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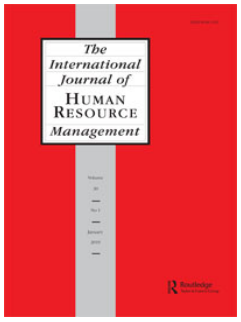

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Collaborative-based HRM practices and open innovation: a conceptual review

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ABSTRACT

This conceptual paper analyses the role of collaborative-based HRM practices in supporting open innovation. There is already an extensive literature that investigates the impact of HRM practices on organizations' innovation performance. As organizational boundaries become increasingly permeable and knowledge flows more freely, open innovation continues to receive close attention in management studies. However, relationships between HRM practices and open innovation have still not been examined. From a knowledge management perspective, we identify three kinds of barrier that may deter or impede open innovation. These relate to cognitive biases, concerns about transaction costs, and shortfalls in terms of organization capability. We also discuss the role of four types of collaboration-oriented HRM practices (i.e., teamwork-based recruitment, training in teamwork skills, team-based appraisals and rewards, and rotational job design) in reducing barriers to open innovation. Based on our analyses, we envisage future research directions about the role of collaborative-based HRM practices in supporting open innovation.

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Introduction

Triggered by higher mobility among knowledge workers, by increasingly permeable organizational boundaries, and by more widely distributed knowledge and competence, organizations have begun to adopt an open innovation paradigm (Chesbrough, 2003). Defined as 'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation, respectively' (Chesbrough, Vanhaverbeke, & West, 2006, p. 1), open innovation brings

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both unique benefits and unique challenges to organizations under a shifting knowledge landscape.

In terms of benefits, permeable boundaries provide advantages in terms of greater access for the focal organization to new knowledge from external sources while increasing the diversity of the internal knowledge pool (Chesbrough, 2003; Chesbrough & Crowther, 2006). However, such permeability also gives rise to two organizational challenges, both of which correspond to gaps in research literature, and which might deter or impede open innovation. First, the prospect of open innovation can carry with it the assumption that this would necessarily entail a high level of transparency that would be difficult to maintain without leaking proprietary knowledge, thereby losing bargaining power vis-a-vis external parties (Alexy, Henkel, & Wallin, 2013; Henkel, 2006; Laursen & Salter, 2014). Second, the issue of equity needs to be addressed when converting collaboratively generated knowledge into valuable assets (Alexy, Henkel, & Wallin, 2013; Henkel, 2006; Laursen & Salter, 2014), resulting in the question: on what basis should the collaborating parties distribute the benefits that arise from their innovative achievements?

Although prior studies have examined a wide range of barriers that can obstruct open innovation (Chesbrough, 2010; Gil-Marques & D Moreno-Luzon, 2013; Lichtenthaler, 2011; Lichtenthaler & Ernst, 2006; Lichtenthaler & Lichtenthaler, 2009; Remneland-Wikhamn & Knights, 2012), such analyses have typically been conducted without analyzing the associated knowledge management challenges. Therefore, understanding the barriers to open innovation in terms of knowledge management remains a gap in the literature.

Furthermore, because of the implicit assumption that innovation processes normally take place within the boundaries of one particular firm, the role of HRM practices in supporting *open* innovation, constituting an effective approach to promoting 'the best use of internal and external knowledge in a timely way' (Chesbrough, 2003, p. 52) has been largely overlooked. Extant research on the contributions of HRM to innovation tends to focus on practices that nurture 'employee involvement and maximizes the firm's return on human capital investment' (Lepak & Snell, 1999, p. 37) by improving their skills and expertise (Chow & Gong, 2010; Fu et al., 2015) and enhancing staff commitment (Ceylan, 2013; Wang & Chen, 2013; Zhang & Li, 2009). However, there is a need to clarify what kinds of HRM practices can promote and support knowledge sharing (Lepak & Snell, 1999; Lepak & Snell, 2002) and equitable knowledge harvesting among partnering organizations in the context of open innovation (Greer & Stevens, 2015; Hurmelinna-Laukkanen, 2011).

Based on a systematic review of literature, this review paper aims to address the two main gaps identified above in the nascent stream of

literature on open innovation by answering two questions: (1) What are the barriers to open innovation? (2) Which HRM practices are likely to help to overcome such barriers and promote open innovation?

The rest of this paper consists of five sections. First, we explain our review methodology. Second, in providing a conceptual background on open innovation, we shall identify four processes within open innovation and relate these to corresponding processes of knowledge management. Third, we shall identify three types of barrier to open innovation, along with their impact on the corresponding knowledge management processes. Fourth, we shall provide illustrations of the role of collaborative-based HRM practices (teamwork-related recruitment, training in teamwork skills, team-based appraisals and rewards, and rotational job design) in overcoming the barriers to open innovation and facilitating related knowledge management processes. Fifth, we summarize our contributions, point out the associated managerial implications and discuss future research directions.

Methodology

The objectives of our literature review were to synthesize the literature on the main barriers affecting open innovation and to identify specific HRM practices for overcoming such barriers. These objectives required a comprehensive understanding of the focal issues before proceeding to evaluate extant literatures. A systematic review methodology was therefore adopted to ensure that the review process would be conducted in a 'systematic, transparent and reproducible manner' (Tranfield, Denyer, & Smart, 2003, p. 207). In this section, we will explain how we conducted our systematic literature review (Tranfield et al., 2003).

Setting-up the literature review

The setting-up process entailed establishing the review protocol, to minimize our own biases and limitations (Pittaway, Robertson, Munir, Denyer, & Neely, 2004). The review protocol involved the delineation of the inclusion criteria and the exclusion criteria for article search (Tranfield et al., 2003). Modeling our approach on Dada (2018), three sets of criteria were adopted, comprising: establishing source boundaries, setting key search terms for inclusion and exclusion, and establishing the period of coverage.

First, we established our source boundaries by targeting only refereed academic journal articles published in English, thereby excluding book chapters and unpublished papers since journal articles can be deemed to

be a more valid and authoritative source of knowledge (Keupp, Palmié, & Gassmann, 2012). We focused on three categories of journal, namely 'Management', 'HRM', and 'Innovation', available from several key bibliographic databases, including *ProQuest*, *Science Direct,* and *Web of Science* (Nolan & Garavan, 2016; Savino, Petruzzelli, & Albino, 2017). Second, we adopted the following search terms for inclusion: open innovation, human resource management, barriers, challenges, facilitators, enablers and human resource practices. In addition, we set search terms to exclude those articles that addressed only a specific area of HRM practice, such as staffing (e.g., Collings, Scullion, & Dowling, 2009), and we also excluded articles focusing only on innovative HRM (e.g., Bélanger, Giles, & Grenier, 2003; Som, 2007) but not on the relationship between HRM and innovation beyond the domain of HRM itself. Third, we arranged for the search period to span the years 2003 to 2017, reflecting that the concept of open innovation (Chesbrough, 2003) first emerged in 2003.

