

2 Conceptual Foundation

This chapter outlines the underlying concepts of this study and research questions are framed, based on the identified research gap. The fundamental concept is the OI-approach. Therefore, the first sub-chapter provides information about antecedents and basic principles and gives an overview of prior and current research related to open innovation. Further, the link between open innovation and knowledge management is emphasized. As a result, OI-relevant aspects of knowledge management are discussed in the second sub-chapter. Finally, attention is drawn to the identified research gap and research questions for this study are compiled.

2.1 Open Innovation

The term open innovation can be traced back to the eponymous book of Chesbrough (2003), where he describes the opening up of the conventional, rather closed innovation process and introduces the OI-concept based on observations mainly from high-tech industries. He defines open innovation as *"[...] a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology."* (Chesbrough 2003, p. xxiv) He succeeded in creating a broadly known keyword for the integration of external sources into the innovation process, even though he was not the first to expound this idea.

This chapter provides insights into the OI-phenomenon, although it does not aim to deliver a comprehensive review. In the following, the shift from closed to open innovation is explained and basic principles of open innovation are presented. Thereafter, I give an overview of prior research related to the integration of external innovation sources. Lastly, developments in OI-research and different perspectives on open innovation are introduced.

2.1.1 From Closed Innovation to Open Innovation

The typical innovation process follows a stage-gate scheme (see Cooper 1990, 1996; Verworn and Herstatt 2000) and can be described as a funnel with a broad front end. The front end represents the research component of R&D, where ideas enter the process and start the invention. It follows the idea realization and development phase, where promising ideas are realized and the development part of R&D begins. In the commercialization stage, inventions are transformed into innovations and brought to the market. (cf. Herzog 2008, p. 11; Nelson and Winter 1982, p. 263; Schumpeter 1934, pp. 88f)

In the conventional, vertical integrated innovation process, all R&D efforts are centralized and take place solely in-house (see Chandler 1977). As shown in Figure 1, the company

relies on its own knowledge base and only internal ideas gain access to the innovation process. The R&D department uses the most promising ideas to develop products, which are finally marketed and distributed by the company. Chesbrough calls this a “closed innovation” model, because ideas and products can enter and respectively leave the process only at one point. (cf. Chesbrough 2006c, p. 2)

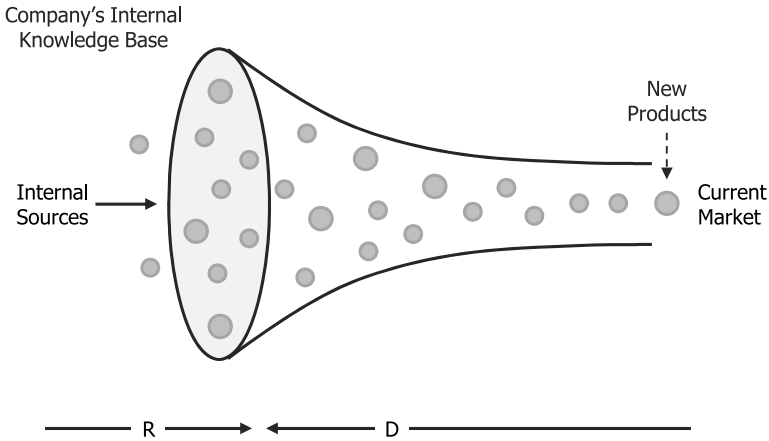


Figure 1: Closed Innovation Model²

For a long time, this approach proved very successful for companies. They heavily invested in their R&D and were able to achieve breakthrough innovations. They transformed them into new products and sold the products, which yielded higher margins and increased profits. In turn, these were reinvested in R&D (cf. Chesbrough 2003, p. xxi). This approach helped companies to grow, to protect and control their intellectual property resulting from the innovation process, and to enhance their knowledge base (cf. Chesbrough 2003, p. 34). However, the R&D centralization isolated the experts in one company from their peers in others. Over time, this encouraged R&D employees to believe high quality could only be achieved internally, which, in turn, promoted a preference for internal solutions (even if inferior to external alternatives) and created the NIH-syndrome³ (cf. Chesbrough 2003, pp. 29f.; Möslin and Neyer 2009, p. 88). Clagett (1967) was the first scholar to address the NIH-syndrome directly. In his work, he described it as negative attitude of a technical organization towards ideas and innovations from outside the organization (cf. Clagett 1967,

