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Chapter 1

Knowledge Sharing in Open Innovation: An Overview of Theoretical Perspectives on Collaborative Innovation

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ABSTRACT

Open innovation has received an increasing amount of attention from innovation scholars and practitioners alike. As a specific type of open innovation, collaborative innovation combines knowledge inflows and outflows and is thus at the core of open innovation. To better understand this coupled process of open innovation, this chapter provides an overview of the theoretical perspectives on open collaborative innovation. In particular, knowledge sharing is considered as a main driver of successful collaborative innovation. Accordingly, the chapter reviews some of the main trends in practices and theories related to open collaborative innovation. The main purpose is to provide an overview of the main perspectives on collaborative knowledge sharing within established economic organization and strategic management theories. Thus, by providing a more solid theoretical basis for future work in open innovation, this chapter contributed to the theory behind open innovation, which in turn can be used to inform open innovation practices.

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INTRODUCTION

Open innovation has been proposed as a new paradigm that centers around opening up organizational boundaries in order to use and recombine internal and external knowledge to develop and commercialize valuable innovations (Chesbrough, 2003). At its core, open innovation is about “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively” (Chesbrough, 2006: 1). A particular and increasingly important area within open innovation, which combines knowledge inflows and outflows, is the collaborative development of innovation by multiple organizations (Bogers & West, 2010; Hagedoorn, 2002; Vanhaverbeke, 2006). According to Enkel et al. (2009: 313) this “coupled process” of open innovation “refers to co-creation with (mainly) complementary partners through alliances, cooperation, and joint ventures during which give and take are crucial for success.” Accordingly, as a coupled process, collaborative innovation combines the inbound and outbound processes of open innovation by allowing firms to jointly develop and commercialize innovation. The value of such collaborative innovation, both in terms of economic welfare and corporate competitive advantage, has grown tremendously in recent years (Verspagen & Duysters, 2004; West, Vanhaverbeke, & Chesbrough, 2006). Similarly, patenting, licensing and markets for technology have become more important as a means to appropriate the benefits from innovation (Arora, Fosfuri, & Gambardella, 2001; Granstrand, 2000, 2004b).

However, despite these trends, how to effectively manage knowledge sharing in open collaborative innovation is not yet fully understood (Enkel, et al., 2009; McEvily, Eisenhardt, & Prescott, 2004). To be successful in open collaborative innovation, firms and other organizations need to share valuable knowledge, while they, at the same time, keep the need to protect that

same knowledge against unwanted spillovers (Grindley & Teece, 1997; Gulati & Singh, 1998; Murray & O’Mahony, 2007; Simcoe, 2006). To better understand the rationale and impediments of knowledge sharing in open collaborative innovation, this chapter presents a review of a number of key theoretical perspectives to derive the main opportunities and constraints of collaborative knowledge sharing.

PERSPECTIVES ON KNOWLEDGE SHARING IN COLLABORATIVE INNOVATION

This section provides an overview of some of the key perspectives on collaborative knowledge sharing. In particular, it reviews the main perspectives in economic organization and strategic management theory according to their main research questions, their main building blocks, and in particular their main explanations of (and implications for) collaborative innovation. In line with other investigations of collaborative efforts, specific attention will be paid to the perspectives of transaction cost economics and the resource-based view of the firm—arguably largely representing the economic organization and strategic management theories, respectively (e.g. Das & Teng, 2000; Hagedoorn, Link, & Vonortas, 2000b; Tsang, 2000). In addition, the dynamic capabilities approach, knowledge-based view and technology-based view are also presented as viable perspectives to explain open collaborative innovation (e.g. Eisenhardt & Martin, 2000; Granstrand, 2000; Kogut & Zander, 1992). Collectively, these theoretical perspectives provide an overview of the constructs and relationships that are relevant for studying and implementing collaborative knowledge sharing.

