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Matchmaking for open innovation – Perspectives on multi-sided markets

Proefschrift

ter verkrijging van de graad van Doctor aan de Universiteit Leiden, op gezag van Rector Magnificus prof.mr. C.J.J.M. Stolker, volgens besluit van het College voor Promoties te verdedigen op maandag 15 december 2014 klokke 16.15 uur

door

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Alvin Roth

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Part I: Introduction, background and methodology

1 Introduction

The complexity of technology, business, and innovation increases and industry sectors overlap due to a strong connection via information and communication technologies (ICT). An increasingly networked world opens spaces for external ideas that innovations diffuse across the boundaries of a firm. External ideas, knowledge, and technologies deliver a disruptive potential and create new markets for firms. Thus, networks, collaborative settings, and open innovation are key sources for successful innovation (Chesbrough, 2003; Powell, Koput, & Smith-Doerr, 1996).

Open innovation has gained increased managerial and academic attention since 2003 and follows theoretical approaches of innovation networks. It subsumes the scattered literature about technology and innovation management towards an open exchange of ideas and knowledge across the firm's boundaries in innovation networks and collaborative settings. It further suggests an exchange of innovation and technology on markets, but research has shown that markets for innovation and technology do not work properly (e.g. Arora, Fosfuri, & Gambardella, 2004). This is similar to marriage, job or housing markets where intermediaries often coordinate transactions between demand and supply side and clear market frictions. Such innovation intermediaries are also attributed as brokers, matchmakers or facilitators for open innovation in networks and on markets (e.g. Howells, 2006). Furthermore, new web-based technologies raised the expectations towards internet platforms to solve market frictions by automatically matching innovation seekers with solution providers. Little is known about the matching mechanisms along the process for open innovation, either on- or offline. Theoretical approaches on matchmaking in academia are manifold, ranging from economics, sociology or computer science.

My dissertation reports an explorative action research study on participatory cases about how open innovation partnerships emerge in practice. The research team was engaged in industrial and academic projects where new ideas, external technologies and new start-up ventures were searched and matched for open innovation projects. Therefore,

the formation of new network ties for joint business opportunities, matchmaking, is in the focus of my research. On the one hand, I contribute to the interdisciplinary field of network economics and on the other hand to open innovation as managerial paradigm. Practical implications are presented for innovation intermediaries, managers, entrepreneurs and policy makers.

The problem of matchmaking arises from the network and market structure. First, in my thesis it is shown that matchmaking for open innovation requires a multi-sided market perspective. This offers a new conceptual lens as hybrid form between organizational hierarchies and external markets for innovation - as networked market setting. The contribution is a shift from matchmaking as pure transactionbased market mechanisms towards interactive mechanisms over time, but with economic long-term impact for all market agents. The main argument is that innovation intermediaries create (temporary) matching markets between several agents, manage the matching process and thus actively contribute to collaborative innovation processes and their outcome. Matchmaking is outlined as a distinct managerial capability for market making and structured tie building in innovation networks. This offers possibilities for sustainable value propositions for innovation intermediaries which are often publicly funded. Second, I present a matching process and its corresponding coordination mechanisms for the formation of open innovation partnerships as managerial implications. Third, a critical discussion about the traditional perspective of matchmaking as market transactions ends with the conclusion that matchmaking for open innovation requires an interactive and dynamic approach. These interactions lead to a long-term shared vision with strategic and economic impact for all innovation partners involved, rather than a contractual short-term transaction in the form of technology or intellectual property transfer and licensing.

The following chapter 1.1 introduces my research motivation and the matching problem for open innovation based on problems identified in practice. In chapter 1.2, the research objective, questions, and focus are presented with an outline of contributions to theory and practice. The constructivist approach of knowledge creation in this thesis is dis-

cussed in chapter 1.3 which contains a philosophical discourse and links to resulting methodological approaches. Chapter 1.4 presents the structure of my thesis. Chapter 2 is based on the editorial of the special issue on "matchmaking for collaborative innovation" and gives insights on the interdisciplinary approaches on matchmaking in academia. My research strategy and my methodological approach is part of chapter 3 which builds on the philosophical positioning in chapter 1.3.

1.1 Motivation and problem statement

Research about innovation in clusters or in networks suggests a *collaborative* approach and an *open* exchange of ideas, knowledge, innovation, and technology across the boundaries of the firm (Chesbrough, Vanhaverbeke, & West, 2006). For managing open innovation, a wide spectrum of coordination forms exists, ranging from formal hierarchical organisations, to contractual market transactions or more informal networks (Thorelli, 1986; Williamson, 1973). Despite different forms for collaborative settings such as innovation networks, buyer and supplier relationships, strategic alliances or joint ventures, all collaboration types have in common that suitable partners have to be identified and selected.

Several successful open innovation cases exist, like the multifunctional control system iDrive from BMW which was developed within a cross-industry collaboration with the software firm Immersion whose core competences originally were in the construction sector and medical technology (Gassmann & Sutter, 2011, p.176). Another prominent example of open innovation as market transaction is the acquisition of the start-up firm Siri by Apple in 2010. The intelligent speech recognition technology offered Apple new applications for their mobile devices which opened up further collaboration opportunities and new markets e.g. for (partially) blind customers.¹ Although, studies have shown that the mortality rate of collaborations like in strategic alliances are very high (Duysters, Kok, & Vaandrager, 1999), at its core,

¹ http://www.apple.com/de/accessibility/ios/ (11/19/2014)

¹⁵

the outcome of a collaborative innovation project is determined by the choice of the partner.

The main problem for firms which want to collaborate or partner for innovation is finding each other. At first sight, this statement seems simple, but in reality the matching process is connected with high signalling, search and transaction costs, but also managerial coordination efforts bind valuable internal resources of an organisation. Especially, the formation of innovation partnerships with an unclear outcome and a high degree of uncertainty are difficult to manage. In the literature about managing innovation in networks (Powell et al., 1996), clusters (Porter, 1998), innovation systems (Edquist, 1997) or in living labs (Almirall & Wareham, 2008), and open innovation (Chesbrough, 2003), collaboration is claimed as the central task. If this is so, finding the right innovation partner in such open environments is a necessity for managers, engineers, researchers, and entrepreneurs for creating joint value. In this context, the underlying main question in my doctoral thesis is '*how to find a suitable partner for open innovation?*'.

Matchmaking for open innovation is a phenomenon of market failure and is not well researched (Bakicic, Almirall, & Wareham, 2010; Howells, 2006; Lopez & Vanhaverbeke, 2009). Similar to other inefficient markets, like the job, the dating, or the housing market, online and offline innovation intermediaries emerged trying to facilitate or broker between innovation demand and innovation supply (Howells, 2006; Klerkx & Leeuwis, 2008). Furthermore, innovation network formation is still a public priority supported by governments due to the failure of innovation markets caused by the matching problem. As an example, the European Union recently launched the Horizon 2020 Framework Programme for Research and Innovation in order to foster innovation in networks and through collaboration.²

² <u>http://ec.europa.eu/programmes/horizon2020/</u> (10/26/2014) 16



Figure 1: The matching problem for innovation partnerships: Deviation between Offer (O_x) and Demand (D_y) .

In my dissertation, I therefore explore matchmaking for innovation partnerships from a process perspective using a participatory research approach. The process study furthers our understanding of how the matching process can be coordinated in terms of managerial action with strategic and economic value. Studying the matching process for open innovation is not only interesting from a practical point of view. But it also has potential for very promising contributions to theory. Research about how innovation networks evolve, how innovation demand and supply are matched on markets or other approaches of matching mechanisms and (online) matching tools for coordination are relevant scientific questions. My in-depth process analysis based on insights of the engagement in real industrial cases sets the ground for further research from various disciplines. Chapter 2 gives an overview about the interdisciplinary approaches on matchmaking which provides inspiration for further research.

1.2 Research objectives, questions and focus

This dissertation contributes to a better understanding of matchmaking for open innovation. In particular, I explore the matching process between established companies and entrepreneurial start-ups, so called *asymmetric partnerships* (Minshall, Mortara, Valli, & Probert, 2010). Based on an action research approach as explained later in chapter 3, I was actively involved in industrial technology and venture scouting projects. I documented collaboration intentions and expectations before potential partners were identified and after they were matched.

Furthermore, I observed events along the matching process and extracted patterns for collaboration formation. My work contributes to network economics as interdisciplinary field between economics, sociology and computer science. The theoretical focus of my study is on two-sided markets as theoretical background for open innovation and innovation intermediaries (Chesbrough, 2006; Roson, 2005).

In part II of this thesis, two-sided market theory is elaborated in terms of matchmaking for open innovation. Part III draws attention on the dynamics of the matching process and the corresponding interactions on a multi-sided market and part IV discusses the role of innovation intermediaries in particular.

Throughout the following chapters of my thesis, the research question RQ and its sub-questions RQ_x will be answered:

RQ: How can a suitable innovation partner be identified?

- 1) How can the failure on innovation markets for collaboration be resolved?
- 2) How can asymmetries between innovation partners³ be reduced?
- *3)* What are matching mechanisms as patterns for managerial action?

 $^{^{3}}$ In particular in partnerships between entrepreneurial start-ups and established firms. 18

Perspective	Academic contribution	Managerial contribution	Political implication	Practical implication
Participatory process research	Identification of patterns along the matching proc- ess for open innovation intermediation.	Development of a match- ing process model for open innovation.	Matching processes of public funded intermedi- aries can be monitored and the outcome is measurable.	Facilitating the formation of asymmetric partner- ships.
Established company	Perspective of match- making and collaboration intentions.	Helping managers to better understand internal collaboration intentions and external entrepre- neurs.	Public funded matching initiatives create value in networks for industrial partners, thus profitable income could be gener- ated.	Learning and best prac- tices for scouting and matching new ventures from an established firm's perspective.
Entrepreneu- rial new ventures	Perspective of match- making and collaboration intentions.	Helping entrepreneurs to better understand corpo- rate management.	Structured matching services of public funded intermediaries create valuable access for en- trepreneurs to networks.	Learning and best prac- tices for scouting and matching corporate man- agement from an entre- preneur's perspective.
Innovation intermediaries	Managerial role as inno- vation process manager, market maker and tie builder.	A better understanding about mechanisms and capabilities for open innovation intermedia- tion.	A shift from public funded facilitation role of innovation intermedi- aries towards profes- sional matching services.	Learning and best prac- tices for scouting and matching in networks.

Table 1: Perspectives and contributions in my research project.

I contribute to the field of network economics by first conceptualizing matchmaking for open innovation as multi-sided market in part II of this thesis. With my conceptual model, I add a further empirical example of a two- or like in my case a multi-sided market to the literature besides already existing cases (Hagiu & Wright, 2011). Furthermore, my definition adds an additional perspective to innovation markets where matchmaking is interaction-based, rather than transaction-based like on multi-sided online platforms (Illing & Peitz, 2005). A process perspective on matchmaking in part III of this thesis provides detailed interactional patterns between the agents on a multi-sided market for open innovation. Matching dynamics are presented leading to "virtuous" or "vicious" circles based on social interaction. Unlike to automated transactions or auctions like on amazon or ebay, matchmaking for open innovation requires an adaptive process between goal finding, goal setting towards a shared vision and a common understanding which may result in future transactions. Interactions are discussed as matching mechanisms on multi-sided markets. Additionally, the role of innovation intermediaries is elaborated in detail. In part IV of this dissertation, a managerial perspective on matchmaking with clear capabilities is outlined. This part contributes to the literature on innovation intermediation (Howells, 2006).

Theoretical and practical contributions:

- 1) A conceptual networked multi-sided market model where agents are matched according to their intentions
- 2) An interactive matching process on a multi-sided market which was developed from and tested in industrial participatory cases leading to positive or negative network effects (virtuous or vicious circles)
- 3) Understanding matching dynamics as interactive process over time rather than static transactions
- 4) A managerial matrix for structured matchmaking approaches and managerial action

1.3 Research epistemology and methodology

Academic work aims to create new knowledge which is generated either through experimentation, mathematical and logical proof, hypothesis testing or empiricism (Katzy & Dissel, 2008). Traditionally, academic disciplines have their own epistemological perspective with specific methodologies and methods, but in our networked world scientific fields overlap and influence each other. Technical inventions and findings from engineering or computer science drastically changed social and economic behaviour. Therefore, interdisciplinary research emerged for example studying the management of technology and innovation (Lannes, 2001). Interdisciplinary research is challenging and not easy to justify against the "pure" academic disciplines. But many successful examples of interdisciplinary research do exist, which enhanced theoretical knowledge, practical use and influenced several academic fields. Matching theory and market design is a concrete example which have a high practical impact and contributed to game theory, mathematics and computer science (Roth, 2002; Roth, 2008), market microstructure and pure economics (Mortensen, 2011; Spulber, 1999) and network theory as sociological discipline (Easley & Kleinberg, 2010). Matching theory in particular as part of game theory and neo-classical economics has been explicitly approached in the quantitative research paradigm, but lacks a qualitative in depth understanding about the social processes between two or more individual agents. The how innovation partnerships or networks emerge over time is mentioned in Doz (1996) who claims a further understanding of process dynamics in strategic alliance formation.

Thus, for enhancing theoretical knowledge (episteme), research should be seen from a more holistic perspective. Thinking in monodisciplinary silos may cause problems in communication and joint understanding of real world phenomena between social scientists, engineers, computer scientists or economists. A core problem is the coexistence of different fundamental beliefs between the different disciplines: the rational view and the empirical view (Audi, 1999). While the rationalist draws scientific conclusions from mathematical evidence, the empiricist learns from (practical) experience and concludes more through logical sense making. Mathematicians, computer scien-

tists, and engineers argue based on absolute objective truth and quantitative proofs what is in line with the rational belief. While social and management scientists argue on empirical and more subjective findings (Katzy & Dissel, 2008). The created knowledge can be distinguished between pure objective or subjective knowledge (Burrell & Morgan, 1979). Therefore, a clear epistemological positioning is necessary for a solid interpretation and understanding of interdisciplinary research results between the audiences from different fields.

In this thesis, a naturalist or constructivist position is claimed for the creation and interpretation of the research results (Lincoln & Guba, 1985). This means that individuals create their own knowledge (*episteme, techne, phronesis*) based on their experience and their perspective and through interaction with others. Our theoretical knowledge (episteme), practical knowledge (techne), and knowledge as practical wisdom (phronesis) is something personal and becomes explicit when we articulate our knowledge to others in a way that enhances our understanding of a phenomenon (Nonaka, 1994; Ottosson & Björk, 2004).

Generally, in a constructivist world, there is no absolute truth and thus, the corresponding ontology is relative to specific constructed realities. In contrast to the objective positivistic stance, in which reality is (probably) apprehensible and findings are (probably) true. Positivists use experimental research designs in order to verify or falsify hypotheses or follow clear mathematical proofs, like engineers, economists or computer scientists do. In contrast, constructivists act in dialectical and hermeneutical environments and prefer the discourse of arguments based on existing theories and qualitative data, such as interviews, meeting minutes, observations or field notes. This research approach is useful, especially when there is not much knowledge about the topic (Patton, 2005), which is the case in matchmaking for open innovation (Howells, 2006).

Clearly, there is no true and false between both research stances, but it is important to know that depending on the perspective, a distinction between the quality criteria for scientific assessment has to be made. A positivist judges on external and internal validity of scientific data, reliability and objectivity. In contrast, trustworthiness, credibility, and 22 transferability are considered as important quality criteria by constructivists. Figure 2 contrasts positivism and constructivism based on the epistemological assumptions.

Basic belief	Positivism (Post-Positivism)	Constructivism
Ontology	<i>Naive or critical realism:</i> "real" reality (probably) apprehensible (only imperfectly)	<i>Relativism:</i> local and specific co-constructed realities
Epistemology	(Modified) dualist, objectivist: findings (probably) true	<i>Transactional, subjectivist:</i> co-created findings
Methodology	<i>Experimental, manipulative:</i> verification (falsification) of hypotheses, chiefly quantitative methods (may include qualita- tive methods)	<i>Hermeneutical, dialectical:</i> interpretive approach, chiefly qualitative methods (e.g. inter- views combined with observa- tions)
Criteria	Validity: internal, external	<i>Trustworthiness:</i> credibility, transferability
Voice	Scientific report: "disinterested scientist"	Interpretive case studies: "pas- sionate participant"

Figure 2: An overview of scientific perspectives (similar to Lincoln, Lynham, & Guba, 2011, p. 100 f., with own supplements).

Following a clear constructivist perspective, this work derives scientific results from empirical data which were collected in a practical research setting based on the participation in industrial projects. In my case, action research methodology offers a valid framework for a contribution to both worlds: enhancing practical knowledge and solving practical problems on the one hand, and further theoretical knowledge in science on the other hand (Ottosson, 2003; Van de Ven, 2007). A core problem following such participatory approaches is the knowledge transfer between theory and practice which is caused that scientific and practical knowledge is created separately (Van de Ven & Johnson, 2006, p. 802 f.). Action research is a method for jointly creating theoretical contributions by solving practical problems which is in line with Pasteur's Quadrant for "use-inspired basic research" generating a fundamental understanding of a certain research phenomenon with the considerations of its practical use (Stokes, 1997).



Figure 3: The Pasteur Quadrant for generalized and applied knowledge creation (according to Stokes, 1997)

Matchmaking for open innovation and in innovation networks is a little researched phenomenon. For this reason, an explorative study design is adequate using parts of the case study methodology (Eisenhardt, 1989; Yin, 2009) and action research (Herr & Anderson, 2005; Ottosson, 2003).⁴ The research project is not conducted as a neutral experiment; the practical setting in a real industrial environment is rather researched while it is emerging. This means an active participation during innovation partnership formation, implementation of changes along the matching process based on action learning and theoretical reflection of field data and observations. Therefore, the participatory case studies are analysed in a longitudinal process study design for pattern identification (Miles & Huberman, 1994; Van de Ven & Poole, 1990).

My methodological research approach follows the engaged scholarship philosophy which also suggests an advancement in management sciences by actively participating in practical settings and contributing to theory by solving practical problems (Van de Ven, 2007, p. 2). For the

⁴ Following a broader academic approach in terms of methodology, action research is my main methodology, although case study design and the engaged scholarship approach were also part of the methodological repertoire. Engaged scholarship philosophy from A. Van de Ven is in line with action research as a methodology. A case study approach was combined with participatory action research in the conference article Sailer, K., Holzmann, T., Katzy, B., & Weber, C. 2014. Co-evolution of goals and partnerships in collaborative innovation processes, *XXV ISPIM Conference*. Dublin.



execution of the study, I had designed three action research studies according to Susman and Evered (1978). Alongside the innovation intermediary, I was involved in exploring patterns in the matching process, identifying problems within the process, contributing to develop solutions, and their implementation, and studying the effect of the undertaken actions. Data collection followed the cycle of action research (Kock, McQueen, & Scott, 1997). Sources for data collection were semi-structured interviews with involved managers and small entrepreneurial firms, who were each interviewed regarding their requirements and expectations before the matchmaking (ex ante) and about their evaluation of the experience after the matchmaking (ex post). Interviews were complemented by field observations, meeting participation, and document analysis all along the process. All data are archived on the server of Strascheg Center for Entrepreneurship (SCE), in my research diaries or on separate protocols and surveys.

1.4 Structure of the thesis

The following three parts of the thesis are based on four peer-reviewed papers presented at academic conferences, two peer-reviewed journal articles as extended and improved versions of selected conference papers. My thesis consists of six separate studies of which four are core publications in the chapters 4.2, 5.1, 5.2 and 6.2. The two remaining studies in chapter 4.1 and chapter 6.1 are side papers supporting the main findings from chapter 4.2 and 6.2. All publications have been partly adapted for better linkage in this thesis. The results present theoretical findings and reflections from participatory action research cases triangulated with data and findings from similar research projects in co-authored articles.⁵ Practical implications for managers, entrepreneurs, policy makers and innovation intermediaries are derived in order to close the gap between theory and practice.

In *part I* of my thesis, I describe the motivation and problem statement and define my research objectives and research questions. In addition,

⁵ Together with my PhD colleagues and co-authors Ebru Turgut-Dao and Christina Weber, we compared our data for external validation of our findings and wrote two joint publications. In my thesis, I only rely on the perspective on matchmaking in open innovation and innovation network contexts.

²⁵

details of research epistemology and methodology are provided for a clear positioning in the scientific landscape of how knowledge is generated in my study. For setting the scene, a brief overview about existing research on matchmaking from economic, sociology and computer science is given in chapter 2 which is based on the editorial for the special issue on "matchmaking for open innovation: interaction rather than transaction". ⁶ Further literature from network economics about two-sided markets, multi-sided platforms, innovation intermediaries and matchmaking from interdisciplinary perspectives is summarized in each part of the thesis separately for the particular study in each chapter. In chapter 3, my participatory research approach and the methodological rigor of my study is outlined in detail.

Part II presents insights in matchmaking as economic value creation in innovation networks, especially in projects with strategic long-term orientation. The first study is based on a conference paper and provides a multi-sided market perspective derived from a single in-depth participatory case study about the matching process. It outlines first that matching takes place on an individual level between the agents in a hierarchy and a networked market. The second learning of this study is that innovation intermediation for asymmetric partnerships requires a multi-sided market with a networked logic. The second study is an improved and further developed version of the conference paper. The findings of the in-depth participatory case study are validated in a cross-case analysis. Matchmaking as multi-sided market for open innovation is introduced as a novel conceptual model for innovation markets in detail. Related research questions to part II:

- *RQ:* How can a suitable innovation partner be identified?
- *RQ*₁: How can the failure on innovation markets for collaboration be resolved?
- *RQ*₃: What are matching mechanisms as patterns for managerial action?

⁶ The special issue in Technology Analysis & Strategic Management is based on the research agenda developed by Thomas Holzmann, Klaus Sailer, Brendan Galbraith and Bernhard Katzy. 26

Part III opens the black box of the microstructure on a multi-sided market and provides insights about the interactions on the networked market. Similar to the transactions for market equilibrium in pure economics, the microstructure based on interactions is derived from two process studies about matchmaking. A conceptual matching matrix categorizes open innovation projects for transaction-based or interaction-based matchmaking. The studies of chapter 5 were published as conference articles and present process dynamics as network effects or feedback loops. The theoretical grounding of chapter 5.1 is based on transaction cost economics as reason for market transactions. Chapter 5.2 addresses a sociological and managerial perspective on matching dynamics and extends the existing managerial model of partnership formation. Chapter 5.3 summarizes matchmaking as market transaction and matchmaking as interaction in a conceptual matrix for managerial action based on collaboration intentions. Related research questions to part III:

- *RQ:* How can a suitable innovation partner be identified?
- *RQ*₁: *How can the failure on innovation markets for collaboration be resolved?*
- RQ_2 : How can asymmetries between innovation partners⁷ be reduced?

Part IV analyses the role of innovation intermediaries and identifies matchmaking, innovation process design, and portfolio management as distinct managerial capabilities. The study in chapter 6.1, which was presented at a conference, revisits the facilitation role of intermediaries in innovation networks and provides insights towards a pro-active managerial role in networks. Chapter 6.2 is an improved and further developed study from the conference paper and highlights the strategic management position of innovation intermediaries in networks with a clear economic contribution. Related research questions to part IV:

RQ: *How can a suitable innovation partner be identified?*

⁷ In particular in partnerships between entrepreneurial start-ups and established firms.

- RQ_2 : How can asymmetries between innovation partners⁸ be reduced?
- *RQ*₃: What are matching mechanisms as patterns for managerial action?

Part V discusses the findings from part II, III, and IV in a wider theoretical scope. Chapter 7 outlines first that innovation intermediaries deliver economic value in networks. Matchmaking for open innovation is modelled as multi-sided market. Second, matchmaking for open innovation is based on interactions with long-term impact, and transaction-based reasoning reaches the explanatory limit in this context. This finding provides a further perspective on network effects as interactions towards successful matchmaking. Third, the role of innovation intermediaries as active matchmaker is elaborated. In chapter 8 the discussed findings are linked to the research questions and are briefly summarized. The thesis concludes with theoretical and practical implications, outlines the limitations and provides paths for future research form various perspectives.

⁸ In particular in partnerships between entrepreneurial start-ups and established firms. 28



Figure 4: The structure of the thesis.

2 Background

In this chapter, matchmaking is introduced from different perspectives and gives an interdisciplinary overview of the research streams. The thesis consists of three scientific parts including six independent studies. Each chapter provides a separate literature review based on the necessary perspective for the study. In order to avoid redundancy, I waive a long literature review at this point and present our research agenda based on the editorial of our special issue in *Technology Analysis & Strategic Management* Journal.

Traditionally, matching theory belongs to neoclassical economics researching market transactions, market equilibrium and game theoretical situations (Roth & Sotomayor, 1990). Game theory is based on mathematical proof and probabilistic reasoning assuming rather fictive situations. In order to link theoretical modelling e.g. from game theory or market design (Roth, 2002) to real world problems, those problems have to be understood in detail first. In my study I follow the reasoning of market engineering and market design (Weinhardt, Holtmann, & Neumann, 2003). In order to develop suitable market mechanisms the requirements, the market structure, and the agents on the market have to be clearly analysed.

Therefore, my thesis is based on a process theory approach (Van de Ven, 2007) with socially constructed findings about the matching process on open innovation markets. I contribute to theory building with my work by getting engaged in real matching cases. Research on matching theory and market design may be inspired by my findings as shown in part V in this thesis, the same way as I was inspired by matching theory and market design for my research topic.



Matchmaking as interdisciplinary field⁹

Inter-organizational cooperation is seen to further innovation in clusters (Porter, 2000), in networks (Powell et al., 1996), or for open innovation (Chesbrough, 2003). If this is the case, finding suitable partners for collaboration, matchmaking, is of strategic relevance.

Matchmaking is known for its complexity. Its challenges have been studied for the creation of strategic alliances (e.g. Doz, 1996; Mitsuhashi & Greve, 2009), of strategic joint ventures (e.g. Hacklin, Marxt, & Fahrni, 2006), and with a more operational focus, of supply chains (e.g. McCutcheon & Stuart, 2000) using supplier selection tools (e.g. Chan, 2003). Matchmaking has equally been studied for innovation: to find partners with ideas (e.g. Afuah & Tucci, 2012; Jeppesen & Molin, 2003), technologies (e.g. Mishra, Deshmukh, & Vrat, 2002; Phaal, Farrukh, & Probert, 2006; Shehabuddeen, Probert, & Phaal, 2006) or to find "lead-users" for new product development (Hippel, 1986). Across these diverse situations, a common pattern of intermediation has been observed as a dedicated service to address the challenges of the matching process (Howells, 2006), either as brokers (Hargadon & Sutton, 1997; Katzy & Crowston, 2008) or as online services (Galbraith & McAdam, 2013).

In the literature, the phenomenon of matchmaking has mainly been discussed from three theoretical perspectives (Table 2) as economic

This special issue is the result of an initial call for papers for a workshop about "matchmaking for collaborative innovation" at the ICE & IEEE ITMC Conference in The Hague, The Netherlands in June 2013 from which the open call for papers was developed. Selected presenters from the workshop were specially invited to submit their revised and extended versions for consideration. This special issue builds on two previous Technology Analysis & Strategic Management issues specializing on "Managing open innovation in current and emerging intermediaries in the technology transfer process" Galbraith, B., & McAdam, R. 2011. The promise and problem with open innovation. Technology Analysis & Strategic Management, 23(1): 1-6. and "The convergence of ICT, policy, intermediaries and society for technology transfer: evidence from European innovation projects" Galbraith, B., & McAdam, R. 2013. The convergence of ICT, policy, intermediaries and society for technology transfer: evidence from European innovation projects. Technology Analysis & Strategic Management, 25(3): 249-252...



⁹ This chapter is based on the editorial of the special issue Holzmann, T., Sailer, K., Galbraith, B., & Katzy, B. R. 2014a. Matchmaking for open innovation-theoretical perspectives based on interaction, rather than transaction. *Technology Analysis & Strategic Management*, 26(6): 595-599.

market creation, as sociological network forming, and as a computational multi-criteria optimization process. From an economic perspective, matchmaking is approached with a focus on market transactions (e.g. Williamson, 1998) and the necessary market structures and settings to create optimal allocation of supply to demand (Spulber, 1996). Pricing in auctions or game theoretical negotiations are well known matching mechanisms. If uncertainty increases, real option pricing creates better matching results (Miller & Arikan, 2004). And if supply and demand dynamics distort market stability, the Diamond, Mortensen, Pissarides (DMP) Model explains better matchmaking results e.g. on job markets (Mortensen, 2011; Pissarides, 1985). The advantage of such economic pricing is the reduction of the matchmaking problem to a one-dimensional problem of finding the right price.

The recent advances of computer science enable more sophisticated matchmaking procedures through multi criteria optimization. The growing field of modular ICT applications in the Internet requires fast switching of servers to clients (Mowshowitz, 2002) for the execution of computational tasks, for which dedicated matchmaking algorithms are developed (e.g. Veit, 2003). Such automated routines are coordination mechanisms that allow for scoring or ranking of preferences with multiple criteria and are tools to automatically match and assign criteria or agents. Such optimization of matching processes is of interest to the economics of marriage as matchmaking on dating markets (Gale & Shapley, 1962), the matching of organ donors to patients (Roth, Sönmez, & Ünver, 2005), or emerging electricity markets in "smart" grids because these are inherently multi-dimensional matchmaking problems (Schnizler, Neumann, Veit, & Weinhardt, 2008), which are in practice increasingly facilitated through Web-platforms.

The study of the emergence of inter-organizational innovation partnerships adds interactions as a further dimension to matchmaking as the creation of social relationships between human and organizational actors and thus, the evolution of the partner networks (Ring & Van de Ven, 1994). Sociology focuses on relational and social interactions between actors and organisation theory (Conway, Jones, & Steward, 2001, p. 11), especially network theory helps to understand the social ties between actors (Granovetter, 1983; Granovetter, 1973), the reason for and the emergence of collaboration and inter-organisational relationships, or the role of trust (Cropper, Ebers, Huxham, & Smith Ring, 2008).