² Illustration: cf. Chesbrough 2006c, p. 3

³ The NIH-syndrome predominantly affects R&D employees and relates to external ideas/knowledge/technologies coming into a company. With the Not-Sold-Here (NSH) syndrome, Chesbrough 2003, pp. 186ff. introduced the business counterpart to the R&D-typical NIH-syndrome. The NSH-syndrome is related to internal ideas/knowledge/technologies that leave the company to be used externally. It can best be described as a negative attitude of the business toward the outflow of internally developed ideas/knowledge/technologies for external use.

p. ii). In a later article, the NIH-syndrome “[...] *is defined as the tendency of a project group of stable composition to believe it possesses a monopoly of knowledge of its field, which leads it to reject new ideas from outsiders to the likely detriment of its performance.*” (Katz and Allen 1982, p. 7) This definition expands the first one, as it explains corporate resistance to adapting external ideas (belief in internal knowledge monopoly) and at the same time points out the consequences (impairment of company performance). The NIH-syndrome is likely to have a negative effect on company performance because the internal R&D depends on impulses coming from outside to keep pace with (technical) progress, i.e., R&D employees have to be able to gather and process information from external sources to increase the company’s internal knowledge base and keep it up to date (cf. Katz and Allen 1982, p. 7). This implies it is impossible even for a company with the brightest employees to have all relevant knowledge and expertise in-house, which represents one of the constitutive assumptions of the OI-approach (cf. Chesbrough 2003, p. xxvi, 2006c, p. 2). Over the years, this became clear to more and more companies, which consequently began to open up their innovation processes. According to Chesbrough (2003, pp. 34ff.), this shift from closed innovation models to OI-models was facilitated in particular by the growing availability and mobility of experienced and qualified people. Advances in information and communication technologies and their increased availability further supported the establishment of the OI-approach in various industries (cf. Chesbrough and Brunswicker 2013, p. 6; Dodgson et al. 2006, pp. 333ff.; West and Bogers 2014).

Figure 2 depicts the OI-model.⁴ The company border is permeable and allows interaction between the company and its environment during the entire innovation process. Contrary to closed innovation (see Figure 1), internal as well as external ideas can enter the innovation process at the front end. Furthermore, external impulses can also enter during later phases, e.g., the development stage (cf. Chesbrough 2006c, pp. 2f.). Another fundamental difference is that the OI-approach appreciates the outflow of promising ideas (e.g., in form of licensing or spin-offs), where ideas do not fit with the intended business model and would not be advanced in-house, but could flourish within other business models (cf. Chesbrough 2006c, p. 8). Therefore, Chesbrough (2006c, p. 1) extended his first definition of open innovation as follows: “[...] *Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.*” Furthermore, he underlined the central role of the business model (cf. Chesbrough 2006c, p. 8).

⁴ The difference between inbound and outbound open innovation will be explained in chapter 2.1.3.1.

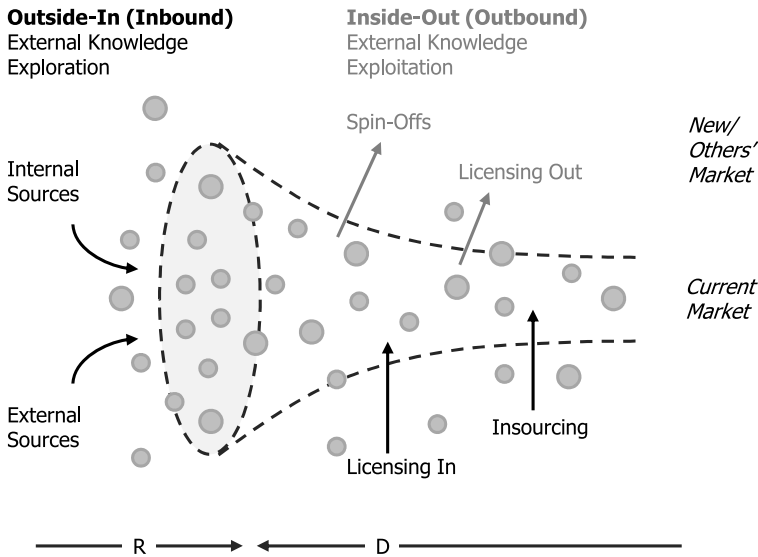


Figure 2: Open Innovation Model⁵

As already mentioned, the OI-concept assumes it is impossible for a company to have all of the required expertise and suitable knowledge in-house (cf. Chesbrough 2006c, p. 2). Useful knowledge is rather expected to be widely distributed and of generally high quality (cf. Chesbrough 2006c, p. 9). Moreover, internal and external knowledge is considered to be equally important for a company (cf. Chesbrough 2006c, p. 8).⁶ Thus, knowledge exchange with external sources is necessary and valuable. In order to optimize the outcome of the innovation process, companies should try to find the appropriate balance between internal and external R&D (cf. Chesbrough 2003, p. xxvi).