Conducting the review

The first stage of our review involved using the protocol, described above, to conduct searches of the citation databases. Because we found very few studies that examined more than one of our key concepts together (e.g., open innovation *and* HRM practices), we extended the scope of our search by adding collaborative-based innovation and closed innovation to our search terms. After making this adjustment, the resulting searches retrieved a cumulative total of 260 articles. The second stage entailed identifying and eliminating duplicate articles, after which a total of 125 remained. During the third stage, we engaged in further screening, to retain only those articles with a combined focus on innovation and an integrative approach to HRM. Hence, we ended up with 79 articles as listed in Table 1.

Analyzing the content

We conducted a thematic analysis of these 79 full-text articles to identify areas of concern and issues that warrant further attention. After conducting an inductive analysis, it was evident that much of the literature on open innovation has addressed three broad themes: (1) the use in open innovation of both external and internal knowledge sources (Chesbrough, 2003; Chesbrough & Crowther, 2006; Chesbrough, Vanhaverbeke, & West, 2006); (2) barriers to open and collaborative innovation (Lichtenthaler, 2011; Lichtenthaler & Ernst, 2006; Lichtenthaler & Lichtenthaler, 2009);

Table 1. Items analyzed in the literature review.

	Journals	Papers reviewed
1	*International Journal of Human Resource Management*	31
2	*International Journal of Manpower*	13
3	*Human Resource Management Journal*	10
4	*Employee Relations*	5
5	*Personnel Review*	5
6	*Journal of Product Innovation Management*	3
7	*Research Policy*	3
8	*R & D Management*	2
9	*Technovation*	2
10	*Asia Pacific Journal of Human Resources*	1
11	*Industrial Marketing Management*	1
12	*International Journal of Project Management*	1
13	*R&D Management*	1
14	*Human Resource Management Review*	1
	Total	79

and (3) HRM practices as a mediating factor (Antonioli, Mancinelli, & Mazzanti, 2013; Bamber, Bartram, & Stanton, 2017; Kok & Ligthart, 2014; Zhang, Edgar, Geare, & O'Kane, 2016).

Drawing on the insights of extant research on HRM and innovation, we identified barriers to open innovation at three levels of analysis (Chiang & Shih, 2011; Lin & Sanders, 2017; Shipton, Sparrow, Budhwar & Brown, 2017; Shipton, Sparrow, Budhwar, & Brown, 2017). At the level of the individual, we identified barriers associated with cognitive processes (Bartram, 2005; Ma Prieto & Pilar Pérez-Santana, 2014; Shipton, West, Dawson, Birdi, & Patterson, 2006) and with psychological biases (Chowhan, 2016; Ma Prieto & Pilar Pérez-Santana, 2014). At the organizational level, we identified capability-related factors (Chow & Gong, 2010; De Winne & Sels, 2010) that could potentially inhibit firms from undertaking open innovation by impeding or deterring their engagement in requisite knowledge management processes (Chen & Huang, 2009). At the inter-organizational level, we identified challenges regarding governance structures, such as high transaction and coordination costs (Bornay-Barrachina, López-Cabrales, & Valle-Cabrera, 2016) that might also impede or prevent requisite knowledge management processes across organizations.

Regarding HRM practices as potential means for removing barriers to open innovation, we identified those that 'encourage and reward cooperation, collaboration and information sharing' (Lepak & Snell, 1999, p. 41). Such practices comprised: recruiting and selecting employees based on their ability to engage in collaborative work in teams; training for team building and relational development; basing appraisals and compensation on team performance (De Leede & Looise, 2005; Lopez-Cabrales, Pérez-Luño, & Cabrera, 2009; Lepak & Snell, 2002; Seeck & Diehl, 2016; Shipton et al., 2006; Zhou, Liu, & Hong, 2012); and rotational job design (Dorenbosch, Engen, & Verhagen, 2005; Jiang et al., 2012).

Reporting the review

In reporting the findings of our review, we shall first provide the conceptual background about open innovation and its distinctive challenges, followed by an analysis of the requisite knowledge processes underpinning the open innovation processes. Thereafter, we shall analyze the key emerging themes in relation to our two research questions, namely the barriers to open innovation and the enabling role of collaborative-based HRM practices.

Conceptual background on open innovation

We shall begin this section with a characterization of what open innovation is not. Closed innovation mainly depends on a single organization for the processes of discovering, developing, and commercializing innovative ideas. Chesbrough (2003) and Chesbrough & Crowther (2006) suggested that closed innovation is driven by four key assumptions. First, all involved talents are employed by a single organization; second, this organization aims to fulfill all innovation processes; third, the basic aim is to be first to win against other market competition; and fourth, there is a need for control over intellectual property (IP), so as to prevent other firms from profiting from the IP that belongs to the focal organization.

The assumptions behind closed innovation have been challenged by several factors in the socio-technical environment, such as higher mobility of workforces, lower transportation costs, intensification of technology development and diffusion processes, and increasing globalization. These impede efforts to implement closed innovation (Gassmann, 2006), and have brought about a change in the innovation paradigm (Chesbrough & Crowther, 2006; Lee, Park, Yoon, & Park, 2010). Chesbrough (2003) thus proposed the concept of open innovation, which is based on collaboration with external actors in driving innovation and conducting its constituent processes, as an imperative for the contemporary business environment. As organizational boundaries become increasingly permeable and knowledge flows more freely, organizations build partnerships to utilize unique external intellectual capital and support the innovation process (Wang & Chen, 2013). As shown in Figure 1, open innovation is considered as a new paradigm of innovation that involves seeking to 'use external ideas as well as internal ideas, and internal and external paths to market' (Chesbrough, 2003, p. xxiv). It has been practiced by various types of organization across various industries (Brunswicker & Vanhaverbeke, 2014; Chesbrough & Crowther, 2006; Van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009), and is