Transaction Cost Economics

Transaction cost economics, or transaction cost theory, of which the roots go back to Coase (1937) and Williamson (1975, 1985), is part of the New Institutional Economics, which incorporates property rights and transaction costs into neo-classical economics to explain economic behavior. It tries to explain why firms organize their activities in a certain way. The main concepts—also of the New Institutional Economics in general—involve the economic effects of institutions, with rational decision-making that is not complete and based on non-costless available information, and with actors that can act opportunistically.

The basic premise of transaction cost economics is that firms decide how to transact by trying to minimize the sum of production and transaction costs. Transaction costs consist of costs for searching for relevant information as well as negotiating, monitoring and enforcing contracts related to an economic exchange, and are influenced by both human and environmental factors. In making decisions about a transaction or governance mode, economic actors might act intentionally rational but are ultimately limited in their ability to make fully rational decisions. Also known as “bounded rationality”, this concept can be described as follows: “the capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world” (Williamson, 1975: 9).

Moreover, the concept of “opportunism”—described as “seeking self-interest with guile” (Williamson, 1975: 26)—implies the possible provision of incomplete or wrong information or false promises, in order to realize a certain individual advantage. As the degree of opportunism is not known *ex ante*, there is a need for more complete contracts that deal with potential opportunistic behavior, which in turn is a driver

for increasing transaction costs. Opportunism is especially relevant in the case of “small numbers”, which relates to the situation in which a firm can only transact with a small number of others.

The basic dichotomy given by transaction cost economics is the one of transacting through hierarchy or through the market (Williamson, 1975). In other words, in this dichotomy, firms will expand up to the point where the costs of an additional transaction through the hierarchy equal the costs of that transaction carried out through the market mechanism. However, instead of this dichotomy of firms and markets, transaction cost economists started to consider a continuum of mechanisms to govern transactions, with the market and the organization on each end of the spectrum. Relational contracting is one of the possible mechanisms in between the two ends and is seen as an important economic institution, which is a more efficient intermediate governance structure when transactions are costly, complex and difficult to specify (Williamson, 1985). Therefore, cooperation among firms has become an important alternative form of organizing or governing transactions (Williamson, 1996).

The choice for a certain governance structure will be determined by asset specificity, frequency and uncertainty. For example, if a firm more frequently transact with another firm, collaboration can create more efficient transactions. An appropriate governance mechanism will economize on bounded rationality and safeguard transactions against the hazards of opportunism (Williamson, 1991). Open collaborative innovation can cope with a high degree of asset specificity, which can cause high switching costs and, more importantly, collaboration can create a lower uncertainty over specifying and monitoring the performance of the other partner (Kogut, 1988). Because of the closer relation that firms have with the collaborating partner, they are able to build better, more suitable contracts with the possibility to monitor each other.

However, in collaborative innovation, contracts are often still incomplete, due to the difficulty to fully specify the contribution of each partner and to specify intangible assets, such as technical knowledge (Das & Teng, 2000; Hagedoorn, Link, & Vonortas, 2000a). Furthermore, if firms transact with a small number of other, this can create a situation in which firms are locked in. The mutual contribution of efforts and assets can even create a “mutual hostage situation”, in which the collaborating partners both gain or lose by the performance of the collaboration (e.g. Kogut, 1988), which can nevertheless balance out the contributions and lower opportunistic behavior. This perspective has however been criticized for explaining little about the motives for collaboration related to capability building and learning (Dodgson, 1993: 47).

Resource-Based View

The basis for the resource-based view of the firm, or resource-based theory, goes back to Penrose (1959) who views a firm as an administrative organization with a collection of productive resources, which ultimately determine the growth of the firm. She conceptualizes firms as bundles of resources and services, of which the organization and application causes firms to be heterogeneous. The growth of the firm is related to diversification and is path-dependent. The resource-based view, which builds on Penrose’s work, further develops the notion that firms diversify and try to outperform other firms. This perspective especially emerged with the work of Rumelt (1984), Wernerfelt (1984) and Barney (1986). The key ideas are that firms are essentially heterogeneous in terms of underlying resources, that these resources can be anything that could create an advantage for a firm, and that the resource differences, which are relatively stable, cause performance differences.

