What does it Take to Implement Open Innovation? Towards an Integrated Capability Framework

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Purpose – In a world of ever-changing corporate environments and reduced product life cycles, most organizations cannot afford anymore to innovate on their own. Hence, they open their innovation processes to incorporate knowledge of external sources and to increase their innovation potential. As the shift towards open innovation (OI) is difficult and makes many initiatives fail, the question arises which capabilities organizations should develop to successfully implement OI. As the literature encompasses mature but isolated streams on OI capabilities, there is a need for an integrated capability framework.

Design/methodology/approach – This paper proposes the Open Innovation Capability Framework (OICF) that compiles and structures capabilities relevant for implementing OI. The OICF covers the outside-in and coupled processes of OI. To integrate multiple streams of the OI literature, the OICF builds on a structured literature review. The OICF was also validated in a two-step review process with OI experts from academia and industry.

Findings – The OICF comprises 23 capability areas grouped along the factors strategic alignment, governance, methods, information technology, people, and culture. To analyze the existing body of knowledge on OI capabilities, we compare the OICF with other OI-related capability frameworks and compile a heatmap based on the results of the literature review. We also discuss the experts' feedback on individual factors of the OICF as well as on interdependencies among these factors.

Practical implications – The OICF provides practitioners with a structured overview of the capabilities to consider when implementing OI. Based on the OICF, practitioners can define the scope of their OI initiatives. They can use the OICF as a foundation for prioritizing, selecting, and operationalizing capability areas as well as for deriving implementation roadmaps.

Originality/value – The OICF is the first framework to take a holistic perspective on OI capabilities. It integrates mature but isolated research streams of OI. It helps practitioners define the scope of OI initiatives and academics gain insights into the current state of the art on OI capabilities.

1 Introduction

Open innovation (OI), a term coined by Chesbrough (2003a), has taken academia and practice by storm. Attributed to the relevance and growing interest in OI, many scholars embrace the OI concept (Huizingh, 2011; West and Bogers, 2014; Chesbrough *et al.*, 2014). From a practical view, shorter product life cycles, reduced time to market, advancements in Internet and social networking technologies, and globally distributed knowledge landscapes have induced organizations to open their innovation processes and move away from the traditional closed innovation paradigm (Chesbrough, 2003a; Dodgson *et al.*, 2006; Enkel *et al.*, 2009; Whelan *et al.*, 2011). For instance, a comparison of Procter & Gamble's innovation projects shows that their OI projects outperformed closed innovation projects by achieving a 70% higher net present value (Enkel *et al.*, 2011). A recent survey on OI conducted by the Corporate Innovation Center and the Fraunhofer Society examines OI activities in large firms beyond US\$ 250 million in annual sales, highlighting that more than 78% of those firms engage in OI activities (Chesbrough and Brunswicker, 2013). The study also reveals that most organizations fail in the change process from closed to OI and that more knowledge is needed about capabilities such as managing and organizing OI. Likewise, other studies reveal that small and medium-sized enterprises (SME) increasingly implement OI, but face managerial challenges, such as organizational or cultural issues (van de Vrande *et al.*, 2009; Enkel *et al.*, 2009). Risks and challenges, such as finding the right partners, loss of control, or loss of knowledge, inhibit these organizations from capitalizing on OI initiatives (van de Vrande *et al.*, 2009).

Different research streams, such as from information systems, innovation management, and knowledge management, have already taken a capability perspective on OI, analyzing capabilities relevant for implementing OI. Most existing capability frameworks focus on single facets of OI. For instance, Lichtenthaler and Lichtenthaler (2009) mainly investigate knowledge capabilities and the interactions among these capabilities. Joshi *et al.* (2010) investigate absorptive capacity, analyze the relationship between information technology (IT) and innovation performance, and introduce IT-enabled knowledge capabilities. Enkel *et al.* (2011) provide an OI maturity framework that encompasses three core elements, namely partnership capacity, climate for innovation, and internal processes. Habicht *et al.* (2012) argue that some aforementioned capabilities are not specific enough to OI. They therefore propose a more OI-specific competence management framework, which focuses on project- and individual-level capabilities. Dreiling and Recker (2013), in contrast, offer a comprehensive capability framework that encompasses organizational, individual, process, and technological capabilities required throughout the innovation process. However, their framework does not cater for peculiarities of OI. Beyond these capability frameworks, various papers present insights into more specific OI-related challenges and capabilities (Felin and Zenger, 2014). Cheng and Chen (2013) also investigate the effect of dynamic innovation capabilities on radical innovation moderated by OI activities. However, they do not consider how OI itself can be implemented. In summary, by focusing on specific facets of OI, prior research led to mature, but isolated and scattered pockets of understanding of OI capabilities. The challenge is to integrate these pockets of understanding. Thus, our research question is as follows: *Which capabilities should organizations consider when implementing open innovation?*

To address this question, we compile and structure prior work by proposing a comprehensive open innovation capability framework (OICF). The OICF reflects factors and capability areas relevant for implementing OI. Focusing on the outside-in and coupled processes of OI, the included capability areas relate to strategic alignment, governance, methods, IT, people, and culture. To derive the OICF, we conducted a literature review and compiled capability areas, drawing on established capability frameworks. We also validated the OICF in a two-step review process with OI experts from academia and industry. Finally, we compared the OICF with existing OI-related capability frameworks, compiled a heatmap based on the findings of the literature review, and discuss the experts' feedback,

This paper is structured as follows. In section 2, we provide background information on OI and capability development. In section 3, we introduce the research method. In section 4, we present the OICF. After discussing the OICF in section 5, we conclude with a summary, limitations, and ideas for further research.

2 Background

2.1 Open Innovation

OI has evolved into an established paradigm of innovation management. It refers to "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the market for external use of innovation, respectively" (Chesbrough, 2006b, p. 2). Organizations with a too strong internal focus may miss opportunities because they "will fall outside the organization's current businesses or will need to be combined with external technologies to unlock their potential" (Chesbrough, 2003b, p.37).

Many scholars highlight absorptive capacity as a concept closely related to OI (Vanhaverbeke and Cloodt, 2014; Spithoven *et al.*, 2011). Cohen and Levinthal (1990) already underlined – long before the term OI was coined – the importance of incorporating external knowledge to improve innovation performance. In this context, they introduce their seminal definition of absorptive capacity, i.e., a firm's ability to "recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128). Zahra and George (2002) reconceptualize and extend absorptive capacity, splitting it into two subsets – a firm's potential and realized absorptive capacity. The former refers to knowledge acquisition and assimilation, the latter to knowledge transformation and exploitation. Zahra and George (2002) also introduce a social integration mechanism that assists in converting potential into realized absorptive capacity by establishing shared understanding and connectedness of the involved actors, two properties that foster the exploitation of external knowledge. Using an analysis of 289 papers on absorptive capacity, Lane *et al.* (2006) propose a process-based view. Accordingly, knowledge from external sources can be leveraged through three sequential processes – exploratory, transformative, and exploitative learning – and these processes call for capabilities to (1) recognize and understand external knowledge, (2) assimilate it, and (3) use the assimilated knowledge to create new knowledge and to ultimately put it into commercial use (Lane *et al.*, 2006).

