

PROBLEMS AND SOLUTIONS IN KNOWLEDGE TRANSFER
BART NOOTEBOOM

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PROBLEMS AND SOLUTIONS IN KNOWLEDGE TRANSFER

*Paper for the conference on
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Bart Nooteboom

Rotterdam School of Management, Erasmus University Rotterdam
b.nootboom@fbk.eur.nl

ABSTRACT

A central feature of innovation systems is that innovation arises from interaction between organizational units. This requires 'cognitive distance' that is sufficiently large to yield novelty of combinations, but not too large for mutual understanding. Two problems and solutions in the transfer of knowledge, especially to small firms, are identified and discussed. There is a problem not only of expressing tacit knowledge, but also of absorbing new knowledge when it needs to replace existing tacit knowledge. Next to issues of learning or competence development there are also issues of governance, in the management of relational risk of dependence and spillover. The analysis yields a number of tasks and functions for regional systems of innovation.

Key words: regional innovation systems, small business, knowledge transfer, technology policy.

1. INTRODUCTION

Next to the production of innovation its diffusion requires attention. As is well known from the innovation literature, innovation entails much more than R&D, and includes design, marketing, test production, and service. When only formal R&D is measured, this yields a considerable under-estimation of more informal development activities in small firms. When we take this into account, there is considerable evidence that small firms participate less in R&D than large ones, but when they do, they do so at a greater intensity and efficiency. In the adoption of new technology produced by others small firms tend to lag behind. National prosperity results not so much from the production of innovations, but from their widespread adoption among firms. Special attention is needed to small firms, because of their share in national economies and the special problems they face. In modern economies small firms make up more than 90% of all firms, and some 60% of employment, in the private sector. For a survey of evidence and explanation, see Nooteboom (1994).

It should be noted that innovation and diffusion go hand in hand. In order to innovate one needs to adopt knowledge of markets, technologies and appropriate forms of organization. Often adoption requires a certain amount of re-invention in the adopting firm, and modification for implementation in a variety of organizational forms. Small firms operate differently from large firms, and exhibit a greater variety of organization. Innovation is increasingly seen as emerging from interaction between different firms or organizational units, with different, complementary knowledge and competencies. If all this is true, then for understanding innovation and diffusion we must understand knowledge transfer between organizations. An important task for regional systems of innovation (RIS) is to identify problems in knowledge transfer and solve them. That is the topic of this paper.

One caveat here is that it is tricky to generalize about small firms. They show a large variety of motives, objectives, organization, and modes of operation. People enter self-employment because of unemployment, discrimination on the job market, social pressure to take over from a self-employed father, maladjustment in the bureaucracy of a large firm and inability to conform to authority, the challenge of realizing a new idea that finds no acceptance in a large firm, the desire to be independent, and the identification of a 'hole in the market'. Their objectives vary: not only growth and profits, but often also independence, small scale, informality and idiosyncrasy of operations as part or even the whole of their objective. There is also a large variety of educational background and experience, which affects the ability of small firms to understand and absorb new technology ('absorptive capacity', cf. Cohen and Levinthal 1990), which is crucial in the present analysis. Idiosyncrasy of operation is viable to the extent that the firm is not subjected to the rigorous selection mechanism of stock markets and the resulting demands on performance, because capital and ownership are to some degree in the hands of the entrepreneur or his family. Such variety of goals, background and operation is relevant here, because possibilities and limitations in innovation and adoption depend on them. For example, an entrepreneur who emerged from a traditional craft environment, often continuing a family tradition, with limited formal training, faces more obstacles, especially in absorptive capacity, than a university graduate who escapes from a large bureaucratic firm to spin-off a firm of his own.

A second caveat is that the notion of firm size as a distinguishing characteristic is becoming obsolete as a result of the development of a 'network economy'. Small firms can to a large extent compensate for weaknesses of small size in linkages with other firms, in networks or 'industrial districts', based on the sharing of resources, division of labour and complementarity of assets and competencies, while maintaining flexibility in the configuration of activities in the network. Here we see markets mimicking organization. On the other hand, large firms can mitigate problems of bureaucracy and inertia by decentralization of activities across highly autonomous units, in intra-firm networks of a 'virtual firm'. The classic example is 3M company, where development is allowed to take place in highly autonomous 'skunk works', which may even be in competition with each other. Here, we see a firm mimicking markets. Both intra- and inter-firm networks are facilitated by information- and communication technology. However, in spite of this blurring of boundaries between large and small firms, we can still recognize the phenomenon of the independent entrepreneur and his behaviour in the adoption of new technology.

A third caveat is that knowledge transfer should not be analyzed only in terms of competence. There is also an indispensable dimension of governance. As argued by Williamson (1999) there is a need to connect the research areas of competence and governance. In governance, we are faced with issues of 'relational risk': risk of 'spillover' (leakage) of knowledge to competitors, and risk of extortion or 'hold-up' (to use that term from transaction cost economics, TCE). This is especially

important for small firms, who often have limited strategic options, with a relatively high risk of one-sided dependence in relations with large organizations. Also, customization of products to niche markets is often a viable and attractive option for small firms, but this can entail the need to engage in investments that are 'transaction specific'. According to TCE, this is a cause of dependence, resulting in a risk of hold-up. Also, often the absorptive capacity of small firms is small relative to that of large firms, so that in collaboration in the joint production of knowledge the advantage can be one-sided, with the large firms expropriating the advantage of joint knowledge production. The stimulation of knowledge transfer to and from small firms that is naive with respect to these issues of governance can cause more harm than good.

