generation innovation built on and around the revealed knowledge (e.g., Harhoff et al., 2003). In addition, because selective revealing may decrease the fear of lock-in by a monopolistic supplier (Farrell & Gallini, 1988), higher levels of use of the revealed knowledge, also among consumers, is more likely. For example, Google's decision to make its mobile operating system, Android, open source has created confidence among consumers and mobile operators that this platform will be built on by other firms, helping to increase its chances of adoption.

Taken together, these two mechanisms suggest a high likelihood of network externalities, which may ultimately result in the establishment (or reinforcement) of favorable norms about the focus, structure, and language of knowledge production (Spencer, 2003)—as, for example, articulated in the dominant design—*potentially even if no firm is actively colluding with the selectively revealing actor*. While some externals may be skeptical of such strategic efforts (Dollinger, 1990; Oliver, 1988, 1990)—yet may still decide to use the selectively revealed knowledge and possibly even reciprocate—at the same time others will *unknowingly* become more isomorphic to the firm in their knowledge generation.

In turn, this induced isomorphic behavior and the resulting higher structural and content compatibility should render future collaboration with the focal firm an increasingly attractive option for externals. For example, as a response to problem revealing, firms that have a related technology may decide to adapt it to match the signal, thus interpreting it as information about a potential market. Similarly, complementers having to choose between competing platforms should strongly prefer an open one since it decreases uncertainty regarding the outcome of contracting and future access. Finally, firms struggling with high technological uncertainty should be more likely to model their explorative efforts on the problems of others (see DiMaggio & Powell, 1983) and, thus, also use free intermediate solutions to then extend these as needed. Notably, in all of these cases, uncertainty reduction will be higher if the external permanently aligns itself with the revealing firm, which is likely to continue to supply further uncertainty-reducing knowledge. Permanent alignment may be the outcome of subsequent interactions, even in the absence of trust, which is only developed subsequently (Van de Ven & Walker, 1984). Furthermore, each transaction increases mutual dependence on each other and, thus, increases the likelihood and value of future collaboration (Gulati & Sytch, 2007).

Accordingly, firms that strive to extend an existing path may benefit from induced isomorphism by increasing the value of their extant resources or prolonging their longevity. Firms working to create new paths may find that by

inducing isomorphic behavior among externals, they may foster the emergence of a more favorable trajectory. We thus propose the following.

Proposition 2c: The more the focal firm seeks to influence the evolution of technology trajectories, the more likely it will consider engaging in selective revealing.

WHEN? BOUNDARY CONDITIONS OF SELECTIVE REVEALING

Of course, we are not trying to argue that selective revealing is universally beneficial to all firms in any given competitive situation. Rather, managers will need to make boundedly rational evaluations of whether anticipated benefits outweigh potential costs (Henkel, 2004). Even if the above-mentioned benefits render selective revealing a strategic alternative worth *considering*, this needs to be separated from the decision of whether an organization *should actually reveal*. Such a decision needs to factor in the costs that the firm must bear to initiate selective revealing and the risks of unwanted outcomes. Here three forms of risk seem to be particularly crucial. First, the organization may accidentally disclose knowledge beyond what it wanted to or should have released, potentially culminating in loss of control over current and future product development (Chesbrough & Teece, 1996). Second, it might struggle to manage the increased complexity of its innovative activities that now transcend the boundary of the firm in a way that runs counter to the traditional emphasis on the protection of intellectual property generated in-house (Alexy et al., 2009). Third, the organization may fail to attract externals to even use the revealed knowledge. These risks may, of course, be mitigated. Specifically, organizations can decide which resources to reveal, after taking into account their competitive position, capabilities, and internal processes to ensure that they may reap possible benefits of selective revealing. Moreover, factors external to the organization need to be taken into account.

Internal Drivers of the Selective Revealing Decision

Whether or not to reveal a specific resource is a question of trade-offs. While an organization must not reveal valueless resources (since these would most likely neither be used nor reciprocated by externals), it will try to abstain from disclosing resources that are of high competitive relevance (e.g., Polidoro & Toh, 2011). For example, firms will hesitate to disclose tacit or complex knowledge since it can be kept secret easily, thus promising high returns from excludability and inimitability (Rivkin, 2000; Teece, 1986; Winter, 1987). However, should a firm decide to release such high-value resources nonetheless, this may substantially increase the likelihood that those resources will be picked up by other parties, which may ultimately overcompensate for the initial cost of giving up exclusivity. Accordingly, such trade-offs will need to be evaluated for each selective revealing decision, limiting the scope for generalization.

Looking at an organization's resource base more broadly, modularity should increase the likelihood the organization will decide to engage in selective revealing (Henkel & Baldwin, 2011). If the firm's resource base is modular, the firm can release some parts of it without having to disclose others it wants to keep proprietary. Still, the released knowledge will have content and structural compatibility with what the firm keeps in-house so that both direct and indirect benefits of selective revealing are attainable. For example, an organization that has its knowledge base modularized along the layers of industry architecture (Jacobides, 2006) may be able to reveal knowledge only on one layer of the industry architecture and at the same time retain relatively secure revenue streams originating from activities on other layers (West, 2003). Furthermore, such modularity may increase the likelihood that externals exist that are interested in the knowledge the firm reveals yet are not direct competitors in the product market. In turn, this should increase the likelihood that these externals use and reciprocate the revealed knowledge to engage in collaborative research (Branstetter & Sakakibara, 2002) or even collusion (Alexy & Reitzig, in press; Dollinger, 1990). Accordingly, we propose the following.

Proposition 3a: The degree of modularity of the organization's resource base will increase its propensity to engage in selective revealing.