Although absorptive capacity and OI are linked, clear differences exist between them. Whereas absorptive capacity focuses on the incorporation of external knowledge, OI also comprises the use of purposive outflows of knowledge (Chesbrough, 2006b), which is why "absorptive capacity cannot explain all dimensions of [OI] in terms of capabilities" (Vanhaverbeke and Cloodt, 2014, p.270). Therefore, Lichtenthaler and Lichtenthaler (2009) propose a capability framework that complements the concept of absorptive capacity. In contrast to absorptive capacity, the Lichtenthaler framework focuses on knowledge capacities required for internal and external knowledge exploration, retention, and exploitation as well as on interactions among these capacities. By considering these different external dimensions, the Lichtenthaler framework reflects different OI dimensions. In addition to external knowledge exploration, which is in line with (potential) absorptive capacity, the framework highlights external knowledge retention (connective capacity), i.e., the organization's ability to enter into exchange relations with others and to extend its internal knowledge base. Further, external knowledge exploitation (desorptive capacity) refers to external outward knowledge transfer, such as out-licensing (Lichtenthaler and Lichtenthaler, 2009).

Similarly, Enkel *et al.* (2009) decompose OI into three processes: outside-in, inside-out, and coupled. Each process refers to different OI activities and calls for different capabilities. The outside-in process encompasses activities to leverage external knowledge to gain new sources for innovative ideas. This process may entail the integration of suppliers, customers, universities, or research institutions (Chesbrough *et al.*, 2006). The challenge is in obtaining, integrating, and bringing the external innovation to the market (West and

Bogers, 2014). The inside-out process refers to the externalization of internal ideas and (unused) technologies, i.e., purposive outflows of knowledge, such as by commercializing one's technologies in new markets, which is also known as cross-industry innovation (Enkel *et al.*, 2009; Enkel and Heil, 2014). The coupled process refers to co-creation and collaborative activities among (complementary) innovation partners. This process is reflected in the outside-in and inside-out activities that jointly leverage innovations (Enkel *et al.*, 2009). Whereas previous research focuses on more traditional forms of collaboration, such as alliances, recent research streams broaden the concept of coupled processes (Chesbrough *et al.*, 2014; West and Bogers, 2014). Through an extensive review of OI research, West and Bogers (2014) provide two additional types of coupled processes, namely collaborative networks and OI communities.

2.2 Capability Development

The OICF draws from knowledge related to capability development. Capabilities stem from the resource-based view of the firm (RBV) (Wade and Hulland, 2004; Wernerfelt, 1984). The RBV argues that organizations are collections of resources that enable the achievement of competitive advantage and superior long-term performance if the resource configuration is valuable, rare, imperfectly imitable, and non-substitutable (Barney, 2000; Wade and Hulland, 2004). Resources encompass "anything which could be thought of as a strength or weakness" (Wernerfelt, 1984, p. 172). The RBV considers assets and capabilities as resources (Wade and Hulland, 2004). Assets are defined as anything tangible or intangible that an organization can use, capabilities refer to the ability to execute tasks to achieve particular results (Helfat and Peteraf, 2003). In light of dynamic capability theory (DCT), static resource configurations cannot sustain competitive advantage (Teece *et al.*, 1997; Helfat and Peteraf, 2003). DCT extends the RBV by distinguishing operational and dynamic capabilities (Pavlou and El Sawy, 2011). Operational capabilities refer to the ability to "make a daily living" (Pavlou and El Sawy, 2011, p.242). Dynamic capabilities help integrate, build, and reconfigure operational capabilities to address turbulent environments and improve effectiveness (Teece *et al.*, 1997; Pavlou and El Sawy, 2011; Zollo and Winter, 2002). Innovation management thus is a specific dynamic capability that enables to "transform knowledge and ideas into new products, processes and systems" (Lawson and Samson 2001, p.384).

Capabilities are typically structured via capability frameworks, comprising different levels of granularity (Forstner *et al.*, 2014). Capabilities with similar characteristics and that refer to a particular world view can be grouped into capability areas and, if applicable, into factors, which describe specific and independent elements reflecting the fundamental characteristics of a given domain (Rosemann and vom Brocke, 2015; Rosemann and Bruin, 2005). Capability frameworks exist in many domains (e.g., business process management (BPM), project management, and software engineering). For instance, organizations require frameworks that support identifying BPM capabilities (Bruin and Rosemann 2007). Thus, Rosemann and vom Brocke (2015) provide six factors (i.e., strategic alignment, governance, methods, IT, people, and culture) and related capability areas. As another example, Dreiling and Recker (2013) provide a theoretical framework for innovation that structures organizational, individual, technological, and process capabilities, enabling organizations to identify which capabilities are missing to successfully bring an idea to market. Lichtenthaler and Lichtenthaler (2009) propose a capability framework that supports management by introducing different knowledge capabilities related to OI. Hence, as mentioned in the introduction, taking a capability perspective is an accepted approach when reasoning about OI. This is why we draw on existing OI-related capability frameworks and on further capability-related OI papers when developing the OICF.

3   Research Method

To derive the OICF, we followed a two-phase research method. In the first phase, we conducted a structured literature review to compile and structure existing knowledge on OI capabilities. In the second phase, we validated and refined the OICF in a two-step review process with OI experts from academia and industry.

In the first phase, we conducted a structured literature review that split in two steps, i.e., a bottom-up and a top-down step. Both steps followed the guidelines offered by Webster and Watson (2002) and built on three databases, i.e., AISeL[1], EBSCOhost[2], and ScienceDirect[3] (Brunswicker *et al.*, 2012). The databases were queried using keyword search (vom Brocke *et al.*, 2015). As for the bottom-up step, the search strings were (1) "Open Innovation", (2) "Capabilit*", (3) "Capacit*", (4) "Competence", and (5) "Practice". The search strings were combined using the following logic: (1) in the title AND (2 OR 3 OR 4 OR 5) in the abstract or keywords. Subsequently, we expanded our search using backward and forward search. The bottom-up step provided us with an overview of existing knowledge on OI capabilities. To structure these capabilities, we reviewed existing capability frameworks from different domains. We decided not to rely on the existing OI-related capability frameworks because, due to their special focus, no framework can be used to structure the capabilities included in all other frameworks. Moreover, the results of the bottom-up literature review indicated that there are OI capabilities that have not been covered by existing capability frameworks yet (section 5.1). We decided to adopt the factors of Rosemann and vom Brocke's (2015) seminal BPM capability framework (e.g., strategic alignment, governance, methods, IT, people, and culture) as high-level approach for structuring OI capabilities. This is reasonable as Rosemann and vom Brocke's (2015) framework, independently from its domain, structures capabilities holistically. Moreover, both BPM and OI are dynamic capabilities (Forstner *et al.*, 2014). On this foundation, we conducted a top-down literature review for each factor as second step. This time, we used (1) "Open Innovation", (2) "Strateg*", (3) "Governance", (4) "Method", (5) "Information Technology", (6) "People", (7) "Individual", and (8) "Culture" as search strings. The search strings were combined as follows: (1) in the title AND (2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8) in the abstract or keywords. Overall, the literature review resulted in 127 unique relevant references[4]. We used these results to derive an initial version of the OICF.