D (1	. .	a	<u> </u>
Perspective	Economics	Sociology	Computer Science
Theory/field	Market microstruc-	Organization	Multi-agent sys-
of applica-	ture, transaction	sciences, network	tems, matching
tion	costs, matching the-	theory & evolu-	algorithms, infra-
	ory, two-sided mar-	tion	structure
	kets	uon	
Units of	Transactions	Ties	Algorithms/source
Analysis			code
j a a	(Homo economicus)	Actor	(Computational)
	Agent		Agent
	igent		ingent
Input	Offers & demands	Expectations &	Attributes & di-
F		intentions	mensions
		intentions	
Matching	Economic deals.	Relationships	Assignments
output	equilibrium resource	renutionships	rissigninentis
output	allocation		
	difocation		
Mechanisms	Negotiations, aug-	Social interac-	Algorithms, rou-
for coordina-	tions pricing real	tions communi-	tines scoring rank-
tion	ontions	cation trust	ing
uon	opuolis	cation, trust	mg

 Table 2: Theoretical perspectives on matchmaking.

The dissertation is based on pre-published articles discussing matchmaking for innovation at the cross road of summarized theoretical fields. The contributions are of conceptual nature and equally show underlying mechanisms for intermediation in open innovation contexts and *how* emerging innovation networks and market transactions for open innovation can be managed. Theoretical and practical implications are derived from my research agenda I have followed from October 2010 to September 2014.

3 Methodology

Following the epistemological and methodological positioning in the introduction in chapter 1.3, I treat the participatory research strategy in this chapter in detail. In order to answer the identified research gap with the corresponding research questions presented in chapter 1.2 with scientific rigor, I present my research strategy and the used methodology in this chapter.

Innovation in relation to economic development has been identified as evolutionary processes of creative destruction and dynamic change (Nelson & Winter, 1982; Schumpeter, 1912). Therefore, a research design is required in which the researched phenomenon emerges while it is observed since innovation cannot clearly be predicted. The engaged scholarship approach offers a suitable framework for active participation in real life settings and research change processes over time (Van de Ven, 2007, p. 195). I chose a process study approach based on action research as a participatory methodology. This approach allows direct interaction with the research environment, implementing change, and directly observing the outcome of taken actions (Ottosson, 2003). Based on rigorous scientific reflection between practical experience, actions taken, and theory, relevant scientific contributions are derived. During my research, I was integrated and engaged in an interdisciplinary research team consisting of my two supervisors and research colleagues for theoretical reflection and practitioners from a German automotive manufacturer and two innovation intermediaries for practical reflection and learning.

3.1 Action research and engaged scholarship

Due to the identified practical problem of finding suitable partners for open innovation, I chose an action research approach. In order to reduce methodological weaknesses of action research, I combine the action research as methodology with the engaged scholarship approach as process study (Van de Ven, 2007) and also used parts of case study research in my publications, as cross-case analysis (Yin, 2009). The cyclic approach of action research as described in figure 5 has been applied as main methodology. Engaged scholarship sets the ground for participatory action research with practical problem solving and theoretical contribution as already described in chapter 1.3 (Susman & Evered, 1978; Van de Ven, 2007).



Figure 5: The action research cycle (similar to: Susman & Evered, 1978).

I designed three participatory case studies leading to three action cycles. The first two action cycles started in December 2010 and officially ended in March 2012. The third action cycle started in January 2012 and officially ended in February 2013, but the evolution of collaboration was still documented until September 2014. In each case, data from multiple sources were collected; meeting minutes and field notes based on observation were documented. More details about the case protocols, documentation, data collection, action taking, and evaluations can be found in the following chapters.

3.2 Research setting and qualitative sampling

This doctoral dissertation identifies and explores matchmaking for collaborative innovation projects between entrepreneurial new ventures and large established firms. It presents my research work from October 2010 until September 2014. The early stage of innovation partnerships, the matching process is researched by getting engaged in
the formation of real industrial collaboration projects for open innovation. Practical relevance of this topic is increasing, as several firms systematically search for external innovation partners or try to commercialise unused internal technologies and intellectual property (IP). Developed mechanisms in practice are corporate venturing departments, business incubators, technology scouting, and transfer or markets for IP.

For my research project, I got exclusive field access to a large German automotive manufacturer who asked for a better understanding how entrepreneurial firms can be identified for joint open innovation projects. Due to the relevant practical problem of how to find an unknown innovation partner, I designed an action study. Based on three action cycles, I got engaged in three different participatory cases. My sampling strategy followed a purposive sampling strategy. I had the chance of exclusive field access to ongoing strategic innovation projects of one company searching for external partners. The management of the company offered me the possibility to research the matching process of their projects from different units along the whole value chain. In contrast to a convenience sample which is only available by chance to the researcher, a purposive sample chooses cases in a strategic way (Bryman & Bell, 2011). As my research focus and research questions were clearly identified as a relevant problem in academia and practice, I could follow purposive sampling in order to conduct my research. However, one could argue whether I followed a purposive or convenient sampling strategy. On the one hand, my sampling was convenient because the company offered me to participate in their strategic matching projects, which was definitely "convenient" for me getting unlimited access to rich and exclusive field access. On the other hand, we hold several meetings before we launched each matching project as action cycle, in order to exactly define the scope of the project. Thus, I argue for purposive sampling as strategic approach due to my developed research agenda.

3.3 Quality criteria and methodological rigor check

As already discussed in chapter 1.3 in this thesis, a constructivist approach with qualitative data stands in contrast to positivist world views arguing based on objective truth. Action research is a suitable methodology for contributing to constructivist approaches and thus, follows different criteria for ensuring academic rigor; trustworthiness is the most important criteria. According to Lincoln and Guba (1985) credibility, transferability, dependability, and confirmability ensure the assessment of action research.

"Rigor in action research is based on checks to ensure that the outcomes of research are trustworthy – that they do not merely reflect the particular perspectives, biases or worldview of the researcher and that they are not based solely on superficial or simplicistic analyses of the issues investigated." (Stringer, 2007, p. 57)

The following quality criteria for action research studies are based on Stringer (Stringer, 2007, p. 57 ff.) and were strictly applied in my studies.

Quality check for	Application in this thesis	Fulfil-
rigorous action research		ment
Credibility (the plausibility and integrity of the study)	-The practical and academic contribu- tions of my work are documented in a project report, several publications, practical workshops, and expert pan- els for academia and industry.	Done
Prolonged engage- ment	-I was involved in collaboration in the regional innovation network in Munich for more than 4 years. Meet- ings and results are documented.	Done
Persistent observa- tion	-I carefully documented the field interactions and reflected regularly my observations carefully with col- leagues, practitioners, and my super- visors. This is also documented in my research diaries.	Done
Triangula- tion	-I used several sources for informa- tion and data collection: semi- structured interviews, field documen- tation and notes, meeting minutes, secondary literature. External validity was ensured by comparing my find- ings with my PhD colleagues doing research about innovation processes and networks a) in disaster manage- ment and b) in innovation systems; we wrote two joint publications.	Done
Member checking	-Participants of my research got ac- cess to my documentation and find- ings.	Done
Partici- pant de- briefing	-Feedback was given in separate reflection meetings.	Done
Diverse case analysis	-Diverse perspectives of stakeholder groups were addressed in my re- search: a) managers of the established firm; b) entrepreneurs of the start-ups and c) the innovation intermediaries	Done

 Table 3: Quality check for rigorous action research (Stringer, 2007).

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Quality check for	Application in this thesis	Fulfil-
rigorous action research	••	ment
Referen- tial ade- quacy	-As the search and matching criteria were based on real industrial projects, they reflect the perspective of the participants. Feedback sessions about the action cycles lead to validation of the findings.	Done
Transferability (apply the findings to other settings)	-The findings of my three action cycles were transferred to the level of the European Commission in terms of matchmaking for Living Labs by improving the process and testing an online matching tool for process support (see section 8.4 and two conference publications).	Done
Dependability (clearly defined research process, open to scrutiny)	-In the appendix of this thesis my main data analysis instruments are attached. Other documentation as field notes or my research diaries with meeting minutes can be re- viewed.	Done
Confirmability (confirm that described pro- cedures took place)	-Collected data are saved online at the server of SCE, research diaries and field notes are captured and are accessible for review. -Documentation about action cases is also available on the internet (e.g. <u>www.charging-ev.net</u> and see section 8.4).	Done

 Table 3: Quality check for rigorous action research (Stringer, 2007), continued.

3.4 Justifying the research setting

Finding the suitable innovation partner in innovation networks, innovation clusters or for open innovation is a very relevant question for managers and entrepreneurs. Managers from established companies can derive profit for path breaking innovations from external partners which makes their corporation competitive in future. Especially young entrepreneurial firms can be seen as "innovation carrier", but they are rarely visible on the market. In particular, collaboration between entrepreneurial firms and established companies, so called asymmetric partnerships (e.g. Cao, 2006; Minshall, 2010), can lead to radically new innovations which can disrupt existing markets or create completely new business fields (Rothaermel, 2002), but they also include high risk and failure rates (Doz, 1987). Such asymmetric partnerships pose challenges for entrepreneurs and corporate managers in various forms e.g. culturally, team size and flexibility or decision making and business processes (Doz, 1987; Minshall et al., 2010). At an early stage, finding the right start-up with a suitable solution causes high search costs for established companies. New ventures are often invisible on the market due to their small size or they are simply not founded yet and they only exist as ideas, business plans or prototypes in (university) incubators. From the opposite site, entrepreneurs have difficulties in identifying the suitable contact person in a large organisation which results in high signalling costs and rejection rates. In order to systematically research the matching process between managers of an established company and entrepreneurs of new start-up ventures, I followed the iterative circle between practical engagement and theoretical abstraction along the matching process.

Due to the complexity of the topic and the multiple possible perspectives, my thesis focuses on matchmaking for asymmetric partnerships. This is due three main reasons. First, with the right set up, partnerships between start-ups and established firms can deliver a high degree of innovativeness and novelty in collaborative settings (Rothaermel, 2002). Thus, it offers a suitable setting for researching the emergence of collaborative innovation processes. Second, the existing deviation and complementarities in such asymmetric innovation partnerships can generally be seen as maximal in multiple dimensions (Doz, 1987; Minshall et al., 2010; Mitsuhashi & Greve, 2009), therefore I expect a higher deviation along the matching process. Third, the literature mainly discusses how to find and select suitable partners for stable supply chain networks, strategic alliances, technology transfer or joint ventures, but neglects matchmaking for asymmetric partnerships and fourth innovation intermediaries offer a relevant perspective on the emerging phenomenon of matchmaking. However, their function and coordination mechanisms are not well understood yet (Chesbrough, 2006; Howells, 2006).

Part II: Economic value creation in networks¹⁰

¹⁰ This part is based on two pre-published articles. Chapter 4.1 presents the conference paper Holzmann, T., Sailer, K., & Katzy, B. 2013. The matching process for innovation partnerships: A multi-sided market perspective *IEEE International Technology Management Conference & 19th ICE Conference*. 24. - 26. June 2013, The Hague: IEEExplore. Chapter 4.2 is an adapted and an extended journal paper version Holzmann, T., Sailer, K., & Katzy, B. R. 2014b. Matchmaking as multi-sided market for open innovation. *Technology Analysis & Strategic Management*, 26(6): 601-616.

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4 Matchmaking as economic value creation in networks

The following chapter presents the matching process between organizational hierarchies of the potential partner firm's and the interactions on the matching market as networked setting. Literature analysis on two-sided markets and matchmaking sets the base of the derived multisided market model. Interactions between the market agents are presented along the matching process. Chapter 4.1 is based on a conference paper and chapter 4.2 is an extended and improved version for journal publication.

4.1 A multi-sided market perspective¹¹

Many studies exist about open innovation as transfer of innovations inside and outside of the firm or as joint projects in collaborative partnerships. In this chapter, I investigate the matchmaking between innovation seekers and innovation providers, with the focus on asymmetric partnerships between incumbent large companies and young entrepreneurial firms. In particular, I introduce the matchmaking problem as a multi-sided market with different internal and external agents and describe the phenomenon. Furthermore, the matching process on a multisided market is presented based on existing literature and an in-depth participatory action study.

4.1.1 Introduction

Firms who want to collaborate or partner for innovation have to find each other. At first sight, this statement seems simple, but in reality the matchmaking is connected with lots of costs and managerial coordination efforts. In the literature about managing innovations in networks (Powell et al., 1996), clusters (Porter, 1998), and innovation systems (Edquist, 1997) or in living labs (Almirall & Wareham, 2008) and open innovation (Chesbrough, 2003), collaboration is claimed as the central

¹¹ This chapter is based on Holzmann, T., Sailer, K., & Katzy, B. 2013. The matching process for innovation partnerships: A multi-sided market perspective *IEEE International Technology Management Conference* & *19th ICE Conference*. 24. - 26. June 2013, The Hague: IEEExplore.

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task. If this is so, finding the right innovation partner is a necessary process for managers, engineers and entrepreneurs.

Collaboration is connected with bilateral exchanges between a demand and a supply side. This let assume that the exchange can be coordinated through market mechanisms, even though, studies show that especially markets for innovation are imperfect because of its uncertain outcome (Cesaroni, 2004; Lichtenthaler & Ernst, 2007; Lichtenthaler & Ernst, 2008). This complex phenomenon is similar to the housing, the job, the dating or the stock market, where broker entities or intermediaries facilitate and clear the exchange between agents. In this context, we address the question 'how to find the right innovation partner?' and present results from a process study of real matchmaking for a collaborative innovation project.

This chapter reports on an in-depth action study of the intermediation for *asymmetric partnerships* (Minshall, Mortara, Elia, & Probert, 2008; Minshall et al., 2010) between established companies and entrepreneurial firms. The automotive industry offered a suitable research setting, with its current strategic relevant topics of electro-mobility infrastructure and suitable business models for the launch of new electro-vehicles in the near future. The matching process was coordinated by an external innovation intermediary accompanied by the researcher.

The problem for automotive manufacturers, electric power producers and corresponding suppliers along the value chain is the lack of knowledge for sustainable business models and competing technologies. In such a transitional phase, young entrepreneurial firms can provide valuable innovations for business models, services and technologies, but finding them remains a challenge. A theoretical contribution is made by describing the matching process on a multi-sided innovation market as the economic rationale on open innovation coordination in the early phase.

The chapter is structured as follows. In the second paragraph, an overview is given about the literature on matchmaking, innovation intermediaries and two-sided markets. The third paragraph summarizes the qualitative research methodology. Results from the action cases are presented in the fourth paragraph, which ends in a discussion and implications for theory and practice in the fifth paragraph.



4.1.2 A literature review on matchmaking and two-sided markets

Following intermediation theory, firms create and clear markets by an efficient matching of demand and supply (Spulber, 1999; Spulber, 2003). On a linear neoclassical market with perfect information, the producer delivers his goods to a re-seller who acts as intermediary by selling the good to the customer. Normally, the customer knows his needs and knows where and how to get the product or the service. In this case, the matching between the demand and the supply side is clear and frictionless along the value chain. Trading partners can easily find each other.



Figure 6: A linear one-sided market (Hagiu & Wright, 2011)



Figure 7: A bidirectional and centralised two-sided market (similar to Järvi, Schallmo, & Kutvonen, 2011).

This one-sided market logic with a unidirectional perspective does not work for markets with bilateral interactions between both sides. The theory about two-sided markets is an emergent field in economics which offers a valuable approach for a better understanding of networked markets. Network externalities (Katz & Shapiro, 1985) play an important role on such markets, as the success of these markets depends on a critical mass of users on both sides who attract each other. Basic definitions of a two-sided market are:

"Two-sided markets involve two distinct types of users, each of whom obtains value from interacting with users of the opposite type..." (Wright, 2004, p. 44).

"Broadly speaking, a two-sided market is one in which 1) two sets of agents interact through an intermediary or platform, and 2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality" (Rysman, 2009, p. 125).



Figure 8: Theoretical framework of a decentralised two-sided market (based on Raivio & Luukkainen, 2011; Tuunainen & Tuunanen, 2011 with own complements).

The main characteristics of two-sided markets are matchmaking between two or more market sides which requires different mechanisms and capabilities, building a platform which offers network effects for both sides and facilitating the transactions and make them more efficient (Evans & Schmalensee, 2007). On a two-sided market, the intermediary coordinates the market sides and facilitates interactions. In this context, the literature mainly discussed pricing mechanisms (Hagiu, 2006; Rochet & Tirole, 2004) and empirical examples like housing or job markets, dating clubs or social media networks (Evans, 2003b; Evans & Schmalensee, 2005; Raivio & Luukkainen, 2011; Rochet & Tirole, 2006).

The underlying mechanisms for open innovation platforms and intermediation services can be also seen as two-sided markets (Chesbrough, 2006, p. 139), but detailed insights in the mechanisms of these innovation markets are not provided. In regard to the management of open innovation, InnoCentive or NineSigma are empirical examples of such online two-sided markets (Lopez-Vega & Vanhaverbeke, 2009; Lopez 48 & Vanhaverbeke, 2009). Innovators can register on their platform for free while companies have to pay a fee for their innovation requests or challenges posted to the community.

The problem in terms of collaborative innovation between two companies is that such communities are very difficult to form within the organisation, because of hierarchical constraints (Holzmann, Sailer, & Katzy, 2012, see Chapter 5.1 in this dissertation) and because of the complexity of organisations with individual interests of their agents (Barnard, 1938). Furthermore, innovation itself is something unpredictable and the outcome is not definable ex ante. This is connected to a high level of uncertainty as managers often cannot articulate their explicit needs towards innovation which often results in a lower commitment. Therefore, managing the matching process remains very difficult which often leads to a termination of the process flow if there is no external agent managing the matchmaking (Katzy, Sailer, Holzmann, & Turgut, 2011; Katzy, Turgut, Holzmann, & Sailer, 2013). Partner selection tools for strategic alliances are already developed and tested (e.g. Hacklin et al., 2006; Holmberg & Cummings, 2009) and models for supplier selection are well researched in academia (e.g. Luo, Wu, Rosenberg, & Barnes, 2009; Wu, 2009). We identified a gap in the literature about the understanding of processes on innovation markets and networks for matching suitable innovation partners. Moreover, studies about entrepreneurial firms as "innovation suppliers" are rare, as well as the selection of suitable collaborative innovation partners.

4.1.3 Partner matching and the exchange of information

Especially in negotiations for collaborative innovation partnerships the exchange of knowledge and information is essential for the matchmaking. The problem is that entrepreneurs basically do not want to transfer their ideas or business models, while established firms basically do not want to transfer their knowledge and strategy to external partners.

In this context, Arrow's Information Paradox (1962) is seen as a main reason for market failure. It states that the resource allocation under uncertainty is non optimal. One reason is the "... fundamental paradox in the determination of demand for information; its value for the purchaser is not known until he has the information, but then he has in

effect acquired it without cost" (Arrow, 1962, p.615). Within the open innovation paradigm (Chesbrough, 2003), innovation intermediaries are addressed as a solution to the "Arrow Information Paradox" between two or more agents (Chesbrough, 2006, p. 139). Lopez and Vanhaverbeke (2009) provide a comprehensive literature review on innovation intermediaries and their activities. While there are already studies about the different typologies of innovation intermediaries (Howells, 2006; Lopez-Vega & Vanhaverbeke, 2009), their business models (Lopez & Vanhaverbeke, 2009) and a process model of consultant agencies as bridge builders in technology transfer (Bessant & Rush, 1995; Hargadon & Sutton, 1997), we now open up the black box and present a participatory study of the matching process of an innovation intermediary which has not been explored yet in this context. In other studies, we introduced the function of innovation intermediaries as process managers, with distinct matching capabilities (Katzy et al., 2013).

The examples of studies about innovation intermediaries and (open) innovation coordination has mainly explanatory focus, process insights like presented in Bessant and Rush (1995), in Hargadon and Sutton (1997) are very rare. Studies about the evolution of cooperation in stable supplier networks, like in the *Virtuelle Fabrik* from Katzy and Crowston (2008), do not solve the partner finding problem in dynamic or evolving networks with high uncertainty. In this study, the information about the capabilities and competencies of the network partners was known which ended in a structured process called "*competency rallying*". This setting allowed an efficient formation of temporary partnerships as all the necessary information was available for a successful partner matching.

In our case, entrepreneurial firms are not visible on the market, as they are very young or unknown and they do not belong to an existing supplier network of an established firm. Together with the problem of a clear articulation of the innovation demands, the question how to identify, built a trustful setting for information exchange and match them in order to explore innovations in collaborations remains unsolved.

To the best of our knowledge, Bakicic et al. (2010) have started a first attempt to give in depth insights in innovation intermediaries by presenting five distinct mechanisms. They also claim a lack of research that specifically explores matching mechanisms (Bakicic et al., 2010), but

they neglected the matchmaking between two or more companies for collaborative partnerships. We address this question in our paper by presenting a partner finding process which we refer to as "matching process".

4.1.4 Methodology and research setting

The research methodology follows an exploratory and qualitative approach. In-depth studies of emerging innovation partnerships are rare and that is why our study explores the partnership formation in a real industry setting. Strategic agendas of established companies are strictly confidential, thus field access to ongoing management topics is difficult. Therefore, most of the case studies in literature are retrospective and have no in-depth perspective of the collaboration formation. In our study, we attended the whole process of the partner finding project. The researcher's access to a strategic innovation project for electro-mobility infrastructure is in line with a convenient and purposive sample and fulfils the requirements for an in-depth study of the matching phenomenon (Easterby-Smith, Thorpe, Jackson, & Lowe, 2008, p.217 f.).

Our methodology offers valuable insights in an ongoing research project with industrial partners and therefore, we conducted a participatory action research approach (Ottosson, 2003; Susman & Evered, 1978). This paper reports the second action research cycle of a research project and builds on the learning from a first action research cycle published in the last two years (Holzmann et al., 2012; Katzy et al., 2011). In the first action cycle, we explored the matching process with two innovation managers in two separate projects (Katzy et al., 2013). The learning was implemented in the second action cycle in different business units of the same company. The iterative research design (Kock et al., 1997) emerges within reflection meetings with all project participants.

We are aware of the weaknesses of uncontrollability, contingency and subjectivity in action research (Kock, 2004), but especially in exploratory studies new insights might be gained and relevant questions are addressable. Furthermore, the research setting allowed us to study all agents and events on the multi-sided market within one case in a real

environment with different methods. Therefore, we developed the project plan with the intermediary and implemented our developed process from the first action cycle (Holzmann et al., 2012). The case sample consists of one intermediary who operates as network multiplier and service entity, a market side A (established firm as innovation seeker) and a market side B (SME's and entrepreneurial firms as innovation supplier).

Market side A:

In our example of a multi-sided market, market side A is an established automotive manufacturer with more than 100.000 employees, searching for innovative electro-mobility solutions. The strategic focus was on a fast roll out and implementation of electro-vehicle charging infrastructure with new technology and new business models for electro-mobility services. Participants on market side A were strategic managers, sales managers, product managers and R&D mangers from the same established company, the automotive manufacturer. Totally, 37 employees from different hierarchy levels were involved. The systematic involvement of multiple agents on market side A was the first implemented change compared to the first action cycles.

Market side B:

Young entrepreneurial firms formed market side B which mainly derived from the intermediaries' network. During the case study, market side B was formed by an online application tool, a pro-active search by the intermediary and by network multipliers who forwarded the search profile through their channels. After the search process of 8 weeks, 71 innovative firms applied as potential partners and formed the portfolio. The applications ranged from established large companies and SME's to very young entrepreneurial firms and student teams. The set-up of an own online application tool for criteria assessment was the second implemented change compared to the first action cycles.

Innovation intermediary:

The coordinating entity was the intermediary who involved three full time employees, including the researcher. The involvement of a professional intermediation service operating since 1996 was the third change compared to the first action cycles. The defined main tasks of the intermediary based on the reflection of the first action study were profiling (i.e. assessment of demands of market side A), search (i.e. identification of suitable partners through different search channels), selection (i.e. a proposed ranking of potential partners – the final decision was made by the corporate management of market side A), matching (i.e. organising a two day matching event, coaching and facilitating the interactions during the event) and an ex-post evaluation of the matching success (i.e. monitoring and reviving follow up meetings). The matching process similar to (Marxt & Link, 2002) is shown in figure 9.



Figure 9: The matching process for the action case.

Data collection was undertaken in a process study design (Van de Ven, 2007) which fits in the participatory action research approach. Semistructured interviews were conducted and audio-taped with 4 top managers from each business unit involved from market side A and 19 entrepreneurs/SME managers from market side B. A second round of interviews was conducted for an ex-post evaluation of further steps via interviews by telephone. Furthermore, participatory observations during the matching event were documented by the research team, meeting minutes and specific events were collected and a feedback survey with open and closed questions for specific learning was distributed after the matching event. According to the "*engaged scholarship diamond model*" an iterative process between problem formulation, prob-

lem solving, research design and theory building (Van de Ven, 2007, p.10) was applied for the statements in this paper. The action cycle started in January 2012 and ended in February 2013.

4.1.5 The matching process for asymmetric partnerships

Based on the matching process (figure 9), interactions between the participating agents and coordination mechanisms on the multi-sided market during the study could be observed. Each paragraph describes the observations for the corresponding process step.

Learning 1: The *matching takes place on an individual level between the agents* in a hierarchy and a networked market.

Profiling: From hierarchical structures to a networked organization

According to our finding, the underlying rationale on innovation intermediation is a multi-sided market. If we assume a two-sided market, we would only focus on the established firm as one agent and the entrepreneurial firm as the counterpart. Following Chester Barnard (1938) a firm always consists of individual agents (the employees or entrepreneurs) with individual goals according to the strategy of their business unit, personal intentions and motivations. We have identified their personal involvement in the profiling process as crucial. Thus, an observation of the matching process only on firm level according to our understanding is not reasonable. Concerning the profiling, we suggest two perspectives the individual assessment of search criteria and the agglomerated assessment on firm level. Hence, we can see the firm's organization as a hierarchal network where matchmaking occurs because of a mixture of different search criteria. These search criteria differ depending on the project, group, department, business unit or board level. One statement in a group meeting was:

"We from the R&D department have already some ideas and solutions the strategy department is searching for. Why do we need such a matchmaking event? They could also just ask us." (Meeting minute R&D Manager)



In contrast, the strategy department (who initiated the matching project) was more focused on business models for collaborative projects and sales multipliers, not specifically on technological details, like the R&D department had expected. Another interesting feedback after the matching event was:

"Involve all partners to prevent confusion of our partners! We are operating on CEO level." (Open question from feedback survey)

Therefore, the intermediary should take the requirements from each business unit into consideration, respectively their agents beforehand. For a concrete search request which fits best with the whole corporation, it is important to find a search profile based on a group decision, in order to anchor the demands within the hierarchy and get commitment from all agents.

This points out that the profiling stage of the matching process starts in the hierarchy of the firm. The challenge for the intermediary is to form an "internal multi-sided market" based on individual requirements (which are not made public) from different business units and generate a corporate requirement profile (which is published for application similar to a job profile). Hereby, the intermediary gains an additional value position by confronting the established firm with the individual requirement profiles and knows all individual needs of the business units. This is the stage, where the matching process is decoupled from hierarchical organisation and transferred in the external network. During the group decision making, moderated by the intermediary, the individual profiles are combined for a corporate requirement profile. This process helps the agents of the firm learning about their own organisation and the requirements from different business units. These same-side network effects between the agents on market side A foster a common understanding and widen the individual perspective in terms of the addressed problem.

Search: External process management and network access as multiplier

The search process was separated from the hierarchical organisation of the established firm and implemented in the external network. First, the network access of the intermediary offered the established firm and their agents' new channels for external innovations and second, the external process management was not interrupted by internal routines. One of the main tasks of the intermediary was to establish a portfolio of potential partners by conducting an intensive market and technology analysis. By accessing the intermediaries' network multipliers, several new innovative firms could be acquired for the portfolio.

Selection: Ranking, scoring and joint decision making

Three stages distinguish the selection process. The first stage was a pre-ranking by the intermediary. The long-list consisting of 71 applicants was ranked by a qualitative ABC method. In the second stage, the managers from the established firm checked the ranking and considered the 17 A-ranked applicants internally. In the third stage, 12 entrepreneurial firms were selected for invitation in a group meeting. Feedback was provided by the intermediary according to the managers' requirements to the applicants. The reflection meeting revealed some potential for improvement of the selection process, like one manager stated:

"I underestimated the time effort organising the matchmaking event with all the profiling and selection meetings." (Meeting minute)

Matching: The Arrow's information paradox - a two sided sword

What we have observed is that the information is not automatically transferred once it is made explicit. Some start-ups even presented prototypes of their technology in the one-to-one matching meetings. Surprisingly, it was often mentioned that the negotiations in these meetings were held in a trustful and open environment. One reason 56

could be that complementary partners were searched for electromobility infrastructure, which obviously was not the core business of the established firm. We cannot make any statements about matching negotiations on a horizontal level between two firms from the same stage of the value chain, e.g. competitors. In our case the established firm was not directly interested in the technology know-how, more on the joint implementation, the entrepreneurial firm as market opener and an overview on the market for the roll out of their electro-vehicles. Therefore, in our case we cannot confirm the "*information paradox*". It is true that there were information asymmetries and some restrictions beforehand from some entrepreneurs concerning their ideas. One entrepreneur said:

"I am completely surprised why they search for charging infrastructure; their core competence is the manufacturing of cars. They should focus on that instead of caring about things which are not their business. Concerning their intentions about a co-operation, I think more, that they are interested in our idea, like some other big companies we were in contact before. They wanted to know everything and then realized it by themselves."

(Interview citation)

Others wished: "more information about the intentions of the established company before the matching event" or "it was not completely clear why the established firm organized this event". (Open questions from feedback survey and field notes)

Therefore, we identified the intermediary as trust builder and platform provider reducing these asymmetries beforehand. All in all, we observed on the one-to-one matching meeting very fruitful and open discussions. The information flow was not necessarily balanced, sometimes the established company shared more insights sometimes it was the entrepreneurial firm. The following feedback summarized and confirmed our observations:

"During the event, I was impressed by the enthusiasm from more than 20 employees of the established firm, we felt aligned and not like David and Goliath." (Open question from feedback survey)

Depending on the search criteria which were defined during the profiling process, we discovered differing forms of negotiations during the one-to-one meetings. Also some criteria stated before the event changed per some agents. The younger and the more innovative the entrepreneurial firm was the more was discussed about visionary concepts in future and ideas about new implementations. The more mature the product or the service of the entrepreneurial firm was, the most factual the negotiations were, comparable to buyer and supplier discussions. It was quite surprising that the firms with mature products opened up the vendor's tray and tried to sell their products, whereas the younger firms were more reserved and tried to understand the intentions of the established firm, which generally arouse more interest by the other side.