2.1.2 Prior Research with Focus on External Innovation Sources

By introducing the OI-concept, Chesbrough succeeded in creating a broadly known term for the integration of external sources into companies' innovation processes and the appreciation of related knowledge inflows and outflows. Of course, Chesbrough's work was not detached from prior research and not all underlying ideas were completely novel. His research was based on – and is in line with – many previous studies. Due to this fact and the popularity of the open innovation term, it is not surprising some critics have described it as "[...] *old wine in new bottles*." (Trott and Hartmann 2009, p. 1) But even if its actual degree

⁵ Illustration: cf. Chesbrough 2006c, p. 3

⁶ It is also considered equally important that innovations find internal as well as external ways (e.g., licensing, spin-offs) to market (cf. Chesbrough 2006c, p. 1).

of novelty is arguable, the OI-approach definitely complemented prior concepts by explicitly addressing some underlying principles, e.g., the equal importance of internal and external knowledge and the central role of the business model (see Chesbrough 2003). Furthermore, Chesbrough successfully labeled a collection of previous developments and research activities and so coined an umbrella term for a variety of phenomena:

"By giving it a label, it got a face, and the following stream of studies gave it a body too."
(Huizingh 2011, p. 3)

This made it easier especially for practitioners to communicate.⁷ Although not everybody might have exactly the same understanding of open innovation, it at least established a common denominator. Due to scope of prior research, there now follows an overview of selected studies that contributed to the development of the OI-concept.

The importance for companies to establish external linkages was recognized relatively early. Hippel (1976) claimed users were an important source of innovation. In 1986, he introduced the lead user concept and so highlighted a specific group of users as a promising innovation source.⁸ In his book "The Source of Innovation", published two years later, Hippel suggested that not only users but also other groups, such as suppliers, possess high innovative potential. In his eponymous article, Allen (1983) examined the phenomena of "collective invention" among firms. Teece (1986) demonstrated companies' need to connect with their business environment using the example of complementary assets. According to Cohen and Levinthal (1990), the ability to recognize valuable information from outside the company and to absorb and assimilate it is an essential capability (absorptive capacity), since external knowledge is crucial to companies' innovation process. That firms can benefit from permeable company boundaries, even if knowledge is exchanged with competitors, was argued by Schrader (1991). Jaffe (1989) and Lee (1996) examined the role of universities and academics in industrial innovation. Due to the increased interest in external technologies, Chatterji (1996) presented a code of practice for technology sourcing. In 1999, Raymond published an article about the open source concept and, thereby, triggered intensive research in that area.⁹

⁷ However, some academics believe it has complicated academic communications (see Groen and Linton 2010; Hippel 2010; Linstone 2010).

⁸ Interest in user-driven innovation, particularly the concept of lead users, rocketed in the following years, which resulted in countless publications (see e.g., Baldwin et al. 2006; Bogers et al. 2010; Franke et al. 2006; Herstatt and Hippel 1992; Lüthje and Herstatt 2004; Reichwald and Piller 2009; Schreier and Prüg 2008; Schweisfurth and Raasch 2012).

⁹ Open source has its origins in the software industry and unlicensed handling of source code is central to this, i.e., developers are given the necessary access to advance, modify, and distribute the source code. In 1998, Raymond and a colleague established the Open Source Initiative (<http://www.opensource.org/>) to promote this idea. Further information on this initiative and a detailed definition of open source are provided on the website. For more information on related research see Feller and Fitzgerald 2002; Krogh and Hippel 2003; Krogh et al. 2003; Lakhani and Hippel 2003; Raasch et al. 2009.