Furthermore, we expect an organization to engage in selective revealing if it perceives that it is fit to benefit from it. Here the assessment of fit includes an evaluation of all steps of the selective revealing process. First, is the organization good at disclosing knowledge—can it present the knowledge in a format so that others can successfully use and possibly build on it? Specifically, the organization will need to decontextualize its problems and solutions enough so that they are accessible to externals, yet not too much so as to ensure that subsequent related knowledge generated by externals will be valuable to the firm. Recent research shows this is indeed a nontrivial process (Baer, Dirks, & Nickerson, in press; von Krogh, Wallin, & Sieg, 2012). Second, the firm will need to be ready to reap external knowledge. At the very least, sufficient absorptive capacity is a prerequisite to be able to gain from the contributions of others to the selective revealing effort, but specific internal organizational practices may be required (Foss, Laursen, & Pedersen, 2011). On a larger scale, the organization may have to adjust its processes for value creation and capture—tied together to form its business model—should it look to profit from its selective revealing endeavor (e.g., Chesbrough, 2006; Chesbrough & Appleyard, 2007). In addition, particularly if the organization seeks to induce long-term relationships with externals, it will need to ensure that its internal routines and culture are up to the task (e.g., Alexy et al., 2009). Organizations that have not internalized these respective capabilities will more likely shy away from selective revealing since they would otherwise need to bear the considerable burden of establishing them. Accordingly, we posit the following.

> *Proposition 3b: Existing organizational capabilities in extracting value from external knowledge will increase its propensity to engage in selective revealing.*

External Drivers of the Selective Revealing Decision

Two kinds of external considerations will matter in particular to firms considering selective revealing: (1) the firms' competitive environment and (2) the perceived likelihood externals will use or reciprocate the revealed knowledge. Below we take each in turn.

Competitive dynamics have the potential to affect the urgency to selectively reveal and, thus, increase a firm's tolerance to disclose valuable knowledge. In particular, selective revealing may be a reaction to a severe threat to a firm's competitive position. Here, as alluded to before, the perceived threat of substitution (Polidoro & Toh, 2011) should strictly positively affect the firm's willingness to engage in selective revealing. Especially if knowledge is path dependent and learning is cumulative (Scotchmer, 1996), an organization should be willing to defend its path against others while hoping to be able to fend off imitators through lead time (Clarkson & Toh, 2010). Thus, particularly when multiple technological trajectories proposed by different organizations are competing against each other, selective revealing might become a compelling option since some externals may be enticed to support the focal firm (Alexy et al., 2009), possibly tipping a standard race in favor of the focal firm (Varian & Shapiro, 1999).

At the extreme end of such efforts lies what is described in the literature on open source software. Here companies engaged in solution revealing to prevent being squeezed out of a market entirely by a (to-be) monopolist. Specifically, firms such as Netscape—which found itself overwhelmed by Microsoft in the "browser wars" of the 1990s—felt that they would be better off competing on open products and standards rather than awaiting certain competitive annihilation, and therefore revealed essential parts of their product portfolios to the public. While of course a gamble, these companies expected higher odds of survival from taking a chance on whether selective revealing dynamics unfolded rather than from following traditional forms of product-market competition on proprietary intellectual property (Henkel, 2004).

> *Proposition 4: The perceived strength of a substitutive threat to the organization's resource base will increase its propensity to engage in selective revealing.*

Beyond substitute threats, a brief look at the existing literature on collaboration shows an extensive list of elements of competition, which should also affect selective revealing and its costs, urgency, or likelihood of success. These

include existing collaborative networks and their structure, which can be reactivated for the selective revealing effort (Gulati & Gargiulo, 1999) and predict a firm's reach (Schilling & Phelps, 2007) and its influence on other actors (Galaskiewicz, Bielefeld, & Myron, 2006; Powell et al., 1996). Further, regarding the ecosystem surrounding the firm, the number of players and their level of diversity determine what knowledge the firm may possibly attain (e.g., Gulati & Sytch, 2007; Van de Ven & Walker, 1984). Modularity of these ecosystems at large (Baldwin & Clark, 2000), as expressed by layered architectures (Pisano & Teece, 2007) or fragmented markets (Dollinger, 1990; Jacobs, 1974), may also increase the chance that disclosed knowledge will be used and reciprocated. Finally, the existence of institutions and social norms supporting collaboration will also positively affect the performance of selective revealing strategies. These include intellectual property regimes (Teece, 1986), a culture that facilitates trust building (Kale & Singh, 2009), and the general existence of an appropriate legal framework governing and supporting knowledge production and sharing (Fosfuri & Rønde, 2004). Whereas each of these factors could potentially affect selective revealing, we have restricted our propositions to those where there is a preponderance of evidence to build theory. Our intention is not to diminish the importance of other plausible drivers but to be parsimonious in our selection from a multitude of potential influences.

HOW? ARCHETYPES OF SELECTIVE REVEALING STRATEGIES

In this section we address the question of how selective revealing may be embedded in innovation strategies. To do so we build on our distinction of problem and solution revealing, which respectively focus on improving access to technologies and markets. In addition, we consider the innovation goals of the organization in light of the existence of technological trajectories, looking at whether the firm intends to create a new path or extend a current one.

Combining these two dimensions results in the matrix depicted in Figure 2. Below we explain the resulting four archetypes of selective revealing and how they allow firms to access technologies and markets; examples of practices embedding these strategies from several industries are shown in Table 1. Our examples highlight the plurality of revealing strategies. These strategies are often conducted through a variety of organizational structures, including, for example, research consortia, open source software, and crowdsourcing. Rather than seek to explain the specific organizational structure that enables selective revealing, we focus on the rationale behind the decision of the firm to reveal knowledge. Thus, while we present a variety of examples of selective revealing to illustrate what it may help firms achieve, at its core our argument is indifferent to the specific mechanism chosen to selectively disclose knowledge.

Issue Spreading

Issue spreading, the selective revealing of technology-related knowledge to extend existing paths, may have two effects on the firm's environment. Both of these build on the fact that issue spreading directly embodies a need of the focal firm that others may be able to satisfy in a way that is mutually beneficial. First, external actors may be encouraged to submit to the focal

FIGURE 2
Selective Revealing Strategies

		Mode of revealing	
		Problem revealing	*Solution revealing*
Goal	*Path extension*	Issue spreading (broadcast search)	Product enhancing (open source software)
	Path creation	Agenda shaping (open research calls)	Niche creating (academic publishing)

Note: Exemplar practices embedding selective revealing are given in parentheses.