For example, one innovative start-up demonstrated a prototype which ended in very detailed discussions and a successful matching with a big project consortium. Other firms presented a catalogue with a range of standard products which they tried to sell. Derived from this observation, we may conclude, that the matching process are distinguished in four archetypes:¹²

- 1) Buyer and supplier relationship
- 2) Technology transfer and intellectual property exchange
- 3) Co-creation and ideation processes
- 4) Collaborative innovation for new business fields

According to our understanding, a distinction between these archetypes is reasonable and should be linked with literature addressing coexploitation and co-exploration (Parmigiani & Rivera-Santos, 2011) and incremental or radical innovation projects (Leifer et al., 2000).

¹² Chapter 5.3 extends this categorization towards a matching matrix for managerial decision making. 58

Evaluation: Refreshing/reviving the first contact

A further problem which was identified in our first action cycle (Holzmann et al., 2012; Katzy et al., 2011) was that the managers are blocked by their daily work routines and cannot proactively pursue the matching process. Especially after the first contact at the matching event, the process flow fizzles out while the counterpart on market side B waits for feedback. The intermediary can accomplish a valuable support by managing this process. From our sample of 12 entrepreneurial firms participating in the event, three months after, there were 5 concrete follow up meetings agreed and organised. The other 7 expected feedback within 4 weeks after the matching event. This shows that the intermediary can reduce such communication asymmetries by actively mediate between both market sides.

4.1.6 A multi-sided market for finding an innovation partner

In our action study, we facilitated interactions within and between both market sides, namely between the established company and the entrepreneurial firms. In contrast to the two-sided market logic, we observed multi-sided interactions between all participating agents, not on a firm level. This networked market logic offers several opportunities in terms of matchmaking for collaborative innovations.

Learning 2: The underlying rationale on innovation intermediation for asymmetric partnerships is a *multi-sided market* with a networked logic.

First, we observed same-side network effects between the agents on both market sides. For the established firm, the networking between R&D, sales, product and strategic managers offered a cross-functional exchange on market side A. Other studies show a positive impact with cross-functional collaboration on innovation outcomes within an organisation (Denison, Hart, & Kahn, 1996; Kahn, 1996). This was facilitated through the networked multi-sided market and the conducted matching process. On market side B, entrepreneurs also had a very good networking opportunity and one co-operation between three par-

ticipating entrepreneurial firms was reported after the matchmaking event, as well as several business contacts.

Second, the networked multi-sided market offered a trustful environment for an open information exchange between all agents. In contrast to the literature about two-sided markets, network effects are mainly discussed as positive or negative feedback-loops between the two market sides. Our multi-sided innovation market did also work without a critical mass of agents on one side, as it was a temporal created market based on one search project for collaborative innovation with a distinct topic and a unique portfolio of 71 collaboration candidates.

Third, the matching event offered an opportunity for ideation about new business opportunities, audience building for the political topic of electro-mobility and charging infrastructure and technological discussions about concrete implementation of solutions. Especially in uncertain situations, like the competing technologies for electro-mobility the multi-sided market supported interactions with the concrete outcome of 5 matches.¹³

4.1.7 Conclusions

According to our understanding, there is a lack of research about the underlying processes and mechanisms on innovation markets. Our case shows first, the innovation market is a *multi-sided market* where internal and external agents from different firms interact on a networked market. Second the matchmaking takes place between agents and not on a firm level. We may conclude concerning the matchmaking for collaborative innovation partnerships that the right agents from all market sides must be brought together. Thus, a multi-sided market perspective offers the possibility to further understand these mechanisms for developing process models and tools.

Our case further supports same-side and cross-side network effects during the matching event and this emphasises the networked structure of multi-sided innovation markets. Furthermore, the intermediaries' network access to potential innovation suppliers which we earlier defined as "*deal-flow portfolio*" (Katzy et al., 2011), increases the prob-

¹³ A match means that either a non disclosure agreement (NDA) was offered, or further negotiations and meetings were agreed or concrete steps towards collaboration were demonstrated. 60

ability of a successful match.¹⁴ By demonstrating concrete outcomes to the managers of the established company, several follow-up meetings were decided and tentative agreements were offered to the entrepreneurial firms. Referring to the network literature this is also explainable by closing structural holes between two or more network agents and strengthen them to direct ties, which positively influences innovation (Ahuja, 2000; Burt, 1995; Walker, Kogut, & Shan, 1997).

In our case the multi-sided market constructed by the innovation intermediary helped:

- 1) the established firm in learning about the innovation requirements within its own organisation
- 2) the established firm in getting a common understanding about a strategic relevant topic or problem for future business opportunities
- 3) the entrepreneurial firms in finding suitable collaboration partners on both sides and
- 4) in matching suitable innovation partners for joint projects.

In this context, the multi-sided market facilitated the matchmaking and interactions between the agents on the market. Nevertheless, our research still leaves some place for further practical improvements and future research. In particular, we argue, that different forms of multisided markets and different matching mechanisms are needed depending on the innovation demands. From our study, we can distinguish between matching for suppliers, for existing technologies, for new ideas or new business models.

This study is limited to a single action case and builds on a previous action study which does not permit general conclusions. Therefore, further studies have to be conducted in similar settings. We further cannot give insights about the success of the emerged collaborations, as our study ended after the matchmaking with one ex-post evaluation. The collaboration process is still ongoing and a concrete outcome is expected in summer 2013.

¹⁴ For a detailed elaboration about the functionalities of innovation intermediaries see part IV.

More studies are needed to gain a better understanding of the different matching mechanisms from a process, algorithmic and agent perspective (Bakicic et al., 2010; Holzmann et al., 2012). Once the matching mechanisms are elaborated in detail for different multi-sided market forms, on- and offline markets can be (re-)engineered or improved for more efficient matching mechanisms which help clearing the market inefficiencies from today.¹⁵

¹⁵ Acknowledgement

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⁶²

4.2 Matchmaking as multi-sided market for innovation¹⁶

This chapter builds on the previous findings from chapter 4.1. Matchmaking as multi-sided market for open innovation is further developed with a cross-case analysis based on three participatory case studies. Arguments and feedback from the audience at the conference were integrated, as well as from the reviewer of the journal.

An obvious task in open innovation is to find suitable partners for collaboration. In this chapter, I present results from three participatory case studies of identifying and matching technology firms for collaborative innovation projects. I observe that matchmaking is a more complex process than an (online) market transaction. The cases show how innovation intermediaries organize the matching process as external service-providers and what economic contribution they can have. The chapter conceptualizes matchmaking for collaborative innovation as economic resource allocation process in the shape of a multi-sided market which involves the innovation partners and intermediaries. The chapter concludes with theoretical and practical implications that such a conceptual lens opens for exploratory technology analysis projects and the management of matching processes for innovation partnership formation.

4.2.1 Introduction

Open innovation promotes a more collaborative and networked approach to innovation and highlights the strategic benefits of transferring ideas, technology, knowledge and intellectual property (IP) between firms (Chesbrough, 2003). Economic exchange between firms happens in markets and a number of dedicated (online) market places have been established for exchanging and trading technologies and innovations. Some of these market places are commercial, others are publicly funded. Most of them emerged in the past decade and share the mission to facilitate market transactions between open innovation partners by matching a

¹⁶ This chapter is based on the journal publication Holzmann, T., Sailer, K., & Katzy, B. R. 2014b. Matchmaking as multi-sided market for open innovation. *Technology Analysis & Strategic Management*, 26(6): 601-616.

⁶³

particular innovation demand with the corresponding supply (Howells, 2006; Klerkx & Leeuwis, 2008). The shared assumption is that the exchange of technologies and ideas can be coordinated through market mechanisms. Recent studies, however, show that especially markets for technology and innovation are imperfect and do not always work properly (Arora, Fosfuri, & Gambardella, 2001; Cesaroni, 2004). The search for new alternatives is in the name "open innovation" as contrast to organizational hierarchies, the classical economic coordination alternative when markets fail (Williamson, 1975).

Alliances are a known mechanism e.g. in R&D management to build quasi-organizational hierarchies in inter-organizational settings (Osborn & Baughn, 1990; Parmigiani & Rivera-Santos, 2011; Sydow, 1992). Literature provides some success stories of such alliances as well as testimonies of failures (Littler, Leverick, & Bruce, 1995; Marxt & Link, 2002). Especially in the early phase of exploratory innovation, when the outcome is still unclear, concrete requirements towards collaboration partners are often difficult to formulate or change. In consequence, innovation collaboration can fail simply due to wrong partners involved. As the formation of R&D alliances is a long-term investment frequent changes in uncertain environments lead to high transaction costs or - in case of abandoning the project - to "sunk costs" and irretrievable losses for the involved partners. Process models of R&D alliance formation from literature therefore distinguish between a more stable network of competencies and resources, and what Katzy and Crowston (2008) call the rallying process for projects that follow innovation opportunities. Some projects require partners beyond the pre-existing network, for example, because the innovation addresses opportunities in new markets, new industries, or through new technologies that go beyond the competencies of the firm and its existing network partners. Such situations do not only call for opening firm boundaries but for "opening" the network as well.

The aim of this paper is to understand how firms find collaboration partners beyond their current networks. The emergence of collaborative innovation projects on electromobility in the Bavarian automotive industry offers an insightful research setting to study this question because relevant technologies, services, and suitable business models for the production and launch of new electro vehicles requires partnering beyond the scope of the existing automobile supply chains: electricity providers, Internet firms or young start-ups are expected to play a future role. In our case studies, BMW searched for innovations and new technologies from young entrepreneurial firms. In order to gain deep understanding on the managerial processes, we joined the effort of establishing new partner-ships in three different cases following the engaged scholarship study approach (Van de Ven, 2007).

We observed an extensive matching process over several months through which new partners engaged in collaborative projects. In the course of this process, technological trends as well as new business models were explored, which lead to innovation transfer between the future collaboration partner firms. In consequence, inter-organizational coalitions of individuals formed and new partners often joined different projects than the initially intended ones. Rather than any single transaction, the extension of the innovation network emerged as a priority. Transactions, in form of contracts were only signed late in the process. Innovation intermediaries provided an essential contribution for this to happen in providing access to mainly invisible small entrepreneurial firm networks, in facilitating trust building between individuals by reducing asymmetries, and in process coordination.

We contribute to theory by conceptualizing matchmaking as a multisided market, coordinated action of the party demanding innovation services, the party supplying innovation services, and the innovation intermediary. The nature of multi-sided markets - in contrast to simple neoclassical markets - is that the transaction is not limited to one point in time but a process with long duration over time. The economic rationale of a matching market for open innovation is complemented with a managerial component of coordinating the process. In doing so, the paper contributes as well to defining the role of innovation intermediaries as partner in the multi-sided market process. The practical impact of this novel theoretical perspective is a shift in the understanding of the managerial roles in the early phases of establishing open innovation partnerships.

The paper is structured as follows. In the second section, we give an overview about the literature on innovation intermediaries, matchmaking and two-sided markets. The third section summarizes the qualitative re-

search methodology and describes the setting of the cases. We then present results from the participatory case studies in the fourth section, which ends in a discussion and implications for theory and practice in the fifth section.

4.2.2 Matchmaking and the economic setting for open innovation

With the increased interest in open innovation and the suggestion of trading IP, technologies and innovation on markets (Chesbrough, 2006), more studies on such markets are undertaken from different disciplinary backgrounds. Innovation economics researcher rather found that technology and innovation markets fail and identified reasons for failure, e.g. information asymmetries result in a frequent mismatch between demand and supply and consequently lead to exaggerated search and transaction costs (Arora et al., 2001; Cesaroni, 2004). Innovation intermediaries have been observed and generally been described as solutions to market failure, as broker agents or facilitators for technology transactions (Galbraith & McAdam, 2013; Howells, 2006). This is in line with economic literature, where intermediation theory is used to explain how firms create markets and reduce transaction costs by efficiently matching demand and supply and thus showing a concrete economic value to market agents (Spulber, 1999; Spulber, 2003). In the light of this theory, too little is known of the market structure and its mechanisms for economically efficient open innovation.

On a simple commodity market, matching between demand and supply is clear and frictionless. All necessary information is assumed to be available so that trading partners can find each other for efficient transactions. The classical structure of commodity markets therefore is one-sided which means e.g. a producer can sell goods either directly or via a re-seller to the customer. This simple one-sided market logic does not explain matchmaking mechanisms and reciprocal interactions between two or more agents of the type that characterize collaborative settings in innovation networks. Furthermore, the term one-sided market is generally misleading, because each market needs at least two

sides - demand and supply - for a successful transaction (Evans & Schmalensee, 2005).

For this reason, the theory of two-sided markets (Rochet & Tirole, 2004) gained more importance in academia, especially related to the fast growth of e-businesses like ebay[®], Facebook[®], or GoogleTM. Such online platforms facilitate trading partners to find each other autonomously. Similar to "switchboards" (Mowshowitz, 2002), these platforms use algorithms to efficiently match demand and supply so that users can easily choose between alternatives. It is not surprising that online platforms also appeared for technology and innovation transfer. Examples are the Enterprise Europe Network (EEN), InnoCentive[®] or NineSigma[®] and are described in literature (Chesbrough, 2006; Lopez-Vega & Vanhaverbeke, 2009). They create online market platforms where innovation proposals are matched with problem owners or problems are posted to potential problem solvers.



Figure 10: A bidirectional (a) centralised (similar to Järvi et al., 2011) and (b) decentralised two-sided market (similar to Hagiu & Wright, 2011).

The economic rationale is a two-sided market where demand and supply interact via the online platform as depicted in figure 10a (Rysman, 2009, p. 125) or directly interact with each other through affiliation with the platform as depicted in figure 10b (Wright, 2004, p. 44). The main characteristic of these markets are network externalities (Katz & Shapiro, 1985) which play an important role in building the market: matchmaking depends on a critical mass of transactions, which increase with high numbers of platform users on both market sides who attract each other. Successful examples are dating agencies or online

recruitment platforms. Such matching markets have in common, that market agents simply cannot choose a collaboration partner; they also have to be chosen.¹⁷ Research on two-sided markets is mainly economic aiming at understanding the pricing structures (Rochet & Tirole, 2006) or antitrust policy (Evans, 2003a). Empirical research about market structures and market mechanisms is scarce. Little is known how innovation markets are structured and whether innovation intermediaries only offer passive database-platforms or need to get actively involved in the market as market maker with active managerial support. Katzy et al. (2013) show the operational involvement of innovation intermediaries in the firm's innovation process for actively coordinating the matching process with the responsibility for concrete resources. However, a clear definition of such networked markets is still missing in literature.

From a managerial perspective, three open innovation processes have been distinguished for technology and innovation markets by Gassmann and Enkel (2004). The outside-in process and the inside-out process are comparable to the above described market transactions for commodity markets as either the transfer of IP, technology or innovation from external partners into the firm or the commercialisation of internal IP, technologies or innovation to external buyers has to be coordinated. The third process, the coupled process, focuses on open innovation in collaborative settings like R&D alliances or in innovation networks and follows bidirectional/reciprocal transactions. Compared to studies on technology or IP transfer for exploitation (e.g. Tietze, 2012), there are very few studies on the coupled processes, namely the finding of partners for collaborative innovation in strategic, long-term projects (Hacklin et al., 2006).

While technology transactions can readily be explained as single transaction in the sense of transaction cost theory (Remneland-Wikhamn & Knights, 2012) the formation of collaborative partner-ships requires other theoretical approaches that include the impact of relational interactions (Mortensen, 1988; Ring & Van de Ven, 1994).

¹⁷ Interview with Alvin Roth: The Ultimate Matchmaker – Winning the Nobel Prize and His Pioneering Research <u>http://engineering.columbia.edu/web/newsletter/spring_2013/391</u> (25th March 2014) 68

Relational interaction processes in inter-organizational relationships have been conceptualised for innovation with more exploitative and more explorative nature (Parmigiani & Rivera-Santos, 2011).

Matching theory offers a more generalized approach of market transactions than transaction cost theory. Matching theory explains the microstructure of markets, the how and why economic transactions work (Spulber, 1999). Alvin Roth and Lloyd Shipley use this insight to call for market engineering and mechanism design because markets for different services require different mechanisms, which relates economics to computer science in market design to solve market frictions (Veit, 2003). Market efficiency is formulated as a design challenge to be addressed by operational, algorithmic, or game theoretical means (Roth & Sotomayor, 1990). The design of marriage algorithms for dating markets (Gale & Shapley, 1962) and top trading cycles and chains for kidney exchange in medical markets (Roth et al., 2005; Roth, Sönmez, & Ünver, 2007) or the high-school matching programme demonstrate the potential of matching theory (Roth, 2008). Open innovation, following this line of thought, is a distinct market that requires specific configurations of market mechanisms, for which the requirements need to be identified.

4.2.3 Participatory research approach and case study description

Our research approach followed the engaged scholarship philosophy which suggests an advancement in management sciences by actively participating in practical settings and contributing to theory development by solving practical problems (Van de Ven, 2007, p. 2). For the execution of the study we designed three action research studies according to Susman and Evered (1978). Alongside the innovation intermediary, we were involved in exploring patterns in the matching process, identifying problems within the process, contributing to developing solutions, and their implementation, and studying the effect of the undertaken actions. Data collection followed the cycle of action research (Kock et al., 1997). Sources for data collection (see Table 4) were semi-structured interviews with involved managers and the small entrepreneurial partner firms, who were each interviewed about their

requirements and expectations before the matchmaking (ex ante) and about their evaluation of the experience after the matchmaking (ex post). Interviews were complemented by field observations, meeting participation, and document analysis all along the process.

Research Set-	Participatory Case 1	Participatory Case 2	Participatory Case 3
ting	(12/2010-03/2012)	(12/2010-03/2012)	(01/2012-02/2013)
Focus on	Process innovation	New ideas for ser-	Business model in-
partner scout-	in the production	vice innovation	novation for EV-
ing:	line		charging infrastruc-
			ture
Data collec-			
tion:	I semi-structured	I semi-structured	4 semi-structured
Managers	interview (ex ante)	interview (ex ante)	interviews (ex ante)
(market side	DI 11 1		DI 11 1
A)	Phone calls and e-	Self intermediation	Phone calls and e-
Internetions	Mail correspon-	and event organiza-	Mail correspondence
Internetiary	mediation	uon	+ sen mermediation
	mediation		12 sami structured
	A semi-structured	3 workshops for	interviews (ex ante)
Entrepreneurs	interviews (ex ante)	solution develop-	interviews (ex ante)
(market side	interviews (ex ante)	ment	Observations from 12
B)	Observations from	mont	one-on-one matching
_,	2 one-on-one	Organization of one	sessions (à 40 min)
Documentation	matching sessions	network event (En-	Field notes and Meet-
	(à 2h)	trepreneurship Day	ing minutes
	Field notes and	2011)	>4 telephone inter-
	Meeting minutes	Field notes and	views (ex post)
	1 telephone inter-	Meeting minutes	>12 telephone inter-
Managers	view (ex post)	1 telephone inter-	views (ex post)
	2 telephone inter-	view (ex post)	
Entrepreneurs	views (ex post)	-	
Dete such:	Desarrate and state	De sum ent en else 's	Desument analysis
Data analysis:	Document analysis	Document analysis	Document analysis
	Cross case analysis	Cross asso analysis	Cross case analysis
	Cross-case analysis	Cross-case analysis	Cross-case analysis

Table 4: Research setting and qualitative data collection.

Conceptualization was undertaken through coding of the field data and its analysis in the light of existing theory (Eisenhardt, 1989, p. 544). From cross-case analysis, we extracted patterns of matchmaking from which our presented model emerged (Miles & Huberman, 1994). The three cases included six managers of different departments of BMW and over 30 further employees, two innovation intermediaries and the invited entrepreneurs.

The research method is exploratory and qualitative for an in-depth study of the process of the emerging innovation partnerships. We attended the matching processes for three projects between 2010 and 2013 and compare them to identify the patterns described in this paper.

The Bavarian automotive industry in search of innovation partners

Bavaria is famous for its high-tech industry, its technology clusters, university-industry cooperation initiated by the Bavarian state, and its leading entrepreneurial activities in Munich. Audi and BMW are the two Bavarian automakers that are central players in the Bavarian automobile cluster. This setting gave us the opportunity to study the formation of innovation networks and emerging innovation partnerships. In concrete, our research involved BMW as a large firm searching for innovative entrepreneurial partners for building new ties in innovation networks outside their stable supplier network. Two innovation intermediaries participated in the studied projects, the publicly supported Bayern Innovativ, which is member of the EU funded European Enterprise Network (EEN) initiative, and the private Munich Network (MN) which offers networking and matchmaking services since 1996.

Recent changes in the German automotive industry, force Original Equipment Manufacturers (OEM) to adapt new concepts for electromobility. The National Electromobility Development Plan of the German Federal Government set the target of one million electric vehicles till 2020. This transitional phase drives OEM's to invest in new technologies and to find technologies and innovative business models outside their core business. The roadmap towards more sustainable cars
and value added services for the customers requires new partners for collaborative business models e.g. with electric power producers or charging infrastructure providers, especially in combination with ICT solutions. In such transitional phase, many entrepreneurs create innovative solutions which can lead to future markets (Rothaermel, 2002), like this was the case in car sharing initiatives, charging infrastructure or mobile energy storage.

Unlike the traditional automotive supply chain, where innovations are created by well-known suppliers in well-structured tiered network organizations, it is difficult to find relevant, often young entrepreneurial firms outside an OEM's stable supplier network. For this reason, innovation managers and technology scouts from BMW asked to study new sourcing processes in order to better understand open innovation and to find new innovation partners for collaborative innovation. Together, we set up three projects with different departments involved. In our cases, we covered corporate functions ranging from corporate strategy, R&D management, product management, manufacturing, innovation marketing and sales each with different innovation managers and their specific requirements towards potential innovation partners.

Case 1: Process innovation in the production line

In our first case, the involved innovation manager searched for innovation in the production line for more sustainable manufacturing processes. Based on detailed internal analysis concrete technological search criteria were specified which led to a structured process, similar to the selection of venture partners presented by Marxt & Link (2002). We published a technology request on the EEN database and actively scouted potential partners. After eight weeks of search, we had over 100 potential partners in our portfolio. Most of them were identified on the EEN database. As the innovation manager did not have the time to evaluate all profiles, the intermediary team pre-selected the most promising ones according to the manager's requirements. With one biotech start-up firm from Eastern Germany, for example, ideas for a joint project were developed and presented to the BMW manager. After his positive evaluation, a half-day matching event was held and the concepts were discussed more in detail between the manager and the entrepreneur. The entrepreneurial firm presented their biotechnology solutions, a business case of significant cost reduction through more efficient recycling processes and innovative ideas for collaboration. When all participants gave positive feedback at the matching event follow up meetings were decided between the participants.

Coaching of both sides by the intermediary team before the matching event did reduce information asymmetries and proved essential in creating a trustful and open environment for discussions. On the one hand, the biotech firm gained concrete understanding of the needs of BMW, which enabled them to develop concrete project ideas. On the other hand, the intermediary team interfered with the internal processes of BMW. When the research team conducted telephone interviews for an ex post analysis of the matching event, it turned out that the partners had been side tracked and had not called for follow-up meetings. All involved parties agreed that there was a gap in the matching process and asked for active managerial support by the intermediary.

Case 2: New ideas for service innovation

In the second case, the innovation marketing department searched entrepreneurs and student teams for service innovation ideas. The responsible innovation manager also wanted to get involved in the entrepreneurial network in Munich for improved access to new ideas and new ventures. It proved impossible to fill in the requested criteria of a search profile in an online platform so that systematic online scouting was not possible. Therefore, the intermediary team organised a trade show, invited entrepreneurs, local investors, and student teams with their projects, and launched an idea challenge for future services around the car. For better matchmaking with participants from BMW three selected start-up teams were coached in their development for a potential collaboration. The intermediation team systematically facilitated the exchange and matched the managers with the entrepreneurs and the student teams. For example BMW and a 2003 started tech venture from Mountain View, CA, were brought together for collaboration through this process. The US venture got an exhibition booth at the trade show and a live video call with one of the founders was arranged. Post mortem analysis showed that intermediation between the entrepreneurial scene and BMW was considered as inspiring and many new business contacts emerged, but for a variety of projects in various domains.

Case 3: Collaborations for EV-charging infrastructure

The third case had its origin in the corporate strategy department. The aim was to explore new business opportunities for the launch of the first electronic vehicles (EV) in 2013. Business partners for a joint development of the charging infrastructure or additional services were looked for. In a meeting, the intermediation team systematically involved more managers than in the first two cases. In particular, an innovation intermediary from the network and four managers from the sales, R&D, strategic and product management department contributed to this project. The aim was to set up an internal team for the matching process in order to gain a more complete picture toward the requirements from different departments. Based on the resulting common search profile, the intermediation team created a webpage where potential partners could apply for a two day's matching event in Munich, similar to a job recruitment platform. At the end of the recruitment process, 71 applications were received, were pre-ranked and presented to the managers. 12 selected entrepreneurial firms were invited to the matching event. Based on action reflection of the first two cases, the team involved many managers to the matching event, with the aim to increase matching success and avoid low commitment for the matching process. Over 30 managers from different departments participated at the event.

On the first day, the intermediation team coached entrepreneurs and managers to reduce information asymmetries and explained the background of the matching event. On the second day, the team organised a public pitching session and later 12 one-on-one meetings for a deeper matchmaking session. All meetings were observed and minted for research purposes. As expected, we observed matchmaking efforts between the managers of BMW and the entrepreneurs. Moreover, we also observed interesting exchanges among BMW members and entrepreneurs reported successful business contacts with other start-up firms. Our ex post analysis showed five further negotiation meetings and technology assessments between managers of BMW and the matched start-ups which resulted in two collaboration projects. We again experienced, that facilitation of the follow up meetings remained necessary. Interview partners pointed to high workload of the involved managers, cultural differences, or simply time zone differences as the reason.

4.2.4 Findings from the participatory case studies

Our observations in the cases clearly confirm that matchmaking was an interactive process which emerged and changed over time. At points, fully automated transactions and online technology transfer platforms were used but complemented with additional managerial support similar to what is reported in literature (Bessant & Rush, 1995; Katzy et al., 2013). In contrast to other contributions to the discussion on open innovation markets, we found that matchmaking is more than only a market transaction between two trading agents on a two-sided market (Chesbrough, 2006; Lopez & Vanhaverbeke, 2009, p. 23). Our observation suggests that this was especially the case for technology exploration projects with strategic long-term impact, because concrete requirements on innovation partners could not be clearly stated at the outset. Under these circumstances the innovation intermediary contributed to matching success by creating a partner network based on the requirements of innovation seekers. Collaboration emerged through interaction of the agents and - in the successful cases - over time a common vision evolved that ultimately lead to a contractual transaction.

This leads us to conclude that matchmaking is better modelled as a multi-sided market where supply and demand comes together through support of an intermediary. Our observations suggest that a better understanding of the intermediary role will enhance our understanding of

matchmaking for open innovation. The basic model of the multi-sided market, where individual agents are matched, requires at least three agents to form the networked market: the innovation seeker, the innovation provider and the innovation intermediary.

Matchmaking therefore requires an economic setting where the agents perceive a certain value based on their individual supply. Like any market, a multi-sided market is driven by the perspective of economic outcome, which thus is a necessary condition, as e.g. managers have to achieve their performance goals. This is equally true for the innovation intermediary, whose economic value of coordinating matching processes needs be made transparent for markets to emerge. Our networked multi-sided matching market framework fulfils these requirements by integrating an economic concept with managerial capabilities for coordination.

A process view on matchmaking for open innovation

Cross case analysis of the three cases in which we were involved, leads to pattern of a process of recurring activities in stable order. Within an organization multiple stakeholders share views and align their individual requirements. This step helps creating awareness, a joint commitment and a common understanding towards the requirements for potential innovation partners. We refer to it as *profiling* of strategic selection criteria, of collaborative intentions, and of a common vision about future topics within a large organization. The following meeting minute illustrates the need for such a step and that more departments should be included in the matching process for a broader perspective on the requirements:

"We from the R&D department have already some ideas and solutions the strategy department is searching for. Why do we need such a matchmaking event? They could also just ask us." (Meeting minute R&D Manager)

In contrast, the strategy department (that initiated the matching project in this case) was more focused on business models for collaborative projects and sales multipliers, not specifically on technological details, 76 like the R&D department had expected. Without the internal alignment of different departments, the matching would have been less successful since the process could have got stuck in the organizational structures as it happened in case one. Another interesting feedback indicating the same argument was:

"Involve all partners to prevent confusion ..." (Open question from feedback survey)

The task of the innovation intermediary team in this stage of the process was to create a common understanding inside the organization, to work towards consolidated innovation requirements and coordinate the matching process first within the BMW organization and to then convert this into a dedicated *search* in the network, on market platforms or databases.

Selection of partners is the clear outcome of the internal alignment in order to balance the external matching process with internal processes and deadlines of an organization.

"We cannot conduct an endless matching process, because we also have to follow our internal processes. Therefore, we cannot wait too long for the right innovation partner due to internal deadlines in our innovation processes." (Meeting minute strategic manager)

The *matching* between potential innovation partners can be structured in three stages. First a coaching stage, in order to reduce information asymmetries for the invited entrepreneurs (innovation providers), this builds a trustful environment, second, a pitching stage where the entrepreneurs present their concepts and third, a matchmaking stage where closed one-on-one sessions are organised and facilitated by the intermediary.

"During the event, I was impressed by the enthusiasm from more than 20 employees of the established firm, we felt aligned and not like David and Goliath."

(Open question from feedback survey from entrepreneur)

Evaluation of the follow up meetings pointed out to be very important in order to ensure an ongoing matching process between the involved agents and for strengthen the tie building for further collaboration.

According to our findings, we therefore suggest an interactive matching process with mechanisms like *group formation*, *joint commitment*, *common understanding*, *market making*, and *tie building* for partnership formation rather than short-term exchanges like the transactional view suggests. This extends the understanding of the development of inter-organizational relationships in the form of emerging innovation partnerships (Ring & Van de Ven, 1994). Table 5 summarises our matching process with the undertaken actions, interactions and mechanisms. Matchmaking is not only an assignment problem like matching theory shows with the stable marriage algorithm, the kidney exchange mechanisms or the school assignment algorithm which practically improved the efficiency and cleared these markets (Roth, 2002), it furthermore requires active managerial coordination support.