Subsequent analyses within the resource-based view dealt with how firms can obtain a sustained competitive advantage. According

to Barney (1991) this is the case when a firm is able to implement a value-creating strategy other than its competitors who are also not able to duplicate this strategy. For this, the underlying resources have to be (a) valuable, (b) rare and (c) imperfectly imitable, and (d) there should not be strategically equivalent substitutes. According to Peteraf (1993) the conditions that underlie a sustained competitive advantage are (a) efficiency differences that create superior resources (i.e. heterogeneity within an industry), (b) difficulties in imitating these resource-bundles (i.e. ex post limits to competition), (c) mobility of resources that is imperfect, and (d) limited competition for the potential superior position.

Continuing on the resource-based logic, a firm has to develop its resource base in order to obtain a sustained competitive advantage. Access to external complementary resources can be necessary to achieve this sustained competitive advantage (Teece, 1986). Therefore, collaborative innovation takes a natural and important place in a firm’s exploitation and development of resources. The resource-based view has identified various motives for collaboration. With respect to partner selection, two important elements are absorptive capacity (Dyer & Singh, 1998; Mowery, Oxley, & Silverman, 1996) and bridging the gap between existing and desired capabilities in a short time frame (Kogut, 1988). More generally, the main motives to collaborate, as argued by Barney and Hesterly (1996) are to exploit economies of scale, to gain low cost entry into new markets, to learn from competitors, to strategically manage uncertainty, to manage costs and risks, and to facilitate tacit collusion.

The exploitation of resource complementarities, as a primary economic incentive for collaboration (Barney & Hesterly, 1996), relates back to Penrose (1959) who assumed that firms tend to expand whenever profitable opportunities exist. In this context, the exploitation of a firm’s resource base, to achieve competitive advantage, takes place by accessing and transferring knowledge

from one firm to another, i.e. through open collaborative innovation. This point is emphasized by Das and Teng (2000: 37) who state that “the overall rationale for entering into a strategic alliance [according to the resource-based view] is fairly simple. It is to aggregate, share, or exchange valuable resources with other firms when these resources cannot be efficiently obtained through exchanges or mergers/acquisitions.”

Dynamic Capabilities Approach

The dynamic capabilities approach has its foundations in, and thereby to some extent integrates, the resource-based view and evolutionary economics.¹ Therefore, it attempts to give a more dynamic view on a firm’s resources (Helfat, et al., 2007). This view focuses on how firms can accumulate and deploy both internal and external resources in their changing environment. The main representatives of this view are Teece and Pisano (1994) and Teece et al. (1997), and some have further developed or reconceptualized (some elements of) this perspective, such as Eisenhardt and Martin (2000), Zollo and Winter (2002) and Winter (2003).

Dynamic capabilities—originally referred to as “the firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments” (Teece, et al., 1997: 516)—have recently been defined as “the capacity of an organization to purposefully create, extend, or modify its resource base” (Helfat et al., 2007: 4). Although the external link essentially refers to possible imitation by other firms, collaboration takes a natural place in this approach. Due to the complex and tacit nature of a firm’s competences and capabilities, replication by others is impossible, which creates a source of competitive advantage. The three classes of factors that jointly form and shape a firm’s competences and dynamic capabilities are positions, processes and paths (Teece, et al., 1997). The positions consist of a variety of assets (cf. resources in resource-based view); the processes entail static, dynamic

and transformational concepts; and, finally, a firm’s current position is a function of the path it traveled. This path dependency has important implications in industries with increasing returns to adoption (Teece, et al., 1997). This means that firms are dependent on the path that lies behind them and that they have to act in a world with positive feedback (Arthur, 1994). This refers, for example, to the case in which different technologies are competing for dominance. In this case, it is important to allocate dynamic capabilities in such a way that a firm is able to take part in the development of this technology. On a more general level, increasing returns imply that a firm’s decisions will determine the opportunities and constraints in the future. This all means that firms have to choose such a strategy that enables them to achieve a competitive advantage.