I recognize, and indeed share, the well-known criticism of TCE that it does not take innovation and learning into account, and that it neglects the role of trust next to opportunism. Therefore I employ a wider theory of relations, which does, however, retain some elements from TCE, such as the notions of specific investments, hold-up, and hostages (Nooteboom 1999a).

This article proceeds as follows. For the analysis of knowledge transfer we need an underlying theory of knowledge. The theory used here is based on an interactionist, constructivist perspective. It connects well with the central notion of absorptive capacity, and yields the notion of a firm as a 'focusing device' and the notion of 'cognitive distance' between firms (Nooteboom 1999a). It is outlined in the second section. Issues of governance are summarized in the third section. Problems of knowledge transfer are identified in the fourth section. In particular, account is taken of the degree to which existing knowledge in the firm and the new knowledge to be transferred to the firm are tacit (rather than codified). In the knowledge literature it is customary to recognise the problems involved in the transfer of tacit knowledge, but here it is shown that tacitness of existing knowledge on the part of the recipient also creates an obstacle, due to a limitation of absorptive capacity. Section five gives a discussion of solutions of the problems of knowledge transfer. The final, sixth section gives conclusions.

The main purpose of the paper is to specify and solve problems in the transfer of knowledge, in particular to small firms. That is an issue for innovation policy in general and for RIS in particular. The analysis suggests institutions that may have to be provided in RIS.

2. KNOWLEDGE AND COGNITIVE DISTANCE

It is a truism to say that information is not the same as knowledge. To become knowledge, information needs to be interpreted in a cognitive framework. Here, I employ a theory of knowledge and language which is based on the view, adopted from a stream of thought in cognitive psychology, that intelligence is internalized action (Piaget 1970, 1974, Vygotsky 1962). It is linked to 'symbolic interactionism' in sociology (G.H. Mead 1934, 1982). In the organisational literature this has been absorbed by Weick (1979, 1995). This leads to the 'situated action' view rather than the dominant 'computational representational' view in cognitive science. The situated action view entails that knowledge and meaning are disambiguated, complemented and shifted in specific contexts. As argued elsewhere (Nooteboom 2000), I propose that this view of knowledge provides the basis for a fundamental explanatory perspective of 'methodological interactionism' that can replace both the methodological individualism of economics and the methodological collectivism of (some) sociology, to provide a basis for a unified science of behaviour. I take 'cognition' in a wide sense, including perception, interpretation and evaluation, hence including value judgements.

The theory of knowledge that I employ states that cognition takes place on the basis of cognitive categories that are developed in interaction with the physical and social environment. Those cognitive categories form our perceptions, interpretations (assignment of logical and causal connections) and evaluations (value judgements). Thus, they constitute our absorptive capacity. This precludes objective knowledge (or at least any certain knowledge whether or to what extent knowledge is objective). Our absorptive capacity is context-dependent, cumulative and path-dependent. It is context-dependent because it is built on previous experience, in specific contexts. It is cumulative and path-dependent because previous experience determines the cognitive structures by which we assimilate new experience.

This view does not necessarily entail radical relativism or subjectivism. If we construct knowledge from interaction with our environment (of which it is reasonable to assume that it does exist), this entails that reality is at least a material cause of our knowledge: our knowledge is 'embodied realism' (Lakoff and Johnson 1999). Also, to the extent that we share the environment in which our

knowledge develops, there will be similarities of cognition, which yields a basis for inter-subjective debate.

The reverse of this coin is, of course, that to the extent that people have developed their knowledge in different environments, and have not been in communication with each other or each other's environment, cognition will differ: there will be greater or lesser 'cognitive distance' (Nooteboom 1992, 1999a). I do not wish to imply that cognition is any simple, one-dimensional construct that allows for simple measurement of distance. The notion of cognitive distance is closely related to the notion of cognitive variety, but it is more specific. It indicates that people do not just have different thoughts, but that they have different abilities of perception, interpretation and evaluation, and thereby see the world differently, as a function of their experience.

Cognitive distance yields both an opportunity and a problem. The opportunity is that contact with others gives us an opportunity to escape from the myopia of our personal cognitive construction. A problem, however, is that the greater the distance, i.e. the less people share cognitive categories, the more difficult it is to cross it, i.e. to understand the actions and expressions of a partner. Thus there is some optimal cognitive distance: large enough for partners to tell each other something new, and small enough for comprehension. Absorptive capacity is part of our ability to cross cognitive distance, i.e. to connect different cognitive categories. The other part is communicative capacity, or the ability to help others understand what we do or say. Note that there is a difference between crossing cognitive distance and reducing it. Reduction of cognitive distance entails a convergence of cognitive frameworks, whereby people start to think alike. Crossing cognitive distance entails that one develops the ability to understand what others do or say, and to help them understand one's own actions and utterances, without thereby thinking alike. Neither absorptive capacity nor communicative capacity is fixed. They depend on experience and the accumulation of knowledge and skill. For a further elaboration see Nooteboom (2000).

