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Abstract

Although it is currently common to speak of organizational learning, this notion is still surrounded by conceptual confusion. It is unclear how notions like learning, knowledge and cognitive activities can be applied to organizations. Some authors have tried to unravel the conceptual and ontological problems by giving an account of the role of individuals in organizational learning. However, this has not yet led to an agreed upon analysis. In this article an attempt is made to develop a social account of organizational learning based upon structuration theory. This results in a comprehensive account of the relationship between individual and organizational learning and an analysis of organizational learning. This analysis needs not to be interpreted as a metaphor nor falls prey to the fallacies of reification and antropomorphization.

Introduction

The concept of organizational learning has been introduced in the field of organization studies in the early work of March and Simon (1958) and Cyert and March (1963). Cyert and March argued that organizations are not omnisciently rational and therefore unable to completely plan their course of action in advance. In stead, organizations have to adapt continuously to their environment. Cyert and March labeled this process organizational learning (Cyert and March 1963: 123). Since these early contributions, numerous authors have tried to illuminate the concept of organizational learning (for example Cangelosi and Dill 1965; Argyris and Schön 1978; Duncan and Weiss 1979; Hedberg 1981; Levitt and March 1988; Brown and Duguid 1991; Dodgson 1993; Fiol 1994; Cohen and Sproull 1996; Weick and Westley 1996). These and other authors elaborated upon and moved beyond these initial formulations in various ways. Inspiration has been drawn from a variety of perspectives, including psychology, management science, production management, organization theory, evolutionary economics and innovation management. Each of these perspectives has resulted in valuable insights in the conditions, dynamics or outcomes of organizational learning (Easterby-Smith 1997). Most authors do not consider organizational learning as a unique feature of a special type of organization, particularly those that are called 'learning organizations' (Senge 1990). Organizational learning is a process that occurs in every organization (Easterby-Smith 1997). Despite of this presumed omnipresence of organizational learning, this notion is still surrounded by conceptual confusion.

One central point of debate is how the concept of learning, often associated with knowledge, cognition, mental activities and consciousness, can be applied to

organizations. To some authors this necessarily implies committing the ontological fallacies of reification and antropomorphization, that is, considering organizations as independent entities and ascribing human-like qualities to them. Therefore it has been argued that organizational learning should be interpreted as a metaphor in order to avoid these fallacies (Argyris and Schön 1978; Dodgson 1993). Cook and Yanow (1993) and Weick and Westley (1996) propose another interpretation. According to them a cognitivist perspective on organizational learning either takes the organization as an independent cognitive entity, which can only be interpreted as a metaphor, or reduces organizational learning to individual learning in an organizational context. They propose that organizational learning should be interpreted in terms more appropriate to organizations such as changing an organizational culture. Both options, calling organizational learning a metaphor and abandoning the concepts of knowledge and cognition in favor of organizational culture, can be viewed as escape routes. Therefore many authors stick to a focus on cognition, but try to avoid the mentioned fallacies by offering an adequate account of the role of individuals in organizational learning. For this reason the relationship between individual learning and organizational learning has been discussed from early works on organization learning, such as those of Cangelosi and Dill (1965) and Argyris and Schön (1978) onwards to recent publications like Crossan et al. (1999). However, these latter authors conclude in a summary of some major statements that none of them has satisfactorily dealt with the different levels that play a role in organizational learning. And Nicolini and Meznar (1995: 730) stated that the relationship between individual learning and organizational learning is far from clear and that more work, both empirically and theoretically, is necessary.

Our contribution is intended to be as follows. We want to present a comprehensive analysis of the relationship between individuals and organizational learning. Some previous accounts of this relationship will be discussed and shown to have limitations. Our own social account of organizational learning will draw upon structuration theory as developed by Giddens. In addition to that, we want to defend the claim that organizations can learn, without having to take recourse to calling it a metaphor or committing the fallacies of reification and antropomorphization. As part of the analysis an alternative interpretation of the concept of organizational knowledge will be given.

This article will continue with a discussion of the problematic of the relationship between individual and organizational learning and some of the answers that have been proposed. After that, structuration theory will be introduced. Drawing upon structuration theory and some basic ideas on learning, we will give an initial account of organizational knowledge and organizational learning. After this initial description of organizational learning has been given, a structurationist account of organizational learning will be developed further. We will conclude with a discussion of the merits of our analysis and some suggestions for further research.

