

## **2. Innovation by Networking: An Economic Perspective**

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### **2.1 Introduction**

The concept of innovation "networks" has by and large been developed in social sciences other than economics. A whole number of quite different definitions of what a network is can be found in the literature (see the contribution of Knut Koschatzky in this volume for an overview). According to this heterogeneity of concepts and definitions, a considerable divergence of hypotheses concerning the main forces that govern such networks exist. In this contribution, I want to outline an economic approach to the analysis of innovation networks. That is, to show why it might be advantageous for the innovation activities of individual economic actors to be embedded in a network of relationships to other actors. My argument will focus on those kinds of networks that mainly consist of private sector firms. Pure policy networks are, therefore, excluded.

Seen from an economic perspective, networking represents a means to improve the efficiency of innovation processes and, in particular, to overcome some impediments to a division of innovative labour. Therefore, the specific problems of labour division in the field of innovation constitute the starting point of the analysis here (Section 2.2). Based on that, I will give a definition of what a network is (Section 2.3) and then explicate the potential advantages of network relationships for the firms involved (Section 2.4). Section 2.5 contains some final remarks for policy and for further research.

### **2.2 Impediments to a Division of Innovative Labour**

Division of labour in the field of innovation is characterised by a number of *specific problems*. These problems are a consequence of the very nature of innovation processes as well as of certain characteristics of information as a subject of market transaction. Because the combination of existing knowledge and the generation of

new knowledge constitutes the core of innovation activities, a transfer of relevant information plays an essential role in interaction on R&D.

One main impediment to a division of innovative labour is caused by the fact that the output of innovation activities cannot be completely specified beforehand in a relevant contract. This implies that the resulting incomplete contracts leave room for *opportunistic behaviour* of contractual parties, i.e., self-serving interpretation of the terms of the contract to the disadvantage of other contract parties. Due to this danger of opportunistic behaviour, economic actors may avoid contracting out certain tasks of the innovation process that otherwise would be purchased from external sources.

Another problem for a division of innovative labour is *asymmetric information* that may constitute a severe impediment for trading information on markets. The reason is that in order to make suppositions about the economic value of certain information, one needs to know its properties. Therefore, the supplier of information should describe the characteristics of that information and, in many cases, this implies a more or less complete disclosure. However, once a potential customer possesses the information, he has no reason to purchase it. Therefore, information that is intended to be sold cannot be completely disclosed. Consequently, the supplier has better knowledge of the subject of the potential market transaction than the customer. This may hamper the trading of information on a market and, thus, interaction on R&D.

A third possible difficulty concerns the *transfer of information* as such. One obstacle to information transfer may be, for example, that the information is "tacit", i.e., not completely codifiable so that it can only be communicated face-to-face or by a transfer of the person who possesses the knowledge. Moreover, the identification and the use of relevant information may require a certain "absorptive capacity" (Cohen/Levinthal 1989; for a comprehensive treatment of problems of information transfer see v. Hippel 1994). Co-operation with regard to innovation may also be hampered by the danger of *uncontrolled knowledge flows*, i.e., that by co-operating on R&D the transaction partner comes into possession of sensitive information without paying an adequate compensation for it.

A further problem of a division of innovative labour may be due to the fact that R&D processes often require very special inputs that are not commonly traded in large markets. This *rareness of appropriate inputs* in many cases is a result of the very nature of innovation activities characterised as generating something new: new products or processes may require new or very specialised inputs that are not readily available. In fact, markets for inputs to R&D processes may be fairly "thin" with only very few suppliers able to fulfil the desired task and transactions taking place rather infrequently. Because suppliers are rare, an immense amount of effort may be required in terms of *search costs* to identify a suitable transaction partner for a division of innovative labour. Since such transaction-specific investment will be "sunk"

if the respective relationship is abandoned, there is an incentive to utilise such relationships – once established – over a longer period of time in order to reap the rewards from this investment. Moreover, if only few transactions take place, a clear market price may not exist so that negotiations about the price and further conditions of an exchange tend to be rather costly.

