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# The dark side of knowledge transfer: Exploring knowledge leakage in joint R&D projects

Johan Frishammar [a,*], Kristian Ericsson [b], Pankaj C. Patel [c]

[a] Luleå University of Technology, Entrepreneurship and Innovation, SE-971 87 Luleå, Sweden
[b] TRUMPF Machine Tools International, Johann-Maus-Straße 2, 71254 Ditzingen, Germany
[c] Ball State University, Miller College of Business, 2000W University Avenue, Muncie, IN 47306, United States

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ABSTRACT

Knowledge leakage refers to loss of technological knowledge intended to stay within a firm's boundaries and may cause a "weakened state" in which a focal firm loses its competitive advantage and industry position. Based on multiple case studies of knowledge leakage in joint research and development (R&D) projects in large firms in Sweden, this paper makes two contributions. First, in contrast to the uni-dimensional dyadic leakage process assumed in the literature, we find that the knowledge leakage process is multi-dimensional and exists in three varieties: i) a process whereby an external party assimilates knowledge from a focal firm, ii) a process whereby an external party assimilates knowledge from another external party, and iii) a process whereby the focal firm uses knowledge already shared with an external party in such a way that it becomes sensitive. Second, where the prior literature suggests that core knowledge must be protected from leakage, we find that some core knowledge can leak without negative effects, whereas some knowledge, being non-core to a focal firm, can have severe negative effects. These insights provide novel theoretical implications and new insights into how firms can manage knowledge leakage in practice.

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## 1. Introduction

Knowledge transfer, defined as the transmission of knowledge across organizational boundaries (Easterby-Smith et al., 2008), is positively related to firm performance. Knowledge transfer improves innovative capabilities (Huizingh, 2011), increases the pace of innovation and strengthens competitive advantage (Foss et al., 2010). With increasing technological uncertainty and complexity, knowledge transfer has become critically important, as firms are relying on open innovation processes to ensure long-term competitiveness (Chesbrough, 2003).

Unfortunately, knowledge transfer also has a potential dark side that of knowledge leakage—situations in which a focal firm loses important knowledge to other actors that, in turn, lowers firm performance (Easterby-Smith et al., 2008). The fact that makes knowledge leakage a significant problem in inter-organizational collaboration, such as joint R&D projects, is that efforts to receive knowledge also lead to knowledge leakage. Similarly, firms often need to share some of their own knowledge to gain access to external knowledge to perform innovation activities (Ritala et al., in press; Zhang and Baden-Fuller, 2010). As an exchange process, collaboration requires knowledge conversion cycles when firms must share knowledge to jointly identify, acquire, and assimilate knowledge with collaborating firms.

Protecting existing knowledge during collaboration is a challenging task, because "devices that are used to prevent knowledge leakage often also hinder knowledge transfer" (Easterby-Smith et al., 2008, p. 685). Prior literature highlights this paradox: firms can risk being *underprotective* by sharing too much knowledge, thereby weakening their competitive position, or being *overprotective* by sharing too little knowledge, thereby weakening the positive effects of transferring knowledge (Norman, 2002).

This paper addresses two gaps in the literature on knowledge leakage: first, we attempt to provide a conceptualization of the knowledge leakage process. Multiple authors have used the term "leakage" in knowledge management or open innovation research (Becerra et al., 2008; Chesbrough, 2007a; Easterby-Smith et al., 2008; Gambardella and McGahan, 2010; Meyer, 2008; Ritala et al., 2014). Others have used alternate terms, such as knowledge loss (Norman, 2002); involuntary knowledge appropriation (Sawers et al., 2008); unregulated, unmonitored, and unbridled information exchange (Yoshino and Rangan, 1995); loss of control of technological assets (Oxley and Sampson, 2004); and unilateral or disproportionate loss of one's own core capability or skill (Kale et al., 2000).

By drawing on these prior conceptualizations, we investigate the knowledge leakage process by assessing both direct and second-order

* Corresponding author. Tel.: +46 920 491407, +46 73 805 76 41 (mobile).
*E-mail address:* Johan.Frishammar@ltu.se (J. Frishammar).

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transfer of knowledge among collaborators and competitors. Moving from a uni-dimensional conceptualization of knowledge leakage to a multi-dimensional view, we highlight knowledge leakage that is indirectly received by third parties through collaborating firms and suggest that firms may reach a "weakened state" (i.e. loss of competitive advantage and industry position when technological knowledge leaks) along three different paths—knowledge leaks to collaborator A, collaborator A transmits leaked knowledge to third party B, and the knowledge diffusion process continues to others in the network of collaborating firms. This conceptualization introduces greater non-appropriability of knowledge through diffusion across collaboration networks. Thus, we posit that, when managing knowledge, firms must also consider degrees of separation in the network of the collaborating firm.

Second, the threat of knowledge leakage to one's competitive advantage increases when knowledge that is closer to the core is being absorbed by the collaborators (Amit and Schoemaker, 1993; Leonard-Barton, 1995). Hence, "core proprietary information or know-how" (Kale et al., 2000) or "highly tacit and core" (Norman, 2002) are terms often used to emphasize the specific subset of knowledge that must be protected from leakage. However, extending the conceptualization of protecting core knowledge from leaking, we propose that some knowledge that is not at the core of the focal firm but at the core of a collaborating partner could also weaken a focal firm's competitive position (Anokhin et al., 2011). Consequently, a strong focus on preventing leakage of core knowledge may overlook the value of non-core knowledge to collaborators. We target this gap by investigating the nature of the knowledge involved in the leakage processes and the consequences resulting from leakage of various types of knowledge.