TABLE 1
Selective Revealing Strategies: Examples of Successful Implementation from the Academic Literature

Strategy	Definition	Studies	Study Contexts
Issue spreading	Encourage others to participate in shared problem solving and/or to make complementary investments	Füller (2010); Jeppesen & Lakhani (2010)	Firms on InnoCentive, consumer goods, IT
Agenda shaping	Highlight focal firm's future demands so others can privately invest in and/or actively assist firm in developing solutions and complementary offerings	MacCormack & Herman (2004); Alexy, Criscuolo, & Salter (2009)	Defense industry, IT, pharmaceuticals, consumer goods
Product enhancing	Facilitate wide use of revealed knowledge to increase value of complementary assets and likelihood of reciprocal behavior	Allen (1983); von Hippel (1988); West (2003)	User innovation in all sectors, engineering, IT
Niche creating	Build critical mass supporting firm's technology trajectory to attain buy-in from crucial actors in ecosystem	Garud, Jain, & Kumaraswamy (2002); Dodgson, Gann, & Salter (2007)	Built environment, IT

firm their existing knowledge to address the specific problem. Alternatively, the revealed knowledge may act as a trigger for new development activity since the focal firm is signaling downstream demand. The crowdsourcing examples given earlier in this article clearly illustrate this point. Here the focal firm directly signals to its environment current problems it is unable to solve on its own in the hope of finding externals with related yet sufficiently distinct knowledge able to tackle the issue at hand.

Second, issue spreading can be interpreted as an invitation to collude on extending existing technology paths. Under the condition that R&D is either too costly for one firm to bear or when R&D is not a differentiation factor, the focal firm can reasonably hope for other actors facing similar technological problems to accept this invitation, thereby enabling or supporting collective strategies (Bresser & Harl, 1986; Dollinger, 1990). An example of issue spreading can be seen in the GreenTouch initiative, a new consortium of leading IT companies that have come together to try to increase the environmental performance of networks. Although often competitors, GreenTouch members have sought to outline the architecture, specifications, and road map required to improve network energy efficiency by a factor of 1,000 over 2010 standards by 2015. Issue spreading allows these firms to indicate their commitment to this technological path, make interdependencies publicly visible, attract new participants and complementers, and ease the coordination of R&D investment decisions.

Agenda Shaping

Theories of power make clear that the ability to shape discourses serves as a source of power in collaborative relationships (e.g., Lukes, 2005; Phillips et al., 2000). By influencing what is being talked about and how, actors may steer the social construction of technology paths in a direction more suitable to their needs. Extending this argument to our context, we suggest that problem revealing may allow the focal firm to *shape the development agenda* for new paths it intends to create so as to entice externals to coordinate or align around the production of solutions fitting the focal firm's intended trajectory and its gaps. Thus, a firm will communicate those issues it considers relevant for the creation of its most preferred pathway and will try to set in motion a legitimate discourse around it and connect other actors to this discourse to facilitate collaborative behavior (Hardy, Lawrence, & Grant, 2005; Phillips et al., 2000). Such communication to the environment may occur, for example, through open research calls. Even more basic, simply making the focus of R&D activity known to the public through the company website may spur the development of related activity and its submission to the firm from its environment. Most famously, agenda shap-

ing is incorporated in the so-called DARPA model, which has been executed successfully by the U.S. Department of Defense for decades and which has also been transferred to several Silicon Valley companies, as clearly shown by the examples of Intel and HP given earlier.

Product Enhancing

By engaging in *product enhancing*—the extension of current paths through solution revealing—the firm has the opportunity to improve its competitive position in current markets or to advance into new ones, even if strong competitors exist. Product enhancing might be particularly appealing to firms in control of nondominant technology platforms. For example, IBM opened up the core of its Eclipse software development tool to the public, including the source code of the software (West, 2003). Doing so increased its diffusion among end users and led many commercial firms to abandon their efforts to develop similar tools and, instead, to focus on adapting Eclipse to their respective needs. As many of these actors made their adaptations open to the public again at no cost, the functional scope of Eclipse and its compatibility with other platforms were extended substantially beyond IBM's initial contribution. This led to a further boost in diffusion, rendering Eclipse the de facto standard software development tool on most platforms, including those controlled by IBM's fiercest rivals, Microsoft and Sun, in which IBM previously had been unable to establish a foothold. In turn, IBM was able to create a bustling ecosystem around its platform, producing upgrades and extensions to its program, and a substantially increased installed base to which it could sell complementary offerings.

Niche Creating

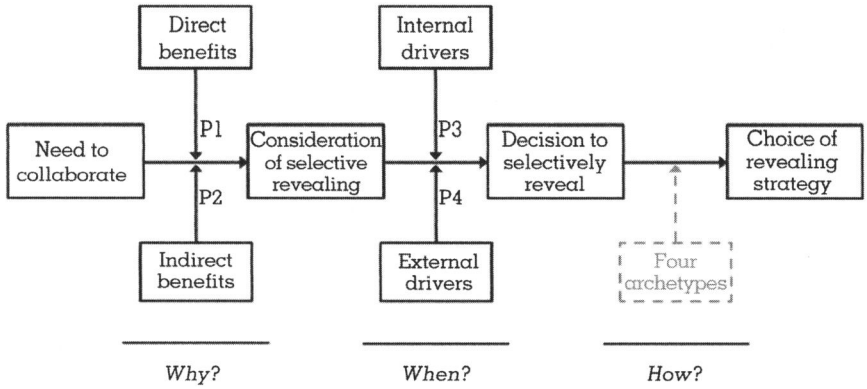
Niche creating is the use of solution revealing to shape and establish novel knowledge paths by collaborating with relevant others to assemble a critical mass that allows for the creation of new institutional rules and resources (Phillips et al., 2000). Specifically, niche creating assists the firm in trying to convince other industry stakeholders that its preferred technology trajectory is both viable and legitimate and should be preferred over alternative solutions, if these exist (Garud & Rappa, 1994). By encouraging others to use the revealed knowledge, the firm may be able to influence its environment to converge (or at least shift) toward the focal firm's preferred trajectory (Garud, Jain, & Kumaraswamy, 2002). As these externals' future paths become more aligned to that of the focal firm, niche creating will increasingly allow the firm to impact how other industry stakeholders think about the evolution of the technology, guiding them toward the firm's preferred path and encouraging them to participate in the social construction process necessary for its eventual legitimation. In doing so, niche creating ultimately may enable the firm to shape relevant discourses and create entirely new markets that are closely aligned with its interests and resources (Garud et al., 2002; Phillips et al., 2000).