Thus, the firm-specific asset positions and evolutionary paths shape the firm’s managerial and organization processes determine its competitive advantage (Teece, et al., 1997). A firm has to develop its capabilities in a changing environment by exploiting external firm-specific competences, among others. It can access these competences from other firms that are all heterogeneous. Therefore, open collaborative innovation can develop a firm’s competences and capabilities and thus enhance its competitive advantage.

Knowledge-Based View

Given the importance of knowledge as a resource in economic and technological development in general and in open collaborative innovation in particular, the literature related to intellectual capital and knowledge management provides a valuable perspective on collaborative knowledge sharing. More specifically, with the rise of the knowledge-based economy (e.g. digitalization, virtualization, the role of networks and services) in the background, the knowledge-based view of the firm emerged with a shift in focus from tangibles to intangibles or intellectual capital (Grant, 2002).

When discussing the fundamentals of the knowledge-based view, Grant (2002: 135-136) gives the following assumptions and observations concerning the nature of knowledge and its part in production. First, knowledge is the overwhelmingly important productive resource (Grant, 1996; Machlup, 1980). Second, different types of knowledge vary in their transferability. Explicit knowledge can be articulated and easily communicated between individuals and organizations. Tacit knowledge (skills, know-how, and contextual knowledge) is manifest only in its application—transferring it from one individual to another is costly and slow (Kogut & Zander, 1992; Nonaka, 1994). Third, knowledge is subject to economies of scale and scope. A characteristic of all knowledge is that its initial creation is more costly than its subsequent replication. Together with the complementarity of different types of knowledge, this implies increasing returns in knowledge-intensive industries. Non-specific knowledge furthermore leads to economies of scope. The economies of scale and scope are especially great for explicit knowledge, information in particular (Shapiro & Varian, 1999). Fourth, knowledge is created by human beings, and to efficiently create and store knowledge, individuals need to specialize (Simon, 1991). And, finally, producing a good or service typically requires the application of different types of knowledge (Kogut & Zander, 1992). Subsequently, Grant (2002) acknowledges that these assumptions lead to the distinction between activities that are concerned with increasing the stock of knowledge, i.e. “exploration”, and those that deploy knowledge in order to produce goods and services, i.e. “exploitation” (March, 1991).

Taking knowledge as the main competitive resource or asset has important implications for the analysis of collaborative innovation. Within the knowledge-based view, firms are superior in the integration of knowledge as the exchange of knowledge through the market mechanism is a costly process (Grant, 1996; Kogut & Zander,

1992). Furthermore, the disclosure dilemma, also called Arrow’s information paradox, which relates to the difficulty of concluding contracts without first revealing the involved knowledge, gives problems in market transactions for explicit knowledge (Arrow, 1962). The exchange of tacit knowledge, on the other hand, also has problems because it cannot be readily transferred and integrated (Cowan, David, & Foray, 2000; Polanyi, 1958). As in transaction cost economics, open collaborative innovation takes an intermediate position between the hierarchy and the market. Trust between the collaborating partners can solve the disclosure dilemma by limiting opportunism. Furthermore, collaborative innovation can establish certain routines that facilitate knowledge integration and the transfer of tacit knowledge, although firms (i.e. hierarchies) are generally more efficient in this. Nevertheless, collaborative innovation can be superior to the hierarchical firm especially as the range and diversity of knowledge increases (Grant, 2002).

