A Framework for the Externalization of Tacit Knowledge Embedding Repertory Grids

Jeannette Hemmecke[a] and Christian Stary[a]

[a] Department for Business Information Systems-Communications Engineering

Johannes Kepler University, Austria

{jeannette.hemmecke, christian.stary}@jku.at

Abstract

Highly differentiated work procedures require stakeholders to share knowledge within and between communities. In the course of knowledge sharing, not only explicit knowledge has to be communicated, but also tacit knowledge. Tacit knowledge cannot be exchanged by traditional means, such as language. For externalization of tacit knowledge we currently face a lack of accurate method support. We introduce a conceptual framework (i.e. activity theory) and a procedural framework embedding repertory grids enabling contextual externalization. The procedure starts out with critical incident analyses based on activity theory elements. Processing the results from the initial step of the procedure the repertory grid technique can be applied for the context-sensitive identification of personal constructs. The elicited knowledge about work practices allows for feedback at the individual and community level. The latter is also termed co-construction of knowledge and implements sharing of tacit knowledge within and between communities. Empirical evidence provided by two case studies reveals a high rate of acceptance as well as a high degree of effectiveness when sharing tacit knowledge in learning organizations.

Keywords: externalization, knowledge elicitation, repertory grid, activity theory, co-construction.

1 Introduction

As knowledge of employees has become a crucial asset of companies (e.g., Willke, 1998), sharing and creation of knowledge within and between different communities[1] is of vital interest for organizations (e.g., Brown & Duguid, 1999). Tacit knowledge is assumed to be a major cornerstone of knowledge sharing and creation (Nonaka, 1994; Nonaka & Takeuchi, 1997; Malhotra, 2000; Heisig, 2003). Knowledge sharing between employees requires communicating tacit knowledge. Unfortunately, it is difficult to be

communicated in a formalized way like, for instance, through language. In well functioning teams sharing of tacit knowledge occurs through "the establishment of shared understanding" (Becerra-Fernandez & Sabherwal, 2001, p. 21) and through practice itself (Brown & Duguid, 1999). Communities of practice are a well known example of knowledge sharing through "participation" (i.e. practicing) in a community (Lave & Wenger, 1991; Wenger, 2000).

When separated from practice, which is the case when tacit knowledge has to be exchanged *between* different communities, sharing becomes more difficult (Brown & Duguid, 1999). Additional hindrances are intra- and inter-organizational boundaries, various professions, and different personal and cultural backgrounds.

From innovation research (Rogers, 1995) it is known that communication, i.e. exchange of ideas (and knowledge), occurs most frequently between individuals who are alike (i.e. homophilious). Similarities that make people alike concern, for instance, beliefs, education, social status, and occupation. The flow of communication between people who are dissimiliar (i.e. heterophilious) is less frequent, because the communicated message may cause cognitive dissonance.

The division of labour requires a differentiation of communities. As such, it causes the heterophily within an organization, namely, the development of particular, local, and highly specialized knowledge within parts of the organization (Brown & Duguid, 1999). At the same time, heterogeneteity is one of the crucial success factors for creating innovation in groups or organizations (e.g., Johnson & Johnson, 2000). "Consequently, the problematic *between* relationship is a critical organizational feature – and one that demands significant organizational investment." (Brown & Duguid, 1999, p. 35).

It is assumed that knowledge moves differently *within* than *between* communities (Brown & Duguid, 1999). Knowledge sharing *within* communities is embedded in practice. This kind of knowledge sharing corresponds to the process of *socialization* (Nonaka, 1994). Knowledge sharing *between* communities has to occur partly decontextualized from the actual practice and background of the involved communities. We can conclude that knowledge sharing between communities (or heterophilious individuals) can only happen when the socially embedded tacit knowledge is – at least partly – converted into explicit knowledge. The conversion process from tacit into explicit knowledge is called *externalization* by Nonaka (1994).

---

[1] A community is understood as a group of stakeholders in the context of this paper.

Externalization is one of Nonaka's four knowledge conversion processes being part of his spiral model of knowledge creation (Nonaka, 1994). It is the process of turning tacit knowledge into explicit knowledge. However, it is not commonly accepted that the articulation of tacit knowledge is possible at all. There are two conflicting positions: the "no-access" versus the "possible-access" position (Büssing, Herbig & Ewert, 2002). The "no-access" position claims that tacit knowledge is not accessible to consciousness. For example, Cook and Brown (1999) state that tacit knowledge cannot be transformed into explicit knowledge, it might help to create explicit knowledge. The "possible-access" position claims that at least parts of tacit knowledge can become conscious (Nonaka, 1994; Hacker, 1992; Büssing et al., 2002). In line with the latter position, we assume that it is possible to make parts of tacit knowledge conscious, in the sense that some parts of tacit knowledge become "focal points" of (conscious) attention (Tuomi, 1999). This consciousness (Bewusstwerdung) enables articulation and, thus, externalization of tacit knowledge.