In the second phase, we validated the initial OICF in a two-step review process with experts from academia and industry. We first invited academic OI experts. We selected these OI experts based on their reputation in the OI field. The review process included the following steps: First, we provided the academic OI experts with a description of all factors and capability areas. Second, we asked the experts to provide open-ended feedback, such as proposals for additional capabilities, or to adjust the description of distinct capability areas. Third, we asked the experts for the extent to which they agree with these descriptions, using a six-point Likert scale, where 1 indicated strong disagreement and 6 indicated strong agreement. Capability areas and factors were rated separately to allow for a more detailed analysis. We used the experts' ratings and qualitative feedback to refine the initial OICF. The feedback also helped identify boundary conditions, limitations, and avenues for future research. In the end, we sent the refined OICF to the academic OI experts to approve whether we appropriately incorporated their feedback. In a second step, we let the refined OICF review by OI experts from industry. These experts were working for organizations from our industry network highly engaged in OI. The industry experts had the following job titles: Director Innovation and
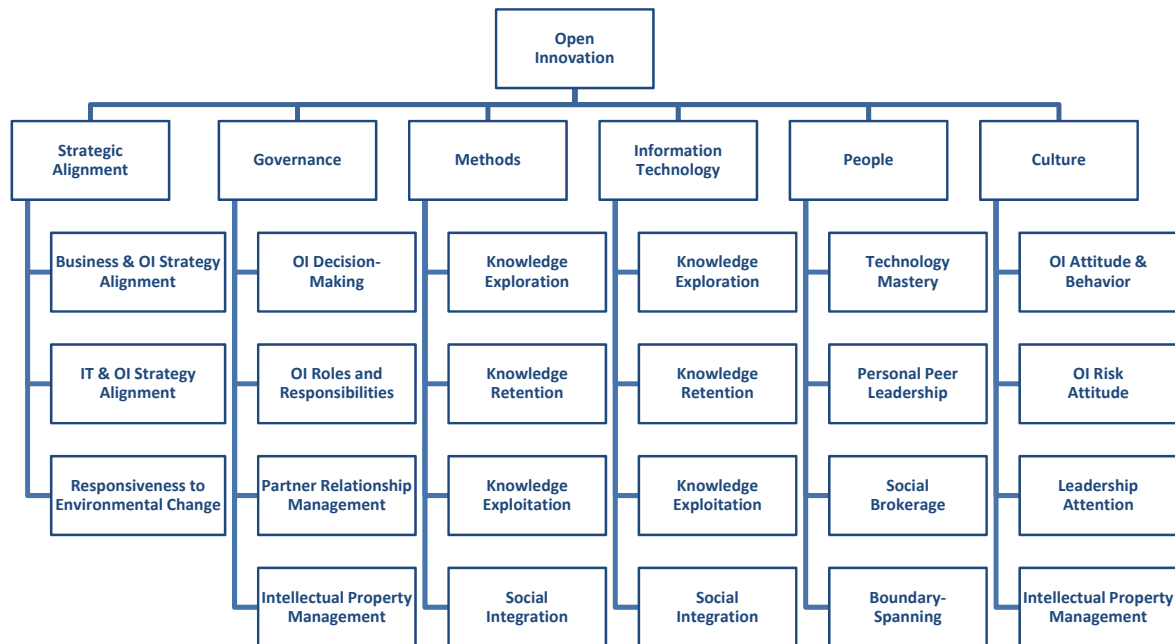
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[1] http://aisel.aisnet.org/
[2] http://search.ebscohost.com/
[3] http://www.sciencedirect.com/
[4] The authors are happy to provide a complete lists of these references upon request.

Disruption, Innovation Management Consultant, Open Innovation Manager, Strategic Manager Open Innovation. This second step enabled us further refine the OICF on the basis of industry feedback. The review followed the same procedure as above. Overall, four academic OI experts and four OI experts from industry participated in the validation of the OICF. Detailed results of both review steps can be found in section 5.2. As, after the second step, the rating was stable and high as well as the experts' feedback indicated consensus with the refined OICF, we refrained from inviting further experts.

4   Open Innovation Capability Framework

In this section, we present the final version of the OICF, which reflects the results of our structured literature review as well as the feedback of the academic and industry OI experts (Figure 1). We first elaborate on the OICF's scope, boundary conditions, and intended use. We then present an overview of the six factors. Finally, we outline the capability areas of each factor, including selected justificatory references.

Figure 1: Open Innovation Capability Framework (OICF)

4.1   Scope, Boundary Conditions, and Intended Use

The OICF's scope comprises the outside-in and coupled OI processes to provide a comprehensive overview of related capabilities. Given its holistic nature, the OICF helps decision-makers prioritize, select, and customize the proposed capability areas. The OICF posits that organizations should carefully analyze the relevance of the distinct capability areas in light of their context (e.g., industry, environmental turbulence, size) (Huizingh, 2011; Schweitzer *et al.*, 2011; Schuster and Brem, 2015). Grimaldi et al. (2013), for instance, have explored different SMEs that successfully implemented OI, and featured different capability profiles depending on their specific OI approach. Then again, depending on the context factor size, smaller organizations might naturally exhibit higher capability levels in specific regards such as decision-making

and responsiveness to environmental changes compared to larger organizations (Rainone *et al.*, 2014). Following Lawson and Samson (2001), we nevertheless argue that there exists a range of core elements that influence innovation outcomes independent from industry- or firm-specific peculiarities. When compiling the OICF, we paid attention to keeping the included capability areas as OI-specific as possible. Thus, the OICF captures capability areas that are specific, but not necessarily unique to OI. Du Chatenier *et al.* (2010) argue that certain capabilities are also required in closed innovation settings, but may require higher maturity levels in OI settings. To enable a straightforward visualization, factors and capability areas were treated as independent. We return to interactions among factors and capability areas (e.g., moderating effects or predecessor/successor relations) in the discussion section.

4.2   Overview of the Critical Factors

The OICF integrates different streams of capability-related OI research. To reflect that OI calls for an integrative perspective combining different perspectives into a broader framework (Vanhaverbeke and Cloodt, 2014), the OICF groups capabilities into the six factors strategic alignment, governance, methods, IT, people, and culture (Rosemann and vom Brocke, 2015). These factors are described as follows.

Strategic Alignment: Successful strategic alignment requires an organization's OI strategy to be aligned with its business and IT strategy. Moreover, organizations must be able to flexibly adapt the employed OI methods in response to changes in their corporate environment.

Governance: OI governance refers to the establishment and operation of appropriate mechanisms to ensure and continuously improve innovation performance. With OI heavily depending on interactions with innovation partners from outside organizational boundaries, organizations must address governance-related issues, such as OI decision-making, roles and responsibilities, partner relationship management, and managing intellectual property (IP).