Individuals and organizational learning

The relationship between individual learning and organizational learning has been extensively discussed within the literature on organizational learning. The central problem has often been posed as follows. To most authors it seems obvious that individuals play an important role in organizational learning. Individuals are seen as the agents or instruments of learning (Cyert and March 1963; Argyris and Schön

1978; Hedberg 1981; Shrivastava 1983). Simon (1991: 125) states that 'all learning takes place inside individual human heads'. On the other hand authors tend to agree that organizational learning is more than a simple aggregation of individual learning (Duncan and Weiss 1979; Fiol and Lyles 1985; Crossan et al. 1999). Argyris and Schön (1978) consider individual learning as a necessary but insufficient condition for organizational learning. Organizational learning cannot be reduced to individual learning. Several answers to the question of how organizational learning relates to individual learning have been given in the literature. A representative, but surely not complete, overview of these answers is presented in Table 1. Suggestions include that organizational learning is the learning of some key individuals, that individual learning products need to be shared in order for the organization to have learned, that individual learning should be incorporated or institutionalized in organizational memory or other organizational features and that the collective component of organizational learning lies in the working out of controversies. Some authors suggest that one or more extra conditions have to be fulfilled for individual learning to turn into organizational learning. Others suggest that organizational learning should not be conceived as individual learning plus something extra. Some of these ideas might be complementary, others contradict each other. We believe that each of the mentioned authors has made valuable remarks on the differences and connections between organizational and individual learning, but none of them has sketched a comprehensive picture of it.

- Insert Table 1 around here -

In our opinion, one of the reasons for the lack of a comprehensive account of the relationship between individual learning and organizational learning, is the absence of a genuine social theory. Organizational learning is a social phenomenon, as is indicated by the characteristics mentioned in table 1. However, most inspiration in the theory of organizational learning seems to be derived from theories of individual learning. Several authors, for example Dodgson (1993), would like to connect organization theory and psychology, in order to apply concepts developed for individuals to organizations as well as to discuss the learning of individuals in an organizational context. However, the former use of theories of individual learning seems to be misguided and the latter use incomplete. Theories of individual learning are relevant, for individuals play a role in organizational learning, but they are unable to capture the social nature of organizational learning. In this article a more comprehensive account of the social nature of organizational learning is developed, based on Giddens' structuration theory (Giddens 1976; 1979; 1984). There are four reasons why structuration theory looks a particularly useful starting point when discussing the relationship between individual and organizational learning. In the first place, the relationship between individual and collective phenomena is at the heart of structuration theory. Second, Giddens puts the knowledgeability of actors on the frontstage of his theory. This makes his theory useful for the analysis of knowledge and learning in organizations. Third, Giddens' analysis of structure provides a starting point for the description of the interplay of different structural elements. The fourth reason is that the structuration theory sketches a dynamic picture of social reality that suits well to the dynamic nature of the phenomenon under study.

Structuration theory

Structuration theory (Giddens 1976; 1979; 1984) is an ontology of social reality that attempts to overcome dualisms that have become deeply entrenched within social theory: subjectivism versus objectivism, individual versus society and social atomism versus holism. Over the last years structuration theory has received increasing attention within the field of organization studies (see for example the recent special issue of Organization Studies on the agency-structure debate (Bouchikhi et al. 1997)). Structuration theory reconceptualizes the dualism of individual versus society as the duality of agency and structure. Agency and structure, the subjective and objective sides of social reality, are considered to be inseparable. To develop this thesis, Giddens had to rework both the concept of social structure and that of the acting individual.

Social structure has often been seen as a stable, constraining phenomenon, like the skeleton within a body or the walls of a building. Giddens sketches a dynamic picture of structure, as both outcome and resource for action, both constraining and enabling. According to structuration theory, structure consists of rules and resources. Giddens distinguishes two types of rules: interpretative and normative. Interpretative rules govern the way actors interpret the world in which they live. They constitute the cognitive aspect of social structure. Normative rules regulate the legitimization of actions. Resources fall apart into authoritative resources (power relationships) and economic resources. This interpretation of structure is different from and broader than the way structure is commonly used in organization theory. For example, it encompasses what is generally taken to be organizational culture. One of the main concepts of structuration theory is the 'duality of

structure'. This means that social structures are both the outcome and the very medium of social interaction (Giddens 1976: 121). Structures are an outcome in the sense that they are produced and reproduced in interaction. Structure is a resource for interaction in the sense that actors do not construct social reality from scratch, but draw upon each of the pre-existing structural elements in their actions. The existing rules and resources make human actions possible. On the other hand, however, human action is also constrained by existing structures. This implies that structure is both enabling and constraining. In order to draw upon pre-existing rules and resources, and therewith reproduce them, actors have to be 'knowledgeable' of them. 'Knowledgeability' refers to the knowledge individuals have of the circumstances of their actions and the rules they follow. Some of this knowledge is propositional in character, but most of it is carried in what Giddens calls practical consciousness. This is comparable to Polanyi's (1958) concept of tacit knowing.