Technology-Based View

Also based on the growing importance of knowledge and intellectual capital in innovation in general and collaborative innovation in particular, the technology-based view has been put forward as a perspective that focuses on the technology base as a central part of a firm’s resource base. Granstrand (2000) subdivides intellectual capital in (a) embodied capital, including human competences, (b) relational capital, including organizational embedded structures, and (c) disembodied intellectual capital, including intellectual property (IP). A firm acquires, combines and exploits its resource base in general as well as its specific technology base. This technology base represents a firm’s technological competence, based on which the firm develops appropriate acquisition and exploitation strategies (Granstrand, 2004a). The technology-based view is highly relevant in high-technology industries, in which open col-

laborative innovation is increasingly important. In this perspective, it can also be explained why firms, to deal with market uncertainties, have to externalize their technology sourcing, giving collaborative innovation a logical place in a firm's strategy (Granstrand, Bohlin, Oskarsson, & Sjöberg, 1992; Granstrand & Sjölander, 1990). And because the technology base of companies became more diversified in recent years there is an increased need for external sourcing and partnerships (Granstrand & Lindmark, 2002).

The technology-based view considers technology as being a special kind of knowledge, with the following attributes: technology has a link to (physical) artifacts and to science; it has a relatively high degree of explicitness (although tacit knowledge remains an important asset); it has a "practical purpose" with possible performance measures; and it is embedded in a global system of operationalization and assessment (Granstrand, 2000). Furthermore, related to disembodied IP, it is possible to protect technology by patents. Given the special characteristics of technology as a specific kind of knowledge and collaborative innovation as being part of a technology-based firm's acquisition and exploitation strategies, it provides a valuable perspective on the specific elements knowledge sharing in open collaborative innovation.

An Overview of Theoretical Perspectives in Economic Organization and Strategic Management

Table 1 gives an overview of the contribution of the different theoretical perspectives on knowledge sharing in open collaborative innovation. Starting with transaction cost economics, this perspective has the transaction as the unit of analysis with a strong focus on the form of a contractual agreement. This transaction involves costs and accordingly firms, as economic actors, will choose an appropriate governance mechanism to organize

their activities and go into transactions, either internally or externally. In this context, collaborative innovation is a hybrid or intermediate governance modes. When focusing on the collaboration itself, the concept of transaction cost is a relevant one to monitor the agreements that are made in this collaboration. The aspects of asset specificity, uncertainty, frequency, bounded rationality and opportunistic behavior are therefore important ones to consider when setting up collaborative knowledge sharing.

The other perspectives are generally more concerned with understanding the forces and causes that explain performance differences between organizations. The resource-based view and dynamic capabilities approach tend to focus, to a large extent, on internal resources and capabilities as sources of sustained competitive advantage. The knowledge-based and technology-based views (both considered as intellectual capital approaches) consider the firm as a repository of respectively knowledge-based and technology-based resources and capabilities. These resources can give a sustained competitive advantage because they are unique, rare and difficult-to-imitate. All in all, these perspectives present the firm as a bundle of resources and/or capabilities and, in general, they consider open collaborative innovation as a means of acquiring and exploiting resources, knowledge or technology.

Revisiting the explanations these approaches provide for open collaborative knowledge sharing, it can be identified that the different approaches each have their own way of explaining the existence of collaborative innovation. From the different perspectives, transaction cost economics mainly explains the existence of collaborations per se and it puts emphasis on the environmental and relational dimension and to a lesser extent on the characteristics of the collaboration. The resource-based view and the related perspectives more explicitly analyze the exact sharing of resources, such as knowledge, and put the emphasis on the