Methods: To succeed in OI, organizations must develop capabilities related to knowledge exploration, retention, and exploitation. This includes the adoption of appropriate methods (i.e., tools, techniques, and practices) that support knowledge capabilities as well as the underlying social integration mechanisms.

Information Technology: IT can facilitate the knowledge capabilities essential to successful OI as well as the related methods. Therefore, organizations must develop appropriate IT support for knowledge exploration, retention, exploitation as well as social integration capabilities.

People: Individuals and corporate OI teams play an essential role in OI. Important capabilities that can foster innovation performance are technology mastery, personal peer leadership, social brokerage, and boundary-spanning. These capabilities need not necessarily be held by all individuals. Rather, organizations must ensure to dispose of sufficient individuals placed in the right functions or dedicated teams that have these capabilities.

Culture: Compared with closed innovation, OI calls for a different mindset. Employees need to change their practices with respect to dealing with ideas, knowledge, and technologies. Cultural values and beliefs can be as vital for OI as formal practices, which is why organizations must implement an innovation culture that enables and promotes OI activities. Related capabilities are OI attitude and behavior, risk attitude toward OI, leadership attention as well as an attitude towards IP management.

4.3 Overview of the Capability Areas

4.3.1 Strategic Alignment

Business and Open Innovation Strategy Alignment: Openness in terms of search breadth (i.e., the number of external sources and channels involved in OI) and search depth (i.e., the intensity of single collaborations) is a strategic choice. To benefit from OI, organizations must align their OI strategy with their business strategy. For example, the appropriate degree of openness of a market defender substantially differs from that of an opportunity-seeking prospector. An appropriate degree of openness that goes along with corresponding internal structures and processes is essential for improving the organization's innovation performance through OI. (Justificatory references: Bader and Enkel, 2014; Keupp and Gassmann, 2009; Lazzarotti and Manzini, 2009; Saebi and Foss, 2015)

IT and Open Innovation Strategy Alignment: Different OI strategies in terms of search breadth and search depth must be supported by an appropriate IT strategy. In the context of OI, flexibility and integration are critical properties of an organization's IT strategy. Flexibility enables organizations to obtain knowledge from a broad variety of external partners and across various channels by quickly adjusting IT applications. Integration enables organizations to integrate communication technologies and collaboration platforms with external knowledge sources. Integration is characterized by deep links among the innovation partners' IT infrastructures. OI strategies oriented toward search breadth require more flexibility. OI strategies oriented toward search depth require tighter integration. *(*Justificatory references: Cui *et al.*, 2015)

Responsiveness to Environmental Change: In light of an ever faster changing corporate environment, organizations must be able to adjust not only their business and IT strategies but also the methods used for knowledge exploration, retention, and exploitation in the OI context. To achieve superior innovation performance over time, organizations need to reconfigure their knowledge capabilities depending on how markets and technologies change. This reconfiguration may include the flexible adaptation of OI methods, such as how to integrate knowledge of customers or how to access the knowledge of relevant startups to better fit environmental changes. (Justificatory references: Bader and Enkel, 2014; Lichtenthaler and Lichtenthaler, 2009; Schweitzer *et al.*, 2011)

4.3.2 Governance

Open Innovation Decision-Making: Depending on the nature of an innovation problem, organizations must decide on an appropriate governance model. Organizations require the ability to decide when to use specific open forms (e.g., partnerships, innovation contests, communities) and closed forms of innovation (e.g., authority-based, consensus-based hierarchy). In turn, different governance models require distinct approaches to project management and selection. This requirement is why OI needs decision-making that enables a comparative analysis of different governance models. Furthermore, OI requires well-defined procedures regarding the assignment of IP emerging from OI among collaborators, the compilation of OI teams, and the definition of OI success. (Justificatory references: Du *et al.*, 2014; Du Chatenier *et al.*, 2010; Felin and Zenger, 2014)

Open Innovation Roles and Responsibilities: Clearly defined OI roles and responsibilities help ensure the successful adoption and execution of OI activities. Specific roles and responsibilities regarding gate keeping, boundary-spanning, promoting, or championing facilitate the successful incorporation and utilization of relevant external knowledge. In particular, complementary roles such as idea scouts and idea connectors are meaningful in creating successful OI outcomes. Roles and responsibilities also prevent the "absorptive capacity problem", i.e., too many external ideas exist to manage, and the "attention allocation

problem", i.e., ideas are not taken seriously or given the required level of attention to exploit them in the event of idea abundance. (Justificatory references: Chesbrough and Crowther, 2006; Lüttgens *et al.*, 2014; Whelan *et al.*, 2011; Whelan *et al.*, 2013)

Partner Relationship Management: The ability to integrate external knowledge is fundamental to OI, possibly requiring the selection of external innovation partners who possess relevant knowledge. Thus, organizations require appropriate partner selection processes to ensure that the right partners are selected while accounting for diversity within the portfolio of innovation partners. Such governance mechanisms ensure that internal capabilities and external relationships complement rather than substitute one another. Further, organizations must actively take care of OI partners as well as within the partner portfolio (or communities) to maintain their motivation for ongoing collaboration. (Justificatory references: Dahlander and Gann, 2010; Enkel *et al.*, 2009; Enkel *et al.*, 2011; Nooteboom *et al.*, 2007)

Intellectual Property Management: IP becomes even more strategically important in OI. A higher degree of openness increases the challenge of protecting one's IP. However, selectively revealing information to and exchanging information with OI partners can pay off through an improvement in the quality of returned information with the amount of initially revealed information. Therefore, organizations need the ability to balance and selectively define the optimal amount of information to disclose (disclosure capability). (Justificatory references: Habicht *et al.*, 2012; Henkel, 2006)

4.3.3 Methods

Knowledge Exploration: Knowledge exploration is split into internal and external knowledge exploration. Internal knowledge exploration requires methods that help develop inventive capacity, i.e., the ability to create and integrate knowledge. External knowledge exploration refers to methods to develop potential absorptive capacity, i.e., the ability to acquire and assimilate knowledge from external sources. Inventive capacity or a basic research capability fosters the acquisition and assimilation of external knowledge and can be viewed as an "admission ticket" to other information networks. The complementary nature of internal and external knowledge exploration calls for an integrative approach when implementing OI. If absorptive capacity is not sufficiently developed, external intermediaries can assist in identifying and translating valuable external knowledge to make it easier to internalize external knowledge. (Justificatory references: Huang and Rice, 2009; Lichtenthaler and Lichtenthaler, 2009; Rosenberg, 1990; Spithoven *et al.*, 2011)

Knowledge Retention: Organizations must be able to maintain knowledge inside and outside their boundaries. Internal knowledge retention (transformative capacity) refers to methods for incorporating explored knowledge into the internal knowledge base and for keeping this knowledge "alive" over time. Keeping knowledge alive makes it easier to reactivate and combine existing knowledge with new explored knowledge. External knowledge retention (connective capacity) refers to maintaining knowledge in inter-organizational relationships (e.g., alliances). External knowledge retention helps organizations enter into exchange relations with other organizations and extends its internal knowledge base, which allows for greater innovativeness. (Justificatory references: Dreiling and Recker, 2013; Lichtenthaler and Lichtenthaler, 2009)