The analysis leads to the notion of organization, or a community of practice, as a focusing device (Nooteboom 1992). An important function of organization is to create sufficient focus, i.e. alignment of cognitive categories, for people to achieve a common purpose. This is related to the notions, in the organizational literature, of an organization as a sensemaking system (Weick 1979, 1995), system of shared meanings (Smircich 1983), or interpretation system (Choo 1998). Arguably, this is more fundamental than the function of a firm to reduce transaction costs, as TCE proposes. Now, focusing, here again, yields a problem of myopia, by which organizations may fail to see or adequately interpret potential opportunities and threats to its existence. To compensate for myopia, organizations need outside partners for complementary cognition, or 'external economy of cognitive scope' (Nooteboom 1992).

The sharpness or narrowness of the focus depends on whether the organization, or part of it, needs to concentrate more on efficient exploitation (utilization of existing resources and competencies, including cognitive competencies) or on exploration (development of new competencies). Efficient exploitation requires a sharper focus, with more unity of perception and interpretation for the sake of efficient co-ordination. It requires division of labour, with clear and sharp linkages, on the basis of clear, unambiguous meanings and standards. Exploration, on the other hand, entails crossing and shifting boundaries, linkages and meanings, for the sake of finding Schumpeterian 'novel combinations'.

The literature on organizational learning states that organizations need to do both: to combine exploitation and exploration. This is not a trivial task. How can they be combined? One can think of several solutions, and one can observe a variety of attempts. The innovation literature proposes that exploration yields novel forms, which converge on a dominant design, which is used as a basis for exploitation. Elsewhere (Nooteboom 2000) I proposed that next the novelty is carried into new applications, in which it is challenged with failures, which motivate adaptations and yield opportunities and inspiration for experimenting with novel combinations. Here, exploration is combined with exploitation. Novel elements put the existing architecture under strain. That architecture constrains the utilization of potential of novel elements, and pressure arises to engage in more radical architectural innovation (Henderson and Clark 1990), and here we are at the beginning of the cycle again.

Thus, up to a point exploitation and exploration can be combined. However, exploitation remains connected with a more or less integrated structure, in the sense of strict linkages between elements, or fixed standards, for some activities. Exploration requires more or less disintegration, with rupture of existing connections and standards.

One solution is to let an organization fluctuate between integration and disintegration, as needed for development to proceed, and we often observe that (ATT, Apple). That exerts great

demands and stress on an organization. It is particularly difficult if the organization has a portfolio of activities in different stages of development, because then the organisation would have to be integrated for the one product and disintegrated for the other. A solution can then be a network of organizations, or of highly autonomous parts of organizations. That may be the underlying reason for the emergence of the 'network economy'. This connects with the need, identified earlier, to combine cognitive distance, for the sake of exploration, with cognitive proximity, for the sake of exploitation.

More specifically, in this context there are three arguments for network structures. The first is to maintain autonomy of participants, each with his own set of activities and connections, to maintain cognitive distance. The second is the argument of strategic flexibility: the novel combinations of innovation are achieved by variable configurations of participants in the network. There is no guarantee of inclusion. Participants are included or excluded according to the viability of configurations. The third argument is that participants can specialize in a stage of innovation. Some units concentrate on exploitation and others on exploration, and activities are shifted between the units as they move through the cycle of development. It can be an attractive position to act as orchestrator of activities in such a network. Of that we also see several examples (Benetton, Nike).

The above specifies the importance of transfer of knowledge between firms for innovation. I propose that this yields a way of looking at RIS:

RIS1: For a RIS to function (i.e. produce and utilize innovations), it needs to combine exploitation and exploration. For the first it needs organizational units that each have sufficient focus to ensure efficient utilization of their specialized competencies. For exploration, there should be organizational units with cognitive distance that is large enough to ensure variety of cognition but not too large to block mutual understanding and relevance.

As indicated before, absorptive capacity is not fixed. When the knowledge involved is codified, absorptive capacity can be increased and maintained by more formal forms of learning, such as R&D. Often, when firms outsource certain activities, they maintain R&D in that area in order to maintain absorptive capacity (Granstrand, Patel and Pavitt 1997). When knowledge is tacit, I propose that absorptive and communicative capacity depend more on cumulative experience in absorbing and communicating tacit knowledge, and developing shared, tacit cognitive frameworks, with a variety of partners.

RIS2: The performance of a RIS is enhanced by the ability of firms to communicate and to absorb tacit knowledge. This enhances the ability to cross cognitive distance. That ability enables one to deal with larger cognitive distances. That yields a greater variety of knowledge sources, which enhances innovation.

Inter-firm relations, networks and regional systems can get bogged down in inertia and lack of exploration when cognitive distance gets too short, i.e. when there is too much overlap of cognitive frameworks. Here, social capital degenerates into social liability (Gabbay and Leenders 1999). This can happen when relations become too exclusive and durable. Then cognitive distance will reduce: units will come to perceive and think alike.

RIS3: To prevent the disappearance of cognitive distance in the long run, RIS should facilitate the influx of new participants in the network or region, relations with units outside the region, or for frequent excursions of members of the network or region to other regions, in order to maintain cognitive distance.