Table 1. Overview of theoretical perspectives on open collaborative innovation

<i>Theoretical perspective</i>	<i>Main research question (origin of perspective)</i>	<i>Main answer to research question/basic elements</i>	<i>Main explanations/implications for open collaborative innovation</i>
<i>Transaction cost economics</i>	How can firms organize their activities?	The preferred governance mechanism is determined by the minimization of production and transaction costs, which depend on asset specificity, uncertainty, frequency and costs for controlling opportunistic behavior.	Collaborative innovation is the preferred governance mechanism in the case of medium production and transaction costs. It copes with high degree of asset specificity, creates lower uncertainty over specifying and monitoring partners' performance, internalizes spillovers, balances the partners' contributions, and lowers opportunistic behavior.
<i>Resource-based view</i>	Why do some firms outperform others?	A firm's difficult-to-imitate resources determine its competitive advantage.	Collaboration can be used to exploit resource complementarities. Motives for collaboration and partner selection are exploitation of resource complementarity and economies of scale, gaining low cost new market entry, cost and risk management, tacit collusion, and capability building and learning.
<i>Dynamic capabilities approach</i>	How and why do firms build and sustain competitive advantage in dynamic markets?	A firm's difficult-to-imitate position, processes and paths determine its competitive advantage.	Collaborative innovation is established to develop a firm's dynamic capabilities and thus enhance its competitive advantage. Dynamic capabilities accumulate and deploy both internal and external resources in their changing environment.
<i>Knowledge-based view</i>	How does knowledge, being the overwhelmingly important productive resource, create sustained competitive advantage?	The difficult-to-imitate resources of a firm are knowledge-based, of which the characteristics explicitly affect the possibilities to transfer and appropriate of this knowledge.	Collaborative innovation is a means to benefit from complementarities among firms, and the characteristics of knowledge should be taken into explicit account for its transfer. The transferability of knowledge highly depends on its tacitness.
<i>Technology-based view</i>	How can technology-based firms achieve sustained competitive advantage?	A firm tries to optimally acquire and exploit its technology base, which has specific (resource) characteristics.	Collaborative innovation is one strategy for acquiring and exploiting a firm's technology base as firms have to externalize their technology sourcing to deal with market uncertainties.

characteristics of these resources. Furthermore, the intellectual capital approaches take the nature of the collaboration into more explicit consideration.

CONCLUSION

This chapter gave an overview of some trends in open collaborative innovation—an increasingly important area of open innovation. As a coupled process of open innovation, collaborative innovation combines knowledge inflows and outflows and its success is therefore predetermined by how knowledge is shared in such collaborative efforts.

To better understand how knowledge sharing can be managed in open collaborative innovation, this chapter reviewed a number of key theoretical perspectives in the area of economic organization and strategic management to derive the main opportunities and constraints of collaborative knowledge sharing. By providing a more solid theoretical basis for future work in open innovation, the theory behind open innovation can be further refined, while an improved theoretical understanding can also be used to better inform open innovation practices.

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KEY TERMS AND DEFINITIONS

Collaborative Innovation (Process): An innovation (process) involving several human individuals as creators. A collaboration is either intra- or inter-organizational (i.e. open) depending on whether the (individual) creators belong to the same or different organization(s), respectively.

Dynamic Capability: An organization's capacity to build and adjust its resource base over time.

Governance Mechanism: The instrument used to complete one or several economic transactions, including the market and the hierarchy as well as intermediate or hybrid forms of governance such as collaboration.

Intellectual Capital: The set of an organization's intellectual assets, which can be embedded in people, relationships, systems, and intellectual property.

Open Collaborative Innovation: Inter-organizational collaborative innovation.

Resource Base: An organization's set of assets and capabilities.

Technology: A body of (applied) technical knowledge, or application thereof, which is related to a certain (physical) artifact and as such embodied in products, processes, techniques, tools, methods, etcetera.

Technology Base: A set of inter-related technologies that comprise an organization's technological competences.

Transaction Costs: The costs incurred in an economic exchange (transaction) when searching for relevant information as well as negotiating, monitoring and enforcing contracts (in addition to the costs to the production costs of the product or service transacted).

ENDNOTE

- ¹ Evolutionary economists, such as Nelson and Winter (1982), following Schumpeter (1934), consider economic development as being an evolutionary process, in contrast to economists that use equilibrium models.

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