	Innovation Seeker		Innovation Intermediary		Innovation Provider
Profiling	Managers from the innovation seeker (established firm) define their demands in a group meeting.		The intermediary needs an in-depth understanding about the demands of the innovation seeker and moderates the group meeting. → group formation, joint commitment and common understanding		The search profile is published on different channels by the intermediary that the innovation provider (entrepreneurial firms) can apply for.
Search	The innovation seeker gets access to new network sources which increase the probability of external innovation transfer and receives an overview of the market situation about future technologies and innovations.		The intermediary conducts a market analysis and searches for potential innovation partners. Through the network access, the intermediary acts as multiplier. In our case, the search was still costly because a portfolio to the specific demands must be formed within a defined period of time. Network effects helped in establishing the portfolio. → market making (creating thickness)	×	According to the search profile, the intermediary builds a portfolio of potential partners. In our cases, the portfolios were formed by an active search of the intermediary, similar to a job recruitment process.
Selection	Final selection took place in a group decision process according to the proposed ranking.		Sorting of the long list of the potential partner and pre-ranking of portfolio companies corresponding to the demands from profiling process. → market making (selecting agents)		Invitation by intermediary; establishing a trustful environment by coaching and briefing of participants.
Matching	Coaching by Intermediary for a correct communication with the innovation providers and moderation of matching meetings.		Organisation of a matchmaking event comparable to "speed dating". Moderation of matchmaking event and coaching of both market-sides by reducing information asymmetries and other differences. → market making (matchmaking)		Coaching and briefing of invited portfolio companies from managers and the intermediary. First round to reduce "information asymmetry"
Evaluation	Structured feedback for an internal management report. Ongoing support for communication and arrangements of further meetings.	<	Ex-post evaluation of matching success and continuous management of interactions between agents of both market sides \rightarrow Intermediary as pro-active process manager \rightarrow <i>tie building</i> (<i>managing follow ups</i>)		
			Interactions with Inter Direct interactions bet	medi ween	ary (i)

 Direct interactions between market age

 Table 5: Description of the matching process on a multi-sided market.

Matchmaking as networked collaborative innovation

The concept of a multi-sided market proved helpful in our participatory cases to explain the relationship between markets, networks and collaboration. Multi-sided markets offer a clearer and more explicit theoretical explanation compared to the positioning of networks "in between" markets and hierarchy (Chesbrough & Teece, 1996; Powell, 1990). The innovation intermediary is modelled as market maker that actively creates the market and manages the matching process between the organizations (Figure 11).



Figure 11: Theoretical framework of a multi-sided innovation market.

In contrast to existing studies that are based on two-sided market models, the intermediary does not only provide a passive (online) platform where different agents can interact. The innovation intermediary assumes a pro-active role in the management of the matching process and is thus also an agent of the market who is actively involved, establishes paths for future collaboration and influences the matching outcome. A practical implication of this finding is that the intermediary is modelled as agent in its own right, including an economic rationale for its engagement. In consequence, innovation intermediaries do not only attract two market sides to engage in a transaction but engage in managing the matching process efficiently. Innovation intermediaries thus reduce transaction costs in innovation markets with frictions. In the words of the involved managers: "I do not have the time to evaluate the whole portfolio of more than 100 start-ups. The intermediary should give me a relevant preselection which I can provide my colleagues for deeper screening." (Meeting minute from case 1)

"We cannot pursue each single possibility for potential collaboration, as we also have to care about our daily business. This is a pity, but it is like that in a large organization." (E-Mail correspondence from case 3)

4.2.5 Conclusion and future research

In this paper, we explored the matching process for open innovation partnerships by getting engaged in three cases as action research study. Managers from BMW asked for matchmaking services with external support for scouting technology and new ventures in order to identify innovation providers and enhance their innovation network based on their requirements. In all cases the authors were actively involved with the innovation intermediaries and engaged in managing the matching process to get in-depth understanding of the process.

Based on our observations, we model matchmaking as a multi-sided market and conclude first, that matchmaking is possible under economic conditions of a market with frictions if the market is well designed. Second, we conclude that technology analysis and strategic management is a constituting contribution to the coordination of such matchmaking processes in multi-sided markets. Third, matching takes place between agents, the individuals on the market, and not on firm level.

These findings open avenues to address the strategic challenge of interacting with innovation intermediaries, of internal resource allocation, and of the selection managers and formulation of suitable assignments that Sieg et al. (2010) identified for the organization of innovation networks. Further research is needed to advance our understanding of the relationship between economic market structures and social innovation networks of potential collaboration partners. The

structure of a "multi-sided matching problem" brings forward new objects of analysis such as the networked innovation setting, or the matchmaking process and its emerging activities and network externalities.

Innovation networks, on the other side, offer a distinct case for the extension of matching theory. Matching algorithms are developed in detail for the kidney exchange mechanism where donor kidneys are matched to patients for transplantation, or as dating mechanisms where couples can only be assigned once for a stable outcome (Gale & Shapley, 1962) and following pre-established matching criteria. Innovation projects differ from those markets because the outcome is per definition uncertain and requirements towards external technologies or partners cannot be specified ex ante. More research is needed to understand in detail, how intermediaries contribute to market creation against such frictions.

We speculate that this approach could equally contribute solutions to the literature on technology transfer and open innovation reports that has documented market failure mainly based on transaction cost theory and technology exploitation (e.g. Tietze, 2012). Collaborative settings with the possibility of technology analysis processes and matchmaking provide more conceptual means than transactions of black-box technology. Similar to the dating market, collaboration partners can be modelled to iteratively explore joint approaches towards an eventual innovative outcome, built up trust and exchange sensitive information so that partnerships can emerge. Such conceptualization allows relating to network theory based research findings of matchmaking as relational processes (Bidault & Cummings, 1994).

Last but not least, matchmaking in multi-sided markets is a multicriteria optimization process, for which more computer science research could develop advanced algorithms, practical tools and mechanisms that increase the efficiency of the processes.

Practical contributions are derived from the findings of the cases and the description of the matching process. Especially for innovation

managers, technology and venture scouts, innovation intermediaries or policy makers this paper provides valuable insights in how the matching process are managed and which settings could be further developed for sustainable business models.¹⁸

¹⁸ Acknowledgements

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Part III: A process perspective on matchmaking¹⁹

¹⁹ This part is based on two conference publications and has been adapted for the argumentation in this thesis. Chapter 5.1 is based on: Holzmann, T., Sailer, K., & Katzy, B. 2012. Finding partners for Collaborative Innovation - The vicious circle of matchmaking, *The 26th R&D Management Conference*. Grenoble Ecole de Management. and chapter 5.2 is based on: Sailer, K., Holzmann, T., Katzy, B., & Weber, C. 2014. Co-evolution of goals and partnerships in collaborative innovation processes, *XXV ISPIM Conference*. Dublin.

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5 Finding partners for collaborative innovation

The following chapter presents findings from two conference papers and gives insights into the interactions along the matching process on a multi-sided market. The first chapter reports matchmaking dynamics between potential innovation partners and shows that transaction cost theory provides only a limited framework for analysing the matching process. The second chapter presents research insights through a sociological lens and puts interactions in the centre of analysis (Ring & Van de Ven, 1994). The following chapters identify positive feedback loops along the matching process which is named the "virtuous circle of matchmaking" when a common understanding and a shared vision emerges through interaction over time. Negative feedback loops emerge when there is a lack of commitment and no common understanding towards a shared vision. This leads to the "vicious circle of matchmaking" ending in unsuccessful matching processes. These selfamplifying effects lead to network effects on multi-sided markets (see chapter 4.2). Such network effects are a necessary condition for twoor multi-sided markets, but have been rather defined as scaling effects e.g. as adoption of new technologies like fax machines (Katz & Shapiro, 1985, 1986). They become more attractive to customers, the more people use them.

5.1 The vicious circle of matchmaking²⁰

The underlying assumption of this chapter is that matchmaking is similar to market transactions following the intermediation theory (Spulber, 2009, p. 13). According to my research agenda, I compared matchmaking with transaction cost economics (Williamson, 1989) and tried to integrate the analysis in a managerial perspective on matchmaking. I found that the transaction cost approach is too static for analysing the matching process. This supports earlier findings and critique, for example those from Hill (1990) or Nooteboom (2006).

²⁰ This chapter is based on the conference publication and has been adapted for the argumentation in this thesis: Holzmann, T., Sailer, K., & Katzy, B. 2012. Finding partners for Collaborative Innovation - The vicious circle of matchmaking, *The 26th R&D Management Conference*. Grenoble Ecole de Management.

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5.1.1 Introduction

In the recent years, there has been an increasing interest in open innovation research and practice. It is a fast growing topic in the field of technology and innovation management (Elmquist, Fredberg, & Ollila, 2009). Phenomena like corporate venture capital and technology scouting departments or (online) innovation intermediary platforms underline the entitled discussion about open innovation. In general, open innovation means to collaborate with external partners or the exchange of ideas, knowledge, technology or innovation across the boundaries of a firm.

Several successful open innovation cases have been reported in literature (e.g. Chesbrough, 2003; Gassmann & Sutter, 2011). However, many partnerships fail in reality. Reasons for failure are manifold, but deviating perceptions and expectations of transactions always underlie a failed collaboration. In traditional transaction cost theory, opportunistic behaviour is assumed to maximise the own profits in (social) exchange which includes individual intentions and expectations (Williamson, 1985). The problem of failed collaboration lies in the matching process for bilateral exchange. Thus, matchmaking can be also seen as part of transaction cost theory (Spulber, 2009). Therefore, the identification and selection of the collaboration partner determine the outcome and success of the partnership which is part of the early stage transaction process. Little is known about these matching mechanisms in terms of open innovation. Thus, finding and identifying the suitable collaboration partner are central questions which are addressed in this chapter.

The study is part of an ongoing research project which includes industrial partners from the greater Munich area. Two participatory case studies were conducted with project partners from industry for understanding the formation process of open innovation partnerships in a real business environment. We present a concept which describes the complexity of the matching process and its importance in the formation of innovation partnerships. Different to a neoclassical market transaction process with perfect information for both agents, the ex-

change between innovation partners includes many uncertainties and risks as shown by Nooteboom (2006). Thus, finding the right innovation partner is a complex matching process with frictions similar to labour markets or marriage brokering.

The chapter is structured as follows. After the literature review on open innovation, asymmetric partnerships and transaction cost theory, we present the methodology of our research. In the further part, we report the results of conducted matching processes and the derivation of a conceptual framework for a better understanding of the early phase of innovation collaborations. This builds the explorative base for further research in the ongoing project. The critical discussion of our results and suggestions for further research concludes the paper.

5.1.2 Matchmaking as transaction process

Collaboration is seen as one important factor for creating value and gaining competitive advantage (e.g. Chesbrough, 2003; West & Lakhani, 2008). In terms of innovativeness and complementary resources, partnerships between young start-ups and established companies can generate synergies resulting in win-win outcomes for both sides (Alvarez & Barney, 2001; Lawton Smith, Dickson, & Smith, 1991; Minshall et al., 2008; Rothaermel, 2002). Although, the involved asymmetries implicate problems in managing these partnerships (Doz, 1987), finding the appropriate partner is even more difficult, as young entrepreneurial firms are often not visible on the market or have not even entered the market yet. This challenge has also been addressed in the study about collaborative partnerships for new product development (Emden, Calantone, & Droge, 2006).

Much has been said about open innovation as a new paradigm for innovation management and value creation (e.g. Chesbrough et al., 2006; Chesbrough, 2003; Gassmann, Enkel, & Chesbrough, 2010), but little has been reported on how to identify the right open innovation partner and how these open innovation partnerships are formed. Hacklin mentioned the early phase which he defined as "set-up" and "initiation" of collaborative innovation partnerships which is a "rather rarely identified subject" (Hacklin et al., 2006). In their study, the searching com-

panies had already a portfolio of potential innovation partners in mind they could choose from. But it is not addressed what happens in terms of problem formulation and search when the established company does neither know about their concrete needs nor about the existence of a potential innovation partner.

Intermediation theory addresses search and matching problems on markets (Spulber, 1999). In the case of open innovation and technology transfer, innovation intermediaries are such third parties who are involved in the search process like a broker or a scouting agent (Howells, 2006; Lopez & Vanhaverbeke, 2009). Three challenges about managing the interactions with open innovation intermediaries were identified (Sieg et al., 2010). First, the involvement of all stakeholders should be ensured. Second, the problem must be selected and "decomposed into manageable elements". Third, the problem formulation must be on the one hand very specific, but on the other hand open enough for innovative solutions. Additionally, successful transactions from innovation intermediaries have been reported in the literature where search profiles were matched with the right innovation partners or solutions (EC, 2012; Lopez & Vanhaverbeke, 2009), nevertheless complex process mechanisms are behind the matchmaking which need to be better understood.

Classical process stages of inter-firm collaboration are described in five phases: initiation, partner selection, setup, realization, and termination or relaunch (Marxt & Link, 2002). Marxt concluded that the partner selection depends on technological, strategic, and cultural fit and requires a win-win situation for a successful acquisition. Such process steps are in line with transaction cost theory which explains the exchange in or between organisations (Coase, 1937; Picot, 1982). Thus, a transaction cost perspective should provide a reliable framework for a better understanding of the matching mechanisms. A transaction is a contractual agreement between two or more agents and represent frictions in a system or process (Williamson, 1985). Another definition of a transaction "is the creation of value by voluntary cooperation between two or more economic actors. The value created by a transaction equals the benefits ... minus the costs" (Spulber, 2009, p.

12) . In the early phase, ex ante transaction costs like information or negotiation costs are distinguished from ex post transaction costs occurring after closing the contract (Picot, 1982; Williamson, 1985).

Collaboration is the bilateral exchange of knowledge and resources. Thus the exchange is executed through transactions between partners. Transactions are coordinated between a supply and a demand side and explain why firms and markets exist (Spulber, 1999). After the right trading partners have found each other, a transaction is agreed upon and executed. The theory of transaction costs provides an understanding on the economic behaviour of agents during the transactional process on markets or in hierarchical organisations with a focus on exchanges on agent or firm level (Coase, 1937; Williamson, 1975; Williamson, 1991). Transactions on markets are coordinated through price mechanisms, concrete norms, and contracts for economic exchange. While transactions in hierarchical organisations refer to managerial power and strategic or behavioural implications (Remneland-Wikhamn & Knights, 2012), they imply a more relational approach (Dyer & Singh, 1998). These exchanges between agents are comparable to frictions in a system (e.g. signalling, search for information, negotiation or contracting), which make the transaction process flow costly and often in terms of its exploitation economically inefficient (Williamson, 1975; Williamson, 1991, 1998). Therefore, contractual agreements of market transactions should minimize the inefficiencies and reduce opportunistic behaviour. For transaction there are ex ante search and negotiation costs, the transfer of property rights at the moment the transaction occurs (matching) and the ex post execution costs (Picot, 1982).

All these more or less normative approaches assume clear linear transaction processes which are manageable. Matchmaking in this context (which means bringing the right trading partners together) is thus necessary and represent as ex ante transaction costs; while matching is the successful transaction itself according to theory. However, the traditional market perspective assumes that the matchmaking between the trading agents focuses more on short-term transactions, namely a transaction as a single event of exchange which can be undertaken

anonymously on markets (Williamson, 1985, p. 69). This is the case on online platforms like ebay or amazon or even more specific on innovation and technology platforms like NineSigma or the Enterprise Europe Network.

The involved organizations in a transaction are a locus of parameters affecting the institutional environment and arrangements (Williamson, 1991). These parameters make the market transactions more transparent and explicit that transactions offer a clear approach for evaluation towards their outcome. Furthermore, the explicit and implicit negotiations between two or more actors can also be described as transactions (Nienhüser & Jans, 2004). Matchmaking in uncertain contexts, where no real good for transaction exits is thus studied in this chapter.

Another literature stream from technology management field focuses on technology selection (Gregory, 1995; Shehabuddeen et al., 2006) or technology partner selection (Ortiz-Gallardo, Probert, Phaal, & Mitchell, 2010). In these cases, the requirements for selection can be described or categorized per case.

5.1.3 Methodology

For this study, a qualitative approach was chosen. Insights along the matching process are explored for further research. For an in depth understanding of the recognized problem in practice, a participatory field study with two real projects was conducted. The researcher was actively involved in the cases as intermediary. This is in line with participatory action research approach (Ottosson, 2003; Susman & Evered, 1978). Actions were planned, taken and then evaluated and reflected for the next cycle (Coghlan & Brannwick, 2010). Practical problems were formulated and solved in reality and then used for scientific reflection which is discussed in the following part of this chapter. The main purpose of this study was to get an in depth understanding of the identified problem of matchmaking for collaborative innovation partnerships. Therefore, semi-structured interviews (Bryman & Bell, 2011) were conducted with managers and entrepreneurs before matchmaking, in order to gain an understanding about their expectations of potential partnerships. Furthermore, according to action research field notes 92

were collected and a survey for action reflection after an organised matching event was conducted which provided the base for theoretical reflection between the research team (Stringer, 2007).

In the first step, two responsible innovation managers (one for each case) from the established company were asked during semi-structured interviews about their innovation needs. Furthermore, the requirements and their offer to potential collaboration partners were documented for a better profiling. The criteria from the interview were transcribed and further developed to an explicit search profile.

Planned Process	Applied Method	Involved Stakeholder
1) Problem under- standing	Semi-structured interview	Innovation manager and re- searcher
2) Profiling	Survey for (technology) search criteria assess- ment for profile	Innovation manager and re- searcher
3) Search	Semi-structured interviews	Intermediary, potential col- laboration partner and re- searcher
4) Selection	Survey	Intermediary, potential col- laboration partner and re- searcher
5) Matching	Questionnaire and group observation	Innovation manager, potential collaboration partner and researcher
6) Ex post evalua- tion	Open interview	Innovation manager, potential collaboration partner and researcher

Table 6: Planned research process, applied methods and involved stakeholder.

Young entrepreneurial firms as potential partners were also asked for their requirements and proposed solutions. The criteria were used to filter and select the relevant start-ups for a matching event. After the

matching event, both potential partners were asked ex post about the matching success.

5.1.4 Description of results

From the perspective of an established company, the innovation managers searched for innovative solutions for their problems. A collaborative solution was desired, as the addressed innovation needs were not the core business of the established firm. Two participatory cases were conducted over a period of eleven months. In one case, an intermediary with an online database was involved in the matching process, while in the second case, no external partner participated during the research process. The research team organised a network event for matching start-up teams and ideas with the managers of the established firm.

Case 1: Production project

A big manufacturing firm searched for new sustainable technologies for either improving their production processes or their products. The cause for awareness was on the one hand based on the need to develop a more sustainable image. On the other hand, an extensive analysis for using external technologies was conducted on the strategic innovation management level. According to the results of the study, the innovation department chose biotechnology as their search field because a lot of ongoing external activities had been identified. Sources for the analysis were scientific articles, consulting studies and patent databases. The background idea was eco-friendly recycling processes and more efficient or cost saving processes in the production line. The searched technologies in the biotechnology sector were not the core competency of the manufacturing firm, that external partners were desired for collaborative innovation partnerships. Especially small and very agile companies should be searched for a rapid implementation.

The innovation manager got the commitment of his Chief Technology Officer (CTO) for the identification of potential innovation partners or technologies, thus, the project was prioritized. Therefore internal technology scouts were briefed for the search, according to an explicit formulated search profile with the defined requirements. As the outcome of the technology scouts was not successful enough, external network partners were also involved in the search process. The defined external search profile was developed with the researcher and an external intermediary and advertised in an online database.

After six month, no concrete outcome was in sight so that the prioritization from the CTO was revoked which ended in a lower commitment of the innovation manager in the search process. However, the search profile was still in the database of the intermediary and the process was actively managed by the intermediary. More than 60 applications were received via this search channel and four were filtered for the short list.

Another innovation intermediary organized personal meetings and had telephone calls with potential partners where ideas and solutions were discussed and created according to the search profile. The intermediary encouraged the entrepreneurial firms to participate in a matching event, where their concepts could be presented to the innovation manager of the established company. In the end, around 130 entrepreneurial biotech firms were identified of which eight were presented to the innovation manager. With one firm (A), concepts were discussed, as they had already some similar solutions in another industry which had to be adopted. However, with the other firm (B) no coaching was enforced, both entrepreneurial firms were invited for a personal matching. The result of this innovation partner search was one successful matching with firm (A) which was linked to the defined search profile.

Case 2: Innovation marketing project

The innovation marketing department of an established manufacturing company searched for new business models in the service sector, especially for a new target group. Social changes in the behaviour of potential clients had been identified in earlier research. New concepts and ideas were searched to make the current product portfolio more attractive to the new target group. For that reason, collaboration with an

entrepreneurial firm was desired for delivering an innovative idea which could be tested in a marketing project with the established firm. In turn, the start-up could benefit from the reputation and a joint project.

In contrast to the first case, no explicit search profile could be defined in this case, and thus, no database could be used. The focus was on the ideation stage for a new business model or service which should be delivered by the start-up. As no concrete outcome was foreseeable, the managerial support decreased and only the research team tried to identify suitable collaboration partners as intermediary.

Nevertheless, the intermediary talked to start-up firms and in two cases separate brainstorm sessions were held in order to find possible solutions for the rather vague requirement profile of the established company. After seven month, the intermediary presented three entrepreneurial teams to the marketing manager. Visionary concepts and prototypes were presented at a separately organised matching event. The teams developed concrete proposals for the collaboration which were presented. Furthermore, an ideation challenge was organised among the participants of the matching event. The winning idea had the chance to realize the concept in a joint project with the established company. The results of this innovation partner search were three unsuccessful matches.

5.1.5 A process approach of open innovation matchmaking

In both cases, the intermediary had the role as matchmaker and process designer, because there was a deviation of the planned process to reality (see table 6). This is in line with other findings about intermediaries (Bessant & Rush, 1995; Howells, 2006; Katzy et al., 2011). Hence, a static matching via databases with a defined search profile with explicit criteria did not lead to collaboration in our cases. In reality, the process is more complex and includes many implicit criteria which cannot be articulated or defined ex ante. However, the online databases increase the probability of a successful matching and support the process of potential partner finding, the matching process is more than only bringing open innovation partners together. The following steps from 96

figure 12 are developed as conceptual framework for further research. The matching process is a mechanism with many different stakeholders involved. In our case these stakeholders are:

- a) An established company with its internal²¹ and external²² stakeholders which identified a certain problem for an open innovation partnership.
- b) Entrepreneurial firms and their team, willing to enter an open innovation partnership with a suitable idea.
- c) Innovation intermediaries managing the transaction and information flow between both sides. The intermediary might be a technology scout, consultant and/or an online database.

Internal problem definition

The first challenge is the problem identification and definition within an organization. As described in the cases, the explicit formulation of matching criteria is not easy and often, it is impossible for open innovation partnerships. An innovation intermediary helps to find the right criteria and can develop a better understanding of the implicit needs of the company and ensures process flow through active coordination. The implicit criteria need new methods for their evaluation. As these criteria cannot be assessed ex ante, they rather emerge and dissolve over time; thus a dynamic matching approach seems to be promising. This differs from other findings in the literature about the selection of collaboration partners, where explicit strategic criteria, requirements, and goals can be articulated for partner search and selection processes (Hacklin et al., 2006). Innovation is not predictable and thus, other mechanisms must be developed in order to find, match and select the right open innovation partner. As this is a rather unexplored field in research, a matching process approach is proposed in the following section.

²¹ Internal stakeholders are the employees and managers

²² External stakeholders are other involved agents e.g. suppliers

- Problem awareness The key capability of a stakeholder is to identify a certain problem which is out of scope of the core business and might be suitable for a solution by an open innovation partner. In this stage, the requirements for the collaboration partner are not totally clear. On the one hand, it might be problematic to exactly describe the problem in detail and on the other hand, different internal and external stakeholder might have contradicting aims how to handle the identified problem.
- 2) **Problem recognition** Once a problem is perceived by a stakeholder, as many as possible internal and external stakeholders who will be involved in the collaboration have to be recognized and a common need has to be defined. In this stage, the problem that means the requirements of the partner is rather implicit, but becomes more explicit in discussion with others. Vague and general requirements for the innovation partner are definable.
- 3) **Problem formulation** After a better (collective) understanding of the problem and the needs for the potential innovation partner, the problem is described in an explicit search profile. This search profile is the framework for the offered and needed resources, the entrepreneurial firms can apply for.
- 4) **Problem institutionalization** The commitment of all stakeholders is necessary, because the change of strategic directions (case one), political influences or operative problems in an organisation affects the success of the matching process and stops the process flow. Therefore steps 1 to 3 can be seen as an iterative decision making circle which ends in a more or less concrete problem formulation.

External search and process management

The second challenge is to develop, find and match the right solution to the defined problem. Like internal problem definition, the innovative idea cannot explicitly be described at the beginning. On the one

hand, an innovative idea emerges over time during the partnership and on the other hand, a start-up has a suitable solution for the defined problem, but does not want to publish the idea. For this stage, an innovation intermediary minimizes the information asymmetries between both partners, especially in terms of the implicit criteria which also emerge or dissolve over time.

- 1) **Ideation for solutions** Similar to a job application, the startup team has to find the right propositions for an application to the search profile with the defined problem. In the early stage these ideas are rather implicit than explicit expressible.
- 2) Solution transformation Once a suitable idea has been discovered, it has to be transformed and adapted in correspondence to the search profile of the established company. For example, a technology or product has to be adapted from one industry to the other. This needs internal resources for the entrepreneurial firm, but might be important for the matching as a concrete outcome presented to the established company.
- 3) **Solution conceptualization** After a successful transformation of the solution for the problem, a concept for the application to the search profile should be developed similar to a job application which makes the potential innovation and value explicitly visible.
- 4) Application for collaborative innovation partnership The entrepreneurial firm applies to the search profile and the intermediary acts as agent between both sides, albeit both potential partners can also directly interact without a third party involved. If the process steps are accomplished, the collaboration partners are matched by an explicitly described problem and solution concept. Furthermore, the intermediary knows the implicit motives, intentions, and criteria from both sides, which makes the potential matching outcome more probable.
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Again, the steps 1 to 3 should be interpreted as an iterative solution adoption circle which ends in a more or less concrete concept for an application for the search profile.



Figure 12: A process approach for matching collaborative innovation partnerships

5.1.6 Understanding the vicious circle of matching

From the two reported cases a concept for a better understanding of the matching process is derived (figure 12). We called this the "vicious circle of matching" (figure 13), because of the similarity to a negative feedback circle of process and system theory. We identified the problem definition phase and the creation of the search profile as the crucial step in the process chain. The process flow remains stable, as long as there is a clear formulation of a problem and an institutionalized commitment of all stakeholders of the searching side. The explicit description holds out a certain outcome which leads to an internal promotion of the intended search for collaborative innovation partners. However, the matching process for innovation is mainly driven by implicit criteria which cannot be well defined in the beginning. This is quite obvious, because innovation always is something new. Thus, it is more or less a vague feeling towards strategic visions managers can express which is converted to more explicit requirements over time once a shared vision for all stakeholders emerges. The crucial task of the matching process manager is the capability to handle both types of implicit and explicit criteria from both sides in order to manage the transactions of each single process step (Katzy et al., 2011). If one of the process steps is not accomplished, the matching deviation of the requirements of both sides increases, that in the end, the matching might be terminated unsuccessfully. In other words, if there is no concrete problem formulation, the institutional support is missing which 100

ends in a lower stakeholder commitment which has a negative impact on the whole matching process. The 'vicious circle of matching' starts with an insufficient understanding and formulation of an implicit requirement and ends with unsuccessful matching.

From the perspective of the entrepreneurial firm, the 'vicious circle of matching' starts with developing ideas which are realizable through partnership, therefore the understanding of the search profile from all stakeholders, including the innovation intermediary, is necessary. The application for the collaborative innovation partnership must be aligned with the search profile of the established company. That means if the concept of the solution is not in line with the stated problem and the deviation of the stated criteria is too large, the application is not considered for matchmaking. Again, misinterpretations of the search criteria in the beginning increase the probability in terminating the matching process.



Figure 13: The vicious circle of matching – problem definition (established company) and solution creation (entrepreneurial firm) for collaborative innovation partnerships.

5.1.7 Discussion and conclusion

The paper presented a process framework of matching processes in the early stage of open innovation partnerships derived from two participatory action research cases. The results were socially constructed in reflection meetings within the research team and the participants of the action study. It turned out, that transaction-based reasoning according can only be applied when a clear search profile can be defined. The matching process for innovation which is linked to uncertainty is a

dynamic process with several interactions over time which cannot be clearly explained with transaction cost economics. Similar critique about the rather static approach of transaction cost has already been accepted by Williamson (1999, p. 1103). Matchmaking can be seen as part of transaction cost theory, but before the transaction occurs. The three stages of a transaction process according to Nooteboom (1999) can be divided in contact, contract and control. My study shows the contact stage as matchmaking and provides interaction pattern between participating agents in a hierarchical organisation, the external intermediary and potential innovation partners. Matching dynamics are outlined as "vicious circle" which can also lead to a "virtuous circle". In my research, I link such dynamics to network effects on two- or multi-sided markets which show social interaction as matching mechanism rather than for example price finding or explicit contracting. The main finding of my study is the interplay between explicit criteria and implicit assumptions towards innovative solutions. This study is extended in the next chapter where external data from disaster management is triangulated with my case data.

These findings might have potential for further research on matchmaking in the light of cognitive distance between market agents for open innovation or the interplay between intrinsic or extrinsic motives towards collaboration or co-exploitative and co-explorative intentions (Parmigiani & Rivera-Santos, 2011).

Managerial implications

The vicious circle of matchmaking starts within an institution with the identification of innovation needs. Often, the management does not recognize these needs, as routines of daily business are too dominant and there is no time for thinking out of the box. Another problem is the hierarchical structure of established companies with many political and strategic implications. This "problem finding stage" is already very difficult for managers. Which identified problem can be solved with external innovation partners? Once a problem is defined and an internal innovation project is initiated, many internal and external stakeholders are involved in this project. If the manager of an established

company searches now an appropriate collaboration partner, many decision makers are involved along the matching process. The more people are involved, the higher the failure rate of the partnership. On the one hand, it might be possible, that the operative level does not understand the external innovation or technology ("not invented here syndrome") or on the other hand, the strategic management changes the direction which might also be negative for the CIP. For a better matching quality, all stakeholders should be involved in the assessment of innovation demands.

The search and matching process for the suitable innovation partner should be externalized, as the managers are too deeply involved in the daily operational business. For a better quality of the search results, an innovation intermediary can be involved with exclusive network access. This has two advantages:

- First, the process is permanently managed by the external scout who minimizes information asymmetries
- Second, the potential partners are trained and prepared for the matching event which represents a trust building mechanism. Entrepreneurial firms might be afraid of losing their ideas when they negotiate with established companies

When potential partners could be identified, it is necessary that all stakeholders attend the matching event, because the selection is a complex group decision process.

Conclusion and further research

The paper has explored the matching process of collaborative innovation partnerships, based on two practical cases. A conceptual process framework was presented based on transactions of implicit and explicit criteria in process chains. The concept needs to be tested in further cases.

