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Informal networking – An overview of the literature and an agenda for future research

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Informal networking -

An overview of the literature and an agenda for future research

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Abstract

Informal inter-organizational networks provide manifold opportunities to organize the transfer of information, knowledge and technology between actors. Given their potential and their importance, the lack of theoretical discussion and empirical research on informal networks and their dynamics is surprising. The objective of this paper is twofold. It attempts to review the fragmented academic discussion of the notion of informal networking, thereby focusing on how these relationships emerge initially and what conditions (presumably) are required to make them a mutually fruitful and sustainable channel of the transfer of information and knowledge. On that groundwork, the most important empirical studies which try to confirm and disentangle the aforementioned basic mechanisms of informal exchange relationships are reviewed. Finally, we outline an agenda of future research directions that we encourage researchers to pursue in future empirical studies. Five important research gaps can be identified.

Zusammenfassung

Informelle Netzwerkstrukturen bieten vielfältige Möglichkeiten, den Transfer von Informationen, Wissen und Technologie zwischen Akteuren zu organisieren. In Anbetracht des Potentials sowie der Bedeutung informeller Netzwerke ist der bestehende Mangel an theoretischen Diskussionen wie auch empirischer Forschung überraschend. Hier setzt der Beitrag an, indem eine Bündelung der bislang lediglich in Fragmenten vorliegenden Auseinandersetzung mit dem Konzept informeller Netzwerke vorgenommen wird. Der Fokus wird dabei auf Fragen der Entstehung solcher Netzwerkstrukturen sowie auf diejenigen Faktoren gelegt, die notwendig sind, informelle Netzwerke als effektiven und beständigen Kanal des Wissens- und Technologietransfers nutzbar zu machen. In einem zweiten Teil des Beitrags wird ein Überblick über die wichtigsten, zum gegenwärtigen Zeitpunkt existierenden, Studien gegeben, die sich empirisch mit dem Konzept informeller Netzwerkstrukturen auseinandersetzen. Basierend auf dieser Aufarbeitung werden anschließend fünf wichtige Forschungsfragen formuliert, die im Fokus zukünftiger Forschungsbestrebungen stehen sollten.

JEL Klassifikation: D85, O31, O32

Schlüsselwörter: Informelle Netzwerke, Information trading, Wissenstransfer, Literaturüberblick

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1. Introduction

Basically, informal networks can occur *between individuals* within organizational boundaries but, for instance, across functional barriers (Cross et al., 2002)[1], within organizational (innovation focused) teams (Jewels et al., 2003; Kratzer et al., 2006), or between individuals of different organizations (Janowicz-Panjaitan and Noorderhaven, 2008). We concentrate on the latter issue, that is inter-organizational informal networking. This network may include a multitude of actors, such as (individuals from)[2] firms, university departments, public and private research institutes, governmental agencies, etc. Informal inter-organizational networks provide manifold opportunities to organize the transfer of information, knowledge and technology between these actors.

According to Jewels et al. (2003:5/6) informal networks can be understood as ' (…) relationships developed between individuals independently of any formal structure (…) built over time and used as complementary knowledge sharing alternatives to an organization's formal strategy.' In many cases, such informal non-contractual relationships are a necessary stage towards more formalized connections, such as R&D cooperation, supplier-customer relationships or technology exchange agreements. As for instance Freeman (1991:503) underscores: ''(…) behind every formal network, giving it the breath of life, are usually various informal networks.' Thus, the importance of informal networking as channel of knowledge transfer is widely acknowledged.

Given their potential and their importance, the lack of theoretical discussion and empirical research on informal networks and their dynamics is surprising. This may be explained with their fundamental invisibility and intangibility that make these modes of knowledge transfer not only difficult to govern by organizations (Cross et al., 2002), but also difficult to investigate empirically by researchers. These transfers (mostly) leave no paper trails.[3] The objective of this paper is twofold. It attempts to

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[1] Notwithstanding the importance of social contacts and informal networking in the context of job search and job mobility, it will not be discussed here. For related discussion, see for instance Datcher (1983) and Datcher-Loury (2006). Additionally, knowledge transfer and diffusion through job mobility (within local agglomerations) will also not be considered (see Rogers, 1982; Almeida and Kogut, 1999; Breschi and Lissoni, 2001).

[2] Since this dimension of networking focuses on inter-personal relationships between individuals, the so-called 'know-who' knowledge of '(…) who knows what and who knows to do what' (Lundvall, 1996:6) is increasingly important (see also Lundvall, 2004; Jensen et al., 2007).