3. LEARNING AND GOVERNANCE

Above, I argued that to maintain innovative potential RIS must have linkages not only within but also outside the region. As proposed by Oinas and Malecki (2000), we should think not so much in terms of knowledge at a location, but of movements of knowledge across space, within and between regions, in what they call 'spatial systems of innovation'. The argument mirrors the discussion of the firm as a focusing device. A RIS also may require some focus, for efficient exploitation, but this entails a risk of myopia, and to compensate for this an RIS needs external linkages at greater cognitive distance.

As indicated in the introduction, one challenge is to combine competence and governance perspectives. We need to look not only at what people are able to do, and what is useful in networks of firms, but also what motivates people, and what risks there lie in relations, and how they are to be governed. There are two kinds of relational risk. One is risk of dependence, resulting from the loss of value that would ensue from switching to another partner. This yields a 'hold-up risk', as explained in TCE. A second is the risk of spillover of knowledge concerning one's core competencies, on which competitive advantage depends. To the extent that a relation with a partner is more intense, and entails extensive information exchange, there may be a risk that such sensitive information spills over via the partner to a competitor. From this perspective of governance, for the control of relational risk, there are arguments for a certain durability in order to ensure that specific investments are recouped. There may also be an argument for a certain exclusiveness of relations, to reduce the risk of spillover.

Instruments for governance can be summarized as follows. For a more detailed discussion, see Nooteboom (1999a). First, one can avoid the dependence that causes relational risk by not engaging in specific investments, keeping one's options for alternative partners open, and not surrendering information concerning one's core competencies that may yield a risk of spillover. The price one pays for this is lack of depth and commitment in the relation, resulting in low added value by the lost opportunity of utilising complementary competencies and cognitive distance. Second, one can try to cover risks by formal contracts. However, detailed contracts for safeguarding against opportunism may be impossible due to uncertainty (inability to predict and specify all relevant contingencies), too costly, or counterproductive by imposing a straight-jacket on the relation or by signalling distrust, which may lead to a spiral of regulation and counter-regulation that stifles the relationship. These considerations explain the fact, noted long ago by Macauley (1963), that in reality there is only limited use of contracts to settle disputes. Third, one can try to govern on the basis of a balance of mutual dependence, the use of 'hostages' and a reputation mechanism. The notion of a 'hostage' derives from TCE. Hostages often have the form of sensitive information. A partner may threaten to divulge it to a competitor, as a means to impose his will.

Fourth, one can try to govern on the basis of trust. Trust is a complex and slippery notion, and I cannot go into an extensive discussion here (see Nooteboom 2002). One important aspect is the need to distinguish between trust in competence and trust in intentions not to engage in opportunism. The one requires other safeguards than the other. Trust, defined as the expectation that a partner will not fail in competence or intentions, has a range of possible foundations. One is enforcement by authority or contract. Another is self-interest, on the basis of direct advantage, reputation or the protection of hostages. A more altruistic foundation is an ethic of acceptable conduct, in norms of behaviour. Another is personal empathy or friendship, and yet another is routinized behaviour.

Fifth, one can employ the services of an intermediary or go-between (Nooteboom 1999b). As indicated by TCE, a go-between can help as an arbitrator, in 'trilateral governance'. It can also help to solve the 'revelation problem' (assessing the value of especially information before it is paid for), to control spillover risk, to mediate in the building and maintenance of trust, and to provide a reputation mechanism. The role of intermediaries was recognised before by Shapiro (1987), who called them 'guardians of trust', Zucker (1986), who saw them as part of 'institutions based trust', and Fukuyama (1995), who called them 'intermediate communities'. Later, I will discuss these roles of the go-between in more detail.

Sixth, one can design and utilize network position for the purpose of governance. For example, one may limit access of partners to competitors to control spillover, establish centrality in a network in order to maintain alternatives, or bridge 'structural hole' to obtain leverage. This will also be discussed in more detail later.

The role of trust, go-betweens and network position may contribute to our understanding of regional innovation systems, and I will discuss this later. Here, I emphasize that there is neither a single best instrument of governance, nor some fixed recipe for all conditions. One has to craft a mix of instruments that fits the contingencies of the situation. Among others, these are: goals of collaboration, size and type of economies of scale, type of knowledge (e.g. degree of tacitness), speed at which knowledge changes, observability of efforts and accomplishments, institutional support of contract and contract execution, institutional conditions of trust, balance of mutual dependence, and intensity of competition. The mix of instruments can be complicated. For example, trust and contracts can be substitutes but also, and even at the same time, also complements (Klein Woolthuis 1999).

The main point here is that when one engages in specific investments, relations must be sufficiently durable to recoup them. This includes specific investment in the forms known from TCE,

such as location specific investments and specific investments in installations, tools, instruments and training. Also, it includes specific investments in the form of developing mutual understanding. i.e. crossing cognitive distance, and in the form of building up relation- or network- or region-specific trust. Such trust needs to be built up to the extent that it is needed instead of detailed contracts, or as a complement to it, and is not in place prior to the relationship. I propose that all this leads to a condition that may need to be satisfied for a RIS to function.

RIS4: One condition for a RIS to function is an infrastructure for governance. Well known here is the need for legal institutions. However, especially for innovation contracts can be of limited value, and there need to be complementary institutions of ethics, behavioural norms, and reputation mechanisms. Go-betweenes can contribute to such infrastructure.