Like usual business processes, which describe explicit flows of inputs which are transformed to visible outputs, the complex matching proc-

ess can also be defined as a transaction chain of steps, but based on interaction. This argument follows Gregory who mentioned that process management is influenced by humans and thus, explicit or implicit routines determine the flow (1995). Therefore, it is important to identify these routines, intentions and criteria, especially the implicit ones as they cannot be articulated ex ante for an in-depth understanding. Only if the rather undefined or vague ideas at the beginning of the partnership formation process can be transformed in a shared vision, matchmaking will likely occur. Andrew Van de Ven mentioned, "the innovation process is managing new ideas into good currency" (Van de Ven, 1986) which implies to make implicit ideas explicit for all market agents. Nevertheless, a deeper theoretical understanding of the matching mechanisms has to be developed from other theoretical per-

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²³ Acknowledgements

5.2 The virtuous circle of matchmaking²⁴

In chapter 5.1 it was shown that transaction cost theory is a rather static approach and does not explain the complexity of interactions and decisions along the matching process. From action reflection, I conclude that the dynamics of the matching process are based on interaction. These identified patterns of interaction arise in uncertain processes with an unclear outcome. In chapter 5.2 the findings from 5.1 are triangulated with external data from network formation in disaster management. It turned out, that the transaction is not the unit of analysis for matchmaking; it is a shared vision and a common understanding which has to emerge for long-term relationships. Consequently, the findings extend the model of Ring and Van de Ven (1994) which is based on a sociological perspective.

5.2.1 Introduction

This chapter contributes to deepen the understanding of collaborative processes where it is not possible to target a fixed goal. In this, being part of an innovation network, put in a metaphor, is similar to being wintered on a mountain trail. It means to back down from a foggy and dangerous peak to a new and unknown valley, passing nameless environments and unfamiliar situations with foreign partners that speak different languages.

Societal challenges find their academic expression in rising numbers of studies and conferences on sustainability to enhance innovations for sustainable futures. But studies combining fields of social and technological innovation with economic impact still are rare (Hargrave & Van de Ven, 2006). Complex collaborative innovation and how to cope with *uncertainty* is the essential challenge for both fields. In collaborative innovation processes, actors face uncertainty in many dimensions: Goal uncertainty (Tomsic & Suthers, 2006), matching and

²⁴ This chapter is based on the pre-published conference paper and has been adapted for the argumentation in this thesis: Sailer, K., Holzmann, T., Katzy, B., & Weber, C. 2014. Co-evolution of goals and partnerships in collaborative innovation processes, *XXV ISPIM Conference*. Dublin.

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process uncertainty (Katzy et al., 2013), demand and resource uncertainty (Mizruchi & Stearns, 2001).

Despite uncertainty along collaboration innovation processes, it seems not to hinder success as for example shown in regional settings of Biotech clusters (Powell et al., 1996) or the open innovation cases of BMW and Apple in chapter 1 of this thesis. Ubiquitous and auspicious, collaborative innovation takes hold but has a dark side, too: It also often leads to disappointed expectations, suboptimal outcomes (Tallqvist, 2009) and pullout of partnerships instead of fabricating successful outputs in the short run. This is the case in both social and technological innovation (Zahn, Kapmeier, & Tilebein, 2006). How do the more successful cope with uncertainty? To tackle the problem, it has a potential to use examples of successful collaboration from both realms to illuminate long term and short term process dynamics.

Societal change is driven by contingent innovation processes that have long term impacts but sometimes radical origins. An illustrative example of collaboration of multiple actors and technologies (Latour, 1991; Powell, White, Koput, & Owen-Smith, 2005) where networks emerge rapidly and create innovative outcomes over time is global disaster management (Wachtendorf, 2004) or asymmetric partnerships between start-ups and established firms (Rothaermel, 2002). With regards to sustainability, in disaster management among multiple actors, the local organizations are the ones to stay - but rarely the ones to set goals initially. In rehabilitation, new structures, materials, and ideas are used to rebuild villages, cities, and regions, a mass of opportunities exist and multiple actors are forced to collaborate, pool resources and mix local and global standards: It is obvious that we can observe innovation processes of global shape in such cases. From first response to end of reconstruction often periods of 10 years and more can be traced, which allows to measure sustainability of innovative project impacts.

In undertaking this effort, empiric evidence from different successful relief networks showed that while many critical incidents influence ongoing disaster management year after year, most critical events for sustainable outcomes of collaboration happen in initial stages (Weber,

Sailer, & Katzy, 2012). Therefore, it turned out to be interesting to investigate this dynamic in an ongoing collaboration process, allowing zooming in and better understanding important steps of partner finding and matchmaking under goal uncertainty. Thus, we got involved in emerging innovation and matchmaking processes in an industrial automotive setting, where established companies and start-ups are interested to collaborate for radical innovation towards sustainable and emission reduced mobility.

It turns out that for both collaborative processes, innovative outcomes do not depend on initial goal setting and efficient target tracking. Instead a co-evolution of many iterations, goals and partnerships yields to successful, sustainable outcomes. It does so if partner's interests and strategies are early aligned in a shared vision which enables individual activities under a common flag. All depends on creating a vision that is precise and flexible enough to release action and establish bonding: In one case, it is the promise to care for 100 children at least for 10 years, and in another, the claim to bring 1 million electronic vehicles on the road in 2020.

In the next section of this chapter traditional models of innovation management are presented, literature on formation of collaboration is added and tries to connect both for collaborative innovation processes. The still missing explanation for handling goal uncertainty heads us into process analysis in two settings with six case studies which are setup one based on the other. Discussing of our findings brings us back to theoretic implications and contributes new perspectives to collaborative innovation. Concluding, we derive suggestions for effective management of matching processes and open innovation towards more sustainable outcomes.

5.2.2 Literature review

The collaborative innovation process is dynamic, time flowing and often inscrutable and incalculable. In new situations - well known by start-ups - it is often not possible to identify a clear collaboration goal or to know the right partners despite strong interest to find ones (Blank & Dorf, 2012). All actors, however, need to plan before investing 107
scarce time, lots of efforts, and precious resources in an unforeseeable collaboration process. To manage innovations, companies as well as non-profit organizations are used to plan with targets, in timeframes and by sanctioned budgets, just as for daily and routine operations (Powell et al., 1996; Tallqvist, 2009; Tomasini & Van Wassenhove, 2009; Waugh & Streib, 2006).

Literature on innovation processes suggests different realms and orientations for social entrepreneurship on the one hand and industrial or technological entrepreneurship on the other (Cajaiba-Santana, 2014; Carvalho, Fleury, & Lopes, 2013; Hargrave & Van de Ven, 2006; Mulgan, 2006; Zhou, 2013). This division no longer holds as a matter of course (Fuller & Tian, 2006), but so far, little empirical evidence to interlink the fields is available as studies rarely integrate data from both settings (Hargrave & Van de Ven, 2006).

Especially in R&D management, the innovation process is seen as sequential steps in linear order. For example, the stage-gate process (Cooper, 1990) is such a structured manageable approach for innovation in corporations. Its core idea is that an innovation is formed across several stages and is only transferred to next maturity stages when a control gate is successfully passed. This is similar to quality management, where concrete key performance indicators (KPI) for monitoring existing routines are defined (Deming, 1986). Open innovation represents a new generation of more complex and integrated innovation processes (Chesbrough, 2003; Ortt & Smits, 2006).

If we look into the different setting of disaster management, organizational planning in international relief programmes looks very much the same. To get support from public or private donor institutions, NGOs apply for and implement projects that outline sequential stages: Emergency assistance, livelihood restoration, rehabilitation, and - if clinging to sustainability - reconstruction with preparedness and risk reduction (Landry, O'Connell, Tardif, & Burns, 2010). But goal uncertainty and high time pressure are unavoidable characteristics of disaster management, and stepwise efficiency maximizing planning often adds to separated interventions and less sustainable outcomes. In the aftermath,

missing links of relief and reconstruction are deplored (Birkmann, 2005; Satterthwaite, 2010).

Similar problems arise in transitional industrial change like in the German automotive industry. Electro-vehicles are expected to create sustainable mobility impacting other industrial sectors as electricity, telecommunication or services like car sharing. In transitional phases, entrepreneurial start-ups can bring radical change or create new markets outdating established business models, but they often lack resources and market know-how (Minshall et al., 2008). Problems of the stage-gate model in innovation management arise not only in the "fuzzy front end" - regarding outcomes, long term impact on other sectors or sustainability, it also does not explain managing collaboration. This management model remains helpless in situations of complexity, volatility, and uncertainty. More inclusive innovation process approaches (Berkhout, Hartmann, Van Der Duin, & Ortt, 2006; Cheng & Van de Ven, 1996) were developed to integrate collaboration dimensions. Describing the innovation process as a longer journey and traversing corporate perspectives, models of relationship formation (Ring & Van de Ven, 1994) are used to integrate best activities in multi stakeholder partnerships. Therefore the social microstructure and interactions of a multi-sided market for open innovation is shown in this study. The interactions of Ring and Van de Ven's model are taken as starting point and extended by findings from our cross-case analysis.

The interactive collaborative process in this model is explained as "a repetitive sequence of negotiation, commitment, and execution stages, each of which is assessed in terms of efficiency and equity (Ring et al., 1994, p. 97)." In the negotiation stage, all involved actors create a common understanding about an uncertain topic by formal bargaining and informal sense making. The commitment stage is the point, where the "wills of the parties meet" (Commons, 1950) that affects the legal contract, the behavioural norms for basic collaboration and governance structures. This is in line with the already discussed definition of a transaction in form of the transfer of property rights following a transaction cost theoretical perspective (Nooteboom, 2006; Picot & Dietl,

1990). Actor-network theory, another approach to historically investigate the formation of macro-actors, identifies very similar principles of network formation (Akrich, Callon, & Latour, 2002): To form a heterogeneous actor-network, the interests of all actors have to be aligned very early in a common "obligatory point of passage" (OPP) to guarantee alignment and mobilisation of activities in a common orientation and is thus a matter of interaction (Holzmann et al., 2014a). Such a point also can be seen as initial dynamic of matchmaking.



Figure 14: The cyclic process model of inter-organizational relationship formation (similar to Ring & Van de Ven, 1994)

Adding partnership or network formation approaches to innovation management models, the process of collaborative innovation becomes more visible. Still, explanation for successful collaborative innovation under goal uncertainty remains an open question. It highlights assessment of effectiveness, efficacy, and equity, but less is said about how to do this in processes of high velocity and uncertainty. In our study, we start from this point and try to find out how goal finding, goal setting and matchmaking; the partnership formation process itself becomes part of our investigation.

5.2.3 Methodology and research approach

In the following, we present a process analysis with in depth case studies (Eisenhardt, 1989; Yin, 2009) from different collaborative settings. One is based on the other. First, we explore collaboration in innovative relief networks after Tsunami 2004. From the findings of the retrospective long term process analysis, we turn to an action research process to explore in more detail the initial critical formation of the evolution of innovation networks. The second case study, therefore, investigates collaborative innovation in the German automotive industry.

Disaster Management for sustainable long-term impact²⁵

Primary data on three inter-organizational relief networks were collected from 2011 to 2014. Semi-structured in-depth interviews with global and local Humanitarian NGO experts were conducted and triangulated with project reports and Legal Acts as well as with newspaper clippings. Key turning points in collaborative disaster management were mapped and coded in ATLAS.ti, according to principles of Grounded Theory (Glaser & Strauss, 1967).

In 2004, a Tsunami hit Indian coastal regions and caused unprecedented losses. We investigated three cases of networked global-local relief in Tamil Nadu. The heterogeneous inter-organizational collaborations started from chaos in very similar turbulent situations providing lots of opportunities and challenges. Each network mastered challenges to find sustainable solutions in relief and reconstruction over several years.

With regards to *goal setting*, different goals came up and became realized in disaster management in the different networks. Table 7 gives an overview illustrating how network- depended relief measures are.

²⁵ This section belongs to my research and PhD colleague, Christina Weber who researches network dynamics in disaster management. By comparing our findings, we found similar patterns in our process analysis. The section is part of my thesis as the paper has been already pre-published, but I focus my argument on matchmaking for innovation partnerships and not on disaster management. It shows, that also other research disciplines profit from research on matchmaking and vice versa.



The goals defined by each network changed in dependence from local need demand and from collaborative interaction. In the beginning, it would not have been possible to name or address them in the right way.

Collaborative	Case1:	Case2:	Case3:
Dynamics	Paramankeni	Enayam	Velankanni
Goal setting	Rebuilding the village	Livelihood restora-	Safe children/
(2005-2010)	Inclusion of all relig-	tion	Tsunami victims
	ions and castes	Bringing fisher back	from risk of
	Fighting rising costs in	to sea	abuse
	reconstruction	Skill trainings for	Running school
	Fighting discrimination	female population	and shelter
		Income generation	children 9-17,
		Market innovation	Rural commu-
			nity develop-
			ment
			Education centre
			for backward
			villages
Goal finding	Local need for housing	Women need to	Donor Reluc-
		rebuild livelihood	tance of short
			term interven-
			tion
Shared visioning	Achieving 300 houses	To start-up female	Children home
	for all castes and relig-	workshop for engine	to support 100
	ions	repair	children over 10
			years
Matchmaking	Intermediaries	Trusted partners and	Intermediary
	many donors, many	for profit company	NGO
	partners, sector experts		prior collabora-
			tion experience
			multiple old and
			new partners
Callabanding		E1	over time
Collaborative	Organizational Innova-	Explorative innova-	Exploitative
strategy	tion and Capacity build-	tion by network	innovation & use
	ng in asymmetric	protection	in communice
	parmersnip		tive network
Matchmaking Collaborative strategy	Intermediaries many donors, many partners, sector experts Organizational Innova- tion and Capacity build- ing in asymmetric partnership	Trusted partners and for profit company Explorative innova- tion by network protection	years Intermediary NGO prior collabora- tion experience multiple old and new partners over time Exploitative innovation & use of media and PR in communica- tive network

Table 7: Collaborative dynamics in disaster management.

With regards to *goal finding*, in all networks of sustainable relief, the creation of a vision from splattered communication of heterogeneous needs and interests of different partners (affected, donors, NGOs) was reported. Born from informal mass communication, it was spread by initiators and attracted partners that felt their own mission fitted to

contribute. The claim found as a *shared vision* was not a goal; instead, these shared visions facilitated the formulation of goals in ongoing disaster management. In actor-network theory, a shared vision can serve as or become inscribed in boundary objects (Briers & Chua, 2001).

Finding the right partners and this shared vision belongs to the most important steps in long term disaster management. From the investigated cases, a good partner fit was facilitated by former partner experience; trust in intermediaries and early commitment to a shared vision. Partnerships and networks were often initiated before program implementation and endured after the end of disaster management.

The *collaborative strategies* of inter-organizational networks differ but are typical within inter-organizational networks after disasters. In network 1, asymmetric partnership collaboration led to organizational innovation transforming the smaller local partner. Knowledge and capacity building scaled up this NGO to an international network partner with global standards. In network 2, innovations were realized in a completely different mode. Experimental and entrepreneurial ideas were realized locally, in the protective environment, avoiding communication and buzz from outside, which would have put at risk the female technicians at work in this village. In network 3, again, collaborative innovation was realized by strategies of professional media involvement, advocacy experience and high global reach of the network.

In sum, where collaborative innovation in disaster management and relief was realized to sustainable ends over 10 years, it was facilitated by a co-evolution of goals and partnerships. A shared vision enabled actor-network building in the beginning, and by setting recurrently new and following goals, the partner minimized unintended effects of disaster management. But how partner matching happens in detail could not be answered from a retrospective case analysis, and so we went for action research methods for the initial stages.

Matchmaking for transitional change in the automotive industry

The change of the German energy policy, the so called "Energiewende" is a global prototype for sustainable energy production, distribution and consumption. In this, the vision of 1 million electronic vehicles in 2020 is claimed by the federal government. We had the opportunity to join a large automotive manufacturer in searching for innovation partners outside their core network, in order to successfully implement electronic vehicle charging infrastructure for their new e-vehicles. For that reason, an innovation intermediary was engaged to find suitable small entrepreneurial start-ups corresponding to certain requirements defined by managers of the established company.

We set up a participatory research approach (Ottosson, 2003), in order to study the emergence of innovation partnerships and gain a better understanding about managerial processes for partnership formation and matchmaking in real settings. Data were collected from January 2012 till February 2014 by conducting semi-structured interviews, meeting minutes, and field notes. Theory development followed an iterative cycle between active participation, problem solving, reflection and abstraction (Susman & Evered, 1978).

As logical consequence of building new network ties for collaborative innovation, finding the right partners and *matchmaking*, are the essential steps. We joined 12 matching events, all between managers of the established automotive firm and potential entrepreneurial partners. In the end, two concrete collaborations were initiated, which are studied in this paper. For better contrasting of our findings and a wide scope of lessons learned, we also present one unsuccessful case, where no matching occurred.

Collabora- tive Dynamics	Case 1: Successful collaboration forma- tion for joint innova- tion	Case 2: Successful collaboration forma- tion for technology transfer	Case 3: Unsuccessful collaboration forma- tion
Goal setting	Development and Implementation of public charging tech- nology; Bilateral NDA; Resource commitment for collaboration; Integration in OEM's inpovation network	Clear contracting with timelines and deliver- ables, like in classic supply chain man- agement	Development of tech- nology implementa- tion roadmap; Integration of inter- face technology for prototype testing
Goal finding (started 10/2012)	Attraction with intelli- gent public charging solution Joint ideation at matching event and several follow up meetings; Suitable and comple- mentary technology for long term strategy	Based on technologi- cal requirements stated in a catalogue (like a supplier); Technological feasi- bility with short term realisation of goals operationalised	Attraction with open platform for public charging services; Joint ideation, proto- typing and technology implementation; Several follow up meetings terminated
Shared visioning	ongoing Partnership for public charging infrastructure and business model for 2020 vision	Partnership for build- ing supplier diversity for existing charging infrastructure.	A shared vision started to emerge, but did not end in concrete collaborative efforts
Match- making (03/2012 – 02/2013)	Intermediaries coordi- nated the matching; later the start-up became associated member in EV Charg- ing joint venture	Intermediaries coordi- nated the matchmak- ing; supplier contract- ing based on existing technological solution	Intermediaries coordi- nated the matching; loose collaboration started, but terminated
Collaborative strategy	Exploration of new technological ap- proaches and innova- tive open business models	Technology transfer from start-up side as supplier; established firm as resource en- abler	At the beginning, exploration for tech- nological integration

 Table 8: Collaborative dynamics in industrial management.

With regards to *goal setting*, collaborative dynamics were identified in each case. While in case 1 and 3 goals emerged and changed over time in group meetings, case 2 shows, a clear contracting with the start-up as technology supplier.

With regards to *goal finding*, we observed different dynamics based on short and long term goals. Especially for long term collaboration, a shared vision turned out to be essential for successful collaboration. While in case 1 a shared vision emerged during interaction of goal finding and goal setting and lead to successful collaborative innovation, case 3 demonstrates that the lack of a shared vision ends in less commitment between the collaboration partners. Our data analysis also shows, that an early alignment of all involved actors from the established firm and the entrepreneurial teams supports building a shared vision and a common understanding which positively affects the collaboration dynamics.

The *collaborative strategies* differ from case to case, ranging from long-term and explorative focus (case 1 and 3) to rather short-term implementation and technology transfer focus (case 2). Unexpected from previous collaborative intentions, especially in case 1, it turned out that during the collaboration three new innovative paths emerged which are now jointly pursued within the network.

5.2.4 Empirical findings

Innovation networks emerge and change during the collaboration process depending on internal and external dynamics in collaboration. The cases show that successful innovation management in partnerships does not depend on attainment of initial targets but on interplay of collaboration dynamics which co-evolve, influencing one another in matching, collaboration, ongoing goal setting, and goal finding. In both societal and industrial collaborative innovation, according to our data, following collaboration dynamics enable or block collaborative relief processes and sustainable outcomes:

- 1) Identification of heterogeneous social and technical actors
- 2) Early alignment of interests for long term collaboration in a shared vision in organisational hierarchies and in networks
- 3) Flexibility to enrol new and unusual actors and activities
- 4) Intermediaries coordinate the matching between global and local or established and start-up perspectives.

Collaboration with strategic dimensions strongly depends on matchmaking processes in the beginning. Matchmaking was identified as an important time-variant period within the whole complex and hardly controllable innovation process which involves internal resources and skills and external demand. The early periods influence later collaboration stages, the development and the outcomes of the innovation process.

For complex innovation, instead of initial goals, a vision that includes all actors' interests has to be developed in networks and partnerships. This envisioning, either recalled by one organization or as shared vision of the partnership or network is found to be long term driver for the overall collaborative innovation process in both investigated fields. This vision can take very different forms, as claim, contract or prototype, helping to identify concrete goals and outcomes in the end.

Furthermore, we found evidence that transparency and forced visibility over complete innovation processes can hamper the development of goals and sustainable or innovative outcomes. In challenging and turbulent chaotic periods of the innovation process, no capacities are left to communicate to externals. Network capacities are scarce and at some times in the process rather needed for local problem solving than for donor or media relation management (relief). Non-visibility or protection periods are also identified in innovation processes between established and young companies in highly experimental stages.

Events	Goal finding	Goal setting	Shared vision	Matchmaking
Negotiating	Х		Х	Х
(joint expecta-				
tions)				
Commitment		Х	Х	Х
(future action)				
Execution		Х		
(committed				
actions)				
Assessment of	Х	Х	Х	Х
collaborative				
actions				

Table 9: Handling goal uncertainty: Findings from long term and initial collaborative innovation processes – extending Ring and van de Ven's IOR model (1994).

Referring to Ring and van de Ven's model, we extend their sequential model with a clear entrepreneurial orientation for collaborative innovation in partnerships. We found that goal finding is a dynamic process leading to a shared vision in collaboration and is thus a necessary step towards successful partnership formation. Goal setting also affects the shared vision, but unlike traditional management, goal setting becomes part of the collaboration process as a recurring task which leads to concrete execution. In general, the shared vision is the central point in collaboration dynamics and is the managerial lever towards successful or unsuccessful outcomes. This clearly points to entrepreneurial process patterns in collaborative innovation between multiple actors.

5.2.5 Conclusion and discussion

Our qualitative study shows how innovation networks evolve and change during the innovation process depending on internal and external dynamics. The paper presented successive case studies and illustrated how successful innovation management in partnerships does not depend on attainment of ultimate initial targets but rather on the coevolution of goals and partnerships around critical changes and events. For collaborative innovation with societal, technological, and strategic long-term impact, the goal is often not clear in the beginning.

It has to be developed by heterogeneous partners through a shared vision, in and by the ongoing innovation process. It depends as much from this vision as from the strong vision of a wintered group on a mountain trail - that has to share the strong and irrevocable wish to reach a safe valley regardless the way in between might look like. In contrast to traditional strategic management with static goal setting and key performance indicators (KPI's) measuring fixed outcomes, goal finding becomes an interactive activity in collaborative innovation processes. It is the essential task in the beginning to find what we observed as "shared vision".

Envisioning is an important initial step of collaboration. A negotiated shared vision that integrates partners' heterogeneous interests (Latour, 1999) pushes a high commitment (Ring & Van de Ven, 1994) to implement possible activities. In this, a lot of opportunities can be seen, selected and realized by heterogeneous partners. Only then, there is enough flexibility to adapt and develop recurrently goals. This dynamic adaption helps to reach sustainable innovative outcomes, even if changes in goals are necessary on the way to adapt to new necessities or opportunities. Profiling and common development of powerful visions are important steps from the very beginning of collaboration, in the process of matchmaking (Holzmann et al., 2014b). We also contribute to a better understanding of entrepreneurial processes, both for collaborative and managerial action. The suggestion is not to control and monitor in sequential intervals, since innovation needs time to prosper and therefore, a shared vision is necessary to survive positive and negative dynamics along the innovation journey for long term success.

The findings on collaboration dynamics are useful for all who wish to engage in collaborative innovation for societal change. Future questions to be answered could be how goal setting and goal finding might be integrated in managerial long term evaluation towards joint visioning or computational matching tools for automated coordination.

5.3 A conceptual matching matrix

Based on cross-case analysis of data from the action research studies, I identified different intentions towards prospective innovation partners which are summarized in a conceptual matrix for managerial decision making. Learning in organisations or inter-organisational networks is distinguished between exploitation and exploration (March, 1991). Exploitation is driven by efficiency and incremental improvement while exploration aims to discover something new and unexpected. Collaboration intentions towards open innovation partnerships are assessable based on the exploration and exploitation framework. As shown in Santamaria and Surroca (2011, p. 104 ff.) the motivation of firms entering strategic alliances for exploitation or exploration determines the matching. Following the criteria from the meta-review for co-exploitation and co-exploration in inter-organisational relationships²⁶ (Parmigiani & Rivera-Santos, 2011), I hypothesise that a matching process for pure exploitative intentions can be coordinated similar to market transactions, like supply chain operations, technology or IP transfer for exploitation. In this case, clear criteria towards the innovation needs can be defined (as shown in chapter 5.1). In contrast to matchmaking for explorative partnerships where criteria coevolve along the matching process (as shown in chapter 5.2), which is per definition the case for innovation.

The chapters 4.1, 4.2, 5.1 and 5.2 have shown that pure market transaction cannot fully explain the matching process on a multi-sided market. Transaction cost theory on markets works if property rights can clearly be assigned, like this is the case of intellectual property rights or already developed products. My focus on matchmaking for open innovation in this thesis is of exploratory nature and thus, requires intensive interaction mechanisms. For managerial action, the following matrix is derived from the profiling stage as ex ante analysis of collaborative intentions and requirements. Further research could discuss the linkage between the typology of transactions, as shown in

²⁶ See criteria in appendix 10.2 which were used for constructing the semi-structured interview guidelines. 120

(DeBresson & Amesse, 1991) and the findings on matchmaking in this chapter in particular.

The matching matrix supports research results on network structures for open innovation (Powell et al., 1996; Weng, Yang, & Lai, 2014). The authors found that networks for exploitation have dense structures and strong connections in the core and networks for exploration are peripheral, or do not even exist yet. Thus matchmaking for exploitation is more efficient than matchmaking for exploration. In the first case (co-exploitation), stable supplier network in the automotive industry exists, the stakeholders are known and search and matching criteria can be defined. This is in line with matchmaking or 'competency rallying' in stable networks as shown in Katzy and Crowston (2008). In the second case (co-exploration), potential partners are not known and search and matching criteria cannot be completely defined. Matchmaking for co-exploration is a matter of new network formation which requires social interaction on a multi-sided market where collaboration emerges over time leading innovative concepts, new business models and economic return in future. Morris Teubal et al. (1991) stated:

"Network development may be viewed as an evolutionary process triggered by innovation, that is, by the increasingly successful coupling of technology (or technological knowledge) and user needs. This coupling is ignored in economic theory, since it is usually assumed that products and technology already exist, so that the only problem is to determine equilibrium prices and quantities. The qualitative coupling phenomenon is implicit in the analysis; its lack would mean that no market exists."

On the following page the matching matrix is shown in table 10.

Matchmaking for co-exploitation	Matchmaking for co-exploration	
Technology transfer databases	Entrepreneurial partnerships	
IP transfer databases	Collaborative innovation	
Customer relationships	Ideation and crowdsourcing	
Supply chain relationships	New business development	
 →Existing networks for present innovation topics for execution →Concrete search criteria definable and goals can be formulated "I know what I am searching for" 	 →Future innovation topics for visionary projects for market creation → Search criteria and goals co-evolve over time. "I don't know what I am searching for" 	
\rightarrow Transaction based matchmaking	\rightarrow Interaction based matchmaking	

 Table 10: A conceptual matching matrix.

Part IV: Innovation intermediaries as matchmaker²⁷

²⁷ This part is based on two pre-published articles, the conference paper in chapter 6.1: Katzy, B., Sailer, K., Holzmann, T., & Turgut, E. 2011. Deal-flow portfolios in innovation collaborations—Revisiting the rationale of innovation networks, *17th International Conference on Concurrent Enterprising (ICE)*: 1-8. RWTH Aachen: IEEExplore. and the adapted and extended journal article in chapter 6.2: Katzy, B., Turgut, E., Holzmann, T., & Sailer, K. 2013. Innovation Intermediaries: A process view on open innovation coordination. *Technology Analysis & Strategic Management*, 25(3): 295-309.

¹²³

6 Innovation intermediaries and open innovation

The following chapter gives insights in the innovation process in networks and how innovation intermediaries contribute to efficient matchmaking. It contributes to the current discussion in academia about the functionalities of innovation intermediaries and their role in along innovation processes. Chapter 6.1 is based on a conference paper and chapter 6.2 is an extended and improved version for journal publication.

6.1 Revisiting the rationale of innovation networks

Regional innovation systems struggle to live up to certainly exaggerated expectations despite high effort into facilitation of innovation network collaboration and cluster forming. As well, innovation performance remains difficult to measure. Facilitation is the aim of many institutions like technology transfer centres, living labs, incubators, or business idea competitions. In this chapter, a study of seven action research cases is presented from which I argue that a result or "dealflow" rationale of innovation networks mobilizes stronger engagement of stakeholders than the facilitation rationale. Innovation processes on network level then can be designed to coordinate seamless deal-flows. The practical contribution of the chapter is that innovation intermediaries can derive a sustainable value position as innovation process managers. The chapter revisits the concrete intermediary function of "matchmaking" as innovation process design.

6.1.1 Introduction

Much has been said about innovation as the driving force of economic development and the role of collaborative networks to increase innovation activities in a region. Policy makers and universities as well have tried much in practice to facilitate innovation in networks; in the hope to create "Silicon Valley's". While much has been achieved, we need to acknowledge that the often exaggerated public expectations have not generally been met and results are difficult to support with hard facts. Innovation performance remains difficult to measure, from

which some suspect that there might not be much outcome at all. Especially in the current times of public austerity policies such doubts are especially dangerous for the many innovation intermediaries that depend on public funding to sustain their activities.

The aim of this paper is to explore routes to a more sustainable collaborative innovation model. This research is motivated from the sustained general belief in the value of collaborative innovation, for example under the title of open innovation, which is not affected by the doubts about its current implementation through public organization. In order to gain in-depth understanding of the motivations to engage in collaborative innovation we have undertaken seven action research studies over the past four years and in different settings of start-up firms, of networked small and medium sized firms, and collaboration between large and small firms. The study was based on the assumption that innovation is "a creative process engaging a variety of activities, participants and interactions the outcome of which is a technological product or process" (Marinova & Phillimore, 2003, p. 44) and that all action intervention should contribute to creating a seamless process flow.