[3] For reasons of simplicity, in research settings sometimes such personal networks are subsumed under inter-organizational network structures (between firms), but such an approach ignores complex interactions on the (inter-) personal level (see Grabher and Ibert, 2006 for related criticisms). Referring to this difference, Czepiel (1974) differentiates between interorganizational relations and interorganizational communication, and notes in this regard (p. 179): 'The former concept implies the existence of a general relationship which exists between organizations as organizations. The latter is concerned with actual communication which (…) involves individuals in organizations.'

review the fragmented academic discussion of the notion of informal networking, thereby focusing on how these relationships emerge initially and what conditions (presumably) are required to make them a mutually fruitful and sustainable channel of the transfer of information and knowledge. Since the connection between the embeddedness of individual actors in social networks and the consequence for their performance is the central subject of social capital theory, a short overview about the basic elements of this approach is given. On that groundwork, the most important empirical studies trying to confirm and disentangle the aforementioned basic mechanisms of informal exchange relationships are reviewed. The last part of the paper is dedicated to an outline of an agenda of (so far under-studied or even unanswered) research questions, which clearly deserve deeper investigation to further open the ‘black-box’ of informal networking.

2. Social capital as linking element

The benefits that employees or individuals can achieve through networking get to the core of the matter of social capital theory. The term social capital was introduced by Bourdieu (1983). He defines social capital as the set of resources based on the affiliation to a group or a network. Beside this link between social capital and networks, a second key element of social capital theory is the idea that individuals can make use of their social capital to achieve personal objectives (Bourdieu, 1983; Burt, 1992; Portes, 1998). The possibility of a well-directed use of personal relationships is also highlighted by Coleman (1988:98):

> ’Social capital is defined by its function. It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors - whether persons or corporate actors - within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible‘

A similar but more pronounced specification is provided by Portes (1998:6), who defines social capital as the ‘... the ability of actors to secure benefits by virtue of membership in social networks or other social structures‘.

The theoretical background for the economic significance of networks is derived from the criticism by representatives of social capital theory on the neoclassical assumption of atomistic markets (Coleman, 1990; Burt, 1992; Fukuyama, 1995; Portes, 1998; Arrow, 1999). Since there is a risk of opportunistic behaviour in market transactions, the identity of an exchange partner gains in importance. Under these conditions, social networks have also importance for economic issues. For example, Granovetter (1985) describes the preference for transactions with a person who is

already known. In this context, social capital is a source of information about the reputation of potential exchange partners. This may have particular importance in the market for information. In general, the transaction costs of the transmission of information are rather low. However, the seller cannot be sure, that after the transaction the buyer offers the information on the market itself. In addition, the trading of information is complicated by the fact that the real value for the buyer is observable only after the transaction (Arrow 1961). Under these circumstances, the exchange knowledge and information will be much easier if the partners personally know each other. In general, social capital can contribute to the development of trust, reduce opportunistic behaviour and increase the efficiency of economic transactions (Granovetter, 1985, 2005; Coleman, 1988, 1990; Raub and Weesie 1990).

Against this background, social capital is understood as a valuable resource, comparable with human or physical capital (Coleman, 1988; Lin, 2001; Glaeser et al., 2002). Social capital is accumulated through investments of time and attention in social relationships and therefore takes up scarce resources. However, in contrast to other types of capital, social capital has some specific features. First of all, social capital results from a relationship from at least two individuals, who cannot realise the benefits of social capital independently from each other. Moreover, social capital is inalienable and cannot be transferred to another person (Loury, 1987; Sobel, 2002).

As an organization is using the human capital of its employees, it can also benefit from the social capital of its staff. For this purpose it must use the social capital and the networks of the employees as conduits for transfer of knowledge into the organization. The next chapter describes existing theoretical ideas how this knowledge transfer through informal networks occurs.

3. Knowledge transfer through informal networks – Some essentials

3.1 The ‘trading’ of information

Within one year following the initiation of development efforts for a new product, comprehensive technological knowledge about its functionality and composition leaks out to about 70% of the developing firms’ rivals (Mansfield, 1985). Relying on formal appropriability mechanisms, such as secrecy-policies, does not prevent the disclosure and diffusion of proprietary information and knowledge. The appropriation of future profits resulting from expensive R&D and innovative endeavors are jeopardized (von Hippel, 1987), which in turn impairs the competitive position of the innovating firm. Similar problems are faced by universities and other public research organizations, when knowledge and technologies leaving the institutions ‘(…) out of the back door, and hence the university is not realizing sufficient revenue from its

intellectual property portfolio.' (Link et al., 2007:652). This inevitably raises the question, through which channels does this knowledge spread actually?