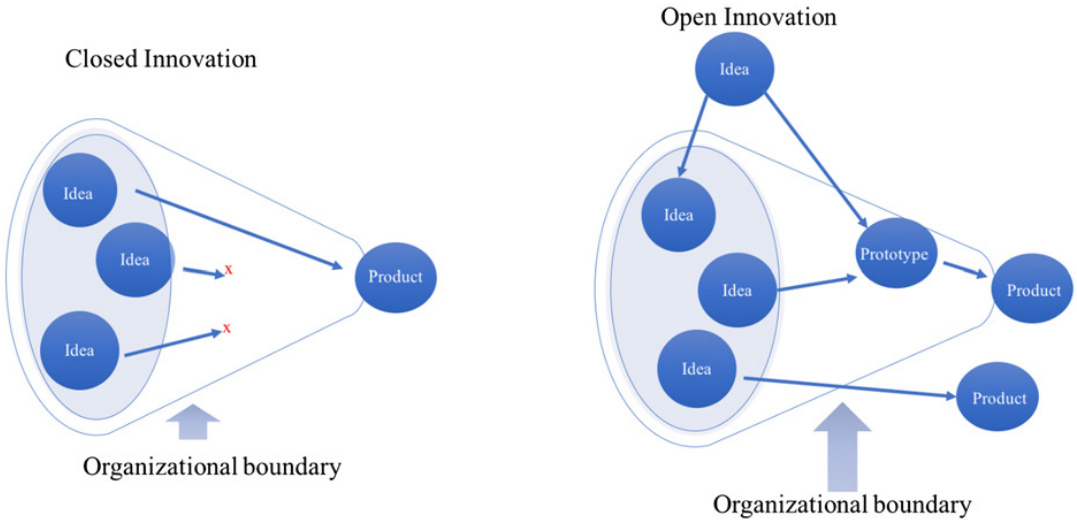

Figure 1: Closed innovation and open innovation.

regarded as a persistent phenomenon rather than a fad (Chesbrough & Brunswicker, 2014). Recent literature has accordingly taken open innovation to be 'a cognitive model for creating, interpreting and researching' (Chesbrough et al., 2006, p. 286).

All open innovation may be conceived as consisting of two overall phases. The first, 'outside-in' phase, refers to the processes of sourcing or acquiring external knowledge and integrating into existing knowledge. The second, 'inside-out' phase, involves increasing the utility of the internal knowledge and commercializing it through developing original paths to the market (Chesbrough & Crowther, 2006; Enkel, Gassmann, & Chesbrough, 2009). Scholars have accordingly distinguished outside-in from inside-out models of open innovation. The outside-in model involves seeking out competent external actors and collaborating with them to draw on and integrate external knowledge that expands the corporation's current knowledge pool (Chesbrough & Brunswicker, 2014). The inside-out model of open innovation focuses on seeking out, partnering with and transferring internal knowledge to external entities to capture the value of given ideas, leverage the utility of otherwise unused IP, commercialize the given knowledge, thereby gaining commercial benefits in the market (Chesbrough & Brunswicker, 2014; Chiaroni, Chiesa & Frattini, 2011; Gray & Meister, 2004; Hansen, 1999; Kamoche & Newenham-Kahindi, 2012; Lichtenthaler & Lichtenthaler, 2009). The coupled model of open innovation combines the outside-in and inside-out models (Chesbrough, 2003; Enkel et al., 2009; Gassmann & Enkel, 2004; Lichtenthaler & Lichtenthaler, 2009), and we shall adopt the coupled model to represent the entire open innovation process (Figure 1).

Four distinctive challenges associated with open innovation have been identified (Chesbrough, 2003; Enkel et al., 2009; van de Vrande et al.,

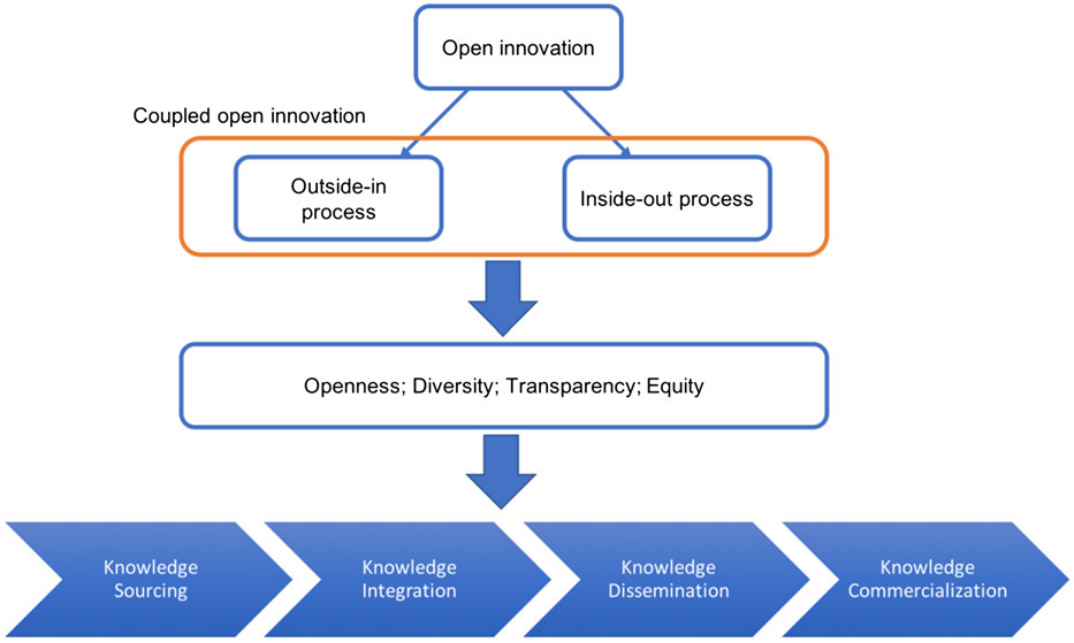

Figure 2. Mapping aspects of knowledge management to processes within open innovation.

2009). The first relates to *openness* as an identity issue and involves coming to terms with the increasing permeability of organizational boundaries (Chesbrough, 2003). The second involves capitalizing on *diversity*, as the breadth and depth of the knowledge available to the focal firm and other parties appears to be more multifaceted and complex in nature than in closed innovation (Brunswicker & Vanhaverbeke, 2014). Third, the need to collaborate with a pool of partners with divergent backgrounds and competencies gives rise to the challenge of *transparency* (Cano-Kollmann, Awate, Hannigan, & Mudambi, 2018; Frey, Lüthje, & Haag, 2011). The fourth relates to *equity*. In pursuing open innovation, firms may need to 'consciously select some of their internally developed knowledge and make it accessible to outside actors, often for free and without contractual requirements' (Alexy, George, & Salter, 2013, p. 271). The need for such disclosures requires underpinning by strong IP management and protection for ensuring a fair and equitable distribution of rewards (Henkel, Schöberl, & Alexy, 2014; West et al., 2014).

Knowledge management for open innovation

This sub-section explains the contributions of knowledge management (Darroch, 2005; Lichtenthaler & Lichtenthaler, 2009; Martinez-Conesa, Soto-Acosta, & Carayannis, 2017; Scarbrough, 2003), in coordinating and supporting the four distinctive features of open innovation, that is, openness, diversity, transparency, and equity, explained above (Figure 2). Knowledge management consists of four processes: knowledge sourcing,

knowledge integration, knowledge dissemination, and knowledge appropriation (Darroch, 2005).