The learning from the study is that those cases did progress well in which the outcome was associated with a clear economic value or "deal" and in which this deal is not only an abstract vision but related through process steps back to each individual partner in the collaboration. From planning action interventions we experienced that the engineering and executing of such collaborative innovation processes is conceptually and practically underdeveloped. The contribution of this work to academia therefore is process integration of existing knowledge on innovation facilitation functions. The contribution to practice is a new business logic for intermediaries as innovation process managers that derive their value proposition from holding a portfolio of deals. Such rationale would pave the way to measuring the performance of innovation networks as network portfolio value.

The paper is structured as follows. We set the scene by a short literature review on innovation processes in networks, their management

and institutional support to then introduce setting, method and data of the action research study. Learning from the study is presented in the discussion section. The paper concludes with directions for future work.

6.1.2 Literature review about innovation process management

Innovation can be seen as a process similar to other business processes (Hammer & Champy, 1993) so that techniques of processes and quality management are applicable (Benner & Tushman, 2002). Like other processes innovation is enabled by promoters from all hierarchical levels (Fichter, 2009; Witte, 1973) who can be compared with supply chain managers and quality managers. They actively conduct distinct functions and link them into processes. More generally spoken, promoters are process managers and co-ordinators of each single process and therewith contribute to generating seamless process flow towards the output.

Supply chain and quality management literature has further developed how advanced process understanding leads to faster work flow, lower cost and/or better quality level and thus higher performance. As for supply chains, open innovation involves external partner in the process chain and their seamless integration into the process flow is as important as process integration inside the firm (Chen & Paulraj, 2004). The process concept has a connotation of efficient management when detailed understanding of the process logic allows the development of dedicated management tools and techniques and continued process improvement (Deming, 1986).

In innovation systems stakeholders collaborate or interact via processes which can be seen as linking mechanisms. Systems theories are popular in explaining how innovation evolves through interactions between the partners of the system (Edquist, 1997; Lundvall, 2010). Inter-connectedness is described to produce synergies for the individual partner and the system as a whole if these can systematically be inter-connected through structured processes. In the words of A. Van de Ven innovation management is the "managing of new ideas into good currency" and fundamentally a problem of process understanding

(Van de Ven, 1986). His study was focused on processes within organization. Further process models of competency rallying in stable networks (Katzy & Crowston, 2008) and in the context of short-term open innovation (Chesbrough, 2003) apply the systems view on collaborative settings.

Fichter (2009) introduced "networks of promoters in communities" for collaborative innovation processes and herewith points to the fact that structured processes in systems do not emerge by themselves, but have to be designed and managed. This often is the role of intermediaries. The intermediary is the communicating entity between stakeholders of an innovation system, as stakeholders typically have the problem of finding the right innovation collaboration partner (Shvaiko, Mion, Dalpiaz, & Angelini, 2010). Therefore, commercial and public funded innovation intermediaries, like business incubators or living labs, emerged to overcome this obvious need in open network structures (Hargadon & Sutton, 1997; Howells, 2006; Lopez-Vega & Vanhaverbeke, 2009). Howells broadly defines the role of "intermediaries" as to "perform a variety of tasks within the innovation process". Bessant and Rush identify consultancy services as main function of intermediaries "which help to bridge the gap between technological opportunity and (often poorly articulated) user needs (Bessant & Rush, 1995, p. 101). Klerkx and Leeuwis also describe the danger of various gaps among innovation system stakeholders that can lead to innovation system failures and less performance. They call for "systemic intermediaries who connect the different components of international, national, sectoral and/or regional innovation systems" (Klerkx & Leeuwis, 2009, p. 850), but they neither give an answer about how the connection could be done in detail nor a description about the intermediated innovation process.

Looking in the existing literature of process management and intermediaries, there seems to be an unclear understanding of what the role of intermediaries is. Various terms are used in the studies and multiple distinctions between types of intermediaries and their role as agents in the innovation system and their function within the innovation process are developed (Howells, 2006). Most of them focus on information

scanning and communication as main functions but leave it open, whether an intermediary is a passive service institution or an active promoter or process manager. Do they only transfer knowledge and technology from one party to the other or do they also offer individual services to the stakeholders? Lopez and Vanhaverbeke identify as significant future research question "how do companies identify, select and interact with innovation intermediaries?" Does the intermediary have a more passive facilitating role or are intermediaries process manager and active promoter with a distinct capability of identifying and linking partners in the innovation process? The impact of intermediaries on the innovation process is also under-researched (Batterink, Wubben, Klerkx, & Omta, 2010; Pittaway, Robertson, Munir, Denyer, & Neely, 2004).

In conclusion this literature research indicates a growing interest in collaborative innovation since the 1990s (Fichter, 2009) where the interdependences in the innovation process chain are still not well understood (Batterink et al., 2010; Pittaway et al., 2004). Especially the pre-collaboration phase with the search for and matching of potential partners is little researched for innovation partnerships. This is in contrast to supply chain management literature which provides various supplier selection models (Giunipero, Handfield, & Eltantawy, 2006; Luo et al., 2009; Wu, 2009).

6.1.3 Research methodology

The study follows an action research design (Susman & Evered, 1978) where the researchers are embedded in real projects and interact in real-life settings to help solving problems and learn from this experience (Ottosson, 2003). We have engaged in seven cases in varying settings to experience different phases and instances of the collaborative innovation process:

- Two cases were start-up teams that were supported in presenting their product ideas to a business idea competition, the European Satellite Navigation Competition ESNC, in 2006 and 2008 respectively. In the consecutive process of developing and testing prototypes and early market introduction included collaboration in the regional Living Lab

as was reported earlier (Katzy & Turgut, 2010). The linking of innovation instruments, namely early idea capturing through an idea competition with prototype development support in the next phase gave rise to more structural project cooperation of ESNC and Living Labs.

- Three cases were generated from a dedicated ESNC Living Lab prize. The three winners of the competition were supported in finding the most suitable Living Lab Europe-wide for their prototype development and testing. These cases focus on the selection and match making process.

- Two cases are open innovation cases where established large firms systematically search for small innovative partners, in particular startups. One is an innovation marketing project for identifying new market niches, the other a manufacturing project for process innovation. The researcher is involved as intermediary in the search of and matching the partners for specified innovation projects of established firms.

Data collection in the study is accomplished in several ways. Structured and semi-structured interviews were undertaken at several points to understand the network situation. Minutes of meetings and field notes from attended meetings and bilateral interactions as well as document analysis of email conversations, project plans, and similar documents were undertaken. Action reflection cycles were established in form of regular meetings by the research team, the authors. The study is designed so that the research scope enhances by iterative learning cycles over time (Kock et al., 1997).

6.1.4 Discussion

From our action research studies we take three learning: (1) The collaborative innovation process must be the leading perspective and needs to be better understood; (2) Especially matchmaking between the partners and through it the coordination of the innovation process is an important capability; (3) Mobilization to engage in the innovation process is driven by the concrete prospect of deals. We conclude from these experiences that innovation intermediaries face the expectation to become process management service providers.

Process perspective as leading focus of actively engineering intermediaries

In the ESNC cases, participants and a specific Living Lab collaborated for the purpose of prototype development because of occasional acquaintance. Even though the actual outcome of this collaboration was only for one of the teams fully successful, the idea to combine the winners of a business plan competition with the user-centric test-bed concept of Living Labs was perceived as a useful collaboration in the innovation process. The combination of the two steps into a process called "innovation highway" (Katzy & Turgut, 2010) was implemented in a project setting as "a seamless process of coordinated" activities in the various phases of the innovation process starting from idea recognition to new ventures creation (see GAINS project plan, p. 7). With support from the initiators three new collaborative innovation projects are launched.

Initially the collaboration between ESNC participants and Living Labs was expected to run autonomously in the future once it had been set-up and successfully demonstrated. However, the experience shows that collaboration partners have an essential demand for active matchmaking and process management. The innovation process to be boosted by means of collaborations in the network clearly needs active promoters and managers.

We observed similar challenges in the large enterprises as the need of a well defined process became also visible in the open innovation cases with an established company. Acting as intermediary, the researchers introduced after some learning cycles a defined process description for properly running the project.

"... I expect you to have a portfolio of start-ups and a structured process (...) like the professional agencies which already offer similar services ..."

[meeting/ field note].

"... I need more transparency for a better understanding (...) how you systematize the profiling of our requirements and the search for new ventures. ..."

[personal interaction/ field note]

The network comprises various innovation processes – individual and collaborative – that need to be initiated, coordinated, interconnected etc. in respect of an outcome that is visible and measurable. This role can be assigned to intermediary organizations to begin with (Batterink et al., 2010; Howells, 2006). We learnt that an even more active intermediary as process manager and deal-flow manager is requested, which is not described in the literature in detail.

Matching partners for collaboration and coordination of the innovation process

What we have seen in all cases is that an innovation process is established by matching the right partners for collaboration. The collaboration between participants of a business plan competition and Living Labs led to different outcomes for both teams: while it resulted in an efficient prototype in one case, the technical specification of the lab did not match the requirements of the other case and the innovation process was interrupted - and called for action by the intermediary. Based on the experience from the first two cases the evaluation basis of potential collaboration partners for the next three cases was enlarged to a European level and the process organized more precisely. Detailed criteria were established and the process was supported by the expertise of the "intermediary" organizations. The more successful the intermediary organizations match the collaboration partners the more visible outcomes of the collaborations will appear and demonstrate the efficiency of those intermediaries. We could not find detailed descriptions in the literature about qualified matchmaking of innovation partners, which is in stark contrast to the explicit articulation of the problem in practice:

"Our problem is not to find sufficient innovation partners; we need to understand how to find the right one, because searching for suitable partners interferes with the actual innovation!" [meeting minutes]

From the cases a further problem was identified, namely that searching the right partner is one problem, but that the selection decision is a complex group decision-making process. Hence, a future research area could be how social media are able to support and increase the likelihood of a proper matching. New processes with higher dynamics and technical support could be developed in order to overcome both the research and the practical gap. The social media aspect already figures out the network characteristic and could therefore be adopted to innovation networks.

Demonstrating concrete prospect of deals for all stakeholders

The essential capability of the intermediary is the translation of the deal to the individual needs of one stakeholder and at the same time to reasonably integrate the single contributions of the innovation network to the whole innovation process. The intermediary assures stakeholders that institutional interests occasionally should be deferred for the benefits of collaboration. The added value of collaboration must be visible and measurable in all phases of the innovation process. To motivate different stakeholders to get involved in the ESNC cases prize money was awarded to both partners of the collaboration. Although it had been a good incentive for starting this type of collaboration an independent and sustainable approach to cooperation along the innovation process chain should be developed.

As one case with the established companies did not hold out prospect outcomes, the innovation manager with the interest in fast deals stopped the project immediately. The manager was result oriented because the companies' investment must have a real return. Thus no process flow emerges, if the deal cannot be made visible. It is therefore the function of the intermediary to make the deal visible. We suggest extending the definition of deals as a process output by the essential requirement of an economic value. This must be transferred to all

process steps. Intermediaries showing a portfolio of many successful deals will be perceived as efficient and capable innovation process managers. Therewith the performance of intermediaries can be measured and evaluated by the size of deal portfolios or the number of realized deals. Future research will address the question of how to establish those portfolios – in particular for not-commercialized intermediaries who are increasingly faced with funding scheme changing. Demonstrating deals to be generated from innovation collaboration strengthens the role of intermediaries and increases the impact of innovation networks in the long run.

6.1.5 Conclusions

The here presented study has a focus on implementation issues of collaborative innovation. Therefore an action study approach has been chosen to understand the innovation process from the inside.

We conclude from the study that a process perspective on collaborative innovation has potential to advance the understanding of phases of the innovation process in networks. Both our study and references to literature show that this understanding is in its infancy and requires more research to develop management tools. The innovation process in networks is distributed across multiple institutions. Our study showed that a seamless process emerges from the matching of partners into the seamless process and an active monitoring and management of the process operation. Concrete instruments such as idea competitions, living labs, or matching platforms do emerge but require more research to increase effectiveness.

Successful innovation creates value and a sign of maturing processes would be a more regular outcome of measurable value from portfolios of mastered innovation processes. A sustainable value proposition of innovation intermediaries would be the mastering of innovation processes and participation in the created value. Valued innovation portfolios would not only create a performance indicator for networks, participation in the value would provide intermediaries with alternative to public funding in addition. To make this possible will require the development of appropriate monitoring and valuation instruments. 134 Future research is necessary for an in-depth understanding of the innovation process in collaborations; therefore more action cycles and cases will be conducted within the next months. The matching capability also needs to be better understood for a more efficient and dynamic process management in collaborations.²⁸

²⁸ Acknowledgement

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6.2 A process view on open innovation coordination²⁹

The chapter reports an action study of seven innovation projects with collaborative partnerships in inter-organizational networks that are facilitated by innovation intermediaries. It contributes to open innovation literature the understanding of innovation processes as nested processes of co-creation on the one side and economic exchange on the other side. While innovation project management and (online) market places are well researched as distinct strategic positions, our observations suggest a third strategic position for innovation intermediaries as process coordinators with strategic innovation capabilities. The paper identifies matchmaking and innovation process design, management of collaborative projects, project valuation, and portfolio management as three strategic capabilities and identifies directions for future research on this emerging phenomenon.

6.2.1 Introduction

Within the scholarly domain of R&D management, open innovation (Chesbrough, 2003) is discussed as a strategy to increase returns from innovation through exchange across firm boundaries. Such exchange can be beneficial in both directions (Dahlander & Gann, 2010): outbound through the independent external commercialization of internally developed intellectual property that does not readily find application in the firm's own product portfolio for example through online market places like NineSigma; or, inbound, adoption of external developments benefits the firm's products for example through online market places as Innocentive. In both cases the firm boundaries are opened up for innovation which is a recent development, but mainly to large firms. Small and medium sized firms (SMEs), whether they are in existence for a long time or have recently launched as start-ups, always had a stronger need to collaborate due to their lack of internal resources. While collaboration has formerly been looked upon as strategic necessity to compensate for the lack of resources (Das & Teng,

²⁹ The following chapter is based on the journal article: Katzy, B., Turgut, E., Holzmann, T., & Sailer, K. 2013. Innovation Intermediaries: A process view on open innovation coordination. *Technology Analysis & Strategic Management*, 25(3): 295-309.

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2000; Eisenhardt & Schoonhoven, 1996), the focus on open innovation now puts strategic opportunities in innovation markets into focus for SMEs as innovation suppliers.

The systemic setting for innovation, much like all markets, only runs with the necessary intermediaries in place that make interactions and matching of partners possible. According to new institutional economics this is a way to minimize asymmetric information on the market (Spulber, 1999). It therefore does not surprise that scholarly discussion on the role and functions of intermediaries has intensified in various fields at the same time (Howells, 2006; Lopez & Vanhaverbeke, 2009; Roxas, Piroli, & Sorrentino, 2011; Zhao & Zheng, 2011). Innovation Intermediaries are no new phenomenon and there is a formidable variance of agents. Because innovation has for long been seen as a domain of market failure it is a public priority to support especially resourcelimited SMEs through technology transfer offices, business incubators, or entrepreneurship centres. These have been strategically positioned close to universities and research centres, where the technology-based start-ups emerge. Others, such as science parks or development agencies have been positioned in often local or regional SME networks (Lee, Park, Yoon, & Park, 2010). Given their strong public funding, many have a legal and governmental non-profit structure. In contrast, younger innovation intermediaries such as the above mentioned examples of NineSigma or Innocentive have a commercial structure and operate on the basis of reward fees that they receive for exchange deals between knowledge and technology supplier and customers. Their success - and with no doubt current public budget austerity - provides theoretical and practical motivation to understand the changes in collaborative innovation processes and the "shift from being a mere facilitator of innovation to being also a source and/or carrier of innovation" (Klerkx & Leeuwis, 2009).

The aim of this paper is to explore collaborative innovation processes in open networks and especially the strategic implications for involved SMEs and intermediaries. The focus of this research is on the early stages of the innovation process in which technology based SMEs are particularly involved. The generally attributed advantage of SMEs in

this stage is their agility in the creation of innovation (Alvarez & Barney, 2001; Lawton Smith et al., 1991; Minshall et al., 2008), a reason for which we found large firms interested in cooperation with SMEs. But again the typical SME resource constraints were in place, for example when SMEs were not able to pay the fees for the innovation market portals. Due to the recent emergence of open innovation and the dearth in identified and described innovation cases in open innovation, we have undertaken an action research study. The research team has participated in open innovation processes to gain in-depth knowledge through direct experience in a total of seven cases in two settings: one setting in which large firms search for SMEs to cooperate with, and the other setting where start-up firms are promoted to find collaboration partners for growth.

We observed that those cases did progress well in which the intermediary could show to both collaboration partners tangible outcome with clear economic value, so that we refer to it as "deals". And we found that those deals can be made in very early stages of the innovation process, for example in form of a price in an idea competition. More deals in later stages provide new valuations and progress measure. But unlike in pure online markets the intermediary got involved not only in brokering transactions but as well in the creation / production part of the innovation process. What looks at first sight similar to the public financed facilitation and SME support, emerged as a value creating service based on competences like matchmaking, innovation process management, and portfolio management on which intermediaries built a sustainable competitive position. From planning action interventions during the study we experienced that young start-up teams, existing SMEs and large firms alike prefer commercially viable innovation value chains that allow for the definition of viable strategic positions, including for intermediaries. We equally experienced that engineering and execution of such collaborative innovation processes is conceptually and practically underdeveloped.

The paper aims at contributing to academic understanding of the managerial issues in open innovation processes, starting with building processes from within open network to managing their execution. The

paper aims at contributing to practice guidance in the definition of business strategies for innovation partners, especially intermediaries from a set of capabilities such as holding portfolios of innovation projects, matchmaking and innovation process/project management. The remainder of the paper is structured as follows. We set the scene with a review of literature on open innovation and in particularly the role of intermediaries on one side and the management of innovation processes on the other side. We then introduce settings and method of the action research study and give a short narrative of the cases. The paper is completed with a discussion of observations from the study, conclusions and directions for future work.

6.2.2 Open innovation and innovation process management

Open innovation thinking offers a framework in the tradition of Adam Smith (1776) in that increasing work specialization, here for innovation activities, is combined with improved market exchange mechanisms to strategically leverage the outcome of innovation efforts (Gassmann et al., 2010). A set of tools like technology trading, knowhow, patent and licensing markets (Chesbrough, 2003) are proposed together with quite normative recommendations for change in organizational culture and corporate governance to make such open innovation successful. Market relationships are facilitated, for example, by recent online market places such as Innocentive or NineSigma that are reported to have received over 20.000 innovation proposals from all over the world and facilitated over 12 USD million in contract awards with mostly large firms like Kraft, Philips, or Unilever (Lopez-Vega & Vanhaverbeke, 2009). These platforms act as market brokers that match innovation problem owners as customers with solution providers as suppliers and get remunerated through transaction fees. Their source of competitive advantage is a monopolized portfolio of supply and demand from which deals can be generated. The examples suggest that market transactions are well suited to generate such deals, but matchmaking is only a part of the transaction cost in the innovation process. It does not surprise therefore that warnings are issued on other costs of coordination if the production or co-creation process of innovation is included in the analysis as a "conceptual frame for open in-

novation from the perspective of product/technology lifecycles and the different phases through which an innovation evolves from conceptualization to commercialization" (Dahlander & Gann, 2010).

In the words of A. Van de Ven innovation management is the "managing of new ideas into good currency" and fundamentally a problem of process understanding (Van de Ven, 1986). His study was focused on processes within organization. Innovation can be seen as a process similar to other business processes (Hammer & Champy, 1993) so that techniques of processes and quality management should be applicable. For example, innovation processes are enabled by promoters from all hierarchical levels (Fichter, 2009; Witte, 1973) who can be compared with supply chain managers and quality managers. Another central thought of quality management is statistical process control (Deming, 1986) that posits that process coordination is based on quantitative measures of outcome and intermediate progress. Fields like production or supply chain management, in which statistical process control has successfully been applied, map process steps along the value chain in great detail and establish quantitative measures for each of them. Such coordination does not necessarily be effected through supervision in organizational hierarchies. For innovation, process overview models exist for aspects such as technology brokering, competency rallying (Katzy & Crowston, 2008) and open innovation (Chesbrough, 2003) but the maturity of innovation process understanding that is sufficient for strategic business process reengineering still needs be developed.

Coordination of innovation processes is often provided in open networks or innovation systems on regional or national level (Edquist, 1997). Such systemic understanding of innovation stresses the interactions between firms and other stakeholders relevant to the social system. Like open innovation this is a view on inter-organizational innovation processes across the borders of single firms and into a broader, but coordinated network of stakeholders including governments, industry, and science/academia in "triple helix"-interrelationships (Leydesdorff & Fritsch, 2005) where knowledge, resources, and capabilities are exchanged.

In contrast to open innovation with its strategic view on firms that create superior economic rents from innovation, the outcome of innovation systems is often modelled as shared knowledge gain from a "nonlinear learning process" (Asheim, 2004). This is especially interesting to young ventures and SMEs with limited resources for basic research, as they often have no own R&D department or the necessary financial background for it. Therefore partnerships with established companies or collaborating in SME networks is seen as a possibility to combine complementary resources and thus create higher - but shared - innovation performance (Edwards, Delbridge, & Munday, 2005; Rothaermel, 2001, 2002). Networks are a double edged knife because of the difficulty to attribute individual economic ownership that emerges from spill-over effects. As a substitution to the economic motivation, social production of knowledge is therefore seen as public responsibility and justification for public research funding. Still, it requires trust especially on the side of participating SMEs that benefits do outweigh cost in open innovation type collaborations.

SMEs especially fear losing technological competence as their sources of competitive advantage in collaboration with large firms. This is a reason that they rather pursue cooperation in the commercialization stage than in the creation phase (Lee et al., 2010). Lee et al. therefore suggest a network model with a trust building intermediary that facilitates the identification and matching of collaboration partners, the evaluation of collaboration projects and the development of an information database.

From the review so far, coordinating the interrelationship of creation and commercialization of innovation emerges as the central concern of innovation in open networks. Another root motivation of open innovation is the lack of user orientation (Von Hippel, 2005). While this rather is an effect of general lack of commercial orientation of R&D departments internal to large firms (Chesbrough, 2003), it is for SMEs again a consequence of resource constraints that are limiting marketing and commercialization possibilities. In the European public framework program for innovation FP 7, the search for alternative combinations of the creation phase and the commercialization phase of the innova-

tion process is subsumed under the term Living Lab to which over 200 regions refer as "... environments for innovation and development where users are exposed to new ICT solutions in (semi-) realistic contexts, as part of medium- or long-term studies targeting evaluation of new ICT solutions and discovery of innovation opportunities." (Følstad, 2008). With reference to the triple helix model the involvement of users in such co-creation process is called "quadruple helix (public, private, government, and end user)" (Galbraith & McAdam, 2011). The Living Lab is presented as a process coordinating innovation intermediary for "(1) closing the pre-commercial gap by manifesting initial demand for products and services, as well as (2) orchestrating the actions of disparate actors in order to gain critical mass for the creation of a product or service" (Almirall & Wareham, 2011, p. 100).

There is broad agreement in literature that innovation processes in open networks are coordinated through a visible hand, often referred to as innovation intermediary. Fichter introduced "networks of promoters in communities" and argues that structured processes in innovation systems do not emerge by themselves or the invisible hand of markets, but have to be designed and managed (Fichter, 2009). The intermediary is as well described as broker and communicating entity between stakeholders of an innovation system, which typically have problems in finding the right innovation collaboration partner (Hargadon & Sutton, 1997; Howells, 2006; Lopez & Vanhaverbeke, 2009; Shvaiko et al., 2010). Howells (2006) identifies further roles of "intermediaries" as to "perform a variety of tasks within the innovation process". Bessant and Rush (Bessant & Rush, 1995, p. 101) add consultancy services as main function of intermediaries "which help to bridge the gap between technological opportunity and (often poorly articulated) user needs. And Klerkx and Leeuwis point to the role of intermediaries to overcome various gaps among innovation system stakeholders that can lead to innovation system failures and reduced performance. They call for "systemic intermediaries who connect the different components of international, national, sectoral and/or regional innovation systems" (Klerkx & Leeuwis, 2009, p. 850).

Innovation intermediaries are described to provide a set of operative activities that link them to the network innovation processes, but literature provides only fragmented insight about the intermediary-process relationship. In contrast to supply chains, where seamless integration of partners into inter-organizational processes has been found equally important as process integration inside the firm (Chen & Paulraj, 2004) there is little report of how innovation intermediaries act as process managers or coordinators. The role as system level agent (Howells, 2006) with an information and communication role has been studied, but it remains open, whether an innovation intermediary remains passive with regard to concrete processes, or actively engages as promoter or process manager. Do they only transfer knowledge and technology from one party to the other or do they also offer individual services to the stakeholders? A frequent conclusion is that the impact of intermediaries on the innovation process remains under-researched (Batterink et al., 2010; Pittaway et al., 2004).

This is equally true concerning the question how intermediaries contribute to the creation of innovation processes. This is in contrast to supply chain management literature which provides various supplier selection models (Luo et al., 2009; Wu, 2009). Fichter describes that promotors contribute to their generation through micro political action (Fichter, 2009), but there are doubts on how the intermediary should get involved with individual partners in concrete processes. Lopez and Vanhaverbeke (2009, p. 30) formulate the open research question "How do companies identify, select and interact with innovation intermediaries?". Especially the pre-collaboration phase with the search for and matching of potential partners is little researched for innovation partnerships.

6.2.3 Research approach and case data

Our study follows an action research design (Susman & Evered, 1978) to study the management of innovation processes in networks where the researchers are embedded in real projects and interact in real-life settings to help solving problems and learn from this experience (Ottosson, 2003). This is a suitable approach for the given research
question as it helps developing a holistic understanding of the identified problem (Coughlan & Coghlan, 2002). The rigorous structure of action cycles with the four steps of problem analysis, action planning, action intervention, and reflection helps organizing research at the interface with practice and to separate scientific learning from practical problem solving. In a first, more explorative action cycle we developed the pre-understanding for gaining insights to specific problems or situations (Gummesson & Van Maanen, 2000). Our second action learning cycle is driven by deliberate planning of theoretically motivated interactions. Action reflection cycles were established in form of regular meetings by the research team, the authors. In total we have engaged in seven cases which can be grouped in two settings, one in which SMEs cooperate with large firms, and the other where start-up ventures are supported in entrepreneurship networks. In the second cycle deliberate and explicit planning was enforced by project plans that were requested by European and national funding bodies.

Setting	SME – network	SME – large firm
Sample	Five collaborations between	Two open innovation collabo-
	SME and Living Lab	rations between large enter-
		prises and start-ups (start-ups
		selected among 205 candi-
		dates)
Data collection	Two semi-structured interviews	Two semi-structured inter-
per case	with CEOs and project managers	views (1 CEO, 3 innovation
	One mid-term report	manager)
	One final report	Four questionnaires
	1-2 personal meetings	Seven personal meetings
	> 3-4 telephone/skype group	> 5 individual phone calls
	conferences	(mostly with young entrepre-
	> 3 bilateral conversation	neurial firms)
	> 50 email correspondence	Two organized matching
		events
		> 50 email correspondence
Data analysis	Document analysis	Document analysis
	Cross-case analysis	Web content analysis
		Cross-case analysis

 Table 11: Research design.

As typical with action research, data collection in the study is accomplished in a number of complementary ways. Structured and semi-144 structured interviews were regularly undertaken to understand the network situation. From participating in projects, minutes of meetings, field notes from attended meetings and bilateral interactions as well as document analysis of email conversations, project plans, and similar documents were collected. Data were subsequently coded and processed from which research relevant issues emerged, which gave rise to additional literature research. Through this the study is designed so that the research scope enhances by iterative learning cycles over time (Kock et al., 1997).

The study setting in European Regions of Knowledge

The study takes place in Europe, where innovation networks are an explicit element of innovation policy. In 1999 Europe has released the Lisbon agenda as its explicit innovation policy and again confirmed it in 2009. One of the pillars of this policy is the strengthening of regional innovation systems, networks, clusters or regions of knowledge (Röttmer, 2011) because a majority of European innovations has been found to emerge from geographical areas with a high density of large and small firms, universities, and research centres. Policy implementation is undertaken through a set of grant programs from different European Commission Direction General (DG), which are the European-level analogy to state ministries. For example, DG Research has created the regions of knowledge program, the aim of which is to strengthen innovation in regional networks. DG Information Society has created an action line Living Labs in its ICT grant program and so forth. National government programs increasingly align their policy objectives with the European level and create own programs such as the German FHprofUnt-program, which aims at strengthening the position of universities of applied sciences in collaborative innovation networks especially with SMEs. All this reaches industry and universities in form of public grant projects.

Most innovation networks are designed with an industry or technology focus. In our study, the automotive industry with its tiered supplier structure provided the setting for the SME – large firm cooperation, with an OEM and a tier-1 supplier participating as large firms. The

start-up network setting has a technology focus on applications for Europe's satellite navigation system GALILEO / EGNOS, the equivalent to the American GPS system. When operational in 2013 it is supposed to create over 100.000 jobs of which over 90% will be in application products and services provided by SMEs. DG Industry in the European Commission therefore stimulates start-up ventures and SMEs from the broadest possible range of application domains but from a limited, steadily increasing number of regions, to adopt satellite navigation technology in their product and service range.

First action cycle exploration of start-ups collaboration in Living Labs

The first two cases of this study were generated in reply to a business idea competition called Galileo Masters, which is organized since 2006 in about 20 European regions in order to stimulate adoption of satellite navigation technology. Each region selects a winner and runner-up, from which a European winner is chosen. The price is a package including a cash price, European media coverage, free incubation services in one of the regions, and potentially matching for venture funding. Both cases were regional winner teams and their projects, one in the location based service industry with a mobile phone application that allows finding restaurants, public transport and other points of interest in vicinity. The other case is in the agriculture industry with an application that allows farmers to automatically generate the legally required reporting on pesticide application to fields from combining position and applied amounts already on the tractor.