Currently, there is no comprehensive theoretical framework to explain the origins, dynamics and impacts of informal networks. The following three sub-sections, therefore, bring together the different theoretical ideas that have been introduced in the academic discussion about knowledge sharing through informal networking.

Researchers argue that knowledge transfer through informal contacts is best described via the notion of 'information trading' or 'knowhow trading'[4] (Von Hippel, 1987; Carter, 1989; Schrader, 1991; 1995; Von Hippel and Schrader, 1996).[5] According to Pyka (1997:210) 'Informal know-how trading is the voluntary exchange of technical information and can be interpreted as a process of actively initiating technological spillovers.' However, one may broaden this understanding by subsuming also the direct involvement in the exchange of non-technical information by managerial personnel. For instance, information regarding valuable business opportunities, new patent applications, distribution channels (of unfamiliar regional markets), or knowledge of appropriate support programs have great potential to contribute significantly to the competitive position of a firm.

Individuals, in most cases scientists or engineers but also actors on the 'management level', establish their own specific network of informal contacts (beyond the organizational boundaries) that they tap into if unforeseen problems occur, which might require novel solutions. The 'list of possible useful contacts' (Pyka 1997:210) – occasionally but not essentially bounded by ties of friendship – might evolve from past workshops, meetings at conferences, trade fairs, common professional backgrounds (former colleagues), former collaborations within formalized projects, as well as from shared times in school, college or leisure time activities.

Professional colleagues might have encountered comparable, or even identical, problems during their work and probably have developed problem-solving strategies already. Gaining access to this specialized know-how not only bears immense potential to save time and (in-house development) costs for the inquiring actors'

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[4] Following von Hippel (1987:291) know-how can be considered as '…the accumulated practical skill or expertise which allows one to do something smoothly and efficiently.'

[5] This specific pattern of informal cooperation, though it is somewhat related, must be differentiated from the 'collective invention' phenomenon (Allen, 1983). 'Collective invention' can be considered as routine or *systematic informal collaboration*, which induces collective learning and economic benefits for all participants (of the whole industry), as demonstrated by Allen (1983) or Fauchart (2003). The 'trading of information', as it might be understood here, refers to the opportunistic (ad-hoc) non-systematic process of knowledge sharing between two or few partners (see Fauchart, 2003 for this distinction). Von Hippel (1987:297) also draws a similar distinction: 'The essential difference between know-how trading and collective invention it that know-how trading involves an exchange of valuable information between traders which at the same time kept secret from the non-traders. In contrast, collective invention requires that all competitors and potential competitors be given free access to proprietary know-how.'

employing firm, but facilitates its own job as well. Internalizing pieces of external knowledge, however, is not straightforward (Mcdonald, 1992). A certain level of 'absorptive capacity' (Cohen and Levinthal, 1989; 1990), that is 'the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends' (Cohen and Levinthal, 1990:128), might be required. Similar professional expertise, academic education, and overlapping mental models of individuals (Sattler et al., 2003) might bridge such knowledge gaps between organizations by assuring the mandatory level of absorptive capacity, thus providing fertile grounds for acquiring and understanding externally available knowledge from within informal networks.

Such processes are not restricted to non-competing firms, but they may also (or particularly) apply to rivals under specific conditions (von Hippel 1987; Hamel et al., 1989; Sattler et al., 2003). Rather, it seems reasonable to assume that the most valuable contacts are found in competing firms, because they use similar machineries and equipment, or produce similar goods.

3.2 Reciprocity – or 'What goes around comes around'

Unlike pure market transactions, reciprocity is considered to be a crucial mechanism for efficient long-term relationships within informal networks. By reciprocity, we refer to the essential process of mutual valuable exchange of information, knowledge and technology. Although, there is no direct accounting of the value of information and knowledge given and received, respectively, there is the implicit assumption (or even obligation) of returning a favor in the future (not necessarily short-term) for reaching equivalence (Carter, 1991; Grabher, 1993; Von Hippel, 1989). The actual value of information exchanged is supposed to be positively related to the probability to repay this 'depth' in the future (Schrader, 1995; Dahl and Pedersen, 2005).[6]

Reciprocity might be understood as a bilateral exchange relationship between two single actors, as well as multilateral mechanisms linking multiple network partners (as for example in a three-way-trade of technological knowledge) (Mcdonald, 1992). Participating in information trading can also occur if the sender does not expect to receive a reciprocal exchange from one particular counterpart, but from any member from the informal network. In a long-term multiple-trade environment, it is expected that every partner contributes roughly equal to the exchange patterns in the network.