As a result of these problems, many contributions to innovation processes cannot be easily traded on anonymous "spot markets". Therefore, a division of innovative labour between different organisations may require incompletely specified, long-term agreements ("relational contracting") that imply a considerable degree of trust and co-operative spirit.<sup>1</sup>

### 2.3 What is a "Network"?

For the present purpose any set of social relationships may be called a "network" if it consists of at least three individuals or institutions and is characterised by some redundant vertical relationships that are only incompletely specified. The networks under inspection here consist mainly of private firms and correspond to the concept of "industrial districts". Redundancy of business relations means that there is a tendency for customers to have more than one supplier of certain goods and that suppliers are not dependent on only one customer. Many of the network relationships are characterised by a long-term orientation. One possible reason for such a long-term orientation is that establishing a relationship with a certain transaction partner may require high relation-specific investment that will be "sunk" if the respective relationship is abandoned. Moreover, repeated transactions over a longer time-period create conditions conducive to the emergence of trust and reputation that are needed to overcome the problems caused by asymmetric information and incompletely specified contracts. Due to the considerable incentives to be gained from relation-specific investments over a longer time period, networks are characterised by a pronounced tendency to solve conflicts by dispute ("voice") because the "exit"-alternative, i.e., abandoning the relationship, would be rather costly. In many cases, networks are characterised by a certain network-"culture", i.e., a set of shared values or certain modes of conduct for transactions and for conflict-solving. Economically, such a culture constitutes a means of reducing uncertainty about the behaviour of other members of the network (cf. Carr/Landa 1983). Although network relationships tend to be long term in character they need not be very tight. In many cases, such relationships may be described as "weak ties" and "loose coupling" (Granovetter 1973; Weick 1976).

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<sup>1</sup> See MacNeil (1978) for a detailed characterisation of the different types of agreements.

Another remarkable feature of many networks that can be found in reality is the clustering in space, i.e., that economic activity in a certain technological field - particularly R&D-activity - is concentrated in particular regions (Porter 1998). This may indicate different things. First, clustering can be caused by the presence of inputs (e.g., a particular university department, a differentiated labour market) in a region that is important for a certain type of innovation activity. Second, there may be considerable positive technological externalities (e.g., knowledge spillovers from R&D) at work that are limited to a region. And third, clustering can be caused by the advantages or the need for being located in spatial proximity when collaborating on R&D. This holds particularly for innovation activities where frequent face-to-face contacts are of considerable importance.

## **2.4 Advantages of Network Relationships**

My main hypothesis with regard to networks of private firms as they are described in the literature is that this form of interaction allows firms to realise a relatively high degree of labour division. The analysis will clearly show that this mainly concerns vertical relationships which are regarded in Section 2.4.1. Further advantages may emerge from horizontal relationships in networks (see Section 2.4.2). In the literature, a number of additional arguments can be found that assert some general benefits of network-type relationships, be they vertical or horizontal. These aspects are explicated in Section 2.4.3.

### **2.4.1 Benefits of Vertical Disintegration and Redundancy of Relationships**

One important feature of private firm networks or industrial districts often described in the literature is a relatively high degree of division of labour (cf. the contributions in Camagni 1991 and in Pyke/Becattini/Sengenberger 1990). Many firms involved in such networks concentrate exclusively on only a few specific steps of the production process and leave the rest to other actors that are specialised to a similar degree. Such a high level of labour division may bring a number of benefits for the individual economic actor as well as for the network as a whole. One of the advantages on the level of the individual member of the network could be an increase of flexibility due to reduced complexity (lower internal transaction costs) of a "lean" organisation in which less tasks are performed.

Other benefits of an increased division of labour in networks presuppose some degree of redundancy in relationships with customers or suppliers. Obviously, redundancy of vertical relationships represents a central issue of a division of labour

within networks. For the individual firm, the *benefits of an increased division of labour* together with redundant relationships encompass a number of issues:

- Higher productivity or quality of output due to a higher degree of specialisation. This effect is mainly caused by the higher volume of production realised by actors who perform the relevant task not only for internal demand but also for other actors.
- Better "match" of available inputs if there is choice between different supplies. As a consequence of a better match, less effort is necessary to adapt the respective goods or services to a firm's specific needs. For a better "match" of inputs to occur it is necessary that there are several suppliers available (= potential redundancy in supplier relations) and that the inputs offered by these different sources are characterised by some degree of heterogeneity. The more differentiated the supply, the higher the probability of finding a perfect fit.
- Better chances of avoiding bottlenecks if one supplier is unable or unwilling to deliver certain goods or to perform a certain task. Therefore, internal or external bottlenecks may be overcome much more smoothly than in the case of a complete internal provision or a single sourcing situation, i.e., when a relationship to only one supplier exists.
- Opportunity to compare the cost and quality of different suppliers' goods and services. Such benchmarking may not be limited to the cost and quality of a product but also to the respective production processes leading to a faster diffusion of process innovation. If, for example, a certain supplier has successfully implemented a process innovation the customer may be interested in having his other suppliers adopt this product innovation and, therefore, engage in actively stimulating the diffusion of the innovation.

In addition to the positive effects of outsourcing and division of labour in innovation networks there are a number of further potential benefits of redundancies. Such *advantages of redundant relationships* are:

- A relatively fast diffusion of information and innovation within networks. Fast diffusion is mainly the result of redundancy of vertical relationships and of relatively rich information flows within incompletely specified interaction. If a supplier is not dependent on a certain customer but has also established relationships with other customers, one may be able to benefit from innovations that have been developed in the interaction of the supplier with the other customers.
- Stability and safeguarding of relation-specific investments. If a supplier delivers a large fraction of his output to one particular customer, his existence may be endangered if the customer breaks off the relationship for any length of time. However, if such a dependent supplier is forced to exit the market due to a loss in demand, the customer cannot go back to his former supplier and all relation-specific investments will be sunk. Non-dependency on a specific customer

makes the supplier more resistant to a temporary break-off of the relationship and enables both parties to benefit from the relation-specific investment over a longer period of time.

- Automatic correction of errors or misperceptions of transferred information. Redundancy of relationships implies that certain information will be communicated from different sources. Therefore, false or misperceived information can be corrected more or less "automatically".
- Limiting the scope for exploitation. Redundancy of vertical relationships implies a possibility of bypassing certain transaction partners and, therefore, limits the danger of being exploited that is always present when some degree of dependency exists.
- Generation of variety. Redundancy may be seen as a necessary but not sufficient condition for the emergence of different approaches and solutions. If, for example, a number of firms try to match a certain demand, their approaches may differ considerably. Variety is a prerequisite for a better match of inputs to occur and may, therefore have welfare-increasing effects in the static sense. Variety may be even more important for the dynamic performance of the system. The more different variants available, the higher the probability of finding solutions to unforeseen problems that may arise in the future.

It has already been mentioned that redundancy of relationships implies the availability of alternatives, and the more acceptable alternatives there are, the lower the danger or probability of being dependent on a certain exchange partner. Non-dependency due to redundant relationships is an issue that has been characterised in the literature as "loose ties" (Grabher 1993; Granovetter 1973, 1982; Weick 1976). Loose coupling of different elements or organisations may have a number of consequences for the dynamic properties of the system as a whole. Most of the effects of loose ties as mentioned in the literature – such as higher flexibility, higher variety, relatively fast diffusion of innovations – have already been discussed in the context of redundancy of relationships (Section 2.4.2). However, a further possible effect of weak ties is not so obviously a result of redundancy, and this is a relatively high sensitivity of loosely coupled systems with regard to their socio-economic environment. This hypothesis proposed by Mark Granovetter (1973) asserts that weak ties are more likely to link members of different groups than strong ones. Granovetter argues that strong ties tend to be concentrated within a particular group with the result that the members of such a group possess approximately the same set of information. Accordingly, the highest probability of learning something new is related to communication across greater social distance because the weak ties between such distant groups allow for more heterogeneity of information among communication partners than that available when the partners are connected by strong ties.

Despite the obvious benefits of outsourcing and redundancy, it should not be overlooked that establishing co-operative relationships with a number of more or less

similar partners implies multiple relation-specific investment and may, therefore, be rather costly. For this reason, the number of redundant relationships will be limited. From an economic perspective, there is an optimum in the number of redundant relationships that results from a cost-benefit comparison.