The first case emerged from a business planning lecture at university, while the second was generated by an existing SME. Both got in contact with one of the authors and were initially supported in their application process towards the Galileo Master competition. After their success they asked for further support with the next step in the innovation process, the development of the product based on their idea. We supported them in joining the regional Living Lab for this step. In both cases the same Living Lab got involved. The specific composition of technology institutions and universities did fit the location based ser-

vice team so that they used the living lab throughout the product development and testing phase. The agriculture team did initial prototyping and user testing in the living lab for about one year and moved on for hardware development of the tractor onboard unit with selected global suppliers. Both teams emphasized the importance of appropriate and extensive testing to the success of their innovation. The locationbased team continues to use the "real-life" environment of the Living Lab for software and concept testing. Priority for the agriculture team switched to hardware testing for which the team was referred to the European Space Agency which provides the necessary facilities. Both ventures have achieved the market introduction milestone.

Action learning results from the first cycle is on the one hand, that action intervention namely occurred for overcoming gaps in the innovation process and that organizing seamless processes in open network benefited the SMEs most. On the other hand, the known issue of orienting innovation projects to user demand early proved highly relevant.

Second Action Cycle of Innovation Collaboration in Networks

The second action cycle started in 2009 with action planning in form of designing projects in reply to new calls for proposals from the public innovation programs. The satellite navigation competition had successfully mobilized numerous innovative product and service ideas for some of which product development in living labs would provide valuable support. Therefore the intermediary organizing the satellite navigation competition and the network of Living Labs agreed to team up as two stages of the innovation process that they call "innovation highway" (Katzy & Turgut, 2010). Institutionalizing regular cooperation across Europe required considerable detail in process planning. For example, a special Living Lab prize was created and awarded three first prizes to start-up teams, which became cases of this study. One case is a location-based eHealth application, the second is an application to help car drivers reduce CO2 emission, and the third is a city tourism application. Upon the selection of the idea winners all European Living Labs were invited to submit their application for hosting field trial and prototyping. From all submissions, one Living Lab is

selected as partner for each start-up team and awarded a grant to partially cover the cost of executing the next stage. Expectation is that in the selected Living Lab the promising idea will achieve the milestone of prototype development and validation through its user community. Action intervention in this phase was for example during a first introductory get-together of interested Living Labs with the prize winning start-ups, contribution to process development and the development of selection criteria for business ideas and Living Labs, contribution to the agreement between start-ups and Living Labs, and eventually coaching of the collaboration process.

At the same time, interest in understanding and developing collaborative innovation processes with SMEs was voiced in the automotive industry. Car manufacturers and their first tier suppliers typically assume the coordination role for large supplier networks and constantly search for new SMEs to join. Problem analysis showed that the large firms face challenges in establishing the innovation network for several reasons, for example because finding the right SME is difficult and costly especially when they come from remote industries. As well, reluctance of SMEs to engage with the much larger enterprises posed an obstacle. The focus of action planning, which again was documented in a project plan, therefore was on designing innovation processes that are facilitated by neutral intermediaries, which in the overall structure is not much different from the satellite navigation competition where as well large firms do offer their resources to find and invite start-ups and SMEs for collaboration. The two concrete cases of our study are first an exploratory study where the marketing department of the established company is searching for new services and technologies for future positioning of their products in new market niches with new business models. The other project is from a manufacturing department that is in search of unconventional solutions for a defined technological problem in the production process. In both cases, action intervention entailed innovation process engineering, support in the definition of objectives, search of suitable SMEs, and establishment of the collaborative relationship.

6.2.4 Findings and discussion

From our action involvement three research issues emerged: (1) the role of the involved innovation intermediaries shifted away from neutral facilitation towards engaged innovation process management, which raises questions on the nature of open innovation processes. (2) matching complementary resources of network partner and integrating them into a coordinated innovation process is an important capability; and (3) valuation of innovation projects at all stages and management of the project portfolio, which could provide a solution candidate for the "funding paradox" (Klerkx & Leeuwis, 2009) for intermediaries in that it provides financial measure of performance from which revenue models can be derived.

Innovation process management capability

The original plans to establish collaboration between the satellite navigation competition participants and the living labs had foreseen support to demonstrate the process in a first round after which the cooperation projects were expected to be self-coordinating. But, experience showed quickly that collaboration partners had an essential demand for continuous collaboration support and process management so that new plans have been drafted to incorporate their requests for future years. The large firms in the automotive industry voiced similar expectations:

"... I expect you to have a portfolio of start-ups and a structured process (...) like the professional agencies which already offer similar services ..."

[meeting/field note].

In fact, all industrial partners did call for an "intermediary" not different from how they are described in innovation management literature (Batterink et al., 2010; Howells, 2006). Namely the expectation was to integrate various functions along the innovation value chain (Hansen & Birkinshaw, 2007; Roper, Du, & Love, 2008) toward concrete outcomes. In contrast to literature, which mostly assumes that innovation

processes are internal to one organization, open innovation processes are in inter-organizational network environment, which however did not moderate expectation on coordination efficiency. Table 12 summarizes what expectations firms openly addressed towards the intermediary. In none of the projects such role for the intermediary had been pre-assigned during action planning. Only during action reflection it emerged that such coordination function in the innovation value chain is only addressed implicitly, if at all.

	Start-up	SME	Big firm
Commercial broker service	limited attractive	Moderate attractive for solution find-	Very attractive for solution finding
	ing, due to limited financial re-	ing, within limits of financial re-	and full service provider
	sources	sources	-
Network facilita-	Very attractive	Attractive espe-	Very attractive as
tion services	especially in form	cially as consulting	full service provi-
	of publicly fi-	services, but some-	sion of external
	nanced coaching	times limited by	idea sources
	services	financial resources	
Broker services	Very attractive	Very Attractive for	Very attractive for
	for further value	running the inno-	running the inno-
	creation, due to	vation process	vation process
	the fact, that early	more efficient	more efficient and
	stage innovation is valuated	through network	fast partner finding
Collaboration Ser-	Promoting con-	Promoting access	Efficient identifica-
vices	tacts with deci-	to collaborative	tion of innovations
	sion makers in	network facilities,	and qualification
	large firms or net-	innovation partners	for cooperation of
	work	& complementary	partner & solution
		resources	

 Table 12: Innovation process coordination perception by case managers.

"...I need more transparency for a better understanding (...) how you systematize the profiling of our requirements and the search for new ventures. ..."

[personal interaction/field note]

In a series of action-intervention meetings firms stressed the importance of explicit explanation of the innovation activities from which the process description in the upper part of Figure 15 emerged as blueprint for running projects. In other words, partners in the innovation process approached innovation intermediaries as service suppliers and requested certainty on approaches, quantified prospects of results, as well as business references. In the course of the study, we observed that intermediaries listed in the lower part of figure 15 describe projects, like the seven cases in which we participated, as their reference portfolio.



Figure 15: Innovation process model.

A priority in the discussions was the structuring of the innovation process to generate marketable intermediate results. The involved intermediaries did have a history in providing support and facilitation, for example as university incubator offering a wide range of start-up consultancy services, but those activities are not prepared to demonstrate results with realized value, making it impossible for firms to quantify economic value of collaboration with the incubator's portfolio. This changed with providing a first economic value to business ideas in form of the cash prize, of project investment plans for the living lab trials, and later valuations in financing rounds with investors. It became the role of the intermediary to demonstrate outcomes of stages of the innovation process and steer to have them validated by closing "deals" between supplier and customers. The process manager in this way is a deal-flow manager visualizing the value for all involved stakeholder to make deals happen. Identifying the right partners for such deals proved a highly debated issue in this context.

Matchmaking capability

Collaboration between participants of the business idea competition and Living Labs led to different outcomes for both teams: while it resulted in efficient prototype development in both cases, the European Space Agency and international hard ware providers proved to be the right partners for the agriculture team's next development phase. The location-based team continued cooperation with the living lab. Based on this experience the process was organized more precisely in the second action research cycle: detailed criteria were established and the process was supported by the experts from the intermediary. The more successfully the intermediary organizations matched the collaboration partners the more visible the efficiency of those intermediaries; or, as one manager put it:

> "Our problem is not to find sufficient innovation partners; we need to understand how to find the right one, because searching for suitable partners interferes with the actual innovation!" [meeting minutes]

Matchmaking is more than searching the right partner and a subsequent market transaction. The cooperation decision is a complex group decision-making process, in that managers are aware that the cooperation decision is path establishing (Sydow, Schreyögg, & Koch, 2009) in that it is often bundled with decisions about technology or business model alternative that determine the future innovation direction. More research is needed to understand not only the strategic implications of this decision but as well its group dynamics. A frequent request was to support the dynamics through social media and to allow for higher dynamics of the process.

Valuation and portfolio management capability

Besides the individual projects, it was the critical mass of concurrent projects on which the innovation networks of the study did thrive. And it was the capability of the intermediary to translation the combined

value of a portfolio of individual deals into individual benefits of the stakeholder in several ways.

The likelihood of finding matching partners for the initiation of a new innovation collaboration project increases with the number of available partners in the network. All intermediaries in the study therefore engaged in building critical mass portfolios. In this way the satellite navigation competition did invest in establishing a network of experts capable of assessing business ideas, just as the living lab network invests in laboratory infrastructure and user communities with different interests and qualification.

Portfolios of active and past deals as symbolized by the circles in the centre of Figure 16 were equally carefully composed as above mentioned portfolios of the sources from which deals can be matched. Portfolios of more than one hundred business ideas in the business idea competition or prototype developments in Living Labs each year allow analysis on technical and business trends. Knowing about similar projects prevents repeating experiences or double work and provides insight in achieved technical capabilities and unsolved issue and challenges. The deal flow, the number of successfully completed matching projects, at the same time proved a strong competence signal on the side of the intermediary. It can be used to evaluate the performance of intermediaries and can be measured by the size or value of the deal portfolios or the number of realized deals.



Figure 16: Deal flow portfolios for intermediaries.

Deal flow portfolios establish financial valuations and therewith open ways for intermediaries to participate in the value created. In the course of the project two of the intermediaries entered into formal share participation of undertaken projects. It is too early to judge on the practical impact of such mechanism, but it introduces the concept of building a position for intermediaries in the innovation value chain based on a share of the value created. Future research will need to address the question of how to establish those portfolios – in particular for not-(yet)-commercialized intermediaries.

6.2.5 Conclusions and future research

This paper explores open innovation processes through the depth of getting involved in seven cases of an action research study. All cases have in common that innovation intermediaries contributed to the establishment of the collaboration and the management of its operations. In some cases online innovation market places were used for selected stages but obviously explicit coordination was needed to integrate the innovation process. This coordination was provided to the studied networks by intermediaries that offer a wide range of known consulting and facilitation services (Howells, 2006). Such facilitation is often provided through public funded agencies with no commercial intent. In the here described cases, however, intermediaries increasingly developed strategies to build viable positions in the innovation value chain. In this respect the study addresses a research gap on coordination in open innovation (Dahlander & Gann, 2010).

In conclusion we saw that the prevailing facilitating rationale for intermediaries is replaced by a value creation rationale in the innovation value chain. In concrete, intermediaries developed capabilities of identifying collaboration partners, matchmaking, innovation process management, and making innovation valuations visible in deals between innovation suppliers and customers. Investment in capability building was accompanied with a shift of revenue models from public funded facilitation to collecting transaction fees and taking co-ownership of innovations in the early phase, from which we hypothesize the existence of a strategic position of open innovation coordinator.

This study shares the limitations of naturalistic inquiries which provide deep insight in a small number of cases. Even more so, the study explores cases of recent changes of strategic behaviour of intermediaries that are motivated by practical need and the publications on the concept of open innovation. More research will be needed not only to generalize the findings through quantitative studies. As well more qualitative studies are needed to chart the evolution of the phenomena. But even if the phenomena shall prove transient, it contributes an opportunity for theorizing on the coordination of innovation processes. In this line there are more opportunities to research into open innovation processes and the strategic capabilities of partners in the value chain.

The paper makes a practical contribution to corporate innovation managers in defining their cooperation with partners in innovation networks. Notably it makes a contribution to research policy makers and decision makers, who search for alternatives in funding schemes, and strategic decision makers who search for sustainable business models for innovation intermediaries where public funding alone is no longer a reliable revenue source. The advice from this paper is to develop complementary market-based revenue streams from holding a portfolio of innovation projects.

Part V: Discussion and conclusions

7 An interactive multi-sided market for open innovation

This dissertation contributes to the academic discussion and theory building about networked markets and innovation intermediation in three ways. First, I present the matching process as multi-sided market where network effects based on interactions lead to tie building in networks for open innovation. The conceptual market model provides an economic perspective on matchmaking, as value is created by matching suitable innovation partners for open innovation by an innovation intermediary. Second, the matching process on a multi-sided market for open innovation is introduced as interactive process which provides a more suitable perspective than transaction based reasoning, as property rights cannot be assigned for innovation in the early stage. Matching dynamics along the process are shown as interactions between market agents. A matching matrix for managerial practice between multiple market agents for co-exploitation and co-exploration purposes is made (Parmigiani & Rivera-Santos, 2011). It is assumed that the framework is applicable for a distinction towards transactionbased or interaction-based matching mechanisms. Third, the role of innovation intermediaries in innovation networks is defined as matchmaker, innovation process, project and portfolio manager generating clear economic value to all agents in the innovation network. Thus the innovation intermediary is modelled as an active market agent. The economic value created by innovation intermediaries in networks closes the circle towards the main argument that matchmaking is a process on a multi-sided market for open innovation, leading to new business opportunities in practice.

7.1 An economic rationale for innovation networks

Part II outlines that matchmaking for open innovation can be explained as multi-sided market. I therefore contribute to the theory on two-sided markets (Roson, 2005) by adding a process study about matchmaking on the one hand and providing empirical insights from innovation networks as multi-sided market on the other hand. As described in chapter II, there were at least three or more agents involved along the matching process which allow me concluding that matchmaking for open

innovation is a multi-sided market. Similar to what is reported in literature about two-sided markets, positive and negative network effects (Katz & Shapiro, 1985) were also observed in my cases. Network effects mainly occurred through social interaction between market agents which may end in "virtuous" or "vicious" circles for matchmaking, showing the dynamics along the matching process.

My empirical findings based on qualitative data documentation and active participation in the field, support evidence from Sun & Tse (2007). They state that a monopolised winner takes it all position of an intermediary depends on how many networks individual agents participate in. A social media platform for example is only interesting, when all friends participate on the platform. This provides a monopolised position for the platform owner, as other platforms become obsolete. In innovation networks, agents tend to explore new connections in order to find the unexpected and thus, participate in several networks, but ties in such networks are rather weak (Granovetter, 1983; Granovetter, 1973). It is the task of the innovation intermediary to match suitable ties to become strong connections for joint open innovation projects with strategic long-term impact. Thus, matchmaking as multi-sided market in networks furthers our understanding of this phenomenon as tie building with economic impact towards open innovation for new markets.

The positive or negative network effects on the multi-sided market were generated through interaction between the innovation seeker, innovation provider and the innovation intermediary as active participants on the networked market. Therefore, my work puts interactions in the focus of analysis in contrast to transaction like assumed in transaction cost theory (Williamson, 1989, p. 142). I do not intend to criticise transaction cost theory, my argument is rather a shift of understanding of economic value towards interaction in innovation networks with long-term impact towards a shared vision and a common understanding on a multi-sided market (see part III). I conclude that this statement may solve the market failure on innovation and technology markets.

Commitment of managers as market agents depends on visible results, as evaluation in hierarchic organisations is mainly based on economic short term goals. For this reason, the innovation intermediary has to provide a certain portfolio with potential "deals" showing concrete potential value to all market sides as outlined in part IV, even if a clear outcome lies in the unpredictable future. In particular, I demonstrated in my study that a structured multi-sided market and a coordinated matching process achieve long-term relationships towards successful open innovation "deals". The findings are in line with earlier discussions in different scientific communities where networks are described as "intermediate systems" between hierarchy of the firm and pure spot market transactions (Bidault & Fischer, 1994; Teubal et al., 1991).

7.2 Theoretical contributions based on interaction

Transaction cost theory builds on the theory of the firm, the reason why firms as organisations exit (Coase, 1937). The reason behind the theory is that firms exist when direct market transactions would be more costly than hierarchical organisation (Williamson, 1973), thus it is a framework for 'make or buy' decisions. The development of the internet led to the new research discipline of 'virtual organisations' building on the theory of the firm. Business partners are assumed to quickly switch between projects based on operational and direct routines and thus, generate nearly spot market transactions in or between organisations (Mowshowitz, 2002).

"Switching depends on the categorical separation of requirements from satisfiers. At any given moment there is an allocation of satisfiers to requirements, but the particular allocation can change over time. ... The use of switching in business practice is only just the beginning." (Mowshowitz, 2002, p. 54)

Studies building on these findings assume that resources are dynamically allocated and switched like reported in the competency rallying process in stable supplier networks where network agents already know each other (Katzy & Crowston, 2008). In the early stage of innovation processes, resources or property rights cannot be clearly allo-

cated and assigned. This leads to explanatory limitation of transaction cost theory, either as dynamic switching concept or classical market transaction. Especially in the early stage of explorative innovation partnerships clear matching criteria cannot be formulated. Therefore, matchmaking is an interactive process leading to a shared vision, adaptive goal finding and goal setting. The interactions are comparable to network effects on two- or multi-sided markets with positive or negative feedback loops resulting in un- or successful matches. I therefore argue to put the interaction in the centre of economic analysis instead of the transaction.

Similar to what is stated for the technology transfer process as a processes with several stages and multiple actors (Bessant & Rush, 1995, p. 98), the matching process can be distinguished in a more transactionbased process for joint exploitation or in a more interaction-based process for joint exploration. In my study (part III), I found that matchmaking for explorative innovation projects differs from matchmaking for exploitative innovation or technology transfer projects. In my cases, the innovation intermediary conceptually contributes in establishing new paths and new network connections for co-explorative innovation processes by involving the right partners and building sustainable ties between market agents which might lead to new markets or future transactions later in the process. Literature on technology transactions has mainly discussed technology transfer for exploitation (Tietze, 2012). My findings contribute to matchmaking for coexploration (Parmigiani & Rivera-Santos, 2011) towards new solutions which is in line with Schumpeter's evolutionary understanding of innovation and entrepreneurship (Schumpeter, 1942), as matching criteria emerge over time, change and lead to a shared vision.

7.3 Innovation intermediaries as active matchmaker

Based on the findings in part IV, the role of innovation intermediaries on a multi-sided market for open innovation is elaborated. I further contribute to the growing literature on innovation intermediaries, as technology transfer offices or gatekeeper (Allen, 1984), online platforms (Chesbrough, 2006; Lopez-Vega & Vanhaverbeke, 2009), network facilitators (Klerkx & Leeuwis, 2008) or patent brokers (Benassi & Di Minin, 2009) among others, and provide managerial insights how innovation intermediaries create value. It therefore builds on studies about the functionalities of innovation intermediaries and seamlessly follows the proposition for future research on innovation intermediaries (Howells, 2006).

"Further research into the range of intermediaries, the type of functions or roles they offer and how these have evolved over time, clearly still needs to be done, together with coverage of this phenomenon in other national and local systems. In addition, much more research needs to be undertaken into the nature of the **relationships** that intermediaries exist in, over and above this more detailed outline of their **functions** and activities. As noted in the above section, most of the discussion about intermediaries has been in the context of their function and not their network relationships. Simple triadic structures are mainly implied, whilst where more complex multi-actor relationships in terms of intermediation are, en passant, acknowledged they are then largely ignored." (Howells, 2006, p. 725)

Three concrete value propositions of innovation intermediaries on a multi-sided market were identified and extend the detailed analysis on the functionalities of innovation intermediaries from Neumüller (2010, p. 231 ff.). I provide insights in distinct managerial capabilities of innovation intermediaries delivering long-term value to market agents by actively getting involved in the innovation process of the organisations from all market sides. In doing so, the innovation intermediary has to organize and coordinate the interactions on multi-sided markets and thus, needs a project and portfolio management capability. Especially the documentation presentation of potential "deals" in a portfolio (e.g. a large database or an individualized collection) presents a clear market value to all stakeholders. This finding revisits the "facilitation rationale" of public funded non-profit intermediaries such as technology transfer offices or university incubators for start-up firms (see part IV and chapter 8.4).

8 Conclusions

In my dissertation, the research questions defined in chapter 1.2 were answered. The main research question 'how suitable innovation partners can be identified' is approached by three sub-questions. In the following chapters, each research question is answered and linked to the findings in the previous chapters.

RQ: How can a suitable innovation partner be identified?

The main research question is answered by the three sub-questions RQ_{1-3} . A suitable innovation partner may be identified through the following setting and mechanisms:

- RQ₁: A multi-sided market, where interactions substitute a transaction-based logic, as it is shown in part II and III. The intermediary coordinates the interactions on a multi-sided market which lead to positive or negative network effects.
- RQ₂: A matching process which is coordinated by an innovation intermediary as active agent on the market, as it is shown in part III (and II). Asymmetries are reduced by dynamic interaction patterns between the market agents. Such dynamic interaction patterns are in line with network effects on multi-sided markets, as it is shown in part III.
- RQ₃: A distinct matching capability for profiling, search and selection, a project and portfolio management capability and an innovation process management capability are distinct mechanisms, as it is shown in part II and IV.

The following table summarises my research findings:

No.	Research question	Finding	In this thesis
RQ	How can a suitable in- novation partner be identified?	Innovation partners are identi- fied on a multi-sided market with a structured matching proc- ess operated by an intermediary with distinct capabilities.	Part II, III and IV (main RQ)
RQ ₁	How can the failure on innovation markets for collaboration be re- solved?	Innovation markets are cleared with a multi-sided market model based on interactions leading to a shared vision, rather than a classical market transaction perspective.	Part II and III
RQ ₂	How can asymmetries between innovation partners be reduced?	Asymmetries are reduced by dynamic interactions between market agents, facilitated by the intermediary.	Part (II), III
RQ ₃	What are matching mechanisms as patterns for managerial action?	Mechanisms are a structured matching processes based on distinct managerial capabilities.	Part II and IV

Table 13: Answers to the research questions.

8.1 The failure on innovation markets

RQ₁: *How can the failure on innovation markets for collaboration be resolved?*

The failure of technology and innovation markets (e.g. Arora et al., 2001) is rather seen as a market with search and matching frictions. Those frictions can be reduced as shown in this thesis that open innovation emerges between partners. Innovation intermediaries contribute to reduce information asymmetries (see chapter 4.1) and enable trust-ful interactions among potential open innovation partners on a multi-sided market (see chapter 4.2). I do not claim having solved the failure of technology and innovation markets with my study. I rather contribute to a better understanding of the matching mechanisms and how

interactions in innovation networks lead to successful tie building over time. My results show that successful matchmaking is possible under the described conditions. First, an external intermediary helps to solve the market failure in creating a common understanding within an organisation (profiling). Second, the intermediary searches partners in external networks and builds a portfolio for potential partners. Third, a temporary matching market is created by the intermediary where agents can interact individually, but through a structured matching process. Matchmaking is not a classical single market transaction; it is an interactive process over time. As shown in part II in this thesis, matchmaking is possible under economic conditions and leads to successful innovation.

As already defined in two-sided market theory, network effects play also an important role on a multi-sided market for open innovation. Such network effects emerge through dynamic interaction among the market agents. Positive network effects lead to successful matches based on a shared vision. Thus I hypothesize that positive network effects as (social) interactions, as described in chapter III, are a necessary condition for successful matching.

8.2 Matching dynamics for reducing asymmetries

RQ₂: How can asymmetries between innovation partners be reduced?

As shown in chapter 8.1, multi-sided market logic may resolve the market failure on innovation markets. Matching dynamics as network effects or also called network externalities are central on such networked two- or multi-sided markets. In part III of this thesis, concrete interaction patterns are presented between the hierarchical organisations of potential partner firms and their agents. They have to be differentiated from market transactions, as no property rights are transferred. Interactions lead to a commitment of market agents within an organisation and to a common understanding between all agents on a multi-sided market. The innovation intermediary is the central agent who coordinates the interactions and creates the matching market.

Thus, the intermediary is modelled with its own right, as economic value is generated through a higher matching probability and the coordination efforts.

The two concepts of a "virtuous" and a "vicious" circle of matchmaking are linked to a dynamic process logic and support an evolutionary perspective on matchmaking. The identified interactions along the process circles reduce asymmetries towards a common understanding and a shared vision. Such process dynamics or positive network effects are necessary for successful matchmaking and may even have selfamplifying effects. The innovation intermediary facilitates the interaction between the market-agents within the organisation, that first a common understanding between the agents in a hierarchy emerges and second a shared vision among the all relevant agents on the market.

8.3 Matching mechanisms for managerial action

RQ₃: What are matching mechanisms as pattern for managerial action?

Matching mechanisms outlined in this thesis are divided in three categories. First, a structured matching process as presented in chapter 4.2 offers insights to concrete mechanisms for each process stage (profiling, search, selection, matching and evaluation). Second, distinct managerial capabilities for innovation intermediaries are outlined in chapter 6.2. Concrete mechanisms are structured matching, project and portfolio management and innovation process design. These are necessary capabilities for managerial coordination. The better the capabilities of an innovation intermediary are, the higher the matching probability becomes. Third, a distinction between matching mechanisms as transaction-based e.g. technology or IP auctions (Tietze, 2012) or interaction-based is useful for managerial decision making (see matching matrix in chapter 5.3). The question whether a static database for the search process or an interactive multi-sided market has to be created for a certain innovation request can be answered with the matching matrix. Further mechanisms could be developed with focus on valuation of matching portfolios or matching tools as mechanisms for profil-

ing, search or selection. Based on my findings, I assume that a complete automated matching process is not possible due to the fact that (social) interactions have been identified as necessary conditions for successful matchmaking.

8.4 Implications of the study

For innovation practitioners, my study has four implications for managers, entrepreneurs, innovation intermediaries and policy maker. First, the participatory cases outline the complexity of finding an open innovation partner. Matchmaking is a process which emerges over time and requires active managerial support. My analysis provides a structured matching process with corresponding mechanisms for implementation and testing in further settings. The findings were already transferred to the European level, where colleagues and I adapted the matching process from the presented cases in the German automotive industry to the European Network for Living Labs (ENoLL). In the ENoLL summer schools 2013 and 2014, we matched participants for joint Horizon 2020 initiatives and proposal calls (Pallot, Alishevskikh, Krawczyk, & Holzmann, 2014; Pallot, Holzmann, Krawczyk, & Ruland, 2014).

Second, managerial thinking has to shift from economic short-term valuation in innovation networks based on market transactions. Finding an innovation partner is on the one hand time consuming and costly, but embedded in a multi-sided market with structured matchmaking it might pay off in the long run. The outcome of the matching process is not immediately visible like this is the case in supply chain networks or on IP markets where property rights can be transferred. In one case of my study, it took almost two years since a final successful result could be presented in public. Nevertheless, as shown in my cases, matchmaking requires a multi-sided market which leads to future innovation based on interaction in a networked setting. Interactions are of economic value which might seed the impulse for new products, new technologies or new markets.

Third, innovation intermediaries can derive an own value position in innovation networks as the coordinator on multi-sided markets. This finding provides new fields of application and future research for university incubators or technology transfer centres which are mainly publicly funded, but also existing commercial innovation intermediaries can apply or improve their services.

Fourth, policy maker might consider my findings for their public goal setting. Key performance indicators could be developed for public funded innovation intermediaries, technology transfer offices or public incubators which would have an impact on their funding structure. Interactions on matching events, through matching tools or organised by innovation brokers should be documented. Professional matching services could deliver additional revenue streams in collaboration with industry partners, if properly managed. The public focus of network facilitation or matching support should be reconsidered. Is matchmaking as subsidisation for network formation desired or should the economic value behind matchmaking be generated through an independent business model?

Research on two-sided markets suggests that one market side is charged for getting access to the other market side. In terms of the business model of public funded innovation intermediaries, it means that established companies could pay for the access to the network of university incubators or technology databases, while young start-up firms receive the access and services for free. This reasoning would exonerate public subsidiaries for innovation intermediaries, but on the other hand generating a commercial revenue stream from industry. The legal form of innovation intermediaries has to be considered in this case, whether profit making is possible or not. Future research could build on the pricing structure of such multi-sided markets for open innovation.

Practical impact of my research was generated by matching entrepreneurial start-ups with BMW as project partner and providing an impulse towards the sensibility of this topic within the organisation. Clear results are demonstrated in the United Kingdom, in Berlin and in

Munich. In Berlin the start-up firm ebee smart technologies was matched with BMW in Munich and became member of the hubject consortium, a joint venture for electro-mobility between BMW, Daimler, Siemens, Bosch, EnBW, and RWE. This is a practical example of a multi-sided market for open innovation, with hubject as late stage intermediary between the joint venture partners.³⁰

8.5 Limitations of the study and further research

Each study has certain limitations which opens paths for further research. My research strategy was based on a research agenda on matchmaking for open innovation. I followed an interdisciplinary approach in this thesis, in order to explore the field for further research. Unlike one in-depth study with one deep theoretical focus, I approached matchmaking from a sociological perspective, from a network economical perspective and a managerial perspective. This helped me to explore the field and gain a holistic understanding. Next steps require drilling deeper in the particular theoretical directions. In the following chapter, the limitations of my study are outlined and ways where the field of matchmaking for open innovation could head in future are presented.

Limitations of the study

The findings of my qualitative action research study provide in-depth insights of the interactions along the matching process and a conceptual multi-sided market model for innovation networks. Like every research project, my contributions can only be discussed within a limited scope on the matching phenomenon. Although action research can be fundamentally criticised by a positivist world view (see chapter 1.3), I am convinced that my explorative study provides valuable results for innovation academics and practitioners, and enhances our theoretical understanding. The two aims of action research, first leading to practi-

³⁰ http://www.hubject.com/pages/de/partner.html?iframe=true&width=850&height=600#undefined (10/20/2014) and <u>http://www.emo-berlin.de/de/newsarchiv/news/ebee-liefert-technologie-fuer-bmws-light-and-charge/</u> (11/09/2014)



cal change with real impact and second contributing to theory development have been accomplished with my dissertation project.

However, I recognize the following limitations of my study. First, the cases are limited to one single organisation searching for external innovation partners. The small sample of three participatory case studies leading to 18 observed matching events in total and a cross-case analysis only provides a base for limited generalizability. Even if the impact of my work in the greater Munich area, in Berlin and in London is visible, I propose to extend the scope to other regions, networks, and cultures to compare my findings with other cases. First attempts are already presented in Ma, Kaldenbach & Katzy (2014).

Second, the collected data (semi-structured interviews, field notes, meeting minutes, observations, and secondary literature) derived from my personal interaction with the research environment. Even if a constructivist position allows subjective perspectives, a neutral objectivity could be added to my findings with an ex post case study design of my participatory cases. Although, my field data were carefully analysed, reflection meetings with external partners and supervisors were documented, there is more space for generalisation of my results. Especially for a measurable framework towards quantitative matching criteria similar to Mitsuhashi & Greve (2009). This could be addressed in further research projects.