[6] Based on early attempts to formalize the decision problem 'to trade or not to trade' by von Hippel (1987) as prisoner's dilemma, Schrader (1995) uses a simple game-theoretical model that is well-suited to illustrate, under which circumstances information trading is beneficial for firms. This model is not reviewed here, but can be seen in Schrader (1995:157-158).

If reciprocity is prevented permanently (in bilateral or multilateral relationships), reputation of agents suffers and the entire exchange relationship is expected to become weaker, which reduces the likelihood of transferring valuable knowledge. In discussing the importance of reciprocity for reputation in networks, Kranton (1996:832) states that 'repeated interaction and reputation mechanisms can enforce cooperation and sustain intertemporal exchange.'

3.3 Competitive backlash, trade-offs and the pursuit of recognition

Problems of undesired, excessive or disadvantageous 'knowledge leaking' in informal interactions are well known (see the introduction to section 3). First of all, since by definition there is no formal transfer agreement, there neither is certainty nor any direct control or monitoring mechanisms that receiving actors keep that knowledge private, that is within the firm (Dahl and Pedersen, 2005).[7] This is especially true for emerging personal relationships where reciprocity, trust and mutual reputation are not yet well developed. A broad (social) network embedding these agents could be able to reduce this uncertainty, because information regarding recipients' 'malpractice' circulates within the network (redundancy) by word-of-mouth processes. As Schrader (1991:168) notes: 'Thus, by not cooperating in one relationship, a player puts several relationships in jeopardy - a strong mechanism for enforcing cooperation.'

Conflicts within informal networks may arise in cases where a personal relationship (and probably the increased feelings of obligation and reciprocity) is valued to be more important than employer loyalty (Rogers, 1982; Schrader, 1991). To sustain friendship, knowledge might be shared whose disclosure significantly threatens the firms' competitive position, but would not have been given away in case of larger emotional distance. Such primarily personal-motivated damaging behavior might also be triggered by, what might be termed 'pursuit of recognition'. An engineer, for instance, might strive to gain recognition in his professional community by consciously confessing the latest breakthrough of R&D efforts, irrespective from any

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[7] Consider a situation with two non-competing firms A and B where employees of these firms exchange information about, for instance, valuable market opportunities. Although, A and B are no competitors, it might be the case that B transfers this knowledge to a firm C, which, is a competitor of A. Similarly, Atallah (2004) points to an important issue that is related to multilateral information exchange. Modeling so called indirect information sharing, he states that an agent does not necessarily have to send his own information, but also information he received by a third party in past exchanges.

Schrader (1991), however, disagrees. He argues that 'industry norms' would prevent such behaviors (and the public-good character of this information) and that the receiver of the information (B in our case) rather acts as a connector (between C and A), announcing that this specific piece of knowledge is available within the industry, but not disclosing it by itself. Indeed, such exchange behaviors have not been studied yet and doubts are remaining.

formalized secrecy policies or contractual arrangements (e.g., non-disclosure agreements). Moreover, individuals could be interested in increasing their personal value as an employee by demonstrating (scientific, technical, or market-related) expertise (Rogers, 1982; von Hippel, 1987; Carter, 1991).[8] Instead, the employing firm wants to keep that information secret to appropriate the economic benefits. Trading this information might therefore jeopardize the firms' competitive position. This contradiction re-emphasizes that studying informal networking presupposes a clear-cut differentiation between inter-organizational information exchange on the firm level and exchange relationships between single actors. Or, as Mcdonald (1992:55, emphasis in parentheses added) verbalizes: 'Obligation to supply [information] is personal rather than a responsibility of the firm; networks are of individuals, collaboration is among firms'.

4. Inter-organizational informal networking – A review of empirical evidence

The following literature review is not systematic in a conventional sense that it focuses on specific research questions and screens the relevant literature according to these research questions. However, since there is an ongoing debate as to whether agents in informal networks in fact diffuse information and knowledge that is highly valuable or if this knowledge has a more general character of low value, and what factors might contribute to these patterns, this second review part puts some emphasis on these two issues.