Knowledge sourcing refers to the 'mobilization and application of knowledge from external and internal sources' (Brunswicker & Vanhaverbeke, 2014, p. 1243) for the purpose of allowing organizations to benefit from the increasing openness of organizational boundaries. Knowledge integration is necessary for 'combining or integrating different types of component knowledge' (De Boer, Van Den Bosch, & Volberda, 1999, p. 380) from external partners with diverse knowledge bases (Grant, 1996). Knowledge dissemination is defined as a process of sharing and distributing 'espoused knowledge throughout the organization and its environment' (McAdam & Reid, 2001, p. 232) with the purpose of increasing knowledge transparency and granting full access to all parties involved (Baldwin & von Hippel, 2011; Hansen, 1999; Henkel et al., 2014; Spithoven, Clarysse, & Knockaert, 2011). Knowledge appropriation indicates 'an organization's deliberate commercializing of knowledge assets to another independent organization involving a contractual obligation for compensation in monetary or non-monetary terms' (Lichtenthaler, 2005, p. 233). The process needs to be done in an equitable manner to allow the participating organizations to profit fairly from internal and external IP (Hurmelinna-Laukkanen & Puumalainen, 2007; Lichtenthaler & Lichtenthaler, 2009).

Barriers to open innovation

We shall follow Cassiman & Valentini (2016) in adopting three perspectives, that is, cognitive, organization-capability related, and transaction-cost related, to identify how the associated barriers affect open innovation, as summarized in Table 2.

Cognitive barriers to open innovation

Cognitive barriers refer to biased mental processes and attitudes among individual managers and employees. Cognitive barriers can disrupt rational decision-making processes and adversely affect the quality of judgments (Rindova, 1999). Kraiger, Ford, and Salas (1993) noted that a lack of readily accessible knowledge typically gives rise to cognitive barriers and may result in irrational behaviors and decisions. If individuals possess insufficient knowledge about external partners and marketplace phenomena, they may form biased attitudes and mindsets that constitute barriers to open innovation, such as uncertainty aversion, the Not-Invented-Here (NIH) syndrome, mere-exposure effect, the

Table 2. Barriers to open innovation.

Level of analysis	Perspective	Barriers	Definitions	References	Knowledge management-related impacts on open innovation
Individual	Cognitive	Uncertainty aversion; NIH syndrome	Insecurity about external knowledge; individuals hold negative attitudes toward external knowledge sourcing	Epstein, 1999; Lichtenthaler, Ernst & Hoegl, 2010	Absent trust vis-à-vis external actors and limited relationship development
		Mere exposure effect; NCH syndrome	Internal exposure and familiarity result in favorable attitudes toward internal knowledge; individuals hold negative attitudes toward external knowledge	Lichtenthaler, 2011; Zajonc, 1968	Overemphasis on internal knowledge, overlooking the need to integrate diverse external knowledge
		ASH syndrome	Reluctance to disseminate internally accumulated knowledge to external parties	Lichtenthaler & Ernst, 2006	Avoidance of uncertainty, and of selective disclosure
		OSH syndrome	Narrow focus on internal knowledge and IP protection	Rivette & Kline, 2010	Under-utilization of external knowledge and failure to exploit it
Organizational	Organization capability related	Lack of networking capability	Inability to develop or maintain productive relationships with external actors	Brunswicker & Vanhaverbeke, 2014	Failure to network with appropriate external parties
		Lack of absorptive capacity	Inability to evaluate the potential of external information, take it in, and/or adapt it for commercial purposes	Cohen & Levinthal 1990; Gassmann & Enkel, 2004	Failure to assimilate and integrate diverse external knowledge
		Lack of multiplicative capability	Inability to codify and share knowledge with external parties and/or to utilize it for various external applications	Gassmann & Enkel, 2004	Failure to engage in selective disclosure of internal knowledge to external parties
		Lack of appropriation capability	Inability to determine the fair distribution of benefits that the organization can access through a collaborative relationship	Lavie, 2007	Ineffective IP management

(*continued*)

Table 2. Continued.

Level of analysis	Perspective	Barriers	Definitions	References	Knowledge management-related impacts on open innovation
Inter-organizational	Transaction-cost related	Costs of screening and evaluating partners	Costs involved in identifying and selecting external actors for alliances	Williamson, 1985	Avoidance of developing relationships with external parties to reduce risks of knowledge asymmetry and opportunism
		Costs of coordination	Costs associated with the complexities of sharing out and coordinating tasks across organizational boundaries	Gulati & Singh, 1998	Avoidance of integrating diverse knowledge
		Threat of knowledge leakage	Concerns about potential erosion of competitiveness and positioning that might arise from the loss of proprietary information	Frishammar, Ericsson & Patel, 2015	Avoidance of selective disclosure of internal knowledge
		Costs of intellectual property protection	Costs of legal safeguards such as patenting, designed to prevent competitors from stealing or imitating intellectual property.	Reitzig & Puranam, 2009	Avoidance of managing a complex IP system

Not-Connected-Here (NCH) syndrome, the All-Stored-Here (ASH) syndrome, and the Only-Sold-Here (OSH) syndrome. These particular barriers, which we explain next, or particular combinations of them may lead to suboptimal performance in the context of open innovation (Lichtenthaler & Ernst, 2006).

Uncertainty aversion would discourage individuals from looking for new knowledge that is unfamiliar to them (Epstein, 1999) as well as discouraging individuals from sharing existing knowledge with outsiders (Chan, Oerlemans & Pretorius, 2010). The NIH syndrome refers to negative attitudes toward external knowledge (Lichtenthaler & Ernst, 2006). It is associated with insecurity about non-resident knowledge and with the absence of trust vis-à-vis external actors. It results in individuals undervaluing external knowledge, overlooking potential opportunities, misinterpreting external knowledge, and delaying innovation processes (Lichtenthaler & Ernst, 2006; Lichtenthaler, Ernst, & Hoegl, 2010).

The mere-exposure effect is explained as follows: 'mere repeated exposure of the individual to a stimulus is a sufficient condition for the enhancement of his attitude toward it' (Zajonc, 1968, p. 1). Those employees, who are suffering from this problem, might hold a favorable but unrealistically positive attitude toward internally generated knowledge. The NCH syndrome may arise if organization members hold a negative attitude toward integrating external knowledge (Lichtenthaler et al., 2010) due to insufficient understanding and lack of trust about the value and usefulness of externally generated knowledge, thus affecting the potential of knowledge integration (Lichtenthaler, 2011).

The ASH syndrome is defined as a negative attitude toward knowledge dissemination and thus a barrier to the latter (Lichtenthaler & Ernst, 2006). It is associated with over-reliance on the utilization of internal knowledge and with a corresponding lack of trust vis-à-vis external partners. The ASH syndrome impedes organizations from exploring optimal paths to utilizing internal knowledge, increases the complexity of managing internal knowledge, and may result in failure to identify appropriate business ideas for future development (Lichtenthaler & Ernst, 2006).