As a poignant example of niche creating, Dodgson et al. (2007) described the case of the engineering consultancy Arup, which had developed a novel technological solution to use elevators in case of fire emergencies. However, since established norms were strictly contradictory to this technological advancement, Arup needed to convince industry stakeholders of the viability of this technology. Arup revealed its solution knowledge to its competitors and other externals to increase the number of actors interested in establishing this market, including the regulators of new building designs. Ultimately, this strategy allowed Arup to create and legitimate "fire engineering," a new niche in the built environment in which Arup became recognized as the primary authority, since everyone was in concordance with Arup's technology trajectory. Finally, since Arup was strategic about which pieces of knowledge it revealed, it continued to command a technological lead over other industry players.

DISCUSSION AND IMPLICATIONS

We have proposed a model of selective revealing as a deliberate, strategic action to improve conditions for innovation (Figure 3). We suggested that selective revealing is a novel mechanism that can shape the collaborative behavior of external actors. First, selective revealing may initiate active collaboration even under conditions of high partner uncertainty and high search costs and when known partners are unwilling to collaborate. Second, it may cause passive and possibly unknowing collaboration by

FIGURE 3
A Process Model of Selective Revealing



Note: Element shaded in gray represents relationships that are discussed in the article but for which we refrain from presenting propositions.

externals, even when these are merely free-riding on the selectively revealed knowledge, by making future involuntary knowledge spillovers more valuable to the focal firm, and it may induce the external to become isomorphic. We further outlined internal and external factors that should positively impact the firm's propensity to engage in selective revealing and pointed out the role of modularity, existing capabilities, and substitutive threats in this context. Finally, we specified four forms of selective revealing depending on whether the firm aims to improve its access to technologies (through problem revealing) or markets (through solution revealing) and whether it aims to extend existing paths or create new ones: issue spreading, agenda shaping, product enhancing, and niche creating.

Selective Revealing and Collaboration

Our work provides three insights for management theory. First, we highlight the nature of selective revealing as a previously undocumented, theoretically relevant mechanism to initiate collaborative behavior. We extend the possibility for strategic action in reshaping environmental dependencies to situations where the strategy and organization theory literature would consider the actor largely unable to establish access to critical resources through collaboration: high partner uncertainty, high coordination costs, and unusable known collaboration options (e.g., Bresser & Harl, 1986; Cook, 1977; Dollinger, 1990; Jacobs, 1974). We show how even under these conditions actors can positively influence environmental contingencies through selective revealing to create an alternative source of supply, rally allies, and mitigate uncertainty.

Our argument points to a dynamic element of network creation spurred by selective revealing. There is scarce current related theory explaining the emergence of collaborative mechanisms such as strategic alliances beyond the argument of multiplex relations—that is, currently existing relationships on another dimension that will be leveraged to form the desired alliance (e.g., Ahuja, Polidoro, & Mitchell, 2009; Gulati & Gargiulo, 1999; Hallen, 2008). While existing relationships will still matter in our model, they are clearly not necessary for collaboration to emerge from selective revealing. Thus, we would argue that selective revealing represents a novel mechanism explaining the emergence of knowledge networks and collective strategies, in which, in contrast to much extant literature (e.g., Kilduff & Brass, 2010), there is a clear role played by managerial agency. This argument further expands on Hillman et al.'s (2009) question of whether organizations progress through a sequence of strategies aimed at lowering their dependence on their environment; we would predict that, in innovative activity, selective revealing may often precede more resource-intensive forms of collaborative engagement.

An important issue that remains to be addressed is what forms of networks will emerge from selective revealing and how these networks may be governed beneficially. For example, Eclipse has long been governed by a foundation in which IBM is one among many members. This would suggest that selective revealing aimed at establishing a collective strategy against dominant competitors may require the revealing firm to give up its position at the formal center of the network. We strongly encourage empirical research in order to better understand these points.

Selective Revealing and Power

Second, our model further allows us to reinvigorate the link between knowledge exchange and isomorphism to provide a stronger integration of theories explaining collaborative innovative behavior with institutional and resource dependence. In this context, as the relationship between the revealing party and the user of its knowledge is established, this link automatically and concomitantly forces the using party to engage in behavior similar and, thus, beneficial to the focal firm. In short, the focal firm is employing selective revealing to subtly exercise *power* over others to purposefully initiate isomorphic behavior.

This induced isomorphism shares similarities with other forms (DiMaggio & Powell, 1983), particularly coercive isomorphism, which results from pressure or persuasion from environmental sources. Yet the use and reciprocation of selectively revealed knowledge by external actors is not a coerced decision, since the voluntary disclosure of knowledge merely represents an open offer to an indiscriminate number of externals, which all are free to reject. Nonetheless, its acceptance mandates at least some isomorphic behavior. Induced isomorphism also shares aspects of mimetic isomorphism; we have explained how some externals will react positively to the focal firm's knowledge disclosures because these disclosures will reduce uncertainty. Finally, the ultimate goal of induced isomorphism is to create normative pressures by establishing dominant standards and designs. Once enough firms have converged on the focal firm's trajectory, normative isomorphism may lead the focal firm to emerge as the central organization in a larger knowledge network or ecosystem, and it may stimulate bandwagon effects that strongly and primarily benefit the focal firm.