This section provides a review of those studies that apply a strong empirical approach on informal networking as source of *inter*-organizational knowledge transfer. To best of our knowledge, such an overview over existing empirical research findings regarding informal networking does not exist.[9] As stated in the introduction, informal networks are much more difficult to capture by empirical investigations since, basically, they are not visible, intangible and in some cases not desired. These might be the reason why so few researchers address informal networking as research objective. Three broad types of studies can be distinguished:

i.) studies observing knowledge sharing patterns between actors of specific industries (sub-section 4.1),

[8] However, it is at least questionable whether such strategies pay off, because 'No one wants to hire someone with a penchant for betrayal' (von Hippel, 1987:302).

[9] It must be noted, that *intra*-organizational informal communication networks are not considered here (see e.g., Cross et al., 2002; Jewels et al., 2003; Kratzer et al., 2006; Rank, 2008).

ii.) studies focusing on informal networking within particular agglomerations or ‘clusters’ (of particular industries) thereby highlighting the importance of spatial proximity between sender and receiver (sub-section 4.2), and

iii.) studies that particularly consider informal networking between academic institutions and industry partners (sub-section 4.3).

4.1 Knowledge sharing in industries

One of the first systematic attempts to turn the attention on patterns of industry know-how sharing is made by von Hippel (1987) in his (highly recognized) empirical investigation of trading behavior in the US steel minimill industry. He observes the process of trading valuable know-how as *consciously and routinely* behavior (supported and approved by top management), even with direct competitors, dependent on expected reciprocity: ‘…they were able to go into considerable detail about the types of firms they did and did not deal with, and why dealing with a given firm would or would not involve a valuable two-way exchange of know-how.’ (p. 295). Von Hippel and Schrader (1996) interviewed 30 experts in the *oil exploration industry* to shed light on the patterns of ‘managed’ information trading between competing firms. Consistent with von Hippel (1987), they not only report in detail how information with considerable proprietary value is traded, but they also demonstrate the importance of two mechanisms securing this system. First, ‘specified trading norms’ guarantee reliability and prevent individuals from cheating in this network. And second, to avoid competitive backlash (by misjudging the value of information) only senior managers capable to evaluate the proprietary value of information are legitimated to decide on the trading of information of particular high (competitive) value. In sum, it is shown how management structures might reduce or even overcome some problems commonly associated with the trading of information.

In contrast, Fauchart (2003) does not find evidence for the sharing of knowledge that can be considered competitive in his investigation of the *chlor-alkali industry* in Western Europe. Further evidence is given on the aspect of reciprocity. While on the inter-individual level reciprocity is important to sustain informal relationships, particularly for the disclosure of tacit knowledge. However, a distortion of reciprocity is accepted on the firm-level, because ‘Large firms (…) are aware that small firms have less resources than they have to participate and do not blame them (…)’ (p. 16). Similar to von Hippel and Schrader (1996), Fauchart (2003) describes some kind of systematic informal sharing, ‘managed’ by an industry association.

Schrader (1991; 1995) and Sattler et al. (2003) again concentrate on the US steel industry, and compare country-specific patterns of trading of technical information with German steel companies (Schrader, 1995; Sattler et al., 2003). First, it is found

that an overwhelming 98% of surveyed employees being asked for technical information by colleagues from other firms indeed provided the desired information. As important parameters influencing this decision are identified: degree of competition, importance of information to deciding party (both negatively related), availability of alternative sources, information relating to domains of low competitive importance, expected improvement of willingness to reciprocity (all positively related) (Schrader, 1991). Performing the US-Germany comparison by using survey responses from 292 middle-managers reveals that informal information exchange is more frequent in German firms. Like Schraders' (1991) results, in both countries the requested information is provided significantly less frequent if the information is of considerable competitive value (e.g. information relating to areas where firms compete) for the transferring firm. Contrasting other results (see Dahl and Pederson, 2004; 2005 below), personal relationships – though they structure informal networks – are less important for what actually is exchanged. Pure economic factors accounting for the costs and benefits for the deciding firm matter more for employees' decision.

More aggressive patterns of informal knowledge acquisition are depicted by Chen (2009) for firms from the machine tool (MT) industry in Taiwan. He reports that detailed knowledge about new products and technologies is often kept private by competitors within this industry. To outflank direct, little promising negotiations about other firms' know-how, local suppliers act as intermediating actors (p.531):

> 'If a supplier, for instance, is subcontracted by one MT firm to manufacture or process a part or a component that he knows might be of great interest to his or her client MT firms, he may privately inform the second firm and invite its engineers to come over and take a look, as well as offering complementary technical information, such as technical drawings and know-how related to the manufacture of that product.'