In addition to a redefinition of social structure, structuration theory implies that the notion of agency, of the individual acting person, has to be reworked too. The individual is not a rock-bottom given, as those who want to reduce society to individuals assume. Individuals necessarily draw upon pre-existing rules and resources. This entails a 'decentring of the subject'. It does not imply that actors are slaves of existing structures. They have the power to 'act otherwise', the possibility to say 'no' (Giddens 1984: 12). This implies that the means whereby systems are reproduced, the interactions of knowledgeable actors, contain within them the seeds of change. However, ascribing knowledgeability to actors, does not imply that they are omniscient about their motives, conditions and consequences of their actions. Giddens speaks of 'unacknowledged preconditions' and 'unintended consequences

of action' which form the bounds of knowledgeability (idem: 294). Both play an important role in the production and reproduction of structure. This construction and reconstruction of structure by the interaction of knowledgeable actors is called 'structuration'.

Structures are properties of social systems, or, more adequately, social systems have structural properties. A social system exists of the reproduced relations between actors or collectivities, organized as regular social practices. According to structuration theory, social systems are not less real than individuals. The one is not less fundamental than the other is. Social systems do have properties that cannot be described in terms of concepts referring to the consciousness of actors. But structures cannot be characterized independently of actors' meanings. Social systems do not have an independent existence.

Giddens also addresses the question how we should interpret our talking about an organization's actions. We speak of an organization firing one of its employees, selling products and taking over another organization. Does this mean that organizations have agency, that is, the possibility to causally intervene in the world? When we zoom in, we will find people filling out forms, packaging products, signing contracts, etcetera. According to structuration theory, organizations are nothing more than the regularized practices of individuals. Organizations differ from other social systems in the degree in which there is an emphasis on the reflexive regulation of system reproduction. The individual actors are the agents of these practices; they are the ones who are able to make a difference. Organizations therefore do not have agency (Giddens 1984: 220). The

apparent ability of organizations to act consists of the agency of its constituent members. Therefore, for example, the statement 'the government has decided …' is shorthand for a statement about actions of individuals. Sometimes the shorthand statement can be useful. But when we want to look inside an organization, we will have to find out how individual practices contribute to what can be described as organizational action.

> It is important to understand that 'The government decided …' or 'The government acted …' are shorthand statements because in some situations it may matter a great deal which individuals were the main initiators or executors of whatever decisions were taken (or not taken) and whatever policies followed (Giddens 1984: 221).

Whenever we say that organizations experiment, experience, reflect, reason or perform other activities associated with organizational learning, we implicitly refer to practices carried out by individuals within an organizational context.

A definition of organizational learning

In order to arrive at a definition of organizational learning, we deem it necessary to specify a general notion of learning. In the behaviorist tradition learning is seen as the process leading to changes in behavior, or in potential behavior, based on experience. Some authors within the literature on organizational learning follow this conceptualization. The idea of an organization adapting to its environment does clearly fit within this perspective too. Others consider the development of knowledge, or a more or less synonymous term, as the defining characteristic of learning (Duncan and Weiss 1979; Shrivastava 1983; Nicolini and Meznar 1995). This knowledge may either be explicit or tacit (Polanyi 1958; Nonaka 1994). A

third approach to the definition of learning couples both aspects. It agrees with the idea that learning implies a change in the range of (potential) behaviors, but only so far as this change is brought about by a change in knowledge (Shrivastava 1983; Huber 1991; Dodgson 1993; Crossan et al. 1999). This is in accordance with recent psychological definitions of learning (Anderson 1995; Bower and Hilgard 1981). Bower and Hilgard for example state that we should not speak of learning when an entity's potential behavior has changed because of growth or increase of strength. In this article we will follow this line and define learning as the process of changing the range of an entity's (potential) behavior based on the development of its knowledge.