From the vantage point of resource dependence theory, our argument implies that an action born out of a dependence on access to resources held by others may in fact be recast to become a source of control. This logic is particularly appealing when looking at the potential of selective revealing to act as a less expensive mechanism for generating an alternate source of supply and for instigating collective action in the face of power imbalance and low mutual dependence. In this situation the high-power actor is likely to be able to withhold the desired resource (Casciaro & Piskorski, 2005) if the low-power actor cannot establish a relationship with a third party constraining the high-power actor (Gargiulo, 1993). We would argue that selective revealing invokes different power dynamics: because of its wider reach and lower coordination cost, the low-power actor should find it *easier* to create alternative sources of supply or supportive coalitions than with other collaboration mechanisms. Also, a swift and comprehensive competitive response by the high-power actor to a newly open competitor, especially if openness is exhibited in the core product market of the high-power actor, is difficult to imagine—for example, because of varying levels of organizational fit with selective revealing strategies. We are unaware of studies on this subject and would thus strongly encourage empirical work to uncover the competitive dynamics underlying these processes.

Selective Revealing and Innovation

Third, we contribute to a rich body of innovation literature by providing a theoretical argument extending selective revealing beyond its known use as a deterrence mechanism (Clarkson & Toh, 2010; Polidoro & Toh, 2011) to its use as a facilitator of collaboration—one that is particularly helpful in, but not limited to, adverse conditions. In addition, our discussion of the indirect benefits of selective revealing has made clear that it can instigate a process in which incoming spillovers become more valuable without the firm's changing anything about its knowledge production process.

In doing so, our arguments extend a recent contribution (Yang et al., 2010) to the literature

on absorptive capacity (Cohen & Levinthal, 1990; Todorova & Durisin, 2007; Zahra & George, 2002) indicating that outgoing spillovers might become beneficial to a firm over time. We contribute to this discussion by conceptualizing selective revealing as a conscious strategy aimed at shaping the knowledge others produce. Outputs of the focal firm's knowledge production process are purposefully disclosed so that they may be picked up by actors in the firm's environment. In turn, externals using these outputs will purposefully or unknowingly transform their knowledge production, making its outputs more valuable to the focal firm. Importantly, since the anticipated benefits of selective revealing lie in the future and depend on the activities of others, the value of such strategies can only be appreciated by including such intertemporal dynamics, which are currently not present in the absorptive capacity literature.

Finally, innovation scholars may benefit from our classification of selective revealing strategies based on what resources companies reveal and what innovation goals they seek to fulfill. For example, it may be used to inform ongoing debates on open innovation and the increasing importance of innovation conducted by noncorporate actors (Baldwin & von Hippel, 2011; Chesbrough, 2003; Dahlander & Gann, 2010). We are hopeful that scholars active in these debates will enrich our conceptual framework with empirical data so as to also clarify the boundary conditions of our argument. For example, much still needs to be learned about the relative effectiveness of problem and solution revealing, as well as the factors that lead externals to reciprocate in the firm's interest.

Future Directions

Selective revealing is gaining recognition as a strategic tool in hypercompetitive industries that may confound established management theories predicting firm behavior and innovation outcomes. By perceiving selective revealing as a mechanism to reshape the collaborative behavior of others, we open new avenues to enrich strategy and organization theory and its attendant implications for innovation and performance. Substantial empirical effort is needed to operationalize the drivers, contingencies, and outcomes of selective revealing discussed in this article in order to guide emergent practice, as well as to provide valuable extensions.

Additionally, our model raises questions about the right degree of influence firms may want to exert, since too similar an environment may not present a firm with sufficiently original knowledge spillovers. Thus, research could try to interrelate (changes in) the position of the revealing firm in the network, the network structure, and the emergent homogeneity of knowledge with firm performance as revealing dynamics unfold. We could also imagine a scenario where selective revealing leads to value-destructive dynamics following the logic of patent races. In a similar vein, one might imagine firms using selective revealing as a bluff. Specifically, a firm may disclose knowledge it considers a dead end, hoping that externals commit substantial resources to find that out for themselves and giving the focal firm the opportunity to achieve lead time in an area it considers crucial. Further systematic evidence is likely to enrich our knowledge of the false signals and competitive gaming even within selective revealing strategies.

When knowledge is to be revealed, an essential issue lies in how to structure and present the selectively revealed knowledge so as to maximize direct and indirect benefits (Baer et al., in press; von Krogh et al., 2012). This would open an avenue to connect our reasoning to the problem-based view of the firm (Nickerson & Zenger, 2004). Also, there is a question of how selective revealing relates to the concept of disruptive innovation and the issue of overcoming inertial forces favoring the extension of known technological trajectories (e.g., Christensen, 1997). Selective revealing may present an opportunity to incumbents to disrupt themselves; however, at the same time it may enable competitors to initiate and coordinate the development and diffusion of disruptive innovations.[3] Finally, we focused on knowledge as a selectively revealed resource. However, we see promise in extending selective revealing to other nonrivalrous resources and in identifying conditions under which it could also apply when the revealed resource is rivalrous.

[3] We are indebted to an anonymous reviewer for bringing this possible extension of our work to our attention, as well as suggesting the intriguing idea of selective revealing as a bluff.

Managerial Implications

From the perspective of managers charged with creating and implementing corporate and innovation strategy, our argument is a clear call to make selective revealing a standard tool in the competitive toolbox. Specifically, we point out *why*, *when*, and *how* managers can reasonably expect to benefit from selective revealing to solve problems, shape technologies, improve market positioning, or even create new niches. In addition, we provide insight to firms in whose environment selective revealing takes place, and we encourage firms to study potential idiosyncratic advantages from reciprocating, even if they know that such action might also be beneficial to somebody else. Finally, our argument can act as a note of caution to managers in currently dominant strategic positions for whom the threat of being attacked through selective revealing may loom large. In turn, even these firms may find that under certain conditions they may stand to benefit from selectively opening their resources to others to preempt being outmaneuvered by a coalition assembled via a selective revealing strategy.

REFERENCES

Abernathy, W. J., & Utterback, J. M. 1978. Patterns of industrial innovation. ***Technology Review,*** 80: 41–47.

Adner, R. 2006. Match your innovation strategy to your innovation ecosystem. ***Harvard Business Review,*** 84(4): 98–107.

Adner, R. 2012. ***The wide lens.*** New York: Portfolio/Penguin.