This is another illustration (see also von Hippel, 1987) of how suppliers can be central facilitators of the informal diffusion of new knowledge in one industry. Although, all industry firms benefit, as suggested by Chen (2009), it is rather undesired 'knowledge leaking' than voluntary knowledge sharing.

4.2 Knowledge sharing in 'clusters'

The basic rationale behind studies concentrating on informal channels in 'clusters' or regional innovation systems, is that knowledge spillovers seem to be geographically bounded (e.g. Jaffe et al., 1993; Anselin et al., 1997; Zucker et al., 1998). Therefore, locating in close vicinity to the sources of those spillovers becomes crucial for their entrepreneurial exploitation (Audretsch and Feldman, 1996). Considering innovation

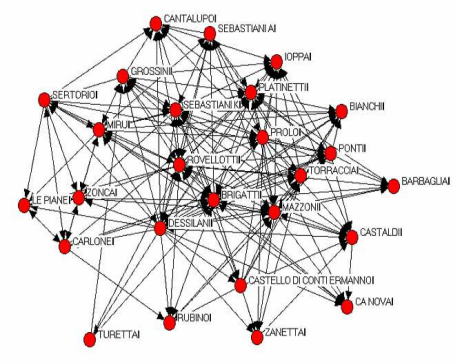
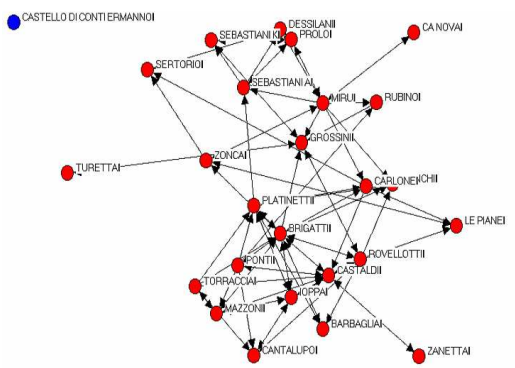
efforts in particular, close linkages act as catalyst for the exchange of experiences, and the transfer of valuable information and knowledge, particularly non-codified tacit knowledge. The transfer of this kind of knowledge requires frequent personal interactions between actors (researchers, engineers, managers, etc.) and is difficult to realize over great distances (Malmberg and Maskell, 1997).

In two articles Dahl and Pedersen (2004; 2005) present their results of an investigation of social informal networks in a 'cluster' of the wireless communication industry in Denmark. Overall 346 engineers from 19 firms are surveyed. Nearly three Fourth of all respondents indicate informal contacts within the cluster,[10] but only 2.6% acquired high-value knowledge useful for their own work (Dahl and Pedersen, 2005). Particularly, shared prior participation in formal cooperation, work experience (in the cluster and the industry) and the existence of private relationships (especially with former colleagues) are found to be key elements in determining (high-valuable) knowledge acquisition (Dahl and Pedersen, 2004; 2005). These results therefore underscore the importance of reputation and trust for informal networking. Remarkably, not even the existence of formal competition clauses in respondents' contracts significantly decreases the likelihood of receiving high-value knowledge in their networks; though it diminishes informal networking in general.

Morrison and Rabellotti (2005) raise some doubts concerning frequent reciprocal exchange of information and knowledge in cluster structures. For a relatively small cluster of wine producing firms in Italy (N=26) they find that ties based on mutual transfer are *not* the dominant form of informal contacts, and therefore question the common assumption of 'dense social interactions based on reciprocity' in clusters. They further show that it is crucial to unravel what is exchanged actually, that is information must be distinguished from knowledge.

[10] In their study, an informal contact is defined as: '(…) as a person working in another firm (in the same local industry) with whom the engineer has a social relationship, which is not part of a formal agreement between the two firms.' (Dahl and Pedersen, 2005:84).

Table 1 An example of graphical representation of the differences between information networks and knowledge networks

The *information* network	**The *knowledge* network**
	

Source: Morrison and Rabellotti (2005:10).

Whereas the information network has a considerable higher density than the network diffusing knowledge (i.e. more actors are connected to each other), it is *less* characterized by reciprocal contacts as well as strong ties at the same time. Almost all firms participate in the informal exchange of information. In contrast, access to circulating knowledge is restricted to 'hard core' of cluster firms. Interestingly, Giuliani (2007) shows for another wine cluster that the knowledge network again is more dense that the network of business interactions.