Knowledge Exploitation: Knowledge exploitation refers to leveraging explored and retained knowledge. Internal knowledge exploitation (innovative capacity) refers to methods used to transmute and commercialize knowledge into products or services. External knowledge exploitation (desorptive capacity) refers to external outward knowledge transfer, such as out-licensing. Although the inside-out process of OI is out of

the scope of the OICF, we mention external knowledge exploitation for the sake of completeness. (Justificatory references: Lichtenthaler, 2011; Lichtenthaler and Lichtenthaler, 2009)

Social Integration: Social integration mechanisms require methods that facilitate the interaction, coordination, and communication among OI partners. Formal (e.g., coordinators) and informal (e.g., social networks) social integration methods foster the connectedness of innovation partners and help achieve a shared understanding. Cultivating social interactions, which is a central precondition for innovation, helps achieve better innovation results. (Justificatory references: Whelan *et al.*, 2011; Zahra and George, 2002)

4.3.4 *Information Technology*

Knowledge Exploration: Leveraging external knowledge sources is central to OI. To support external knowledge exploration, organizations need to provide IT that enhances the recognition and understanding of knowledge from external sources. IT-enabled knowledge exploration may include environmental scanning techniques (including search platforms such as InnoCentive) or advanced data mining tools that help search web pages, the scientific literature, and global patent databases for relevant ideas and technologies. (Justificatory references: Cui *et al.*, 2012; Dodgson *et al.*, 2006; Joshi *et al.*, 2010; Whelan *et al.*, 2011)

Knowledge Retention: IT such as knowledge repositories or organizational memory systems can support both maintaining relevant knowledge and reactivating it later to leverage absorbed external knowledge. Retaining knowledge over time and keeping it "alive" is critical to OI because doing so facilitates the combination of existing and new knowledge resulting from external knowledge exploration. (Justificatory references: Cui *et al.*, 2012; Gammelgaard and Ritter, 2005; Joshi *et al.*, 2010)

Knowledge Exploitation: IT-enabled knowledge exploitation helps commercialize internally and externally explored, as well as retained, knowledge. Information technologies, such as simulation tools or computer-based design applications (e.g., CAD or CAM systems), support knowledge exploitation. Technologies such as CAD may also enable the incorporation of external sources into the design of new products. (Justificatory references: Cui *et al.*, 2012; Dodgson *et al.*, 2006; Joshi *et al.*, 2010)

Social Integration: IT-enabled social integration facilitates communication and connectedness among innovation partners, which allows for better innovation results. The use of IT can enable both formal (e.g., online conferencing tools, groupware systems) and informal (e.g., blogs, e-community) social integration mechanisms to support and accelerate communication among innovation partners within and beyond organizational boundaries. Furthermore, organizational network analysis techniques can enable teams or organizations to analyze internal and external network structures to identify how to more effectively leverage innovative ideas. (Justificatory references: Cui *et al.*, 2012; Datta, 2012; Joshi *et al.*, 2010; Whelan *et al.*, 2011)

4.3.5 *People*

Technology Mastery: The use of modern (information) technology is beneficial to OI. Accordingly, individuals are required to master tools and technologies relevant for OI to ensure that they are used to the maximum effect. This includes using and understanding, for instance, search engines, data mining tools, collaboration platforms, or WEB 2.0 technologies (e.g., wikis, blogs, multimedia online toolkits). (Justificatory references: Dodgson *et al.*, 2006; Habicht *et al.*, 2012)

Personal Peer Leadership: OI can occur in the absence of formal structures and hierarchy. Individuals with personal peer leadership capabilities can motivate innovation partners in a coherent manner toward a common goal (cohesion) and ensure goal achievement through coordinated efforts (locomotion). Therefore,

peer leadership helps ensure OI progress and success despite, or simply because of, the absence of formal hierarchies. (Justificatory references: Carson *et al.*, 2007; Fichter, 2009; Habicht *et al.*, 2012)

Social Brokerage: The incorporation of external ideas and technologies brings along the challenge of identifying and linking those innovation partners who are needed to leverage knowledge from external sources. Individuals with social brokerage capabilities are able to connect the right actors that would normally not be in contact and, thus, ensure that external ideas and knowledge are utilized. By connecting otherwise disconnected actors, social brokerage capabilities assist in overcoming network distance and fostering OI success. (Justificatory references: Du Chatenier *et al.*, 2010; Habicht *et al.*, 2012; Whelan *et al.*, 2011)

Boundary-Spanning: OI partners often bring along diverse knowledge backgrounds. This diversity can be seen as a source of creativity, which is a critical success factor for innovation in general and for OI in particular. However, if diversity results in social or communicative dilemmas attributable to limited mutual understanding among innovation partners, OI projects are likely to fail. Individuals with boundary-spanning capabilities are able to cope with knowledge heterogeneity by translating and relaying information and, thereby, facilitating dialogue between multiple worlds. In this way, boundary-spanning enables cognitive distance to be overcome and mutual understanding and conjoint reframing to be established among partners within and outside organizational boundaries. (Justificatory references: Fichter, 2009; Fleming and Waguespack, 2007; Habicht *et al.*, 2012)

4.3.6   Culture

Open Innovation Attitude and Behavior: Successfully shifting from closed to OI requires organizations to overcome the not-invented-here (NIH) syndrome, which reflects a negative attitude toward external knowledge exploration. The NIH syndrome may lead to a biased and incorrect evaluation of external ideas and technologies. Another barrier of OI to be overcome is the "not-connected-here" attitude, which reflects a negative attitude toward external knowledge retention, e.g., attributable to a lack of trust in innovation partners. Both the NIH syndrome and the "not-connected-here" attitude impede exchange relations with innovation partners. (Justificatory references: Herzog and Leker, 2010; Lichtenthaler, 2011)

OI Risk Attitude: By definition, innovation bears the risk of failure. In terms of OI, external (technology) sourcing may be perceived as an even greater risk given a higher level of uncertainty compared with internal (technology) sourcing. Being too risk averse and attempting to minimize risk by implementing too many risk filters may vehemently slow down the innovation progress, potentially leading to missed windows of opportunity. To benefit from OI, organizations require an innovation culture that is tolerant toward entrepreneurial risk taking. *(*Justificatory references: Cheng and Huizingh, 2014; Chesbrough, 2006a; Herzog and Leker, 2010)