By proposing a multi-dimensional view of knowledge leakage and calling firms to be cognizant of non-core knowledge valuable to collaborators, we answer to a call for more research into the potentially harmful effects of knowledge sharing and knowledge leakage in recent research on knowledge management (Foss et al., 2010), management of external collaborations (Ritala et al., 2014), and open innovation (Chesbrough, 2012; Huizingh, 2011).

In practice, the proactive management of knowledge leakage may help to explain inter-firm discrepancies in knowledge and technology transfer under increasingly open innovation processes. By conceptualizing the knowledge leakage process, we provide managerial guidelines on direct and second-order knowledge leakage to the collaborators, also considering the relevance of the firm's non-core knowledge to collaborators. By providing a broader framework of knowledge leakage, we provide additional managerial guidance within the collaboration efforts.

This paper is structured as follows: first, it provides an outline of the theoretical background followed by case studies and methods, then the empirical results and analyses of these. The paper concludes with theoretical and managerial implications, limitations of the study, and suggestions for future research.

## 2. Theoretical background and literature overview

The knowledge leakage phenomenon has its roots in the knowledge-based view of the firm (KBV). According to KBV, knowledge is the basis for a firm's competitive advantage (Easterby-Smith et al., 2008; Grant, 1996a; Kogut and Zander, 1992; Spender, 1996). Consequently, the loss of critical knowledge is associated with decreased performance (Day, 1995; Norman, 2002).

Protecting knowledge is essential to competitive advantage and has underpinnings in a firm's appropriability regime or a set of mechanisms that protect its critical knowledge from imitation by others. If the appropriability regime is weak and (or) if key competitors are highly proficient in absorbing knowledge, then the focal firm runs a significant risk of losing critical knowledge through leakage (Hurmelinna-Laukkanen and Olander, 2014). The efficacy of the appropriability regime depends in part on the strength of institutional protection mechanisms such as formal protection for IP through patents and copyrights (Hurmelinna et al., 2007; Teece, 1986). However, the appropriability regime is not purely exogenous but may also be a product of a firm's strategy (Pisano, 2006). Thus, mechanisms such as HRM policies and speed in development may complement formal protection (Hurmelinna-Laukkanen and Olander, 2014). Consequently, through formal and informal mechanisms, firms can influence the exposure to and risk of knowledge leakage.

In addition, the efficiency of the appropriability regime depends on a firm's knowledge structure; i.e. tacit vs. codified knowledge. Codified knowledge is knowledge converted into symbols, meanings, and processes to make its transmission and storage easier. By contrast, tacit knowledge cannot be articulated and must be acquired through trial-and-error (Langlois, 2001). Knowledge leakage most likely occurs in codified knowledge, which resembles an Arrowian public good in the sense that codified knowledge can be reproduced and copied by others (Arrow, 1962; Hurmelinna et al., 2007). However, tacit knowledge may also leak, such as when key personnel leave a focal firm for a competitor. In sum, the appropriability regime greatly influences a focal firm's exploitation of knowledge.

Against this background, knowledge leakage issues have been studied at the regional and country levels (Klette et al., 2000), and the literature on agglomeration economies and knowledge spillovers focuses on knowledge diffusion among participating firms (Cassiman and Veugelers, 2002; Fernandes and Ferreira, 2013; Hoetker and Agarwal, 2007). Previous leakage studies have also adopted a transaction cost economics perspective (Oxley, 1997; Sampson, 2004), corporate networks (Dyer and Nobeoka, 2000) and R&D alliances (Kale et al., 2000; Norman, 2002). Information sharing to facilitate learning in alliances may lead to leakage of commercially valuable knowledge. Consequently, a key challenge is to balance the need for an open knowledge exchange regime with the need to control knowledge flows and exchanges to avoid leakage of knowledge (Oxley and Sampson, 2004).

With more direct attention to firm-level issues, knowledge leakage has also been studied in the literature on open innovation and technology acquisition. Knowledge leakage has been discussed in both inbound open innovation (which refers to the internal use of external knowledge) and in outbound open innovation (which centers on external exploitation of internal knowledge) (Huizingh, 2011). With regard to inbound open innovation, Chesbrough (2003) and Christensen et al. (2005) discuss the R&D staff of other firms as potential recipients of knowledge leakage. Prugl and Schreier (2006) find that information asymmetry may mitigate or offset these risks, whereas West and Gallagher (2006) suggest that lack of control and governance may exacerbate them. In either case, through collaboration, firms may expose their own knowledge when acquiring external knowledge, a severe problem especially when the firm has a deep knowledge base that is decentralized, thus posing a significant risk of leakage (Zhang and Baden-Fuller, 2010). Still, knowledge and capabilities to innovate far from always exist within a firm to the necessary extent (Tsai et al., 2011), which presupposes acquisition of technology from outside firm boundaries (Tsai and Wang, 2008). As a result, while firms have increasingly sourced technology in recent years through collaborative efforts (Calantone and Stanko, 2007), firms also face potential appropriability problems and knowledge leakage (Kotlar et al., 2013).

In outbound open innovation, knowledge leakage could strengthen a focal firm's competitors (Fosfuri, 2006; Rivette and Kline, 2000). Of particular importance here is the so-called profit-dissipation effect that lowers profits in a firm's product business when knowledge and intellectual property (IP) are diffused through inter-firm collaboration (Fosfuri, 2006). In addition, knowledge-appropriation hazard occurs

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