A certain exclusiveness of relations may be warranted to prevent unwanted spillover of competitive advantage to competing firms, networks or regions. It does seem that firms are unduly wary of this. Spillover threat is real only when it concerns core competence, can be absorbed, imitated and effectively implemented by a competitor, and when the knowledge involved does not shift by the time that it is imitated and implemented by a competitor. Nevertheless, the threat of spillover can be real, and should then be guarded against. One way to do this is to demand exclusiveness: one's partner may not engage in the same activity with one's (potential) competitors. The disadvantage of such exclusiveness has already been indicated: it reduces variety and distance of cognition.

RIS5: To combine exploitation and exploration, agents in a RIS should craft and maintain relations that are sufficiently durable and exclusive as needed for governance, but not more so. Relations need to be sufficiently durable to recoup essential specific investments. They may have to be exclusive to some extent to limit risks of spillover. However, agents should limit the durability of relations and minimize exclusiveness in order to preserve the flexibility needed for the Schumpeterian novel combinations of innovation and the cognitive distance needed for learning. Go-betweenes or specialist consultants, as participants in the RIS, and part of the intitutional set-up, can contribute to this, by means of advice, intermediation or arbitration.

4. NETWORKS AND GO-BETWEENS

Important components of the infrastructure for governance are institutions, such as legal frameworks, professional standards, and codes of ethics, which are beyond the reach of agents in a RIS, and primarily lie on a national or supranational level. However, they may be influenced or modified to some extent within a RIS. Thus there may be ethical codes, professional or industry associations, and reputation mechanisms that are specific to a RIS, as emergent properties that arise from interactions between the agents involved. Two instruments for governance that may be brought about in collaborative action between public and private agents in a RIS are network structure and go-betweenes. Therefore I take a closer look at those.

One stream of literature on networks suggests that players who span 'structural holes' gain advantage for themselves (Burt 1992). If individuals or communities A and B are connected only by C, then C can take advantage of his bridging position by accessing resources that others cannot access, and by playing off A and B against each other. In the context of information exchange, he can, for example, threaten to pass sensitive information that he has from A to B and vice versa, and can thereby extract advantage from both. As a result, the third party is maximally powerful and minimally constrained in his actions. The Latin term for this third party advantage is 'tertius gaudens'. Krackhardt (1999) pointed out that this principle goes back to Simmel (1950). However, Krackhardt shows that from Simmel one can also derive the situation that the third party is maximally constrained. This occurs when he bridges two different cliques, with dense and strong internal ties, and with different values and norms. The third party then has to satisfy the rules or norms of both cliques (the intersection of norm sets). The key factor that determines whether the third party is minimally or maximally constrained is the degree to which the third party's actions are public, or at least known to both A and B. If they are not public, then the situation described by Burt obtains, and he is minimally constrained. If his actions are public, he is maximally constrained.

I add the following consideration. So far, the assumption seems to have been that A and B are rivals or at the least stand in a substitutive relation: benefit for the one occurs at the expense of the

other. If A and B operate in a relationship of collaboration in learning and innovation, with complementary cognitive and other competencies, the logic is different. There, the go-between can obtain and supply advantage to both A and B by helping them to collaborate. Nevertheless, the earlier logic may still apply. The third party, acting as a go-between, may be tempted to exploit his bridging position by misleading and extorting A and B. To keep him from doing that, his actions should be public, or at least known to both A and B, so that his reputation is at stake.

In collaborative relations, go-betweens can play beneficial roles by facilitating communication, reducing the need for specific investments in understanding, reducing risks of spillover, thus creating social capital rather than liability for the players they connect (Baker and Obstfeld 1999). More specifically, roles of a go-between are to:

- Provide trilateral governance, as already proposed by TCE: when transactions are small or infrequent, it is not worth the cost and effort to set up an extensive scheme for governance, and it is more efficient to engage a third party to serve as an arbitrator of a simple, limited contract.
- Help partners in the art of designing and maintaining collaborative relations, i.e. crafting the right mix of instruments for governance.
- Solve Arrow's paradox of information or the 'revelation problem' in selling information.¹ The solution here is that the go-between judges the value of the information for the buyer without giving him the information.
- Monitor and control spillover.
- Serve as a holder of hostages. A problem with hostages is that the taker may be tempted not to return the hostage even after the giver has kept his part of the bargain. A go-between acting as an independent, non-partisan holder of hostages may not be subject to this temptation.
- Build up trust and eliminate misunderstandings by which trust may break down without good cause. For example, lack of observed performance might be attributed to opportunism, while in fact it is due to accident or lack of competence.
- Facilitate the reputation mechanism, as a sieve and amplifier, by checking accusations of opportunistic or incompetent behaviour and transmitting them if correct.

RIS6: One function of a RIS is to provide these roles of the go-between, for the purpose of facilitating governance. Institutions must be in place to keep the go-between from misusing his bridging position for extortion.

Network position has implications for governance in several ways. Inspiration can be derived here from the extensive literature in sociology on network position and structure. Some examples are the following:

- One's 'centrality' in a network: the number of linkages one has relative to others. A large number amplifies both potential benefits and liabilities. It can yield large cognitive variety, if the cognitive distances involved are sufficiently large. It can yield inertia if the relations are too durable and lacking in cognitive distance, and if one has to preserve the interests of multiple partners. In particular, it may present spillover risks to new partners and thereby constrain one's access to new partners.
- As discussed, if one spans 'structural holes' in a network, i.e. provides a bridge between otherwise ill-connected sub-networks, one can play an important role as an go-between, or one can wield power by 'divide and rule'.