Afuah, A., & Tucci, C. L. 2012. Crowdsourcing as a solution to distant search. ***Academy of Management Review,*** 37: 355–375.

Agarwal, R., Audretsch, D., & Sarkar, M. B. 2007. The process of creative construction: Knowledge spillovers, entrepreneurship, and economic growth. ***Strategic Entrepreneurship Journal,*** 1: 263–286.

Agarwal, R., Audretsch, D., & Sarkar, M. B. 2010. Knowledge spillovers and strategic entrepreneurship. ***Strategic Entrepreneurship Journal,*** 4: 271–283.

Ahuja, G. 2000. The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. ***Strategic Management Journal,*** 21: 317–343.

Ahuja, G., Polidoro, F., & Mitchell, W. 2009. Structural homophily or social asymmetry? The formation of alliances by poorly embedded firms. ***Strategic Management Journal,*** 30: 941–958.

Alexy, O., Criscuolo, P., & Ammon, S. 2012. Managing unsolicited ideas for R&D. ***California Management Review,*** 54(3): 116–139.

Alexy, O., Criscuolo, P., & Salter, A. 2009. Does IP strategy have to cripple open innovation? ***Sloan Management Review,*** 51(1): 71–77.

Alexy, O., & Reitzig, M. In press. Private-collective innovation, competition, and firms' counterintuitive appropriation strategies. ***Research Policy.***

Allen, R. C. 1983. Collective invention. ***Journal of Economic Behavior & Organization,*** 4: 1–24.

Arora, A., Fosfuri, A., & Gambardella, A. 2001. ***Markets for technology: The economics of innovation and corporate strategy.*** Cambridge, MA: MIT Press.

Arrow, K. J. 1962. Economic welfare and the allocation of resources for inventions. In R. R. Nelson (Ed.), ***The rate and direction of inventive activity:*** 609–625. Princeton, NJ: Princeton University Press.

Baer, M., Dirks, K. T., & Nickerson, J. A. In press. Microfoundations of strategic problem formulation. ***Strategic Management Journal.***

Baldwin, C. Y., & Clark, K. B. 2000. ***Design rules: The power of modularity.*** Cambridge, MA: MIT Press.

Baldwin, C. Y., & von Hippel, E. 2011. Modeling a paradigm shift: From producer innovation to user and open collaborative innovation. ***Organization Science,*** 22: 1399–1417.

Barney, J. 1991. Firm resources and sustained competitive advantage. ***Journal of Management,*** 17: 99–120.

Bonaccorsi, A., & Rossi, C. 2006. Comparing motivations of individual programmers and firms to take part in the open source movement: From community to business. ***Knowledge, Technology, and Policy,*** 18(4): 40–64.

Branstetter, L. G., & Sakakibara, M. 2002. When do research consortia work well and why? Evidence from Japanese panel data. ***American Economic Review,*** 92: 143–159.

Bresser, R. K., & Harl, J. E. 1986. Collective strategy: Vice or virtue? ***Academy of Management Review,*** 11: 408–427.

Casciaro, T., & Piskorski, M. J. 2005. Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. ***Administrative Science Quarterly,*** 50: 167–199.

Cassiman, B., & Veugelers, R. 2002. R&D cooperation and spillovers: Some empirical evidence from Belgium. ***American Economic Review,*** 92: 1169–1184.

CED. 2006. ***Open standards, open source, and open innovation: Harnessing the benefits of openness, Committee for Economic Development.*** http://www.ced.org/docs/report/report_ecom_openstandards.pdf, accessed May 12, 2007.

Chesbrough, H. W. 2003. ***Open innovation: The new imperative for creating and profiting from technology.*** Boston: Harvard Business School Press.

Chesbrough, H. W. 2006. ***Open business models: How to thrive in the new innovation landscape.*** Cambridge, MA: Harvard Business School Press.

Chesbrough, H. W., & Appleyard, M. M. 2007. Open innovation and strategy. ***California Management Review,*** 50(1): 57–74.

Chesbrough, H. W., & Teece, D. J. 1996. Organizing for innovation: When is virtual virtuous? ***Harvard Business Review,*** 74(1): 65–73.

Christensen, C. M. 1997. ***The innovator's dilemma.*** Boston: Harvard Business School Press.

Clarkson, G., & Toh, P. K. 2010. "Keep out" signs: The role of deterrence in the competition for resources. ***Strategic Management Journal,*** 31: 1202–1225.

Cohen, W. M., & Levinthal, D. A. 1990. Absorptive capacity: A new perspective on learning and innovation. ***Administrative Science Quarterly,*** 35: 128–152.

Cook, K. S. 1977. Exchange and power in networks of interorganizational relations. ***Sociological Quarterly,*** 18: 62–82.

Dahlander, L., & Gann, D. M. 2010. How open is innovation? ***Research Policy,*** 39: 699–709.

DiMaggio, P. J., & Powell, W. W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. ***American Sociological Review,*** 48: 147–160.

Dodgson, M., Gann, D. M., & Salter, A. 2007. "In case of fire, please use the elevator": Simulation technology and organization in fire engineering. ***Organization Science,*** 18: 849–864.

Dollinger, M. J. 1990. The evolution of collective strategies in fragmented industries. ***Academy of Management Review,*** 15: 266–285.

Dosi, G. 1982. Technological paradigms and technological trajectories. ***Research Policy,*** 11: 147–182.

Dyer, J. H., & Singh, H. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. ***Academy of Management Review,*** 23: 660–679.

Emerson, R. M. 1962. Power-dependence relations. ***American Sociological Review,*** 27: 31–41.

Farrell, J., & Gallini, N. T. 1988. Second-sourcing as a commitment: Monopoly incentives to attract competition. ***Quarterly Journal of Economics,*** 103: 673–694.

Fleming, L. 2001. Recombinant uncertainty in technological search. ***Management Science,*** 47: 117–132.

Fosfuri, A., & Rønde, T. 2004. High-tech clusters, technology spillovers, and trade secret laws. ***International Journal of Industrial Organization,*** 22: 45–65.