The OSH syndrome may arise when organizations are afraid of attenuating core competencies and over-emphasize the importance of the protection of IP (Rivette & Kline, 2010). Individuals with the OSH mentality are reluctant to form external networks for knowledge exploitation and therefore underutilize them, with a resulting loss of financial benefits that might otherwise ensue from external market paths (Lichtenthaler & Ernst, 2006; Rivette & Kline, 2010).

Organization-capability-related barriers to open innovation

Effective implementation of open innovation depends on the collaborating organizations' capabilities for organizing all constituent knowledge management activities. From the organization capability perspective, if an organization opens its boundaries, the ensuing *ad hoc* organization becomes a new unit of analysis, with its own set of requisite organizational capabilities (Argyres et al., 2012; Chesbrough et al., 2006). We shall argue that deficiencies in networking capability, absorptive capacity, multiplicative capability, and appropriation capability would impede the processes of open innovation.

Networking capability enables a firm to initiate and maintain productive relationships with valuable external actors (Brunswicker & Vanhaverbeke, 2014) while avoiding or terminating undesirable partnerships (Mitrega, Forkmann, Ramos, & Henneberg, 2012). Lack of networking capability would limit opportunities for dialogue with outsiders

and impede knowledge sourcing (Brunswicker & Vanhaverbeke, 2014; Mitrega et al., 2012).

Firms engaging in open innovation need to process extensive knowledge flows across boundaries. Their ability to do so depends on their absorptive capacity for 'acquiring and assimilating external knowledge' (Zahra & George, 2002, p.190). Lack of absorptive capacity would impede the focal firm from assimilating new and complementary knowledge from external partners, which in turn would limit the knowledge integration process (Cohen & Levinthal, 1990; Lichtenthaler & Lichtenthaler, 2009).

Multiplicative capability refers to 'the company's capability to multiply and transfer its knowledge to the outside environment' (Gassmann & Enkel, 2004, p. 13), thus exploiting opportunities and avoiding any unintentional leakage of knowledge (Pisano, 2006). Lack of multiplicative capability would constitute a barrier to effectively disseminating knowledge, thereby preventing an organization from promoting the utility of internal knowledge across organizational boundaries.

Appropriation capability is manifest in the ability to determine the distribution of benefits that the organization can gain in a collaborative relationship (Lavie, 2007). Since open innovation operates under a complex IP regime (Pisano, 2006), lack of effective IP management entails a loss of bargaining power vis-à-vis partners which might hinder the development of appropriation capability (Enkel et al., 2009).

Transaction-cost-related barriers to open innovation

The transaction costs perspective regards the transaction as basic unit of analysis and compares likely costs under different transactional arrangements, such as doing everything in-house versus outsourcing (Williamson, 1985). In the context of open innovation, permeable boundaries reduce the advantages of internal development and shift the focus toward external knowledge sourcing. However, if relationships with diverse external parties are weakly governed, this would increase the likelihood of knowledge leakage (Becker, 2001), with associated concerns about the loss of competitiveness and market position if proprietary knowledge were to leak out (Frishammar, Ericsson, & Patel, 2015). Concerns about the risks of asymmetric information and partner opportunism in the marketplace can therefore add significantly to the estimated costs of screening, evaluating, and selecting partners beyond organizational boundaries (Williamson, 1985). Such concerns may, in turn, have the knock-on effect of raising barriers to knowledge sourcing.

Costs of coordination arise when two or more independent entities form partnerships to complete complex tasks across organizational boundaries and thus become interdependent (Gulati & Singh, 1998). The costs arising from the associated communication, information processing, and decision-making activities can be substantial (Tushman & Nadler, 1978). Such costs can constitute a significant barrier to the knowledge integration process.

As argued above, open innovation crosses organizational boundaries and therefore increases the threat of knowledge leakage to outsiders and the associated costs of protecting internal knowledge against imitation. The threat of knowledge leakage is, accordingly, a potential barrier to the knowledge dissemination process. In pursuing open innovation, firms regard IP protection as a tool, such as patenting, that seeks legal means to prevent competitors from stealing or imitating technology (Reitzig & Puranam, 2009), thereby protecting valuable knowledge. This carries costs, which can be especially high in the context of collaborating with external parties to capture the commercial value of internal knowledge, and/or where there is ambiguity about the ownership of IP rights. Although open innovation offers a potential source of benefits from others' IP (West et al., 2014), Savitskaya, Salmi, & Torkkeli (2010, p.19) have commented that 'weak intellectual property protection and the complexity of intellectual property rights, in turn hinder the entry of firms into open innovation practices'. Such concerns may thus constitute a significant transaction-cost-related barrier to the knowledge appropriation process.

Collaborative-based HRM practices and open innovation

Scholars have argued that HRM practices can serve as key drivers of open innovation (Chow, Huang, & Liu, 2008; Delery, 1998; Gooderham, Nordhaug, & Ringdal, 1999; Lepak & Snell, 1999; Tzafrir, 2005). For example, Scarbrough (2003) pointed out that 'innovations arise at the intersection between flows of people and flows of knowledge (p. 504)' and that HRM practices can impact on the flow of people and flow of knowledge to expedite the open innovation process. HRM practices can positively affect innovation by improving employees' willingness to share valuable and unique knowledge (Lopez-Cabrales et al., 2009; Martinez-Conesa et al., 2017). Moreover, flows of knowledge initiated by HRM can open up organizational boundaries (Scarbrough, 2003). Such analyses indicate that appropriate HRM practices can enhance the willingness and ability of employees to engage in processes of open innovation.

Lepak and Snell (1999) identified four types of HRM practices: compliance-based, commitment-based, market-based, and collaborative-based. However, given the unique features of open innovation that demand extensive knowledge sharing across organizational boundaries, we shall focus exclusively on the potential value of collaborative-based HRM for organizations pursuing open innovation.

Adopters of collaborative-based HRM practices assume that the synergies and reciprocity-based relationships among partners are more salient to partnership success than are their individually held bodies of knowledge, and that collaborative-based HRM practices are more suitable and effective modes for managing partnerships and alliances (Lepak & Snell, 1999). Collaborative-based HRM practices focus on developing long-term and quality partnerships with external entities, motivating internal and external actors to participate in collaborative decision-making, and encouraging communication and collaboration between employees and employers (Chow et al., 2008; Lepak & Snell, 1999). Since the external environment can provide non-residential knowledge to expand a firm's knowledge pool and offer new market opportunities, high-quality interdependent relationships and trust across organizational boundaries would support innovation processes (Chow et al., 2008; Gooderham et al., 1999). Moreover, collaborative-based HRM practices enhance the development of external connections and interpersonal relationships (Lepak & Snell, 1999; Zhou, Liu, & Hong, 2012), and can therefore play an important role in capturing value for appropriation in an inter-organizational setting (Hurmelinna-Laukkanen & Puumalainen, 2007). We shall argue, accordingly, that adopting collaborative-based HRM practices will promote information sharing and build interdependent relationships that can foster inter-organizational synergy and cooperation in pursuit of open innovation, as summarized in Table 3.