4.3 Informal networking between 'Academia' and industry

Studying the specifics of informal knowledge transfer between public academic institutions and industry firms (on the level of the individual) has long been a fairly neglected research stream in the context of informal networking. The majority of research efforts are directed towards more formal arrangements of university-industry technology transfer, such as patenting, TTOs, research-based spinoffs, licensing agreements, university-based incubator facilities or science parks and incubators (e.g. Bozeman, 2000; Clarysse et al., 2005; Link and Scott, 2003; Markman et al., 2005; Mustar et al., 2006; Phan et al., 2005; Thursby et al., 2009; Schwartz and Hornych, 2010). Only a handful of (mostly very recent) studies have touched upon the *informal side of academic-industry interactions* (Link et al., 2007; Grimpe and Hussinger, 2008; Grimpe and Fier, 2009).

Link et al., (2007) for the US as well as Grimpe and Fier (2009) for Germany, in an effort to replicate (and extend) the former study, define three channels of informal

technology transfer[11] between scientists and industry personnel: the commercialization of technology, joint publications and (formally) consulting to industrial firms. While the share of scientists using consulting is nearly equivalent (18% and 17%), commercializing technology is considerably more prevalent in Germany (44% compared to 16%). Joint publication was found for 23% in Germany and 15% in the US-study. Inter alia, both studies confirm a higher probability for male scientists to engage in informal networking and a positive relationship between scientists' age and engagement in informal technology transfer. Grimpe and Fier (2009) therefore conclude that institutional differences between the US and Germany do not play an important role. Extending the Link et al. (2007) framework by including discipline effects reveals, for instance, positive effects to cooperate informally for natural sciences and engineering sciences compared to social sciences. In general, Grimpe and Fier (2009) survey 800 scientists from universities and government-funded public research institutes and Link et al. (2007) have a sample population of 1 514 university scientists and engineers. Unfortunately, both exclude 'universities of applied sciences' from their analysis. But since these institutions have a strong focus on applied research (many professors have also worked in industry firms before), it would have been very interesting to investigate and compare their patterns of informal networking behavior.

The general assumption of Grimpe and Hussinger (2008) is that formal and informal transfer mechanisms are, mutually beneficial, accompanied by each other, interacting rather than being independent channels. They suggest several advantages from the firms' viewpoint to engage in informal networking with academia (p.6/7): 'to browse for relevant technological knowledge without mobilizing substantial human or financial resources', 'access tacit knowledge surrounding formalized knowledge' and 'facilitate the attraction of talented researchers'. Using a sample of 2 000 firms from German manufacturing industries and data from the German part of the Community Innovation Survey they find informal technology transfer activities for 37.6% of the firms; but they do not further specify the term 'informal technology transfer'. Similar to Janowicz-Panjaitan and Noorderhaven (2008) for strategic alliances[12], Grimpe and Hussinger (2008) detect that both channels not only are coexistent in most cases, rather they are complementary, i. e. engagement in informal technology transfer arrangements increases benefits of formalized connections.

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[11] 'An informal technology transfer mechanism is one facilitating the flow of technological knowledge through informal communication processes, such as technical assistance, consulting, and collaborative research.' (Link et al., 2007:642).

[12] Janowicz-Panjaitan and Noorderhaven (2008) find a positive effect of informal learning behaviors on inter-organizational learning in the context of strategic alliances. Drawing on social learning theory, the authors base their analysis on a sample of 149 Polish joint ventures with foreign, i.e. geographically distant partners. They find that formal and informal learning behaviors between alliance partners mutually reinforce each other.

5. An agenda of future research directions

The present paper contributes to the literature by reviewing the fragmented academic discussion of the notion of informal networking, thereby discussing theory on how these relationships emerge and what conditions are required to make them fruitful channel of the knowledge transfer. Furthermore, empirical studies that focus on informal networking are reviewed. Based on the findings of this paper, below we outline an agenda of future research directions. Five important research gaps can be identified.

First, it becomes clear that studying informal knowledge transfer between public academic institutions and industry firms is just in its infancy. However, much more interesting seems to be the stunning detail that *none* of the existing studies in this particular field refers explicitly to the concept of informal networking or information trading, as it is discussed theoretically above. Those conceptual linkages – contrary to what should be assumed – are completely absent. Another missing ingredient in these studies is the explicit consideration of the industry in the process of academic-industry knowledge transfer. Whereas the focus clearly is on (the factors shaping) academics' intention or choice to engage in informal networking with industry employees, the other (industry) side of the story is largely ignored. The study of informal knowledge transfer between industry actors and academic personnel in most cases barely scratches the surface of the rich and complex interactions at work.