Leadership Attention: The level of leadership commitment and attention impacts the effectiveness of OI. Top management must create a climate conducive to OI. The articulation of visionary goals and top-down encouragement involves written and spoken communication. Success stories can be used to encourage employees to actively search outside of an organization for new ideas and technologies. By implementing appropriate incentives, top management can also foster employees' engagement throughout different hierarchy levels in OI activities. Incentive structures that foster acquiring innovation from external sources can support moving from a not-invented-here to a proudly-found-elsewhere (invented anywhere) attitude. (Justificatory references: Enkel *et al.*, 2011; Herzog and Leker, 2010; Witzeman *et al.*, 2006)
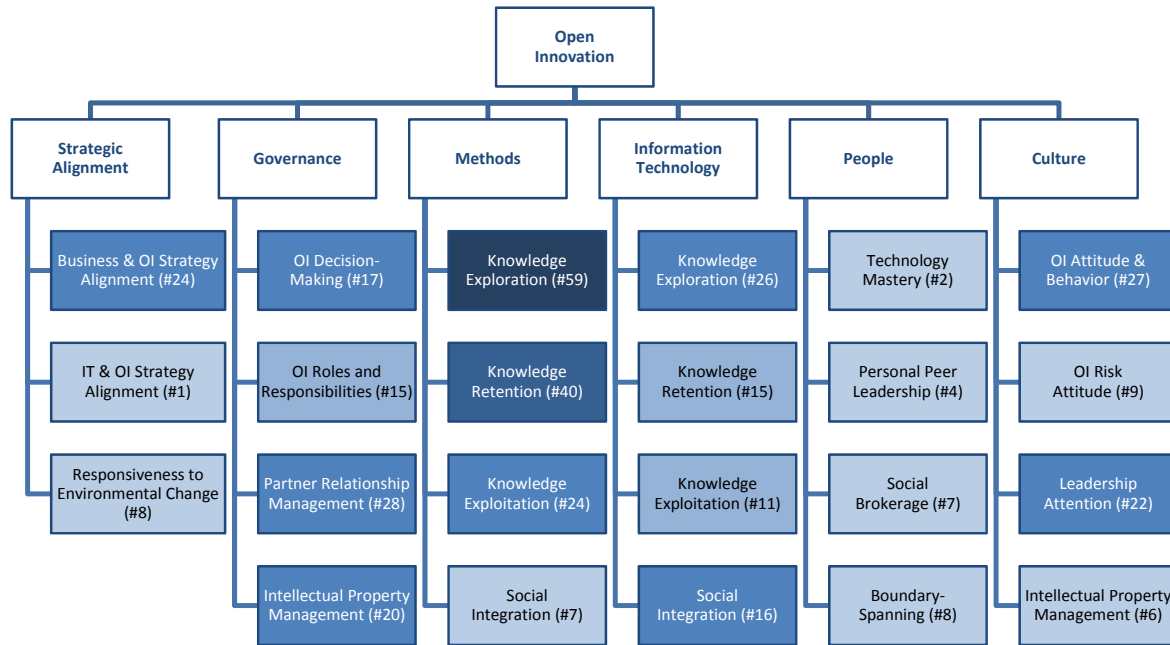
Intellectual Property Management: Compared with closed innovation, OI entails not only governance-related changes but also cultural changes regarding IP. Thus, legal and IP departments must adopt a constructive attitude supportive of OI. Instead of taking an excessive protective position, legal and IP departments should seek win-win situations, meaning that revealing knowledge to innovation partners or communities can pay off as the quality of returning information improves with the amount of initially revealed information. An overprotective attitude may lead individuals to avoid external engagement given the perceived personal and professional risks of the unplanned disclosure of information. (Justificatory references: Enkel *et al.*, 2011; Salter *et al.*, 2014)

5   Discussion

5.1   Results of the Literature Review

We now discuss the results of the literature review, which stem from the first research phase. To derive well-covered as well as neglected areas of capability-related OI research, we classified the papers identified in the literature review according to the OICF. We then compare the scope of the OICF with that of other existing OI-related capability frameworks to substantiate the OICF's value added.
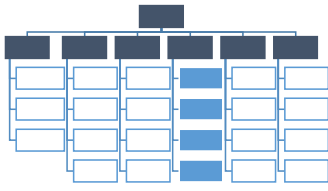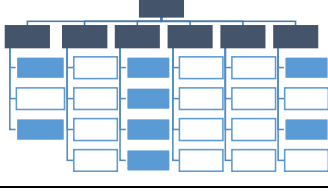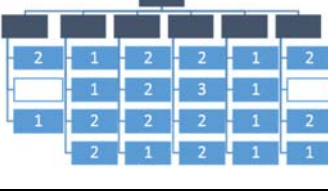
The heatmap in Figure 2 illustrates the results of our literature review, containing the number of papers that address or highlight one or more of the capability areas included in the OICF. The shadings of blue indicate whether a capability area is well-covered (dark blue) or under-researched (light blue). Figure 2 shows that there are capability areas that have been intensely discussed (e.g., knowledge exploration and knowledge retention from a method perspective) as well as capability areas that have been neglected so far (e.g., IT and OI strategy alignment, technology mastery, or personal peer leadership). In sum, the capability areas that relate to the factors methods, governance, and IT have received most attention – apart from few exceptions such as social integration from a method perspective. In contrast, capability areas that relate to the factors strategic alignment, people, and culture have been researched much less frequently and fragmentarily – again apart from exceptions like OI attitude and behavior, leadership attention, or business and OI strategy alignment. The people factor is the least frequently researched factor of the OICF.

Figure 2: Heatmap of the OICF based on the Literature Review

Additional insights can be gained when comparing the OICF's scope with that of other OI-related capability frameworks. As a preparatory task, we mapped existing frameworks to the OICF. We treated a capability area as covered even if a framework only touches on the respective topic. The mappings shown in Table 2 thus tend to overestimate the coverage of existing frameworks. Some frameworks such as that by Joshi *et al.* (2010) are specialized, whereas other frameworks such as that by Enkel *et al.* (2011) cover a broader range of capability areas. As shown in the last row of Table 1, existing OI-related capability frameworks focus on the factors methods, governance, and IT. In contrast, they address the factors strategic alignment, people, culture much less intensely and fragmentarily. This finding is in line with the results of the literature review shown in Figure 2 as well as with the experts' feedback, which we discuss below. The last row of Table 2 also demonstrates that the union of all existing OI-related capability frameworks does not equal the scope of the OICF. The OICF includes further areas (i.e., IT and OI strategy alignment and OI risk attitude) that resulted from the literature review.

Alternative Frameworks	Covered Capability Areas
Enkel *et al.* (2011)	
Habicht *et al.* (2012)	

Joshi *et al.* (2010)	
Lichtenthaler and Lichtenthaler (2009)	
Aggregation of all OI-related capability frameworks from above (including counting)	

■ : covered capability area

Table 1: Comparison of the OICF with existing OI-related Capability Frameworks

5.2   Results of the Expert Validation

Having discussed the results of the literature review and compared the scope of the OICF with that of other OI-related capability frameworks, we now turn to discussion points that arose during the OICF's validation by OI experts from academia and industry. In line with the results so far, the experts' feedback primarily related to the factors strategic alignment, culture, and people as well as to interactions among specific factors and capability areas. When discussing the experts' feedback below, we also take a literature perspective to derive avenues for future research. First of all, we present the experts' rating results.

5.2.1   Rating Results

As outlined in section 3, we conducted a two-step review process with experts from academia and industry to validate and refine the OICF. Figure 3 shows the rating results of both steps. In order to allow for a more detailed analysis, we let capability areas and factors rate separately. For almost all factors and capability areas, the rating increased from the first to the second review step. The average rating increased from 4.6 in the first step to 5.2 in the second step. Likewise, the average standard deviation per capability area decreased from 1.19 to 0.94. Interestingly, the factor IT and some related capability areas as well as the capability areas IT and OI strategy alignment and technology mastery received the lowest rating results.