Applying this definition of learning to organizations would result in describing organizational learning as the process leading to changes in potential organizational actions based on the development of the knowledge of an organization. How should this description be interpreted? Answering this question requires an account of changes in organizational behavior and in the knowledge underlying these changes. According to structuration theory an organization consists of regularized practices. Speaking of organizational actions implicitly refers to these practices. This implies that a change in an organization's potential behavior consists of a change in the possible practices executed by knowledgeable individuals. In what way can the development of knowledge underlie such a change in practices? The knowledge that is used in organizational actions, which might reasonably be called organizational knowledge, is necessarily carried by individuals executing those practices. Thus the development of knowledge which ought to underlie changes in order for learning to have occurred, can only be a development of knowledge

possessed by individuals. This does not mean that all individual knowledge is organizational knowledge, for by far not all knowledge that an individual possesses, or assumes to possess, can be used in organizational practices. Organizational learning can now be defined a little more precisely as the process leading to changes in possible organizational practices, based on the development of knowledge of the actors executing those practices.

Two points have to be clarified about the above account of organizational knowledge and organizational learning. In the first place it might be objected that this account implies that organizational knowledge could be held by one member, which contradicts the tendency in the literature to reserve this term for knowledge shared within an organization. However, in most organizations, especially the larger ones, only a part of the knowledge will be shared by all members. Organizational knowledge is distributed in character (Hutchins 1995; Tsoukas 1996). Members of an organization execute different tasks and will develop their knowledge in relation to their tasks. Due to the situated and tacit nature of part of this knowledge, it is impossible to give an overall representation of the distributed knowledge and it will be unlikely that there is one person in who all knowledge comes together (Tsoukas 1996). To place the conceptual demand that organizational knowledge needs to be shared seems to be unworkable (which does not deny that often knowledge needs to be shared in order for an organization to function effectively (see for example Weick and Roberts 1993)).

In the second place, it is sometimes suggested that organizational knowledge is embedded in routines, or sets of connected routines. If this means that routines are

themselves considered to be knowledge, the suggestion seems to be misguided. Apart from logical behaviorism (Ryle 1949) not many people have considered it adequate to equate behavior and knowledge. If it means that routines are the carrier of knowledge, we face another problem. The execution of a routine can be associated with two types of knowledge. First, the organization members executing the routine need to know how to do so. In this sense routines are based on procedural memory (Cohen and Bacdayan 1994). The second type of knowledge concerns the knowledge why the routine is executed, knowing to what results it leads. Cohen and Bacdayan (1994: 555) refer to the Soviet troops who arrived secretly in Cuba but nonetheless formed into ranks on the dock and marched conspicuously away. The fact that a routine is executed does not imply that it is effective. It makes a difference whether one or more organization members know that the routine leads to certain effects or not, and whether the organization acts on this knowledge. Some might suggest that an organization may 'have its reasons of which its members know little', but we consider that idea untenable (Giddens 1984). Therefore it is not useful to identify organizational knowledge and routines. We stick to the idea that organizational knowledge is knowledge that can be used in routines and other types of practices.

Structuration theory and organizational learning

In the previous section organizational learning has been defined as the process leading to a change in possible organizational practices, based on the development of knowledge of the actors executing those practices. In this paragraph we want to elaborate upon this definition from a structuration theoretic point of view. We want to address the question when new knowledge can be applied in organizational

practices. Before we turn to that question we will first discuss the knowledge development process itself.

Within the literature on organizational learning one can often find the idea that knowledge development is an individual affair. After knowledge has been developed by individuals, it is assumed that something has to be added to turn it into organizational learning. In some cases learning activities will be executed by an individual. But even in those cases people draw upon existing rules and resources. In order to learn, people necessarily make use of existing interpretative rules, and need the resources and legitimation to address the questions they are interested in. Individual learning is always embedded within a social structure. However, knowledge development has often an even more fully social character. Knowledge development can consist of a large number of more or less cognitive activities, which can comprise, amongst others, observation, imitation, coming up with hypotheses, induction, deduction, designing experiments, executing experiments, interpreting results and evaluating knowledge claims. Sets of those activities will often be executed by more than one person. When these activities are executed by more than one person, the knowledge development process will comprise interactions too. These interactions might include processes of consensus formation, argumentation, negotiation, persuasion and knowledge sharing. In these interactions the validity of knowledge claims is at stake. Whether an idea, hypothesis or theory is accepted as knowledge can be heavily dependent upon others. In our opinion this is true whether one defines knowledge in terms of collective acceptance, like sociologists of knowledge do (Bloor 1976) or accepts a traditional epistemological definition like 'justified true belief' (Audi 1998). The