RIS7: In an RIS public and private agents should take into account network structure. In particular, one should consider the implications of centrality and the spanning of structural holes for concentration of power, exclusion, entry barriers, etc.

5. PROBLEMS IN KNOWLEDGE TRANSFER

Above, it has become clear that cognitive distance, combined with lack of absorptive and communicative capacity, yields obstacles for knowledge transfer. It has long been accepted in the innovation literature that knowledge transfer is not a matter of simple, linear transfer. Rather, it requires an ongoing process of interaction, as in the 'chain-linked model' of Kline and Rosenberg (1986). The reasons are clear from the above analysis. Novelty by definition cannot readily be absorbed in existing absorptive capacity. Transfer of new knowledge requires adjustments in capacities of absorption and

communication. The very term 'transfer' of knowledge is misleading. That suggests the 'conduit metaphor' of knowledge, as if knowledge is a physical good transported along a communication 'channel'. A 'food for thought' metaphor would be more appropriate: in order to yield thought, information has to be assimilated in a cognitive interpretation system. Part of knowledge 'transfer' is to adapt information to that system, on the basis of communicative ability, and to develop the absorptive capacity of that system.

A comment is needed here on the familiar distinction between codified and tacit knowledge. It is sometimes suggested that they are distinct and can be separated, in the sense that knowledge can be codified without any tacit residual. I do not believe this is the case. When knowledge is 'externalised' (Nonaka and Takeuchi 1995), reduction takes place: knowledge is disembedded from cognitive frameworks or categories that are and remain tacit to some degree. When this is absorbed by the recipient, it needs to be absorbed again into his cognitive framework, which entails re-embedding in background knowledge that is again to a smaller or larger extent tacit. The transfer of knowledge requires sufficient fit between this dis-embedding and re-embedding. This is the issue of crossing cognitive distance. To the extent that cognitive frameworks are tacit, mutual understanding may require a period of shared practice, in a 'community of practice' (Brown and Duguid 1996), in order to establish a shared basis of tacit cognitive frameworks, in a 'epistemic community' (see the contribution from Lissoni, this volume). Once that has been established, the members can disband to communicate at a distance, but they will probably have to reconvene periodically to maintain and develop their shared cognitive frameworks.

RIS8: A function of a RIS may be to provide a basis of shared tacit knowledge in which imperfectly codified knowledge can be embedded and understood correctly (as intended and consistent with efficient practice).

Related to the distinction between tacit and codified knowledge there is a distinction between different types of memory. Procedural memory preserves know-how. Declarative memory preserves understanding: the ability to specify and explain (Cohen and Bacdayan 1996). This can be illustrated with the following example. Having learned a foreign language, with grammar, many years later one may be able to judge a given sentence in that language to be ill formed, without being able to explain what grammatical rules it violates. The cognitive categories associated with grammar were codified when they were absorbed, but have subsided into tacit knowledge. With one's own mother tongue one may be able to make correct judgements without ever having learned the rules. Thus there is a distinction between two types of tacit knowledge. In one type, knowledge was never codified and stored in declarative memory. In the other type, tacit knowledge was once absorbed as documented knowledge into declarative memory, in what Michael Polanyi called 'focal' awareness, and then became routinized and subsided into 'subsidiary' awareness. Discovery by trial and error and craft skills are typically of the former type: they are absorbed and transferred in practice without ever having been codified.

A problem that is not well recognised in the literature is that there is not only an obstacle in knowledge transfer when the knowledge to be transferred is wholly or partly tacit but also when the knowledge that it is to replace is tacit. In other words: tacit knowledge reduces absorptive capacity for the receiver. As discussed before, it is especially background knowledge, or cognitive categories, that tend to be tacit. The deeper or more fundamental categories are, the more tacit they are. One's own tacit knowledge is taken for granted, as self-evident, and is difficult to replace by new knowledge on the basis of rational argument. For rational criticism knowledge must first be made explicit, externalized by intellectual midwifery or 'maieutics'. This entails such questioning and answering that the person holding the knowledge becomes aware of it and is able to externalize it to a sufficient extent that it can become susceptible to rational criticism (Nooteboom 1994). Socrates was a master at it.

The point now is that in smaller organizations knowledge tends to be more tacit than in large ones. The reason is that co-ordination of work in small 'simple structures' (Mintzberg 1983) can be based on direct supervision, with the entrepreneur taking part in the primary processes of production, on the work floor, transferring tacit knowledge by personal interaction. This makes formal, codified forms of co-ordination unnecessary (such as specification of work processes, in- and outputs or skills. cf. Mintzberg 1983). This yields potential flexibility as a strength of small firms. It also has disadvantages. First, when knowledge is tacit, and embodied in individual people or firms, and was never codified, it gets lost when the carriers of knowledge are lost, due to accident, poaching or other personnel turnover. Second, tacit knowledge reduces absorptive capacity, as argued above.