Foss, N. J., Laursen, K., & Pedersen, T. 2011. Linking customer interaction and innovation: The mediating role of new organizational practices. ***Organization Science,*** 22: 980–999.

Füller, J. 2010. Refining virtual co-creation from a consumer perspective. ***California Management Review,*** 52(2): 98–122.

Galaskiewicz, J. 1985. Interorganizational relations. ***Annual Review of Sociology,*** 11: 281–304.

Galaskiewicz, J., Bielefeld, W., & Myron, D. 2006. Networks and organizational growth: A study of community based nonprofits. ***Administrative Science Quarterly,*** 51: 337–380.

Gargiulo, M. 1993. Two-step leverage: Managing constraint in organizational politics. ***Administrative Science Quarterly,*** 38: 1–19.

Garud, R., Jain, S., & Kumaraswamy, A. 2002. Institutional entrepreneurship in the sponsorship of common technological standards: The case of Sun Microsystems and Java. ***Academy of Management Journal,*** 45: 196–214.

Garud, R., & Karnøe, P. 2001. ***Path dependence and creation.*** Mahwah, NJ: Lawrence Erlbaum Associates.

Garud, R., & Rappa, M. A. 1994. A socio-cognitive model of technology evolution: The case of cochlear implants. ***Organization Science,*** 5: 344–362.

George, G., Kotha, R., & Zheng, Y. 2008. Entry into insular domains: A longitudinal study of knowledge structuration and innovation in biotechnology firms. ***Journal of Management Studies,*** 45: 1448–1474.

Grant, R. M. 1996. Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. ***Organization Science,*** 7: 375–387.

Gulati, R. 1998. Alliances and networks. ***Strategic Management Journal,*** 19: 293–317.

Gulati, R., & Gargiulo, M. 1999. Where do interorganizational networks come from? ***American Journal of Sociology,*** 104: 1439–1493.

Gulati, R., Nohria, N., & Zaheer, A. 2000. Strategic networks. ***Strategic Management Journal,*** 21: 203–215.

Gulati, R., & Singh, H. 1998. The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. ***Administrative Science Quarterly,*** 43: 781–814.

Gulati, R., & Sytch, M. 2007. Dependence asymmetry and joint dependence in interorganizational relationships: Effects of embeddedness on a manufacturer's performance in procurement relationships. ***Administrative Science Quarterly,*** 52: 32–69.

Hallen, B. L. 2008. The causes and consequences of the initial network positions of new organizations: From whom do entrepreneurs receive investments? ***Administrative Science Quarterly,*** 53: 685–718.

Hardy, C., Lawrence, T. B., & Grant, D. 2005. Discourse and collaboration: The role of conversations and collective identity. ***Academy of Management Review,*** 30: 58–77.

Harhoff, D. 1996. Strategic spillovers and incentives for research and development. ***Management Science,*** 42: 907–925.

Harhoff, D., Henkel, J., & von Hippel, E. 2003. Profiting from voluntary information spillovers: How users benefit by freely revealing their innovations. ***Research Policy,*** 32: 1753–1769.

Henkel, J. 2004. Open source software from commercial firms—Tools, complements, and collective invention. ***Zeitschrift für Betriebswirtschaft-Ergänzungsheft [Journal of Business Administration-Supplementary Issue],*** 74(4): 1–23.

Henkel, J. 2006a. ***The jukebox mode of innovation: A model of commercial open source development.*** Paper presented at the DRUID Summer Conference, Copenhagen.

Henkel, J. 2006b. Selective revealing in open innovation processes: The case of embedded Linux. ***Research Policy,*** 35: 953–969.

Henkel, J., & Baldwin, C. Y. 2011. ***Modularity for value appropriation: Drawing the boundaries of intellectual property.*** Finance Working Paper no. 11-054, Harvard Business School, Boston.

Hillman, A. J., & Hitt, M. A. 1999. Corporate political strategy formulation: A model of approach, participation, and strategy decisions. ***Academy of Management Review,*** 24: 825–842.

Hillman, A. J., Withers, M. C., & Collins, B. J. 2009. Resource dependence theory: A review. ***Journal of Management,*** 35: 1404–1427.

Jacobides, M. G. 2006. The architecture and design of organizational capabilities. ***Industrial and Corporate Change,*** 15: 151–171.

Jacobs, D. 1974. Dependency and vulnerability: An exchange approach to the control of organizations. ***Administrative Science Quarterly,*** 19: 45–59.

Jeppesen, L. B., & Lakhani, K. R. 2010. Marginality and problem-solving effectiveness in broadcast search. ***Organization Science,*** 21: 1016–1033.

Jeppesen, L. B., & Molin, M. J. 2003. Consumers as co-developers: Learning and innovation outside the firm. ***Technology Analysis & Strategic Management,*** 15: 363–383.

Kale, P., & Singh, H. 2009. Managing strategic alliances: What do we know now, and where do we go from here? ***Academy of Management Perspectives,*** 23(3): 45–62.

Kilduff, M., & Brass, D. J. 2010. Organizational social network research: Core ideas and key debates. ***Academy of Management Annals,*** 4: 317–357.

Kogut, B., & Zander, U. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. ***Organization Science,*** 3: 383–397.

Kogut, B., & Zander, U. 1996. What firms do? Coordination, identity, and learning. ***Organization Science,*** 7: 502–518.

Kotha, R., George, G., & Srikanth, K. In press. Bridging the mutual knowledge gap: Coordination and the commercialization of university science. ***Academy of Management Journal.***

Lakhani, K. R., Jeppesen, L. B., Lohse, P. A., & Panetta, J. A. 2007. ***The value of openness in scientific problem solving.*** http://www.hbs.edu/research/pdf/07-050.pdf, accessed March 20, 2007.

Lakhani, K., & von Hippel, E. 2003. How open source software works: "Free" user-to-user assistance. ***Research Policy,*** 32: 923–943.

Lakhani, K., & Wolf, B. 2005. Why hackers do what they do: Understanding motivation and effort in free/open source software projects. In J. Feller, B. Fitzgerald, S. Hissam, & K. Lakhani (Eds.), ***Perspectives on free and open source software:*** 3–21. Boston: MIT Press.