interactions that can be part of the knowledge development process take place within the existing organizational structure. People draw upon existing rules and resources, to which they might have access in differing degrees. This means in the first that actors draw upon existing knowledge in the development of new knowledge. But the cognitive aspect is only one side of the coin. It is acknowledged by certain writers on organizational learning that social circumstances, comprising power, economic resources, and organizational norms can influence the content of what gets learned (Boje 1994; Easterby-Smith 1997; Brown and Duguid 1991; Argyris and Schön 1978; Lazega 1992). Interesting parallels can be drawn with sociological studies of science and technology (see for example Hagendijk 1990). Researchers within that field have focussed on scientific controversies (Collins and Pinch 1993) and local interactions between scientists (Latour and Woolgar 1979; Knorr-Cetina 1981). Their studies of scientific developments have shown how scientific theories emerge from social interactions, in which reason and reality do not speak with one voice. These interactions are for example influenced by power relations, interests, networks, differing paradigms and available resources.

According to our definition, organizational learning requires that knowledge can be used within organizational practices. Knowledge becomes organizational knowledge when the practices in which it can be applied become part of the regularized and reflexively monitored practices that make up the organization. The use of new knowledge within the practices of an individual, requires that these new practices should be enabled by all dimensions of the existing structure. In the first place, the application of new knowledge can be enabled or constrained by the existing interpretative rules that form the cognitive aspect of an organization. In

other words, new knowledge should to some degree be in accordance with other knowledge within the organization. Even in the cases in which knowledge development has a more individual character, it should be possible to integrate this knowledge with the knowledge of others within the organization. In other cases this will require a more social knowledge development process, as outlined above. Second, the application of new knowledge can be enabled and constrained by existing authoritative or power relations. To change working practices, one needs to have the authority to do so. This explains the reason why some authors speak of organizational learning as the learning of key individuals, like top management. For they are the ones who are most able to apply this knowledge in their practices and order others to change working practices. However, no one oversees all knowledge that is used and everyone has some power over how he or she executes his or her work. This means that individuals have to some degree the possibility to apply new knowledge in their organizational practices and thereby transforming their learning into organizational learning. When he or she does not have this power it is necessary to convince others who do have it. Third, the distribution of economic resources can enable or constrain the use of new knowledge. The application of knowledge most often needs material and financial resources. One might, for example, have an idea for a new product, but lack the resources to develop this product. Here we see that resources can be both enabling and constraining in the process of organization learning. Therefore the economic power, the access to goods and money, needs careful attention in the analysis of organization learning. In the last place, the application of new knowledge can be enabled or constrained by existing normative rules. Normative rules can be seen as the basis for the specification of rights and obligations in specific situations. From organization

members it is expected that they perform certain tasks, follow certain procedures and meet certain output standards. Standard operating procedures are a clear example of strong normative rules. Normative rules can be enabling in providing the legitimation to change working practices on the basis of new knowledge and be constraining in prohibiting such changes. The constraining effect of normative rules, which can of course be more ore less severe, is what March and Olsen (1979: 57) have called 'role constrained learning'.

The development and application of knowledge will be enabled and constrained by existing interpretative and normative rules and economic and authoritative resources. But, of course, organizations differ in their structural characteristics. This suggests that the way the process of organizational learning is structured differs from organization to organization. One dimension on which the organization of organizational learning might differ is the amount of organizational members involved. Compare for example a manager individualistically interpreting the environment and acting upon his interpretation, with highly participative interpretation processes. Shrivastava (1983) has distinguished between types of organizational learning systems partly based on differences along this dimension. The organization of organizational knowledge production might also vary over time. In a study of the NASA, Vaughan (1999) has shown how the pressure on reaching consensus varied over the course of a project. These and other structural differences might characterize and influence both the process and the content of organizational learning. Such differences in the organization of organizational learning require more attention then they have received until now.