Besides the importance of involving external sources during the process of innovation, scholars were also interested in the ways in which companies can connect with external partners and obtain external knowledge. As a result, two main research directions evolved: Strategic alliances¹⁰ and in-sourcing, through mergers and acquisitions (see Hagedoorn and Duysters 2002). Strategic alliances in particular caught the attention of researchers (see e.g., Hagedoorn 1993; Lambe and Spekman 1997; Mowery et al. 1996; Narula and Hagedoorn 1999; Nicholls-Nixon and Woo 2003). According to Nooteboom (1999, pp. 64ff.), alliances can assume various forms. However, Mowery et al. (1996, p. 79) suggested two dimensions in order to classify them. Firstly, strategic alliances can be divided into equity-based (e.g., joint venture, minor equity investment) and contract-based (e.g., joint development agreement, R&D contract) collaborations. Secondly, strategic alliances can be categorized as unilateral (e.g., licensing), bilateral, or multilateral. Of all forms, joint ventures (i.e., equity based, bi- or multilateral alliance) were of special interest to researchers (see e.g., Harrigan 1986; Kogut 1988). However, Mowery et al. (1996, p. 80) showed this interest is not associated with how frequently joint ventures really occur in practice. In fact, the popularity of joint ventures decreased over time and contract-based alliances were gradually preferred (cf. Hagedoorn 2002, p. 478; Hagedoorn and Duysters 2002, p. 168). Independently from the mode of partnership, the motives for alliances were manifold and not always related to innovation and R&D (cf. Hagedoorn 2002, p. 477). For example, in the early 19th century alliances were used as vehicles for exploiting natural resources (cf. Mowery et al. 1996, p. 78). Later, companies aimed to establish technical standards and “dominant design”, to shorten innovation cycles, to acquire new skills, to share the risks and costs of innovation, and to increase their market power (cf. Hagedoorn 2002, p. 480; Mowery et al. 1996, p. 79). Furthermore, globalization and other factors had increased the complexity of product development and the need for interdisciplinary expertise (cf. Narula and Hagedoorn 1999, p. 285). Regardless of the stated motive, Hamel et al. (1989, p. 134) noted that some alleged alliances can only be considered “[...] *sophisticated outsourcing arrangements*.”

Many studies helped to lay the foundations for OI-research and assisted to “give it a face”.¹¹ Nevertheless, it would be too narrow to assume open innovation is only the sum of these parts. Open innovation is far more than strategic alliances and, on the other hand, not all strategic alliances relate to innovation and can be considered open innovation. Open innovation is also related to the user innovation theory (see e.g., Hippel 1976, 1986, 1988), but not all aspects of this concept conform to the idea of open innovation (see West and

¹⁰ In the literature, many synonyms for strategic alliances are used; among them strategic partnering, inter-firm alliance, collaboration, and co-operation.

¹¹ Prior studies from other research fields (e.g., spin-off decisions, mergers and acquisitions) might also have contributed to the development of the OI-concept. However, since this perspective is not the focus of this study, such prior studies are not discussed here.

Bogers 2010). This implies that prior concepts and the OI-model partially overlap, but are also partially exclusive (see Figure 3). Schweisfurth et al. (2011) revealed that the same is also true of different models within the OI-framework, e.g., open source innovation (cf. Hippel 2010, p. 555; Möslin and Bansemir 2011, p. 13).

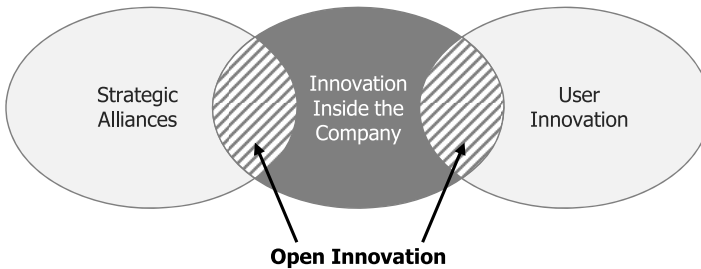


Figure 3: Placement of Open Innovation Research¹²

Lastly, prior studies often considered internal and external sources as substitutes, which is inherent in the “make or buy” decision (cf. Tschirky et al. 2000, pp. 464f.) However, the OI-approach interprets internal and external knowledge as complementary and equally important (cf. Cassiman and Veugelers 2006, pp. 68ff.; Lichtenthaler 2011, p. 78; Reichwald and Piller 2009, p. 156; Schroll and Mild 2011, p. 490). Therefore, it accommodates the idea that internal R&D is essential for companies’ ability to absorb and integrate external knowledge (see Cohen and Levinthal 1990; Veugelers 1997).