Second, there is only vague knowledge regarding the dynamics, particularly the decomposition, of existing informal networks. While some research has been carried out to identify the mechanisms that lead to the formation and the sustainment of informal networks, two related issues remain unclear. What are the deciding factors that lead to decomposition (frequency of activating personal contacts, length of relationship, etc.) and by which pace does decomposition takes place? Considering the latter question, one may assume that there is certain process of fading-out instead of an abrupt abandonment of the relationship. It is also unknown whether there are changing patterns of informal knowledge transfer with increasing duration of exchange relationships. When and under which circumstances do formal relationships develop from prior informal relationships? Does the (economic) value of transferred knowledge increases with time? Or, as already asked by Bönte and Keilbach (2005): 'Which factors reduce or increase the incentives to defect from informal cooperation?'. The basic problem of most empirical studies trying to investigate these processes is that cross-sectional survey data can only capture those relationships, which are actively 'used' at the time the respective studies are conducted. It is difficult to capture prior informal relationships or informal relationships that are just in their start-up phase. This problem calls for longitudinal research designs.

Third, existing research investigated the question whether it is valuable knowledge what is exchanged through informal relationships or pieces of information. The empirical results so far are ambiguous. In this context, Morrison and Rabellotti (2005) showed that the exchange of knowledge with proprietary value is restricted to fewer closely connected partners, but information circulates relatively freely within the informal network. This finding underscores the importance to differentiate between information and knowledge when analyzing the determinants of the structure (e.g., density, connectivity of actors, strength of ties, centralization) of informal networks. Moreover, such research should account for specific fields of knowledge/ information that is exchanged, for instance technical knowledge or business-related knowledge, and should consider the kind of relationships between the partners, such as 'friendship' ties and 'friendly' ties (Kratzer et al., 2006). Most authors treat the actual process of informal knowledge transfer as a black box, that is, they do not investigate the type of knowledge being shared.

Fourth, future research efforts might also focus much stronger on the measurement of the impact of informal networking on the performance of individuals and firms. Whereas some attempts have been made in the empirical literature (Sattler et al., 2003)[13], the direct measurement of the positive as well as negative[14] effects is widely neglected. Developing a set of quantitative indicators, if possible, can be an important step towards of the identification of 'the real effects' informal cooperation. For instance, one might compare the performance of individuals or firms that actively pursue strategies of information trading with individuals or firms where information and knowledge are kept private. With respect to the latter, it might also be interesting to investigate the type as well as the effectiveness of firm-specific (formal) mechanisms to encourage or block (unintended) innovation-related knowledge sharing (e.g., strategic guidelines by management; regulatory frameworks).

Fifth, another missing part that we recognize as valuable avenue for future research relates to the linkages between informal networks and more formalized connections that originate from these informal relationships and vice versa. This aspect has been partly addressed in the introduction. Informal networks are only one of several channels of knowledge transfer between firms or between firms and academic

[13] Sattler et al. (2003:293) use the following variables to capture the potential effects of information trading between firms: Information helps to improve product quality, Information helps to improve operations, Information helps to reduce costs, Information helps to simplify employee's job, and Information helps to meet safety regulations.

[14] Partial empirical evidence for the downside of informal networking is provided by Kratzer et al. (2008) in an examination of communication patterns between separate units in multi-institutional product development collaborations. It is found that highly frequent informal communication is positively associated with *effectiveness* (by facilitating creativity because of rich information flows) but also negatively with *efficiency* of units involved in these collaborations (measured as timely completion of assigned tasks), because of a slowdown of work progress or decision-making due to close social ties.

institutions. Scientists from different disciplines have described numerous forms of formal collaboration between organizations. Especially the Management Science literature has shown great interest in formal cooperation agreements in the field of innovation and R&D (Hagedoorn and Schakenraad, 1994; Powell et al., 1996). The objectives of research cooperation are either daring to make a joint effort in an innovation project or to enable the transfer of technology between the partners. Freeman (1991) refers to various forms of cooperation in the field of R&D, for example contract research, technological advice or licensing. However, knowledge is not only transferred through R&D cooperation, but also in the course of other formal agreements. For example, knowledge is often transferred in the context of long-term supplier-customer relationships. Unlike pure market transactions (arms-length ties) long-term supplier-customer relationships are often accompanied with the building of trust (see Jarillo, 1988; Williamson, 1990) which enables the exchange of knowledge and joint learning processes (Lundvall, 1988). But as McDonald (1992:53) states ‘Collaborative agreements do not generate information flow where there was previously none at all.’. Prior research has not investigated this relationship so far.

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