The following sub-sections will illustrate how particular collaborative-based HRM practices across the functions of recruitment, training, appraisals and rewards, and job design (Jiang, Wang, & Zhao, 2012; Zhou, Liu, & Hong, 2012), are likely to reduce cognitive, transaction-cost-related, and organizational-capability-related barriers to open innovation while also enhancing employees' capabilities and motivation to participate in the constituent processes of open innovation. We shall thus discuss the potential contributions of teamwork-based recruitment, training in teamwork skills, team-based appraisals and rewards, and rotational job design.

Teamwork-based recruitment

As part of a collaborative-based approach to HRM, recruitment practices may be designed to select candidates, who have strong potential to build

Table 3. Collaborative-based HRM practices and open innovation.

Domains of HRM	Specific practices	Relationship with knowledge management issues in the context of open innovation	Contributions to knowledge management processes in the context of open innovation	References
Recruitment	Seeking appointees with potential to develop collaboration skills	Potentially resolving conflicts associated with knowledge diversity	Potentially facilitating the integration of knowledge inflow	Choo, Linderman, & Schroeder, 2007; Cohen & Levinthal, 1990; Volberda et al., 2010
Training	Developing collaboration and networking skills	Building capability to engage in relationship building and to overcome challenges associated with knowledge diversity and selective disclosure	Cultivated employees would support knowledge inflow and knowledge outflow	Dyer & Nobeoka, 2000; De Winne & Sels, 2010; Zhou, Liu, & Hong, 2012
Appraisal and compensation	Reinforcing collaborative and trust-based relationships	Building relationships to overcome challenges associated with IP management, knowledge diversity, and selective disclosure	Trust-based relationships would support knowledge inflow and knowledge outflow	Alexy, George, & Salter, 2013; Lavie, 2007
Job design	Enhancing understanding of and communication with external sources	Potentially overcoming challenges in knowledge diversity	Better understanding of different jobs would facilitate knowledge inflow	Dorenbosch et al., 2005; Gooderham et al., 1999

and maintain internal and external relationships that support intra- and inter-organizational collaboration. In such contexts, recruitment materials and procedures can target teamwork skills and collaboration capabilities (Lepak & Snell, 1999). Collaboration-oriented recruitment practices seek appointees, who will expedite knowledge flow, knowledge sourcing, and knowledge integration (Jiménez-Jiménez & Sanz-Valle, 2008; Scarbrough, 2003). We shall argue that teamwork-based recruitment can help to reduce cognitive, organization-capability-related, and transaction-cost-related barriers to knowledge sourcing, knowledge integration, and knowledge dissemination. The mediating processes are likely to include the development of trust with external parties (Lee, Gillespie, Mann, & Wearing, 2010).

Teamwork skills would facilitate shared understanding to reduce the negative effects of uncertainty aversion (Häusler, Hohn, & Lütz, 1994). If an organization were to screen potential employees based on their teamwork and collaboration skills, the resulting appointees are likely to be less prone to uncertainty and insecurity vis-à-vis external knowledge and external actors (Hurmelinna-Laukkanen, 2011), thereby potentially reducing the NIH syndrome and the ASH syndrome.

Permeable boundaries associated with open innovation are only potentially conducive to complementary knowledge, divergent objectives, and diverse work routines in the workplace. Recruitment of employees with collaboration capabilities would help organizations to rise to the challenges of establishing shared relational norms between the partnering firms (Williamson, 1985), and of integrating their different bodies of knowledge (Volberda, Foss, & Lyles, 2010). Cohen and Levinthal (1990) proposed that organizations could seek to recruit candidates with collaboration skills, with the expectation that appointees would help to build absorptive capacity (Lichtenthaler & Lichtenthaler, 2009) because of their ability to expedite the sharing, exchange and acquisition of knowledge during team projects (Choo, Linderman, & Schroeder, 2007; Cohen & Levinthal, 1990). Appointing members with collaborative abilities can potentially also help to reduce coordination costs (Cummings & Kiesler, 2007) by bridging inter-institutional differences.

Expressing clear organizational objectives during recruitment can have a strong impact in attracting suitable job applicants (Braddy, Meade, & Kroustalis, 2005) and can signal the need for existing employees to develop particular skills and capabilities (Gardner, Reithel, Cogliser, Walumbwa, & Foley, 2012; Wei, Liu, & Herndon, 2011). Thus, an emphasis on the need for candidates to be willing and able to engage in teamwork and collaboration can attract candidates, who do not subscribe to the NIH or ASH syndromes, who can enhance the organization's

absorptive capacity, and who can reduce coordination costs. Hence, in the context of open innovation:

Proposition 1a:	Adopting teamwork-based recruitment in conjunction with clearly expressed policies that emphasize the organization's commitment to open innovation would result in appointees, who are less prone to uncertainty aversion, the NIH syndrome, and the ASH syndrome
Proposition 1b:	Adopting teamwork-based recruitment would enhance absorptive capacity and reduce coordination costs

Training in teamwork skills

The aims of training programs can include reducing employees' attitudinal biases and enhancing individuals' capabilities to engage in knowledge management (Bondarouk & Looise, 2005; Chowhan, 2016; Greer & Stevens, 2015; Jiménez-Jiménez & Sanz-Valle, 2005; Li, Zhao, & Liu, 2006; Martinez-Conesa et al., 2017).

Collaborative-based HRM practices focus on the formation and development of positive interpersonal relations among internal and external actors (Lepak & Snell, 1999). Associated training practices emphasize networking and collaborative skills and mindsets, to enable and encourage employees to access, integrate, transfer, and disseminate knowledge (De Winne & Sels, 2010; Greer & Stevens, 2015; Zhou, Liu, & Hong, 2012).

Knowledge acquired through training can reduce employees' anxiety, insecurity, and negatively biased attitudes toward external sources, and can encourage employees to adopt more rational approaches for evaluating external knowledge and sharing internal knowledge (Diaz-Fernandez et al., 2017; Kraiger et al., 1993). Accordingly, training programs should reduce the effect on uncertainty aversion, and with a broader exposure to diverse types of knowledge, employees may become more open-minded, and receptive toward novel practices (Oliver, 1990), thereby reducing the NIH syndrome and the ASH syndrome.