This yields one of several scale effects in transaction costs (Nooteboom 1993). Other scale effects are that there are 'threshold costs' (Nooteboom 1987) in transaction costs of contact (search costs) and contract, which weigh more heavily at small firm sizes. Furthermore, to the extent that knowledge is tacit there is less documentation as a basis for assessment and evaluation of competencies, needs, reliability, etc. Note that thus tacit knowledge gives a double jeopardy: less information for evaluation and control, and a lesser basis for critical reflection and debate. As discussed, there is limited absorptive capacity until tacit knowledge is made explicit, and this is not always possible.

The analysis explains the familiar phenomenon, identified in the small business literature, of how difficult it is to obtain an audience for the adoption of innovations among small firms, and their inclination to reject it as 'impractical'. A complication is that often it is in fact the case that an innovation that was developed in or for a large firm does not satisfy the operational conditions of a small firm. The point here is that even if it is appropriate, it may still be rejected due to the blindness induced by tacit knowledge.

6. SOLUTIONS

In the eighties, an advisory committee on technology policy for the Dutch Ministry of Economic Affairs noted that, as indicated above, innovation yields prosperity only if it is diffused widely, and that small firms were lagging behind in the adoption of new technology. To remedy this, the committee advised the ministry to institute a regional network of what were then called the 'Innovation Centres' (now they are called 'Syntens'), for the transfer of technology to small firms, and this advice was implemented. One source of inspiration for the centres was the experience in Germany with the Fraunhofer Institute. Part of the idea was that the centres should be regionally embedded, as a part of, and hopefully also as a motor of RIS. These institutes ran into problems of technology transfer. The preceding analysis and the following discussion are informed by experience with this.²

If tacit knowledge yields an obstacle for the absorption of novelty, what can be done? I noted that there are two problems. One problem was that tacit knowledge is self-evident and therefore not subject to critical reflection and debate. For that, tacit knowledge first has to be externalized by means of intellectual midwifery or maieutics. How is this to be done? A knowledgeable outsider is not credible for the very reason that he is subjecting to doubt what for the insider is evident, and thereby he supplies nothing but evidence of his incompetence. An approach that has been proven successful in practice is the following². The key insight for it is that only challenge from insiders, i.e. colleagues, is relevant, and only evidence from them is credible. The way to do it is to arrange a round-table discussion between colleagues, preferably including a few who have already adopted the innovation in question, and act as facilitator for them to exchange experience and thereby externalize, at least to some extent, their tacit knowledge. The trick is not to participate in the debate but facilitate it. Above all: like Socrates, don't tell other people what to think, but elicit thought that will reveal its own error. For this debate to occur, the participants should be sufficiently different not to be direct competitors, and to yield interesting new insights, while they should be sufficiently close to make sense to each other. In other words, their cognitive distance should be just right.

Another problem was that for lack of codification tacit knowledge could only be transferred by comparatively lengthy, direct, on line, real time interaction, with demonstration, trial, error and correction. A remedy then is to transfer knowledge embodied in a worker, who then carries it into the firm while practising it, and transfers it on the basis of the ongoing interaction needed. Note that at the same time this also solves the previous problem of limited openness to rational criticism. New knowledge is assimilated in practice rather than adopted by design. This solution has been applied in the Netherlands, in a programme called 'Knowledge bearers in small and medium sized business (KIM)'.³ This programme is an example (one of the few I can think of) of theory preceding and informing policy: the arguments for it were as sketched above. The scheme worked as follows. Graduates, mainly from polytechnics, could volunteer for the programme, and then followed a crash course on the peculiarities of small firms. Entrepreneurs could volunteer, and would receive a subsidy of part of the wage costs for a trial period, provided there was a perspective for permanent employment of the graduate after the trial period. The regional Innovation Centre counselled the project. A trial project in the region of Twente was deemed a success, and the scheme was implemented nationally. A secondary purpose of the programme had been to stimulate employment of graduates, among whom there was substantial unemployment at the time the programme was started. However, the programme

has been maintained for its success after employment increased. Apparently, a similar scheme is now under consideration in Denmark.

Other solutions of problems in the transfer of knowledge are more concerned with issues of governance. The Innovation Centres quickly learned that the implementation of technology could not be separated from organizational issues, and that the latter had to become part of the expertise of the centres. In fact, the business scholars involved in the programme had foreseen this, but the inclusion of organizational issues was obstructed from the start by a political problem. There already was a network of institutes oriented towards organizational and locational issues of small business. It was problematic to infringe on their territory, and integration of those institutes with the new ones was not deemed feasible at the start. There already was a problem of rivalry with trade associations who offered help in the adoption of innovations on the national level of industries or trades. Integration between the two types of institutes did happen later, however, when the organizational issues involved in technology transfer became more tangible and evident. In their practice, the Innovation Centres had become aware of some of the governance issues involved, as discussed above. My recommendation here is to make such intermediaries more explicitly aware of those issues, and to consider the possibility of playing the roles of the go-between that were indicated in a previous section. In fact, it turned out that without being aware of it they were already performing some of those roles.⁴ Clearly, it is not easy to perform them. The roles require relational skills as well as competence in the technologies and knowledge employed by the parties involved. They also require the scrupulous maintenance of a reputation for fair dealing.