#### **2.4.2 Possible Effects of Horizontal Network Relationships**

Horizontal relationships in networks have two types of advantages. The first type of advantage is the pooling of R&D resources for a specific innovation. As far as face-to-face contacts are necessary for conducting such an R&D-co-operation, spatial proximity may be conducive to establishing and maintaining such relationships. Empirical research suggests that a relatively weak and informal type of horizontal R&D-co-operation, so-called information trading, may be of particular importance for innovation networks (cf. Saxenian 1994). Information trading denotes an exchange of information, in most cases technical knowledge, between personnel of competing firms (von Hippel 1987). Often, a major aim of horizontal co-operation is to overcome disadvantages due to small size caused by indivisibilities of processes or resources. Another possible objective that may be relevant in many cases is spreading the costs of R&D among those firms that will probably benefit from the result. This motive of horizontal R&D co-operation may be of particular importance when the flow of knowledge cannot be readily controlled (cf. Katz/Ordoover 1990).

A second possible benefit of horizontal networking is the joint use of certain inputs, such as infrastructure facilities or factor markets. Joint use of inputs or of input markets may also work as a vehicle for knowledge "spillovers". This can be the case particularly in regard to the labour market due to the knowledge flows which occur when personnel shift between different employers. The availability of such inputs or markets may also constitute an important location factor for firms or industry of a certain type and attract start-ups or relocations into the area.

#### **2.4.3 General Characteristics of Network Relationships**

The characterisation of horizontal and vertical interaction in networks makes clear that a relatively high share of these relationships is long term and only incompletely specified. Several authors emphasise that such kinds of relationship tend to be characterised by a high degree of openness among the interacting parties and by relatively high quality of information flows (see for example Lundvall 1993 and Powell 1990). In this respect it is argued that:

- If the performance of the partners in the co-operative arrangement is mutually rewarding and parties are interested in each others' success, this may motivate both open communication and the supply of relevant information to each other.

- Members of a co-operative relationship are better able to supply "good" and appropriate information to each other because they have better knowledge of the needs of their partner than is the case in spot-market relationships. This better knowledge of information requirements also enables them to filter the information relevant for their partner.
- As far as there is some reputation and trust involved, the quality of information received can be assessed much more easily than in spot-market relationships.
- Long term relationships may lead to some degree of inter-organisational adaptation with regard to the interfaces of the exchange partners. Therefore, information flows between the partners may be faster and less subject to errors than is the case in a spot-market relationship.
- If co-operation involves some trust or knowledge about the respective partner, this may result in a reduction of uncertainty with regard to the partner's future behaviour (Thorelli 1986; Galaskiewicz 1985).

All this leads to the hypothesis that relatively rich information flows within networks may not only accelerate a relatively early adoption of innovations and ideas but also stimulate the generation of new ideas concerning improvements of products and processes (cf. Saxenian 1994; Storper 1992).

## **2.5 Conclusions and Policy Implications**

I have argued here that a basic characteristic of innovation networks is that many of its members have succeeded in overcoming obstacles of a division of innovative labour to a certain degree. In many cases, this requires the establishment of long-term relationships which enable the parties to deal with the problems associated with asymmetric information and incompletely specified contracts. Reviewing the various possible advantages of networking, it becomes obvious that most of such advantages result from the redundancy of vertical relationships and not from horizontal co-operation. This finding is a remarkable contrast to large parts of the literature on networks in which the main emphasis is on horizontal relationships. We may, therefore, conclude that the importance of horizontal relationships tends to be overestimated in this literature.

Stimulating contacts and trying to help economic actors find an appropriate partner for a division of labour would be one strategy to support the emergence and the development of innovative networks. Possible measures could be providing information about potential partners for R&D co-operation and creating opportunities for contact and decentralised exchange of information. Real world examples of effective networks reported in the literature suggest that the provision of a resource that

is jointly used by the members of the network (e.g., a public research institution) may also play an important role in the formation of clusters of firms that later cooperate in networks. However, we still do not know much about promising ways to generate and stabilise networks or networking behaviour of the type under review here. Considerable further research will be necessary before this question can be answered satisfactorily.

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