Third, there might also be successful matching cases where no external innovation intermediary was actively involved. Such cases could be of interest in order to compare them with my participatory case results. If other intermediaries like internal promoter of on organisation (Fichter, 2009) matched open innovation partners successfully the question about how they managed the process would be of further interest and which economic or strategic impact they had in addition to my findings.

Directions for further research

Following my limitations, I propose to further test my theoretical findings from different perspectives. The developed multi-sided market

model and the presented interactions along the matching process provide various paths for future research on the intersection between economics, computer science, and sociology. Based on my epistemological position, I excluded the traditional and well researched approaches in game theory and econometrics in my thesis. These fields should be definitely considered in further investigations.

Following a market design and market engineering approach (Roth, 2002; Weinhardt et al., 2003), my work provides a conceptual market model, data and insights about the interactions between the market agents. In the next step, the market model could be evaluated, improved and then implemented. My study provides insights about the market structure, network effects on the market and the behaviour of market agents. The next step would be to build an economic or computational market model. Computer science has not been in the focus of my research. However, the emergence of artificial intelligence, big data analytics, semantic web and data base modelling offer interesting and promising research approaches on the matching phenomenon for open innovation.

A simulation of a multi-sided market could further develop the understanding of mechanism design (e.g. for online platforms). From a system dynamics perspective, the identified interactions could be simulated in order to better understand dynamics along the matching process. Even though, my findings lead to the conclusion that a fully automated matching process like an online platform, similar to dating sites with automated algorithms (Gale & Shapley, 1962), will not work due to the fact of the interactive nature of the matching process. I see a wide field for further research in computer science. Big data is produced daily in the internet, so new mechanisms can be designed for identifying weak innovation signals, similar to Google analytics which support the matching process. Prediction can markets (Servan-Schreiber, Wolfers, Pennock, & Galebach, 2004; Wolfers & Zitzewitz, 2004) for example are one field which could be linked to this work. Furthermore, network analysis could be a valuable methodological approach similar to what (Weng et al., 2014) published in our special issue.

Concerning the valuation problem of innovation on markets, the effect of real option pricing and matching success on a multi-sided market, especially for "deal-flow portfolios" presented in chapter IV could be further developed. In our special issue, Takao Fujiwara (2014) presented a simulation on this topic which could lead to sustainable business models for innovation intermediaries (Agrawal, Hariharan, Kishore, & Rao, 2005). Further research could explicitly show their value to other agents of the multi-sided market.

The legal perspective as completely other field of research is totally neglected in my work. With my background in industrial engineering and management, unfortunately this is out of my scope. Nevertheless, it is important to understand adaptive, incomplete or implicit contracts in the context of matchmaking for open innovation. The treatment of intellectual property and knowledge which is exchanged along the matching process could be direction for research. Further questions arise in terms of electronic law, if matchmaking occurs on online platforms and sensitive information is exchanged online.

I herewith close my thesis with a research agenda and conclude that matchmaking for innovation partnerships offers various interdisciplinary approaches for future research and I am looking forward tackling some of the identified challenges for further development.

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Summary

Open innovation has gained increased managerial and academic attention since 2003 and follows theoretical approaches of innovation networks. My dissertation reports an explorative action research study on participatory cases about how open innovation partnerships emerge in practice. I was engaged in industrial and academic projects where new ideas, external technologies and new start-up ventures were searched and matched for open innovation projects. Therefore, the formation of new network ties for joint business opportunities, matchmaking, is in the focus of the research.

The problem of matchmaking arises from the network and market structure. In the thesis, it is shown that matchmaking for open innovation requires a multi-sided market perspective. The contribution is a shift from matchmaking as pure transaction-based market mechanisms towards interactive mechanisms over time, but with economic longterm impact for all market agents.

The interdisciplinary study on matchmaking for open innovation offers a research agenda, which is demonstrated in a special issue about 'matchmaking for open innovation: interaction rather than transaction' edited by Thomas Holzmann, Prof. Dr. Klaus Sailer, Dr. Brendan Galbraith and Prof. Dr. Bernhard Katzy in the Journal *Technology Analysis & Strategic Management* published by the Taylor & Francis Group (ISSN 0953-7325).

Samenvatting

Open Innovatie krijgt sinds 2003 toenemende aandacht in bestuurlijke en academische kringen en volgt de theoretische benaderingen van innovatienetwerken. Mijn proefschrift beschrijft een verkennend participatief onderzoek naar hoe open innovatie partnerships in de praktijk werken. Ik heb gekeken in industriële en academische projecten naar nieuwe ideeën, externe technologieën en nieuwe startup ondernemingen, die gecombineerd worden en op elkaar afgestemd worden voor open innovatie projecten. Daarom is de vorming van nieuwe netwerverbanden voor gezamenlijke zakelijke kansen (matchmaking) de focus van het onderzoek.

Het matching probleem komt voort uit het netwerk van matchmaking en marktstructuur. In het proefschrift wordt aangetoond dat matchmaking voor Open Innovatie een meerzijdig marktperspectief vereist. De bijdrage van dit proefschrift is dat het een verschuiving laat zien van transactie- based matchmaking en marktmechanismen in de richting van interactieve mechanismen in de tijd, maar met een langetermijn impact voor de actoren in de markt.

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List of definitions

Innovation intermediary

... is an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations. This definition seeks to include other terms that have been used to broadly describe such processes as 'third-party' or 'broker' (according to Howells, 2006, p. 720).

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. [This paradigm] 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 (Chesbrough et al., 2006, p. 1).

Matching

...is the part of economics that deals with the question of who gets what, e.g. who gets which jobs, who goes to which university, who receives which organ or who marries whom. ... Matching is an important function of markets that focuses on the allocation of scarce goods or resources to individuals, of individuals to institutions or between individuals (adapted from Zweifel, 2009, p. iii f., based on A. Roth).

Two-Sided Market

...is a market in which 1) two sets of agents interact through an intermediary or platform, and 2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality (Rysman, 2009, p. 125).

Multi-Sided Platform

... is an organization that creates value primarily by enabling direct interactions between two (or more) distinct types of affiliated customers (Hagiu & Wright, 2011, p. 7).

Transaction

... is an event that takes place during a process of exchange, in which the transaction has a past and a future. It is a moment at which agreement is established and ownership of rights are transferred (Nooteboom, 2006; Picot & Dietl, 1990).

Appendix

1) Semi-structured interview questionnaire³¹

Forschungsziel:

INNOSTART ist ein Forschungsprojekt, gefördert vom Bundesministerium für Bildung und Forschung, mit dem Ziel, *die Bedeutung von Start-ups für etablierte Unternehmen und deren Netzwerke* zu untersuchen. Der Fokus liegt dabei im Bereich des Innovationsmanagements. Die gewünschten Ergebnisse der dreijährigen Studie sind zum Einen die Entwicklung und wissenschaftliche Absicherung eines Kooperationsmodells zwischen etablierten Unternehmen und Start-ups zur Unterstützung des Managements.

Besonders interessant für die Untersuchung ist die Frühphase der Kooperation, d.h. wie finde ich einen geeigneten Partner (*Matching*), welche Parameter sind für eine erfolgreiche Durchführung sowie Bewertung der Kooperation ausschlaggebend und welche sind eher hinderlich? Darüber hinaus sind für das Forschungsprojekt die Auslöser einer Kooperation aus Sicht verschiedener Stakeholder interessant.

Forschungsgruppe und -partner:

An dem Projekt INNOSTART beteiligen sich Partner aus Wissenschaft und Praxis.



Ziele des Interviews:

In der explorativen Phase geht es uns insbesondere darum, einen Einblick in das ausgeschriebene Projekt zu erhalten und die konkreten Bedürfnisse, strategischen Ziele und Anforderungen aufzunehmen. Daher werden die Interviews mit unseren Forschungspartnern sehr offen gehalten und haben eher einen erzählenden Charakter. Ziel ist es möglichst viele Informationen über bereits durchgeführte bzw. geplante Kooperationsprojekte von unserem Gesprächspartner zu erfahren. Daraus kann ein

³¹ Only available in German.

konkretes Bild über die Bedürfnisse und Anforderungen unserer direkten Forschungspartner machen und im Anschluss darauf näher eingehen.

Hierfür werden relevante Ansprechpartner bei BMW und Mitglieder von munich network ausgewählt und befragt. Darüber hinaus ist geplant beide Seiten der Kooperation, sowohl etablierte Unternehmen, als auch Start-ups in dieser ersten Erkundungsphase zu interviewen. Dabei wollen wir uns auf folgende Schwerpunkte fokussieren:

- Warum werden Kooperationen von etablierten Unternehmen mit/und Startups eingegangen?
- Welche Erfahrungen wurden bereits gemacht?
- Welche speziellen Eigenschaften sind bei den jeweiligen Kooperationspartnern nötig?
- Wie findet man den geeigneten Partner?
- Wie kann man den Fortschritt oder den Nutzen der Kooperation bewerten?
- Wie sah oder soll die Zusammenarbeit konkret aus(sehen)?
- Was sind die jeweiligen Anforderungsprofile an die potentiellen Partner?

Die Aussagen werden ausschließlich für Forschungszwecke aufgezeichnet und verwendet. Zudem bilden die gemachten Aussagen die Grundlage für ein Suchprofil für einen geeigneten Innovationspartner.

Wir bedanken uns recht herzlich für Ihre wertvolle Unterstützung!

Ansprechpartner:					
Thomas Hol: Research Ass INNOSTART Strascheg Cer An-Institut de Heßstraße 89 80797 Münch Germany	zmann istant nter for Entrepreneurship - SCE gGmbH - er Hochschule München				
Tel.	+49 (89) 550506-23				
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Email:	thomas.holzmann@sce-web.de				
Internet:	www.sce-web.de				

EINFÜHRUNG (Geheimhaltung bitte mitteilen!)

- Persönliche Vorstellung und Themeneinführung
- Geplante Vorgehensweise und Fragen (evtl. Anknüpfung pers. Diss.)
- ZIEL: offenes, informatives Gespräch mit erzählenden Charakter (Erfahrungsabfrage) wenig Nachfragen → Beeinflussen → Verfälschung

VORABFRAGEN

Persönliche Daten: Firma: Name des Interviewten: Titel/höchster Abschluss: Abteilung: Funktion: Haupttätigkeit:

KERNFRAGEN

Organisation und Tätigkeiten

- Wie sind Sie organisatorisch und hierarchisch in Ihre Firmenstruktur eingegliedert?
- Was sind Ihre täglichen Aufgabenbereiche?
- Wie viel der täglichen Arbeitszeit erledigen Sie operative Routinetätigkeiten und wie viel Freiraum haben Sie neue Wege auszuprobieren und zu beschreiten?
- In wie fern und bis zu welchen Rahmen haben Sie freie Entscheidungsgewalt? (Strategie, Budget, Politisch, Personal)

Projektbeschreibung

- Welche strategischen Ziele beinhaltet das Projekt für Ihre Abteilung und für das gesamte Unternehmen?
 - Neue Ideen sollen generiert werden
 - Neue Prozesse/Produkte/Technologien/Geschäftsfelder sollen geschaffen werden
 - Existierende Prozesse/Produkte/Technologien/Geschäftsfelder sollen verbessert werden
 - o Werden erst im Laufe der Kooperation definiert
 - Konkretes Projektprofil besteht \rightarrow Wie sieht dies konkret aus?
- Was sind Ihre persönlichen Vorgaben und Ziele in dem Projekt?
- Was sind die strategischen und technologischen Anforderungen und Herausforderungen in diesem Projekt?
- 200

Kooperationsintension (mit Start-ups)

- Warum besteht Interesse/das Bedürfnis, eine Innovationskooperation einzugehen?
 - Was sind Ihre Ziele hinsichtlich einer Innovationkooperation?
 - Was erhoffen Sie sich von einer derartigen Zusammenarbeit?
 - Was sind Ihre Erwartungen diesbezüglich?
 - Welche Anforderungen haben Sie an den Partner, was sollte dieser mitbringen?
 - Verfolgen Sie mit der Kooperation ein direktes Interesse Ihr eigenes Produkt/Lösungsportfolio zu erweitern oder ein indirektes Interesse, um den Markt für Ihre eigenen Produkte vorzubereiten?
- Wie würden Sie den idealen Innovationspartner (nicht Lieferant!) beschreiben?
 - o Ressourcen
 - o Kompetenzen
 - Technologie/-reife
 - o Unternehmensreife
 - o Lokal, Regional, National, International
 - Kultur etc.
- Was würden Sie dem potentiellen Innovationspartner bei einer Zusammenarbeit bieten können?
 - o Ressourcen
 - o Kompetenzen
 - o Technologien
 - Räumliche Einbindung
 - o Inkubationsmodell
 - o Beteiligung/Finanzierung/Lizenzierung
 - o Entwicklungskooperation
 - Übernahme von Entwicklungsumfängen etc.
- Wie intensiv würden Sie den Innovationspartner bei Ihnen einbinden?
- Wie war Ihre bisherige Vorgehensweise bei der Suche nach dem richtigen Innovationspartner? Welche Probleme traten dabei auf oder was hat sich als erfolgreich erwiesen? (→ Unterscheidung Kalt-/Warmakquise)
 - Welche Wege/Medien? (strukturiert/zufällig/standard. Prozess)
 - o Gremien
 - Netzwerke (Welche?) (Multiplikatoreffekte)
 - Konkreter Ansprechpartner
 - Welche Kriterien waren wichtig?

- Welche Eigenschaften müssen beide Partner für eine passende Kooperation erfüllen?
 - Vertrauen
 - Enge der Zusammenarbeit
 - Passende Unternehmenskultur
 - Technologie etc.
- Was verstehen Sie unter einem Start-up und wie definieren Sie (Innovation-) Kollaboration?

Intermediär

- Was erwarten Sie sich von der Einbindung eines Intermediärs/externen Vermittlers zur Partnerfindung?
- Wie stellen Sie sich die Zusammenarbeit konkret vor?
- Welchen Einfluss hat die Einbindung eines externen Vermittlers auf Ihren Arbeitsalltag?

Co-Exploration	Co-Ex	ploitatio	n			
1) <u>Focus:</u> Neues Wissen	1	2	3	4	5	bestehendes Wissen
2) <u>Kern A</u> Lernen	Aktivitä 1	<u>it:</u> 2	3	4	5	Expansion
3) Typ de	er Wert	schöpfu	ng:			
Innovation	1	2	3	4	5	Effizient
4) <u>Kernt</u>	Wissen	s Typus	<u>:</u>			
Implizit	1	2	3	4	5	Explizit
5) <u>Dauer</u>	der Ko	operatio	on:			
Festgelegt	1	2	3	4	5	fortlaufend
6) <u>Kern l</u>	Risiken	<u>:</u>				
Andauernd	1	2	3	4	5	nachlassend
7) <u>Umgel</u>	<u>oende R</u>	andbed	ingung:		-	D: 1
Unsicherheit $(\rightarrow Risiko abscl$	l hätzbar,	2 Unsiche	3 erheit nicl	4 nt!)	5	Risiko
9) T umua	dan aa		on Abbä	naialrait		
6) <u>Typus</u> Beidseitig	der geg	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	<u>en Abna</u> 3	<u>ngigken</u>	5	aebiindelt/sequentiell
Delusellig	1	2	5	4	5	geounden/sequentien
9) <u>Entsch</u>	eidung	sfindun	<u>g:</u>			
Gemeinsam	1	2	3	4	5	getrennt
10) <u>Komm</u>	unikat	ion:				
Hoch, fortlaufer	nd,					niedrig, routiniert
wenig Leute	1	2	3	4	5	mehrere Leute
11) <u>Koord</u>	ination	<u>:</u>				
Interpersonal/						Routinen, standar -
(intern und exte	rnes)					sierte operationelle
Netzwerk	1	2	3	4	5	Prozeduren

Gibt es noch Aspekte die aus Ihrer Sicht wichtig sind, die noch nicht angesprochen wurden?

		Co-exploration	Co-exploitation
Code			
11	Focus of collaboration	New knowledge	Existing knowl-
1.1	1 ocus of conaboration	New Knowledge	edge
12	Key activity	Learning	Expansion
1.2	Type of value creation	Innovation	Efficiency
1.5	Key knowledge type	Tacit	Explicit
1.1	Duration of collabora-	Set	Ongoing
1.5	tion	500	ongoing
1.6	Key hazard	Appropriation	Slacking
1.7	Environmental state	Uncertainty	Risk
1.8	Type of interdependence	Reciprocal	Pooled or sequen-
		*	tial
1.9	Decision making	Joint	Divided
1.10	Communication	Rich, ongoing, few	Thin, routine, more
		people	people
1.11	Coordination	Interpersonal	Routine, standard
			operating proce-
			dures
Code		Radical	Incremental
		Innovation	Innovation
2.1	Statisfying customer's	Future	Current
	needs		
2.2	Availability of resources	Low	High
2.3	Commitment	Low	High
2.4	Driver of collaboration	Technology/"big	Market/competition
		idea"	
2.5	Assessability of success	Very difficult	Relative easy
2.6	Decision making	More strategically	More operational
2.7	Duration of develop-	10 years or longer	0,5-2 years
	ment		

2) Analysing scheme for ex ante profiling³²

Analysing scheme for ex-ante profiling continued.

 ³² Criteria are based on the following publications: Parmigiani, A., & Rivera-Santos, M. 2011. Clearing a path through the forest: A meta-review of interorganizational relationships. *Journal of Management*, 37(4): 1108-1136. and Leifer, R., McDermott, C. M., Colarelli O'Connor, G., Peters, L. S., Rice, M., & Veryzer, R. M. 2000. *Radical Innovation - How mature companies can outsmart upstarts*. Boston, Massachusetts: Harvard Business School Press.



2.8	Chance of success	Low	High
2.9	Eagerness to experiment	Substantial	Minuscule
2.10	Financial needs	Very high	Low
2.11	Profit after success	High	Rather low
2.12	Management support	Low	High
2.13	Quantitative existence	Few	Many
2.14	Risk	Very high and	Low and less
		many	
2.15	Size of enterprise	Important	Unimportant
2.16	Potential for change	High	Low

3) Action research project plan³³

Asymmetrische Partnerschaften für Innovationskooperationen

Ein FHprofUnt Forschungsprojekt gefördert vom Bundesministerium für Bildung und Forschung



1. Projektbeschreibung

In der Vergangenheit wurden Innovationen innerhalb einer Organisation als geschlossenes System betrachtet. Alles was nicht in der hauseigenen Forschung und Entwicklungsabteilung entstanden ist hatte es bislang schwer intern Akzeptanz zu finden und zur Marktreife entwickelt zu werden. Dieses Phänomen ist weitläufig als "not invented here" Syndrom bekannt. Externe Ideen, Technologien und Lösungen können jedoch eine sehr wertvolle Ressource für den eigenen Innovationsprozess darstellen und damit Wettbewerbsvorteile sichern. Erfolgreiche Referenzprojekte wie etwa bei Procter&Gamble mit Connect and Develop, der Philips Campus oder der Siemens Technology Accelerator sind unterschiedliche Beispiele für eine Öffnung des Innovationstrichters.

³³ Only available in German.

Während der Austausch von Patenten über elektronische Märkte oder die Einbindung der neutralen Masse (sog. Crowdsourcing) in den Innovationsprozess bereits sehr erfolgreich von vielen Unternehmen genutzt wird, sind kollaborative Innovationsprojekte noch von einer hohen Abbruchrate betroffen, entstehen eher zufällig und binden dadurch wertvolle Ressourcen durch langwierige Suchprozesse. Jedoch ist gerade letzteres, die richtige Partnerwahl für einen erfolgreichen Abschluss essentiell.

Insbesondere junge Unternehmen bringen in der Regel Innovationen hervor und schaffen die Märkte von morgen. Durch ihre kleine Größe, ihrer Flexibilität und den flachen Hierarchien können Entscheidungen schneller umgesetzt werden und somit auf einen dynamischen Marktwandel schnell reagiert werden.

Im Rahmen einer Innovationspartnerschaft können daher "entrepreneurial firms" gerade den Mehrwert an einer Neuerung bringen, die einem etablierten Unternehmen fehlt. Mit vielen Ressourcen in der Hinterhand kann somit eine komplementäre Beziehung aufgebaut werden, die beiden Partnern langfristig zum Erfolg verhilft.

Die zentrale Frage bei diesen sog. asymmetrischen Partnerschaften aus Sicht einer großen Firma lautet daher: Wie finde ich innovative "entrepreneurial firms"? Wie kann man mit ihnen kooperieren? und Wie sehen mögliche Modelle in der Zukunft aus?

Diese Fragen beantwortet INNOSTART und hilft etablierten Unternehmen dabei die richtigen Innovationspartner zu finden. Das Projekt mit wissenschaftlichen Methoden durchgeführt und der Prozess mit einer entwickelten Matching-Methode geleitet.

Für weitere Information stehen wir Ihnen gerne zur Verfügung:

Prof. Dr. Klaus Sailer, CEO (Strascheg Center for Entrepreneurship) oder Thomas Holzmann, Projektleiter (Strascheg Center for Entrepreneurship)



Abbildung 1: Grundlegendes Konzept von INNOSTART

2. Projektablauf

INNOSTART setzt langfristig auf eine Systematisierung des kollaborativen Innovationsprozesses und hilft somit etablierten Unternehmen bei dem Aufbau eines strategisch relevanten Portfolios an Innovationspartnern. Dabei liegt der Fokus der Suche insbesondere auf junge Unternehmen, um frühzeitig neue Technologien, Services oder Geschäftsmodelle zu erkennen und gemeinsam eine schnellere Entwicklung zu durchlaufen.

Durch ein weites externes Netzwerk innerhalb der internationalen Gründerszene, können etablierte Unternehmen ihr Scouting Netzwerk für New Ventures erweitern und somit die eigene Reichweite erhöhen.



Der Projektablauf kann wie in Abbildung 2 dargestellt systematisiert werden.

Abbildung 2: INNOSTART Projektablauf (Dauer 6 Monate)

3. Projektplan im Detail (Dauer: 6 Monate)

Profiling:

In einem ersten Schritt werden alle internen sowie externen Stakeholder befragt, um ein individuelles Anforderungsprofil zu erstellen. Nach Auswertung der Interviews werden alle involvierten Parteien zu einem Workshop eingeladen, um ein gemeinsames Suchprofil zu erstellen.

Interviewdauer: 0,5 – 1 Stunde Workshopdauer: 2 Stunden

Search und Screening:

Start der offiziellen Ausschreibung des Suchprofils durch Platzierung in unterschiedlichen Netzwerken. Bewerbung der Start-ups erfolgt durch eine offizielle Homepage.

Fitting Start-ups und Assessment:

Alle Bewerbungen und identifizierten Start-ups werden in einer Datenbank gesammelt. Anhand der angegebenen Kriterien wird eine grobe Vorauswahl getroffen, die Entscheidung für eine Einladung zum Matching Event treffen die Stakeholder, die bereits bei dem Workshop zur Profilerstellung anwesend waren.

Auswahl von long-list auf short-list (10-12 Start-ups): 0,5 Stunden

Matching Event:

Alle junge Unternehmen der short-list werden zum Matching Event eingeladen und dürfen jeweils vor den Vertretern der etablierten Firma pitchen. Zudem stehen Möglichkeiten für weitere Vertiefungsgespräche bereit.

Die gesamte Projektdauer beträgt 6 Monate und gliedert sich grob in folgende Aufteilung:

1	Profiling und administrative Vorbereitungen	1 Monat
2	Search und Screening	4 Monate
3	Fitting Start-ups und Assessment (parallel zu 2)	1 Monat
4	Eventvorbereitung und Briefing der Start-ups	1 Monat

4. Leistungsangebot

Im Rahmen des Forschungsprojektes sind die oben genannten Dienstleistungen kostenlos für den jeweiligen Projektpartner. Etwaige operative Kosten (wie z.B. Anreise- und Hotelkosten für Start-ups) müssen individuell geklärt werden.

Für weitere Fragen kontaktieren Sie bitte: Thomas Holzmann Tel.: +49(0)89 550 506 23 E-Mail: thomas.holzmann@sce-web.de

5) List of publications

No.	Publication	Main message and contribu- tion	Downloads/ Citation ³⁴
1	Holzmann, T., Sailer, K., Galbraith, B., Katzy, B. (2014), "Matchmaking for open innovation – theoreti- cal perspectives based on interaction, rather than transaction", Technology Analysis and Strategic Management, Vol. 26, No. 6, 595-599	The editorial for the special issue on 'matchmaking for open inno- vation' provides a brief overview of a research agenda with theo- retical perspectives based on interaction rather than transac- tion.	212/1
2	Holzmann, T., Sailer, K., Katzy, B. (2013), "The matching process for inno- vation partner-ships: A multi-sided market per- spective", IEEE Interna- tional Technology Man- agement Conference & 19 th ICE Conference, The Hague 24 – 26 June 2013	The paper introduces the match- making problem for 'asymmetric partnerships' as a multi-sided market with internal and external agents. Matching mechanisms are presented as coordination between internal hierarchies and hybrid networked market forms. This paper was nominated for the 'best paper award'.	-/1
3	Holzmann, T., Sailer, K., Katzy, B. (2014), "Match- making as a multi-sided market for open innova- tion", Technology Analysis and Strategic Management, Vol. 26, No. 6, 601-615	The paper is an extended version of No.2 and presents matchmak- ing as a more complex process than an (online) market transac- tion. Matchmaking is conceptu- alized as economic resource allocation process on a multi- sided market, especially for exploratory collaboration pro- jects.	152/2

³⁴ Based on google schoolar citation index, research gate and Taylor & Francis download statistics: 11/24/2014. (Citation in this thesis is already included).

List of publications continued.

4	Holzmann, T., Sailer, K., Katzy, B. (2012), "Finding partners for collaborative innovation: The vicious circle of matchmaking", The 26 th R&D Manage- ment Conference, Greno- ble 23 – 25 May 2012	Based on transaction cost eco- nomics and open innovation, the paper reports a "vicious circle of matchmaking" due to failure in open innovation partnership formation. The results are based on the first action research cycle.	-/1
5	Sailer, K., Holzmann, T., Katzy, B., Weber, C., (2014), "Co-evolution of goals and partnerships in collaborative innovation processes", XXV ISPIM Conference, Dublin 08 – 11 June 2014	The argument was jointly devel- oped by C.Weber and T.Holzmann. The main argument concerning the matching process is a shift away from traditional static goal setting towards dy- namic and adaptive goal setting along the collaborative innova- tion process based on a shared vision.	-/1
6	Katzy, B., Sailer, K., Holzmann, T., Turgut, E. (2011), "Deal-flow portfo- lios in innovation collabo- ration - revisiting the ra- tionale of innovation net- works," 17 th International Conference on Concurrent Enterprising (ICE), Aachen 20 - 22 June 2011	The paper revisits the concrete intermediary function of match- making as innovation process design and argues that a "deal- flow" rational of innovation networks mobilizes stronger engagement of stakeholders than the facilitation rationale.	24/2
7	Katzy, B., Turgut, E., Holzmann, T., Sailer, K. (2013), "Innovation inter- mediaries: a process view on open innovation coordination", Technology Analysis and Strategic Management, Vol. 25, No. 3, 295-309	The paper is an extended version of No.6 and includes the strate- gic position for innovation in- termediaries as process coordina- tors with distinct capabilities such as matchmaking and inno- vation process design, manage- ment of collaborative projects, project valuation and portfolio management.	702/16

List of publication continued.

8	Katzy, B., Holzmann, T., Sailer, K., & Thoben, K. D. (2012), Proceedings of the 2012 18 th International ICE Conference on Engi- neering, Technology and Innovation (pp. 1–185). Munich. 18-20 June 2012.	As member of the Conference Organising Chairs 2012, the proceedings are published on IEEExplore and contribute to IEEE Technology Management Council Community.	-/-
9	Pallot, M., Krawczyk, P., Holzmann, T. (2014), "Exploring the Feasibility of an Online Serendipity Service in the Context of Open Innovation within the EU Horizon 2020 Re- search Program", XXV ISPIM Conference, Dublin 08 – 11 June 2014	The paper is based on the theo- retical lens of a multi-sided mar- ket for open innovation and an online service fostering sponta- neous matching between agents based on semantic tags generated from uploaded project proposals. It builds on the theoretical find- ings of No. 2, 3, 6, 7	-/2
10	Pallot, M., Holzmann, T., Krawczyk, P., Ruland, R. (2014), "CONEX: Creat- ing serendipitous connec- tions among Living Labs and Horizon 2020 Chal- lenges ", IEEE Interna- tional Technology Man- agement Conference & 20 th ICE Conference, Ber- gamo 23 – 25 June 2014	The paper reports a matching experiment during the 4 th Euro- pean Living Lab Summer School where participants were matched for joint project consortia based on their Horizon 2020 interests. It builds on the theoretical find- ings of No. 2,3, 6, 7	6/1

Table 14: List of publications.

About the author

Thomas Holzmann (born in 1984 in Munich) received his A-level (Abitur) from Christoph Probst Gynmasium Gilching (Germany) in 2004. He holds a Master of Science in Management from Grenoble Ecole de Management/Ecole Supérieuere de Commerce Grenoble. Previously he graduated from Munich University of Applied Sciences as Industrial and Business Engineer. During his study, he was tutor for thermodynamics and studied in the United Kingdom and France. He visited the Swiss Federal Institute of Technology, ETH Zurich as research assistant and gained practical experience in the automotive and telecommunication industry.

Currently he works as project manager and research associate at the Strascheg Center for Entrepreneurship (SCE) and started his PhD in 2010 at Leiden University. His research focuses on matchmaking mechanisms in the early stage of innovation collaborations, asymmetric partnerships, innovation networks, and multi-sided markets/platforms as interdisciplinary intersection between economics, management, and computer science. At the SCE he contributed to establish the research department and to create an international research network. In 2012 he was local organising chair of the 18th ICE and IEEE Conference on Engineering, Technology and Innovation where he is still member of the Review Committee. He visited the University of Cambridge, University of Mannheim and ESADE Barcelona for participating in international methodology and research courses for PhD students.

His research was published at several international academic conferences and in peer-reviewed academic journals. With his research topic, he was invited as guest editor to Technology Analysis & Strategic Management Journal, contributed to speaker series and expert panels for managers, entrepreneurs and policy makers. As scientific consultant, he matched several start-ups for partnerships with large firms and contributed to technology transfer from university incubators to industry.