7. CONCLUSIONS

This chapter identified several problems and solutions in the transfer of knowledge, particularly to small firms. One problem is that of limited absorptive capacity. This may be limited, in particular, due to implicit, tacit knowledge that is taken for granted and not easily susceptible to rational criticism. One way to try and solve this problem is to conduct ‘intellectual midwifery’ or maieutics. This may be done in the form of a round table-discussion, in which entrepreneurs are stimulated to discuss their work practices and thereby externalize their tacit knowledge. A second problem lies in the fact that transmission of tacit knowledge requires intensive interaction, which can be time consuming and laborious. Then a solution is to transfer the knowledge embedded in new workers joining the firm. Other problems concern issues of governance. Here the recommendation is to consider support in the form of roles of the ‘go-between’. They can provide ‘trilateral governance’, help overcome the ‘revelation problem’, assist in the art of crafting a mix of instruments for governance that fits the situation, monitor and control spillover, perhaps act as the holder of informational hostages, and enhance efficient reputation mechanisms. This yielded one possible function of RIS. Below, an overview is given of functions identified for RIS. That list results from the present analysis, and is not claimed to exhaust all possible or desirable features of RIS.

- 1: For a RIS to function (i.e. produce and utilize innovations), it needs to combine exploitation and exploration. For the first it needs organizational units that each have sufficient focus to ensure efficient utilization of their specialized competencies. For exploration, there should be organizational units with cognitive distance that is large enough to ensure variety of cognition but not too large to block mutual understanding and relevance.
- 2: The performance of a RIS is enhanced by the ability of firms to communicate and to absorb tacit knowledge. This enhances the ability to cross cognitive distance. That ability enables one to deal with larger cognitive distances. That yields a greater variety of knowledge sources, which enhances innovation.
- 3: To prevent the disappearance of cognitive distance in the long run, RIS should facilitate the influx of new participants in the network or region, relations with units outside the region, or for frequent excursions of members of the network or region to other regions, in order to maintain cognitive distance.
- 4: One condition for a RIS to function is an infrastructure for governance. Well known here is the need for legal institutions. However, especially for innovation contracts can be of limited value, and there need to be complementary institutions of ethics, behavioural norms, and reputation mechanisms. Go-betweens can contribute to such infrastructure. SEE COMMENTS MADE EARLIER ABOUT THIS

- 5: To combine exploitation and exploration, agents in a RIS should craft and maintain relations that are sufficiently durable and exclusive as needed for governance, but not more so. Relations need to be sufficiently durable to recoup essential specific investments. They may have to be exclusive to some extent to limit risks of spillover. However, agents should limit the durability of relations and minimize exclusiveness in order to preserve the flexibility needed for the Schumpeterian novel combinations of innovation and the cognitive distance needed for learning. Go-betweens or specialist consultants, as participants in the RIS, and part of the institutional set-up, can contribute to this, by means of advice, intermediation or arbitration.
- 6: One function of a RIS is to provide these roles of the go-between, for the purpose of facilitating governance. Institutions must be in place to keep the go-between from misusing his bridging position for extortion.
- 7: In an RIS public and private agents should take into account network structure. In particular, one should consider the implications of centrality and the spanning of structural holes for concentration of power, exclusion, entry barriers, etc.
- 8: A function of a RIS may be to provide a basis of shared tacit knowledge in which imperfectly codified knowledge can be embedded and understood correctly (as intended and consistent with efficient practice).

This list of potential or desirable features of RIS is aimed, in the first approach, at the researcher: these features may help to understand how RIS work and to explain their success or failure. The list may also suggest that there is some sort of rational design of RIS, in which these features can be configured. But what is governance on the level of a network or RIS? Are RIS entirely a matter of self-organization, or can regional authorities have an impact in stimulating useful features? Some of the features are obviously more amenable to this than others.

The question is what set of regional institutions can support the functions indicated. Such institutions should be mutually consistent and consistent with supraregional institutions. One has to carefully balance intra-regional coherence with intra-regional diversity and extra-regional connections. Inter-firm relations should be sufficiently durable to recoup specific investments but not so durable that they create rigidities. They should not be more exclusive than absolutely necessary for controlling spillover. There should be go-betweens, but those should not be allowed to yield extortion or corruption.

It is not easy to achieve institutional consistency. This is reflected in the current conflict between competition policy, which considers any inter-firm collaboration as suspect, and technology policy, which tends to stimulate inter-firm relations. This conflict of policy perspectives arises even within one ministry of economics, in the Netherlands for example, and is exacerbated by the fact that different perspectives in economic science inform the different perspectives. Competition policy tends to be informed by mainstream, neo-classical economics, and innovation policy is increasingly informed by non-mainstream neo-Schumpeterian evolutionary and institutional economics. Policy debates then are in part debates of scientific ideology.

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¹ The revelation problem entails that before one has the information one cannot judge its value and hence its price, but when one has it one no longer needs to pay for it. This problem is more acute for information than for physical goods. With goods, one can more easily give information to assess the goods, or give samples, without surrendering the goods. With information what one gives in advance either discloses the information in advance or is of limited usefulness in assessing what is not yet given.

² Wisse Dekker, former CEO of Philips company, headed the original committee. Subsequently a new committee was installed to monitor progress with these and other policy recommendations, and I was a member of that committee.

² I developed experience of this when working for an institute for applied policy research for small and medium sized business in the Netherlands (EIM), in the late seventies and early eighties.

³ This was developed in the late eighties. I was involved in it as a member of an advisory committee for a trial project.

⁴ This turned during a series of courses that I gave on the design and management of collaborative relations to consultants of the institutes, in 1997/98.

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