Training in teamwork skills can aim to enhance employees' skills of networking and collaboration, and can potentially equip them to support knowledge management processes throughout open innovation (Mitrega et al., 2012). Networking training seeks to enhance skills of identifying and evaluating external actors, of connecting with them, and of building relationships with them (Brunswicker & Vanhaverbeke, 2014). If successful, such training would potentially reduce costs of screening and evaluating partners during knowledge sourcing (Kumar, Stam, & Joachimsthaler, 1994; Mitrega et al., 2012).

Successful communication skills training can generate greater trust in the context of team projects, thereby reducing coordination costs

(Cummings & Kiesler, 2007). Improved communication arising from such training would also give rise to additional positive impacts, including broadened perspectives, making it easier for employees to explain and understand the potential usefulness of internal knowledge (Cil, Alpturk & Yazgan, 2005), thereby developing multiplicative capability.

Successful training in collaboration skills would promote fruitful interactions among employees and has the potential to reinforce knowledge sharing and knowledge exchange, and to expand the existing knowledge base to enhance absorptive capacity (Choo et al., 2007; Cohen & Levinthal, 1990; Liao, Fei, & Chen, 2007; Lichtenthaler & Lichtenthaler, 2009). Such training would also help to create a strong partnership identity and establish coordination rules to reduce coordination costs (Dyer & Nobeoka, 2000). It could also be designed to inform employees how to utilize selective disclosures as a tactic for simultaneously protecting undisclosed organizational knowledge (Ma Prieto & Pilar Pérez-Santana, 2014), so as to enable knowledge transfer under conditions of uncertainty while also reducing the threats of knowledge leakage. Hence, in the context of open innovation:

Proposition 2a:	Providing training in collaboration skills would result in reduction of uncertainty aversion, the NIH syndrome, and the ASH syndrome
Proposition 2b:	Providing training in networking skills would result in enhanced networking capability and in reduced costs of screening and evaluation during knowledge sourcing
Proposition 2c:	Providing training in collaboration skills would result in enhanced absorptive capacity and in reduced costs of coordination during knowledge integration
Proposition 2d:	Providing training in collaboration skills would result in enhanced multiplicative capability and in reduced threats of knowledge leakage

Team-based appraisals and rewards

Team-based appraisals and rewards are highly salient means for enhancing innovation performance (Camelo-Ordaz, Fernández-Alles, & Valle-Cabrera, 2008). They provide incentives to form interdependent and collaborative lateral and vertical relations (Andreeva, Vanhala, Sergeeva, Ritala & Kianto, 2017; Camelo-Ordaz et al., 2008; Tzafrir, 2005). They can motivate collective behaviors and facilitate knowledge transfer (Cabrera & Cabrera, 2005; Camelo-Ordaz, García-Cruz, Sousa-Ginel, & Valle-Cabrera, 2011; De Winne & Sels, 2010). Team-based appraisals and rewards can thereby help to build reciprocal interdependence and trust, and thereby support open innovation (Lopez-Cabrales et al., 2009), by reducing uncertainty (Inkpen & Tsang, 2005), and, in turn, reducing the NIH and ASH syndromes.

For example, trust serves as a medium for motivating internal and external actors to create social ties for knowledge sourcing, and can also enhance networking capability (Mitrega et al., 2012), thereby reducing

the costs of screening and evaluating partners (Kumar et al., 1994). Moreover, high trust relationships between internal and external actors may serve to overcome conflicts that would otherwise arise from knowledge diversity (Jehn, Northcraft, & Neale, 1999). Trust would facilitate knowledge sharing (Tzafrir, 2005), along with information processing and decision-making, and would thereby reduce coordination costs (Frishammar et al., 2015; Tushman & Nadler, 1978). If team-based appraisals and rewards are successful in increasing the effectiveness and efficiency of knowledge exchange and transfer, this can also foster absorptive capacity (Cohen & Levinthal, 1990).

If team-based appraisals and rewards are successful in developing interdependent and collaborative relationships in teams, this would mitigate moral hazard and facilitate the selective disclosure strategy (Alexy, George, & Salter, 2013). Collaborative and trust-based relationships can thus increase the effectiveness and efficiency of knowledge exchange and transfer. Besides, such relationships can also foster multiplicative capability (Cohen & Levinthal, 1990; Gassmann & Enkel, 2004). Prior studies show that interdependence and trust relationships have positive effects on performance (Zaheer, McEvily, & Perrone, 1998) and can increase the focal firm's bargaining power for knowledge appropriation (Lavie, 2007). Hence, in the context of open innovation:

Proposition 3a:	Adopting team-based appraisals and rewards would create and reinforce interdependent, collaborative, and trust-based relationships among internal and external parties. This would in turn reduce uncertainty aversion, the NIH syndrome, and the ASH syndrome
Proposition 3b:	Adopting team-based appraisals and rewards would enhance networking capability and would reduce costs of screening and evaluation during knowledge sourcing
Proposition 3c:	Adopting team-based appraisals and rewards would enhance absorptive capacity and reduce coordination costs during knowledge integration
Proposition 3d:	Adopting team-based appraisals and rewards would enhance multiplicative capability during knowledge dissemination
Proposition 3e:	Adopting team-based appraisals and rewards would enhance appropriation capability during knowledge commercialization

Rotational job design

Rotational job design is a collaborative-based HRM practice that typically aims to provide employees with a comprehensive understanding of various jobs (Dorenbosch, Engen, & Verhagen, 2005; Jiang et al., 2012), and to empower them to overcome cognitive, transactional, and organizational barriers (Scarbrough, 2003). Rotational job design is typically supported by arrangements for job consultation that can offer a safe and comfortable communication channel for employees to express their ideas and receive timely feedback (Gooderham et al., 1999).

Together, such arrangements emphasize flexibility, connectedness, skill building, and the development of skill variety (Chow et al., 2008; Lopez-Cabrales, Pérez-Luño, & Cabrera, 2009). Rotational job design combined

with timely feedback not only enables employees to gain comprehensive understanding of various jobs but also motivates them to develop additional related skills (Gooderham et al., 1999; Jiang et al., 2012).

In combination with job consultation, rotational job design can provide opportunities for internal and external actors to swap roles, gain exposure to wider knowledge and task demands, thereby reducing biased attitudes toward external knowledge and insecurity toward external sources (Chow et al., 2008; Lichtenthaler & Ernst, 2006). Such partnership-based rotational job designs can accordingly facilitate communication and information flows within and across project teams, thereby reducing uncertainty aversion, mitigating the negative effects of mere-exposure, reducing the NIH, NCH, ASH, and OSH syndromes (Dorenbosch et al., 2005; Gooderham et al., 1999), improving networking capability (Mitrega et al., 2012), and potentially reducing screening and evaluating costs during knowledge sourcing.