Discussion and conclusion

Our main objective in this article has been to deliver a contribution to an unsolved conceptual problem regarding organizational learning: the relationship between individual and organizational learning. In this final section, we want to answer the question whether our analysis meets the requirements set out in the beginning of this article. We have used Giddens' structuration theory to overcome the dualism of organization and individual in the study of organizational learning. Organizational learning was defined as the process leading to changes in possible organizational practices, based on the development of the knowledge of the actors executing those practices. Organization learning requires that this new knowledge can be applied within organizational practices. Both the development of knowledge and the possible application of new knowledge have important collective dimensions. Organizational learning arises from the actions and interactions of individuals, which are enabled and constrained by the existing structural properties of an organization. This implies that organizational learning cannot be reduced to individual learning, individual learning within an organizational context, or individual learning plus something extra such as the sharing of knowledge. Nor is organizational learning a process completely distinct from individual actions and individual learning. According to us, organizational learning can best be viewed as a process of structuration. We believe that this conceptualization of organizational learning integrates both the individual contributions and its organizational character in a well-balanced manner.

In our approach we do not interpret organizational learning as a metaphor. Organizations do learn. That does not mean however, that we step into the pitfall of

reification and antropomorphization. Reification can be thought of as the apprehension of human phenomena as if they were things in non-human or superhuman terms (Berger and Luckmann 1966: 89). In our account of organizational learning, however, the constituting roles of human agents are essential. We have avoided antropomorphization by limiting the analogies with human learning. To assume that organizations go through the same processes of learning as do human beings seems unnecessarily naïve (Cyert and March 1963:123). The apparent likeness in the learning activities of human beings and organizations does not imply that the underlying processes are necessarily alike, as we hope to have shown.

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Argyris and Schön (1978)	the results of individual learning have to be embodied in organizational memory in order to speak of organizational learning
Duncan and Weiss (1979)	an organization has learned if new communicable, consensual and integrated knowledge, relevant to organizational activities, has come available to organizational decision makers
Hedberg (1981)	an organization has learned if the results of individual learning have been incorporated in organizational memory (for example standard operating procedures) and have therewith become independent of any individual
Shrivastava (1983)	an organization has learned if a an organizational member shares newly acquired knowledge, beliefs and assumptions with others
Huber (1991)	an organization learns if any of its units acquires knowledge that it recognizes as potentially useful to the organization
Lyles and Schwenk (1992)	organizational learning involves communicating and integrating alternative schema's by processes of bargaining, consensus and dissensus
Kim (1993)	what an individual has learned needs to become embedded in an organization's memory and structure; this requires an exchange of individual and shared mental models
Dodgson (1993)	organizational learning is the learning of the dominant coalition
Boje (1994)	the collective learning task is to work out the controversies between various sides of a story
Nonaka (1994)	what an individual has learned needs to be organizationally amplified, crystallized, transformed, legitimized and justified
Crossan et al. (1999)	what an individual has learned, in interaction, needs to be institutionalized and embedded in systems, structures, strategy, routines and prescribed practices of the organization

Table 1: perspectives on the relationship between individual learning and organizational learning

WORKING PAPERS

Ecis working papers (November 2001):

98.1:   Per Botolf Maurseth & Bart Verspagen:
          Knowledge spillovers in Europe and its consequences for systems of innovation

98.2:   Jan Fagerberg & Bart Verspagen:
          Productivity, R&D spillovers and trade

98.3:   Leon A.G. Oerlemans, Marius T.H. Meeus & Frans W.M. Boekema:
          Learning, innovation and proximity

99.1:   Marius T.H. Meeus, Leon A.G. Oerlemans & Jules J.J. van Dijck:
          Regional systems of innovation from within

99.2:   Marcel P. Timmer: Climbing the technology ladder too fast?:
          An international comparison of productivity in South and East- Asian manufacturing, 1963-1993

99.3:   Leon A.G. Oerlemans, Marius T.H. Meeus, Frans W.M. Boekema:
          Innovation and space: theoretical perspectives

99.4:   A. Mukherjee & N. Balasubramanian:
          Technology transfer in a horizontally differentiated product-market

99.5:   Marius T.H. Meeus, Leon A.G. Oerlemans & J. Hage:
          Sectoral patterns of interactive learning

99.6:   Bart Verspagen:
          The role of large multinationals in the dutch technology infrastructure

99.7:   Leon A.G. Oerlemans & Marius T.H. Meeus:
          R&D cooperation in a transaction cost perspective

99.8:   Gerald Silverberg & Bart Verspagen:
          Long memory in time series of economic growth and convergence

99.9:   B. Bongenaar & A. Szirmai:
          The role of a research and development institute in the development and diffusion of technology

99.10:   M.C.J. Caniëls & B. Verspagen:
          Spatial distance in a technology gap model