Cross-industry innovation entails distinctive innovation opportunities and challenges according to the knowledge heterogeneity between the collaborating firms, their cognitive distance. While recent theory suggests cognitive distance is positively related to radical innovation, too much diversity hinders efficient knowledge absorption and results in a reduced effect on novelty value. To deal with this and profit from cross-industry innovation in terms of radical innovation, we provide insight how firms can find collaboration partners that are at an optimal cognitive distance and improve their ability to understand and evaluate distant knowledge.

Cross-industry innovation potential

Cross-industry innovation, i.e. the application of established knowledge or technologies of partners from outside the own value chain, has been identified as a key driver of innovation performance in new product development (Enkel & Gassmann, 2010; Gassmann et al., 2010). Whether a partner in a cross-industry collaboration gains incremental or radical results depends on the knowledge heterogeneity between the collaborating firms, referred to as the organizational cognitive distance. Nooteboom (1992, 1999) propose an inverted U-shaped relation between differences in cognitive distance and innovation performance. Subsequently, he and others find out that the innovation potential increases with the increase of cognitive distance (Nooteboom et al., 2007; Wuyts et al., 2005; Gilsing et al., 2008). However, when cognitive distance reaches a certain degree, the effect on novelty value reduces as too much diversity hinders efficient absorption (Cohen & Levinthal, 1990). The crucial implication of these opposite effects is that firms engaging in distant collaboration have to perform the dual task of developing access to heterogeneous sources of knowledge and, at the same time, of ensuring that distant knowledge, once accessed, can be adequately absorbed.

The raised issues suggest that much more remains to be understood about how cognitive distance between cross-industry partners can be assessed and utilized in order to generate radical rather than incremental innovation. We aim at closing this gap by our research investigating (1) how cognitive distance between partners from different industries can be assessed before patent results are created and (2) which specific capabilities firms engaging in distant collaboration possess in order to succeed.

Preparing for distant collaboration

To address this challenge, we developed a new, empirical-based measure that can be used ex ante in order to identify the industry of potential partners according to the intended outcome of the collaboration. Using survey data on 215 bilateral cross-industry collaborations between firms from a variety of industries, we conducted a network analysis and captured cognitive proximity (the inverse of distance) in terms of knowledge redundancy between firms, based on an industry level analysis of structural equivalence. Two industries are structurally equivalent to one another when the aggregate firms from these industries are connected to the same other industry firms in the cross-industry network.

The network graph shown in Figure 1 illustrates the collaboration patterns among industries based on our network analysis. The graph represents the network as a series of nodes, which denote industries, connected by linear ties, indicating the presence and strength of a relationship. Furthermore, the network structure indicates that the nodes automotive and mechanical engineering, for example, have similar ties to other industries (→ cognitive proximity, their knowledge overlaps), whereas there is a strong tendency for automotive to have ties to industries that pharmaceuticals does not, and vice versa (↔ cognitive distance, their knowledge does not overlap).
Second, successful cross-industry innovation, particularly when applied over higher distances, requires a firm to be able to exhibit a high potential absorptive capacity (Zahra & George, 2002; Cohen & Levinthal, 1990) and combine distant pieces of knowledge for radical innovation. Potential absorptive capacity makes firms receptive to understanding and evaluating external knowledge. It prevents them from becoming locked in to a specific field, running the risk of failing to seek out alternative technologies, by providing them with the strategic flexibility to adapt in various industry contexts. In the context of cross-industry innovation, potential absorptive capacity comprises the process stages of

| recognizing potentially valuable external knowledge from other industries,
| assimilating valuable new knowledge and
| maintaining it over time

to set the stage for future knowledge transfer to occur (Zahra & George, 2002; Lane et al.; 2006). Thereby, Zahra & George (2002) propose a positive relationship between a firm's exposure to various and complementary external areas of expertise and its potential absorptive capacity.

Consequently, a highly developed potential absorptive capacity allows a firm to increase its cognitive distance to external partners in cross-industry innovation, as illustrated in Figure 2.
We further examined how firms develop higher potential absorptive capacity for managing high distance collaboration. In order to identify antecedents to capability development, we studied seven companies by conducting interviews and gathering secondary data. The analysis of all case study data reveals three alternative approaches of coordination antecedents that enhance a firm's potential absorptive capacity in order to nurture radical innovation at higher distance:

Firms with a decentralized, well-funded technology sourcing and a large business unit portfolio apply a wide search scope and make regular use of a broad range of mechanisms for recognizing and assimilating distant knowledge. This *innovation flexibility approach* implies an increase in the variability of distant knowledge that can result in both more exploratory innovation and failure (Katila & Ahuja, 2002; Fleming, 2001). The larger the scope of external search activities, the more likely the firms are to identify valuable external knowledge that can be combined with internal knowledge in a novel way (Gary et al., 2012; Fleming & Sorensen, 2001). Similarly, decentralization of decision authority may lead to a larger volume of diverse information as it broadens communication channels and increases the quantity of ideas and knowledge retrieved for problem solving (Jansen et al., 2006). Furthermore, a wide scope on searching for novelty through many decentralized activities increases the proportion of new knowledge to be integrated into a firm's knowledge base (Ahuja & Katila, 2004).

In contrast, firms with a centralized technology sourcing and low resource investments show a much smaller number of mechanisms and apply a problem-oriented, narrow search. When adopting this *resource efficiency approach*, the costs of search and integration of distant knowledge decrease (Henderson & Clark, 1990) while there is a limit to the number of new insights that can be found by applying a narrow search scope (Katila & Ahuja, 2002; Fleming 2001). In other words, firms with a resource efficiency approach run the risk of missing opportunities for innovation but are more resource efficient than companies following the innovation flexibility approach.

Most interestingly, firms with a centralized technology sourcing and reasonable resource investments are also limited in search scope, but stay focused on certain key industries while making additional use of more intelligent mechanisms for recognizing and assimilating distant knowledge. They gain a combinatorial advantage by applying a targeted recognition and assimilation of distant knowledge while simultaneously complementing their external search activities via broadcasting problem information to a diverse community, for example. This *combinatorial approach* allows for a proper balance between the costs of searching and the benefits of acquiring a variability of distant knowledge. On the one hand, given the infinite size of the technological search space outside the industry's boundaries, concentration allows firms to spot opportunities that are really valuable. On the other hand, mechanisms that efficiently leverage external scope in recognizing and assimilating distant knowledge deepen the awareness of what type of external knowledge the firm may need. In turn, they help to develop a more refined filter when actively searching the technological environment for valuable knowledge.

In conclusion, all approaches have yielded promising results, enabling different types of innovative firms to prepare for distant collaboration. Thus, studying certain developmental approach of potential absorptive capacity offers important insights for both researchers and practitioners about how firms may develop important sources of radical innovation.
At a glance – Summary

| Cross-industry innovation entails distinctive innovation opportunities and challenges according to the knowledge heterogeneity between the collaborating firms, their cognitive distance. |
| Cognitive distance between firms from different industries determines whether a partner in the cross-industry collaboration gains incremental or radical results. |
| Our network analysis helps technology managers to assess cognitive distance with potential partners from different industries and guides partner selection according to the intended outcome of the collaboration. |
| Moreover, firms should develop sufficient resources in recognizing, assimilating, and maintaining external knowledge beyond established industry boundaries to enhance potential absorptive capacity and set the stage for future knowledge transfer to occur. |
| Thereby, firms may adopt a certain developmental approach that enhances their potential absorptive capacity in order to nurture radical innovation at higher distance. |

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Further readings