On the downside, complex and flexible job design can increase costs of coordination (Gulati & Singh, 1998), thus hindering the development of absorptive capacity for assimilating and integrating knowledge (Argote & Ingram, 2000). If applied across employers, there can be risks of knowledge leakage and IP loss (Frishammar et al., 2015; Hurmelinna-Laukkanen & Puumalainen, 2007). Hence, in the context of open innovation:

Proposition 4a:	Adopting rotational job design in conjunction with job consultation and two-way feedback and extending this arrangement to cross-employer rotation would mitigate the negative effects of uncertainty aversion and mere-exposure effect and reduce the NIH, NCH, ASH, OSH syndromes
Proposition 4b:	Adopting rotational job design in conjunction with job consultation and two-way feedback and extending this arrangement to cross-employer rotation would enhance networking capability and reduce screening and evaluating costs during knowledge sourcing

Discussion and conclusion

Increasing recognition of the permeability of organizational boundaries, and of the potential benefits of such permeability, has led many organizations to open up their innovation processes by collaborating with external partners. Open innovation has accordingly become an increasingly important area of management studies. In this literature review, we have drawn upon the knowledge management perspective (Darroch, 2005; Gooderham et al., 1999; Lepak & Snell, 1999) to identify potential ways in which four collaborative-based HRM practices, that is, team-based recruitment, training in teamwork skills, team-based appraisals and rewards, and rotational job design, can facilitate (but possibly sometimes impede) open innovation processes (Chesbrough & Crowther,

2006; Darroch, 2005). We have also identified potential barriers to open innovation that may arise from individual-level cognitive biases, deficiencies in organizational capabilities, and inter-organizational transaction costs (Hurmelinna-Laukkanen, 2011; Lichtenthaler & Ernst, 2006).

Contributions

We have contributed to the literature on the role of HRM in open innovation in three main ways. First, we have focused exclusively on the relationship between HRM and open innovation in contrast to the prior literature on the enabling role and the impact of HRM on innovation (Collins & Smith, 2006; Perdono-Ortiz, González-Benito, & Galende, 2009; Shipton, et al., 2006; Tang, Chen, & Jin, 2014; Wang & Shyu, 2009; Wang & Zang, 2005; Zanko, Badham, Couchman, & Schubert, 2008), which does not differentiate between open innovation and closed innovation. We have brought out the knowledge management challenges of open innovation, namely expanding the knowledge sources, integrating diverse knowledge pools, managing diverse relationships and maintaining property rights for knowledge appropriation, which arise from the distinctive demands of openness, diversity, transparency, and equity. We have shown how collaborative-based HRM can address these distinctive challenges and demands.

Second, while prior literature tends to focus exclusively on the impact of organizational policies and external environments on open innovation (Lichtenthaler & Lichtenthaler, 2009; Searle & Ball, 2003), our study contributes to the open innovation literature by identifying cognitive related, organizational-capability-related, and transaction-cost-related barriers (Greer & Steven, 2015; Lichtenthaler & Ernst, 2006; Zhou, Liu, & Hong, 2012) to open innovation, thus providing a more complete multi-level analysis.

Third, we explain the role of four HRM practices as appropriate means for facilitating and supporting open innovation. Taking Lepak & Snell's (1999) conception of collaborative-based HRM practices as a point of departure, we have built on their framework to identify and discuss the potential role of particular collaborative-based HRM practices in overcoming cognitive, organization-capability-related, and transaction-cost-related barriers to open innovation. We discuss how collaborative-based HRM practices can foster the requisite mindsets, skill-sets, and organizational capabilities, and can reduce the transaction-related-costs involved in managing complex relationships with external partners. We have identified potential ways in which four particular collaborative-based HRM practices, that is, teamwork-based recruitment, training in teamwork

skills, team-based appraisals and rewards, and rotational job design, can benefit (and possibly sometimes impede) open innovation processes.

Managerial implications

Our review of the role and contributions of collaborative-based HRM practices in facilitating and supporting open innovation has some practical implications. HR managers should seek to recruit candidates with mindsets and skills that are conducive to teamwork and engagement in knowledge sharing. Besides, rotational job design and opportunities and encouragement for cross-functional career paths should be provided to employees for the purposes of broadening their understanding, facilitating cross-boundary communication, and improving innovation performance by fostering knowledge co-creation and combination (Chow & Gong, 2010). HR managers are nonetheless advised to consider the risk of invoking excessively positive attitudes toward external parties and external knowledge, that is, 'going to the other extreme', which may adversely bias knowledge flow during open innovation (Lichtenthaler & Ernst, 2006).

Limitations

We acknowledge three limitations of our study. First, we could only find a small number of prior studies on the relationship between open innovation and HRM practices. Second, we targeted only specific academic journals in the HRM and innovation fields. Third, this review excluded studies of the impact of specific HRM practices on innovation. We sought nonetheless to provide an exhaustive picture of how collaborative HRM approaches can facilitate and support open innovation.

Future research

Our literature review indicates that there are many potential impacts of collaborative HRM practices on open innovation processes that could be investigated in future research. We envisage three general directions for such research. First, we propose that future research could empirically investigate whether and how, the four collaborative-based HRM practices discussed in this paper facilitate open innovation by reducing cognitive, organizational-capability-related, and transactional-cost-related barriers.

Second, there may be additional collaborative-based HRM practices that also have potential benefits for open innovation. These may include socialization programs and job enrichment arrangements, which encourage employees to share and create knowledge (Chow & Gong, 2010).

Besides hypothesis-testing research, there is room for qualitative case studies that draw on observation and in-depth interviews to gain insights into how particular HRM practices can address and reduce such barriers to open innovation.

Third, although our literature review and analyses have been guided by the coupled model of open innovation, we acknowledge that there may be tensions and conflicts between the aims of outside-in and inside-out open innovation. The purpose of the outside-in processes is to create value and develop core competence within an organization; thus, organizations can seek to internalize knowledge while increasing its opaqueness to outsiders to create competitive advantages (Chesbrough & Crowther, 2006; Gassmann, 2006). On the other hand, the aim of the inside-out processes is to capture optimal economic value by transferring codified knowledge to external parties, who are expected to help to capture maximum value in the marketplace (Chesbrough & Crowther, 2006; Gassmann, 2006). Such potentially conflicting aims present challenges for the application of collaboration-based HRM practices. Once again, this appears to be an issue for further qualitative research.

Summary

This review presents a multi-level framework for understanding the relationship between collaborative-based HRM practices and open innovation process. We highlight the distinctiveness of open innovation processes and identify cognitive, organization-capability, and transaction-cost barriers, thereby conducting our examination at the individual, organizational, and inter-organizational levels of analysis. This review adds to HRM literature by showing how collaborative-based HRM would build collaboration-oriented mindsets and skills that facilitate knowledge flows across organizational boundaries. We also identify directions for future research.

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