2.1.3 Current Developments in OI-Research

With his first book about open innovation, Chesbrough (2003) caught the attention of both practitioners and academics. His second book relating to open innovation (see Chesbrough 2006b) evoked a wave of OI-related studies dealing with different aspects of the concept. It became such a popular research topic that the R&D Management journal alone dedicated three special issues to open innovation.¹³ This explosion of OI-related articles made it hard to keep track of all the developments within the field. Thus, numerous scholars tried to make a contribution to OI-research by reviewing and structuring the existing literature (see e.g., Dahlander and Gann 2010; Elmquist et al. 2009; Lichtenthaler 2011; Schroll and Mild 2012; West and Bogers 2014). These reviews revealed that quantitative research on open innovation is rare – especially in comparison to theoretical and qualitative studies – and

¹² Author’s illustration

¹³ R&D Management published special issues on open innovation in 2006, 2009, and 2010 (see Enkel et al. 2009; Gassmann 2006; Gassmann et al. 2010), but other journals (e.g., Industry and Innovation, 2008; International Journal of Technology Management, 2010; Research Policy, 2014; Technovation, 2011) also dedicated special issues to this topic (see Dahlander et al. 2008; Vrande et al. 2010; Huizingh 2011; West et al. 2014).

should take priority in future OI-research (cf. Dahlander and Gann 2010, p. 702; Lichtenthaler 2011, p. 80; Schroll and Mild 2012, pp. 86f.; Vrande et al. 2010, p. 225). Another finding was related to the level of OI-research. Generally, open innovation can be analyzed at different levels. Following Vanhaverbeke and Cloodt (2006, pp. 276ff.) and West et al. (2006, pp. 287ff.), six research levels can be distinguished (see Figure 4).

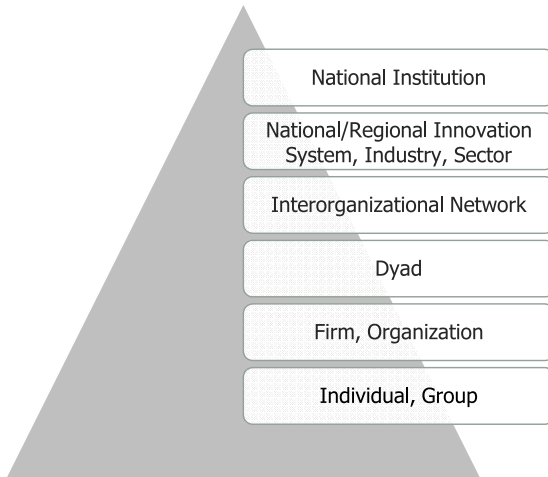


Figure 4: Levels of Analysis in Open Innovation Research¹⁴

The most elementary unit of analysis is the individual or group of individuals that make up a firm/organization (i.e., the second lowest level of analysis). OI-research can also focus on two companies connected through a strategic alliance (dyad level), for example. Furthermore, multiple interrelated parties can be the center of analysis (the inter-organizational network perspective). A fifth level of research relates to national/regional innovation systems, sectors, and industries. Lastly, OI-research can concentrate on national institutions.

Despite this range of possible OI-research levels, current studies have a clear emphasis and are not evenly spread across all layers. The majority of existing OI-studies concentrate on the level of firms/organizations¹⁵ (cf. West et al. 2006, p. 287). Based on a set of 88 OI-related articles, Vrande et al. (2010, p. 226) found that more than 50% of the reviewed empirical studies focused on the firm level. The second largest share of studies (only 15%) dealt with innovation projects. OI-research related to the level of individuals is, however, rare and mainly focuses either on individuals engaged in open source projects and

¹⁴ Illustration inspired by Vanhaverbeke and Cloodt 2006, pp. 276

¹⁵ In the following, firm level, organizational level, and company level are all used interchangeably.