	Average agreement	
	OI experts from academia (1st step)	OI experts from industry (2nd step)
Strategic Alignment	4.3	5.5
Business & OI Strategy Alignment	4.8	5.3
IT & OI Strategy Alignment	3.8	4.0
Responsiveness to Environmental Change	4.0	4.8
Governance	4.4	5.5
OI Decision-Making	4.3	5.3
OI Roles and Responsibilities	4.3	5.3
Partner Relationship Management	4.5	5.8
Intellectual Property Management	3.8	5.5
Methods	4.5	5.3
Knowledge Exploration	4.8	5.0
Knowledge Retention	5.0	4.8
Knowledge Exploitation	4.3	5.7
Social Integration	4.8	5.8
Information Technology	4.3	4.3
Knowledge Exploration	4.7	5.0
Knowledge Retention	5.0	4.3
Knowledge Exploitation	4.3	4.3
Social Integration	4.3	4.8
People	4.8	5.3
Technology Mastery	3.5	4.0
Personal Peer Leadership	3.5	5.3
Social Brokerage	4.5	5.5
Boundary Spanning	5.3	6.0
Culture	5.8	5.3
OI Attitude & Behavior	5.5	5.5
OI Risk Attitude	5.3	5.3
Leadership Attention	5.3	6.0
Intellectual Property Management	5.5	5.5

Remark: Capability areas and factors were rated separately (i.e., no aggregation) to allow for a detailed analysis,
1 = strong disagreement, 6 = strong agreement.

Figure 3: Results of Validating the OICF with OI Experts from Academia and Industry

5.2.2   Strategic Alignment

The validation by the OI experts confirmed the importance of an organization's strategic alignment regarding OI. One academic OI expert mentioned: "*my research shows that strategy and culture are both influence factors on a company's open innovation strategy*". Organizations must align their OI strategy with their business strategy to benefit from implementing OI. Another expert stated that the biggest challenge is to "*define the right open innovation aim regarding the business strategy*". Another academic OI expert indicated that context factors strongly affect an organization's strategic orientation. Chesbrough and Appleyard (2007) coined the term "Open Strategy". Traditional business strategies induce organizations to create barriers to their environment instead of promoting openness. This way of thinking often leads to the neglect or underestimation of OI's potential. However, strategic analysis must consider that openness is not for free. Laursen and Salter (2006) point out respective limitations of OI. Using a statistical analysis of 2,707 firms, they reveal an inverse U-shaped relationship between openness and an organization's innovation performance. This result indicates that, beyond an optimal level of openness, the costs of including more innovation sources exceed the benefit. West and Bogers (2014) label this phenomenon "limits to search",

e.g., attributable to increased costs concerning communication and control. Despite Chesbrough and Appleyard's (2007) call for a more in-depth analysis of strategic orientation in terms of open strategy and OI, Vanhaverbeke and Cloodt (2014) argue that hitherto the link between OI and an organization's business strategy has still been largely neglected, highlighting that future research should focus on the strategic alignment between OI implementation and business strategies. Our paper sample shows that very recent research responded to this call. Bader and Enkel (2014) derive that successful utilization of OI depends on its fit with the organization's overall business strategy. They form distinct strategy archetypes and derive corresponding OI behavioral characteristics that help organizations and innovation managers follow an innovation model that suits their strategic objectives. Saebi and Foss (2015) are the first to systematically investigate different OI strategies (market-based, crowd-based, collaborative, and network-based) and their implications for an organization's business model. Their research reveals that different OI strategies must be aligned with an appropriate business model to ensure that OI can be successfully leveraged. Further, in an empirical study of 223 firms, Cheng and Huizingh (2014) examine the role of an organization's strategic orientation to propose when OI is beneficial. The study supports that a more explicit strategic orientation in terms of entrepreneurial, market, and resource orientation fosters OI effectiveness because each component positively affects the relation between OI and innovation performance. Another strategic alignment perspective is the relationship between an organization's IT and OI strategy. Our study revealed that research on this subject is very limited. Although much work has been done on the role of information systems and IT in enabling OI (Whelan *et al.*, 2014; Cui *et al.*, 2012; Joshi *et al.*, 2010), little has been done on how different IT strategies affect OI strategies. In particular, only one paper draws on the strategic IT alignment perspective regarding OI (Cui *et al.*, 2015). Strategic IT alignment can have different impacts on innovation outcomes (e.g., in terms of innovation radicalness and innovation volume). Cui *et al.* (2015) reveal that different OI strategies in terms of search breadth and depth can be supported by an appropriately aligned IT strategy with respect to IT flexibility and IT integration, whereas a misalignment of IT strategy and OI strategy leads to inferior innovation outcomes. Although their study provides first insights into the strategic IT alignment perspective, future work could focus on research that enables organizations to measure the explicit business value of distinct IT strategies in enabling and leveraging OI.

5.2.3 Culture

Without a doubt, culture affects innovation success. Validation regarding culture raises discussion points about the characteristics of a culture that is conducive to OI. Is there, at all, such a thing as an "*open innovation culture*" or is just "*general good innovation culture*" required for successfully implementing OI, as stated by one OI experts? We agreed on the relevance and importance of the proposed capability areas related to culture, but concluded that no specific OI culture exists, indeed "*different degrees of openness that enable different strategies and activities*" exist. Accordingly, a more granular differentiation within an organization's culture is required. One OI expert highlighted that one overarching culture does not necessarily exist across an organization. Instead, different subcultures exist because "*a low degree of openness in one organization unit could require focusing more on closed instead of open innovation behavior*". Additionally, we discussed that culture may have implications on other factors and capability areas. For instance, regarding IT, one academic OI expert pointed out that "*culture also determines the knowledge management strategy possible (e.g., codification versus personification)*". Codification refers to an approach in which knowledge is codified and stored in databases, whereas personification refers to an approach in which IT is "only" a tool to communicate knowledge but not to store it because, in this case, knowledge is primarily tied to the people who developed it (Gammelgaard and Ritter, 2005; Hansen *et al.*, 1999). In this regard, it was further stated that, "*IT increases efficiency in open innovation, but the extensive*