Lane, P. J., & Lubatkin, M. 1998. Relative absorptive capacity and interorganizational learning. ***Strategic Management Journal,*** 19: 461–477.

Laursen, K., & Salter, A. 2006. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. ***Strategic Management Journal,*** 27: 131–150.

Lukes, S. 2005. ***Power: A radical view*** (2nd ed.). Basingstoke, UK: Palgrave MacMillan.

MacCormack, A. D., & Herman, K. 2004. ***Intel research: Exploring the future.*** Case No. 9-605-051. Boston: Harvard Business School Case Services.

Menon, T., & Pfeffer, J. 2003. Valuing internal vs. external knowledge: Explaining the preference for outsiders. ***Management Science,*** 49: 497–513.

Nelson, R. R., & Winter, S. G. 1982. ***An evolutionary theory of economic change.*** Cambridge, MA: Harvard University Press.

Nickerson, J. A., & Zenger, T. R. 2004. A knowledge-based theory of the firm: The problem-solving perspective. ***Organization Science,*** 15: 617–632.

Oliver, C. 1988. The collective strategy framework: An application to competing predictions of isomorphism. ***Administrative Science Quarterly,*** 33: 543–561.

Oliver, C. 1990. Determinants of interorganizational relationships: Integration and future directions. ***Academy of Management Review,*** 15: 241–265.

Pacheco-de-Almeida, G., & Zemsky, P. B. 2012. Some like it free: Innovators' strategic use of disclosure to slow down competition. ***Strategic Management Journal,*** 33: 773–793.

Parmigiani, A., & Rivera-Santos, M. 2011. Clearing a path through the forest: A meta-review of interorganizational relationships. ***Journal of Management,*** 37: 1108–1136.

Pfeffer, J., & Salancik, G. R. 1978. ***The external control of organizations: A resource dependence perspective*** (2003 classic ed.). Stanford, CA: Stanford University Press.

Phelps, C., Heidl, R., & Wadhwa, A. In press. Knowledge, networks, and knowledge networks: A review and research agenda. ***Journal of Management.***

Phillips, N., Lawrence, T. B., & Hardy, C. 2000. Interorganizational collaboration and the dynamics of institutional fields. ***Journal of Management Studies,*** 37: 23–43.

Pisano, G. P., & Teece, D. J. 2007. How to capture value from innovation: Shaping intellectual property and industry architecture. ***California Management Review,*** 50(1): 278–296.

Podolny, J. M., & Page, K. L. 1998. Network forms of organization. ***Annual Review of Sociology,*** 24: 57–76.

Polidoro, F., & Theeke, M. 2012. Getting competition down to a science: The effects of technological competition on firms' scientific publications. ***Organization Science,*** 23: 1135–1153.

Polidoro, F., & Toh, P. K. 2011. Letting rivals come close or warding them off? The effects of substitution threat on imitation deterrence. ***Academy of Management Journal,*** 54: 369–392.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. 1996. Interorganizational collaboration and the locus of innovation:

Networks of learning in biotechnology. ***Administrative Science Quarterly,*** 41: 116–145.

Puranam, P., Singh, H., & Chaudhuri, S. 2009. Integrating acquired capabilities: When structural integration is (un)necessary. ***Organization Science,*** 20: 313–328.

Rivkin, J. W. 2000. Imitation of complex strategies. ***Management Science,*** 46: 824–844.

Schilling, M. A., & Phelps, C. C. 2007. Interfirm collaboration networks: The impact of large-scale network structure on firm innovation. ***Management Science,*** 53: 1113–1126.

Scotchmer, S. 1996. Protecting early innovators: Should second-generation products be patentable? ***RAND Journal of Economics,*** 27: 322–331.

Spence, M. 1973. Job market signaling. ***Quarterly Journal of Economics,*** 87: 355–374.

Spencer, J. W. 2003. Firms' knowledge-sharing strategies in the global innovation system: Empirical evidence from the flat panel display industry. ***Strategic Management Journal,*** 24: 217–233.

Stam, W. 2009. When does community participation enhance the performance of open source software companies? ***Research Policy,*** 38: 1288–1299.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. ***Research Policy,*** 15: 285–305.

Todorova, G., & Durisin, B. 2007. Absorptive capacity: Valuing a reconceptualization. ***Academy of Management Review,*** 32: 774–786.

Van de Ven, A. H., & Walker, G. 1984. The dynamics of interorganizational coordination. ***Administrative Science Quarterly,*** 29: 598–621.

van den Bosch, F. A. J., Volberda, H. W., & de Boer, M. 1999. Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. ***Organization Science,*** 10: 551–568.

Varian, H. R., & Shapiro, C. 1999. ***Information rules: A strategic guide to the network economy.*** Boston: Harvard Business School Press.

von Hippel, E. 1988. ***The sources of innovation.*** New York: Oxford University Press.

von Hippel, E., & von Krogh, G. 2003. Open source software and the "private-collective" innovation model: Issues for organization science. ***Organization Science,*** 14: 209–233.

von Krogh, G., Wallin, M. W., & Sieg, J. H. 2012. ***A problem in becoming: How firms formulate sharable problems for innovation contests.*** Paper presented at the Research Policy Special Issue Conference "Open Innovation: New Insights and Evidence," London.

West, J. 2003. How open is open enough? Melding proprietary and open source platform strategies. ***Research Policy,*** 32: 1259–1285.

Winter, S. G. 1987. Knowledge and competence as strategic assets. In D. J. Teece (Ed.), ***The competitive challenge: Strategies for industrial innovation and renewal:*** 159–184. Cambridge, MA: Ballinger.

Yang, H., Phelps, C., & Steensma, H. K. 2010. Learning from what others have learned from you: The effects of knowledge spillovers on originating firms. ***Academy of Management Journal,*** 53: 371–389.

Zahra, S. A., & George, G. 2002. Absorptive capacity: A review, reconceptualization, and extension. ***Academy of Management Review,*** 27: 185–203.

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