other OI-communities (for an overview see Schattke and Kehr 2009; see also the exemplary Fleming and Waguespack 2007; Hars and Ou 2002; Henkel 2009) or on lead users (see e.g., Franke et al. 2006; Lüthje 2004; Schreier and Prügl 2008). Very few studies address employee-related topics such as OI-relevant competencies and attributes (see Enkel 2010; Du Chatenier et al. 2010; Pedrosa et al. 2013) or possible barriers to open innovation such as the NIH-syndrome (cf. Enkel 2009, pp. 189ff.). In the study of Vrande et al. (2010, p. 226), only 11% of the articles under consideration were somehow related to the level of individuals. As a result of this imbalance, scholars tried to encourage other researchers to focus more on other levels of analysis and especially on individuals, since every (open) innovation starts with the effort of at least one individual (cf. Herzog 2008, pp. 3f.; Lichtenthaler 2011, p. 81; Vanhaverbeke 2006, pp. 206f.; Vanhaverbeke and Cloudt 2006, p. 279; Vrande et al. 2010, p. 230; West et al. 2006, pp. 287ff.).

The request for more research across all levels and especially on the individuals' level has also been prompted by norms regarding social theory building. According to Coleman (1990, pp. 2ff.), explanations on a macro-level should be based on examinations on the micro-level. Transferred to OI-research and the special interest in company-related issues, this claim echoes the demand for more research at the level of individuals. The argument is that if researchers are interested in open innovation at the firm level (macro-level), it is essential to understand the underlying reasoning and, thus, to involve the component parts of a firm in the research, as represented by its employees (micro-level). Figure 5 illustrates this argument and highlights the contention that it is inappropriate to directly draw conclusions from organizational antecedents on a given outcome. In fact, well-grounded theory has to have a micro-foundation, i.e., it starts and ends at the macro-level, but the arguments follow arrows 1, 2, and 3. The importance of the micro-foundation is further supported by other researchers (see e.g., Gavetti 2005; Teece 2007).

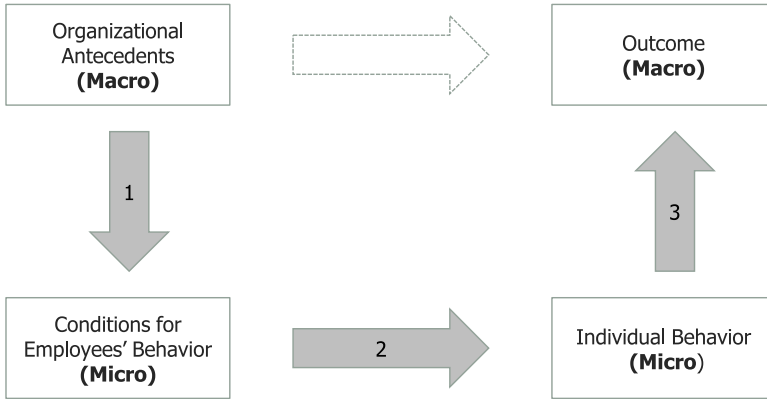


Figure 5: Macro- and Micro-Level Proposition¹⁶

In summary, increased research across different levels of analysis, especially at the level of the individual, is important for two reasons: Firstly, existing OI-studies have a strong focus on the organizational level and so lack consideration of other relevant layers. Secondly, the need for micro-foundation suggests it should start with the most elementary research unit: the individuals (i.e., employees of a company).

After shortly synthesizing existing OI-studies with respect to research type (i.e., theoretical, qualitative, quantitative) and level of analysis, the focus is on thematic aspects of current OI-studies. Consequently, I will now continue with the introduction of selected research streams in order to indicate the diversity of OI-related studies. This will be the foundation for the integration of my study into a broader research context. However, I do not aim to provide a comprehensive review of OI-research in general as it would extend the scope of this study.

2.1.3.1 Archetypes of Open Innovation Processes – Definition and Adoption

Based on Chesbrough's OI-conception, Gassmann and Enkel (2004) introduced three archetypes of OI-processes, which basically differ with respect to the direction of knowledge flows: outside-in (inbound), inside-out (outbound), and coupled processes.

In the case of inbound open innovation, knowledge flows from outside the company and enters its innovation process (see Figure 2). The underlying assumption is that the locus of knowledge creation can differ from the locus of innovation. Consequently, the outside-in process emphasizes the exploration of external knowledge or technologies. One way is to integrate external partners, e.g., in form of co-creations with customers (see Prahalad and Ramaswamy 2004), OI-alliances with competitors (see Han et al. 2012), and collaborations

¹⁶ Illustration: cf. Coleman 1990, p. 8

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