use of IT could be restricted by the innovation culture". However, "*tacit knowledge can hardly be accessed and handled with IT systems*" which constitutes a drawback of IT and might be the main reason why the factor IT was rated 4.3 on average – and therefore being inferior to the other factors. Further, another inter-dependency in terms of a moderating effect was mentioned. For instance, the adoption and necessity of the capability area OI roles and responsibilities may depend on the underlying culture. One OI expert remarked that "*in entrepreneurial cultures with empowered employees there might not be a need for dedicated roles and responsibilities*". OI experts from practice highlighted the interplay between culture and governance, in particular the interplay among capabilities related to OI decision-making and risk attitude. "*Risk attitude is connected to the governance section, and especially with the capacity to the reduction of time between decision and action* […] *decision-making is a very important aspect of success of open innovation. The time parameter in decision-making is crucial; an organization which can reduce the time between decision and action will have a crucial competitive advantage*". However, it was mentioned that, in practice, many organizations miss windows of opportunity and lose value through innovation latency attributable to non-lean processes of decisions and actions. Another interesting aspect is the consideration of predecessor/suc-cessor relations. As previously mentioned, both an organization's business strategy and its culture influence its OI strategy. However, in this context, one academic OI expert stated that "*research has yet not proven what comes first: strategic alignment for open innovation or open innovation-enabling culture*". In general, although organizational culture has been identified to affect OI success, relatively little research has been conducted (West and Bogers, 2014). The literature does not provide sufficient answers to the raised ques-tions. Regarding moderating effects, Lichtenthaler (2011) provides a conceptual framework that, among others, comprises individual-level attributes regarding organizational capability development. Inappropri-ate individual-level attributes and behavior, such as "not-invented-here" or "not-connected-here" can influence and inhibit the development of organizational capabilities (e.g., absorptive capacity, connective capacity) and thus constitute OI barriers (Lichtenthaler, 2011). In light of the limited research regarding an OI-enabling culture, the work of Herzog and Leker (2010) constitutes a noteworthy exception. Their work is the first to empirically investigate OI cultures, providing the first support for cultural differences within open and closed innovation settings. Apart from Herzog and Leker (2010), we found no related research that investigates cultural dimensions and differences between open and closed innovation units within an organization. Therefore, we recommend further research regarding OI-enabling culture in terms of moder-ating effects and predecessor/successor relations with respect to other factors and capability areas.

5.2.4 People

As the driving force, the people involved in OI activities play an essential role for innovation success. Major discussion points regarding people as a critical factor were related to how capabilities required in OI settings differ from those in more closed settings. In this regard, for instance, one OI expert stated that the capability area "technology mastery" is also required in any other innovation-related activity. Importantly, we note that the OICF captures capability areas that are specific but not always necessarily unique to OI. Further, the people factor was noted as not implying that all employees must possess the comprised capabilities, as one OI expert stated exemplarily, "*not every engineer needs to scout for external technologies or build up a network. Companies need dedicated people in the right function to ensure their level of openness*". Both OI experts from academia and practice particularly highlighted the importance of boundary-spanning skills. Facilitating dialogues between multiple worlds is critical since "*a lot of new advantages will come from industries which seem unrelated*". In this respect, another expert referred to the concept of cognitive dis-tance "*in order to understand the optimal cognitive distance between the focal individual or company and their desired external solution or knowledge*". Within technology-based alliances, Nooteboom *et al.* (2007)

reveal a tradeoff between the opportunity of gaining new knowledge and the risk of misunderstanding among innovation partners. Cognitive distance has an inverted U-shaped effect on innovation performance and "to deal with this, firms should seek partners that are at an optimal cognitive distance" (Nooteboom *et al.*, 2007, p.1031) (which has also direct implications for the capability area partner relationship management). In general, our paper sample indicates that most studies tend to neglect the human side of (open) innovation, as also noted by Du Chatenier *et al.* (2010), Gassmann *et al.* (2010), and Kanter (2006). The literature poses questions similar to those from our discussion. Using exploratory interviews and focus groups, Du Chatenier *et al.* (2010) propose a competence profile for OI professionals and highlight that, for instance, brokering solutions are particularly important for OI success. Similarly, Habicht *et al.* (2012) underline the individual-level capabilities that overcome cognitive and network distance to ensure success of OI initiatives. However, Du Chatenier *et al.* (2010) point out that some capabilities might also be required in closed innovation settings, but that the existing OI challenges may require higher skill levels in OI projects. Similar to our discussion, Du Chatenier *et al.* (2010) underline the notion that, according to team theory, not all capabilities must be required by each individual. Specific roles within OI teams may require distinct capabilities and should therefore be considered and assigned accordingly. In this regard, more research is required to identify how capabilities specifically differ between closed and more OI settings accompanied by empirical studies (Du Chatenier *et al.*, 2010).

6 Conclusion

To address the increasing importance of open innovation (OI), we presented the Open Innovation Capability Framework (OICF), compiling 23 capabilities organizations should consider when implementing OI. Following a two-phase research method, the OICF is grounded on the extant body of knowledge (i.e., existing OI-related capability areas and various capability-related OI papers) as well as on the feedback of OI experts from academia and industry. To take a holistic perspective, the OICF groups OI capabilities into the factors strategic alignment, governance, methods, information technology, people, and culture.

From a theoretical perspective, the OICF contributes to the body of knowledge by integrating and extending the scope of existing OI-related capability frameworks. The results of the literature review and the experts' feedback also revealed blind spots, discussion points, and avenues for future research. The results indicate that particularly the human side and the cultural implications of OI have been under-investigated so far and, therefore, represent promising avenues for research. Research is required to identify how individuals' capabilities differ between closed and OI settings. Research should also analyze how cultural dimensions differ between closed and OI settings, accounting for different subcultures in organizations. In this regard, further research regarding an OI-enabling culture in terms of a moderating effect on other factors and capability areas seems promising. Overall, the results of the literature review and the experts' feedback concur that the factors strategic alignment, culture, and people are the less intensely and fragmentarily researched factors of the OICF. The results also indicate that the role of IT in OI requires further clarification because IT-related OI capability areas like alignment of IT and OI strategy as well as technology mastery have not been intensely researched so far and received rather low agreement ratings from the involved OI experts.

From a managerial perspective, the OICF provides OI decision-makers and change agents with an overview of factors and capability areas they should have in mind when engaging in OI. The OICF allows for discovering discrepancies regarding certain factors and capability areas and, thereby, serves as foundation for assessing an organization's as-is and to-be maturity levels regarding the included OI capability areas. The OICF thus helps prioritize and select capability areas against an organization's individual context as well as derive implementation roadmaps. Finally, the OICF directs OI decision-makers' attention to the fact that

succeeding in OI does not only require methods (e.g., knowledge exploration, retention, and exploitation) and governance (e.g., roles and responsibilities, partnership relationship management, and intellectual property management), but also human-centric capabilities (e.g., social brokerage and boundary-spanning) as well as a culture conducive to OI. A synergetic interplay among and within these factors is required in order to successfully implement OI.

Finally, the OICF is beset with limitations that stimulate further research. First, for an organization to apply the OICF, it needs to concretize the framework by accounting for contextual factors. We abstracted from such contextual factors to provide a holistic overview of OI capabilities. Nevertheless, not every organization needs to develop each capability. Depending on an organization's specific OI approach, different capability profiles might be required. Further research should thus focus on specific capability areas in light of contextual factors (e.g., industry, environmental turbulence, size). Second, the OICF does not operationalize the included capability areas. Future research should guide organizations in operationalizing these capabilities and in defining a meaningful sequence of capability development. In this context, following capability maturity models and tailoring them for OI seems promising. Third, OI also comprises the purposive outflows of knowledge, i.e., the externalization of internal ideas and (unused) technologies. However, the OICF focuses on the outside-in and coupled processes. Further research could extend the OICF by incorporating capabilities with respect to the inside-out process.

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