It has to be clarified which dimension of tacit knowledge can become a focal point. Nonaka and Konno (1998) distinguish two dimensions of tacit knowledge: the *technical dimension*, i.e. the "know-how", and the *cognitive dimension*, i.e. beliefs, ideals, values, mental models, schemata. "While difficult to articulate, this cognitive dimension of tacit knowledge shapes the way we perceive the world" (Nonaka & Konno, 1998, p. 42). The cognitive dimension is termed mental models by Senge (1996). These models shape people's actions and are, vice versa, shaped by them. Since knowing the way a person thinks about the world helps to understand that person's actions, focussing on the cognitive dimension allows us to specify the process of externalization as a means for the flow of knowledge *between* communities.

The results of the externalization process enables people with different backgrounds to share the former tacit knowledge. Due to the social embodiment of tacit knowledge the social, cultural, and historical context of knowledge is important, otherwise externalization "…can lead to ontological ills and fallacies…" (Nonaka & Toyama, 2003, p. 3). Consequently, we argue that individual, social, cultural and historical context must be considered in the process of externalization.

Nonaka and Takeuchi (1997) consider metaphors, analogies, and dialogue as methods for externalization. The authors refer to some cases, where metaphors and analogies were helpful to transform tacit ideas into explicit concepts. Nevertheless, in these cases, the use of metaphors or analogies just happened, i.e. they occurred without in-

tervention. It remains open how an organization can help stakeholders actively to externalize concepts out of their tacit knowledge.

In addition to the suggested methods by Nonaka and Takeuchi (1997) Marwick (2001) reviews knowledge-management technologies and their support of Nonaka's four knowledge conversion processes. He refers to groupware and annotations as technologies that support externalization of tacit knowledge. Groupware can be considered as an overarching set of technologies that supports team or group work. There is no indication that this set of technologies *per se* initiates and guides externalization processes (cf. also Brown & Duguid, 1999, p. 35). Annotations are described as protocols of navigation, citation actions, and other interactions with documents considered to be relevant for expert judgments in the domain at hand. The author does not explain, how annotation technologies can practically be used for knowledge creation.

Becoming aware of this lack of method support we have searched in large databases (Inspec, Psycinfo, Business Source Elite) for proper inputs for our research. Using the keywords "externaliz(s)ation" or "knowledge elicitation" in combination with "organiz(s)ational learning" or "knowledge management" or "knowledge creation" did not result in new concepts or methodologies for externalizing tacit knowledge. Lind & Seigerroth (2003) emphasize the crucial role of methods for externalization. For their interviews and seminars (used in case studies) they identify "a need for a congruence between the perspective used for stating questions and the perspective used for documenting answers" (ibid., p. 122), without providing further methodological details. Klamma, Peters & Jarke (2000) focus on representation issues rather than elicitation techniques (cf. ibid., p. 21f). Therefore, we conclude that we are still facing a need for accurate method support for externalizing tacit knowledge.

Finally, any method for externalization has to take into account the dynamic character of knowledge: "New knowledge is continuously being produced and developed in the different communities of practice throughout an organization" (Brown & Duguid, 1999, p. 35). Consequently, the result of an externalization procedure has to be accepted as a snapshot and has to be processed as such.

In our research we aim to develop procedural support and accurate method(s) for externalization meeting the following requirements:

- Capturing the personal, historical-social and material context of knowledge.
- Including both, the individual and collective working practice.
- Being adaptable to and reflecting the dynamics of knowledge in work activities

- Being applicable in various organizational settings, in particular between communities, and at various stages of knowledge-management ‘maturity’.

Using formative evaluation (cf. Bortz & Döring, 1995), i.e. evaluation in process, the mechanism for tacit knowledge externalization can be tested and redesigned.

In order to overcome the addressed contextual deficiencies we introduce activity theory as the framework for capturing the context of knowledge in terms of work processes (*section 2*). An activity, as defined in activity theory, provides a rich context for knowledge, incorporating organizational culture and structure, mediating tools, involved actors, motives and goals of an activity. According to activity theory, each working activity is a cooperative activity, due to the historically grown division of labour. In cooperative activities individual and collective knowledge is embedded.

Blackler (1993), Boer, van Baalen and Kumar (2002), Engeström (2001), Virkkunen and Kuutti (2000), Clases and Wehner (2002), Clases (2003) have already considered activity theory as a valuable framework for knowledge management from different points of view. These approaches feature activity-oriented knowledge management taking into account individual and collective context of knowledge.

In *section 3*, we introduce the novel procedure for the externalization of tacit knowledge based on the activity-theory framework. We make use of the experience with existing techniques for knowledge acquisition from the field of artificial intelligence and empirically validated instruments from task analysis in work psychology. A special interview technique, the repertory-grid technique (Kelly, 1955/1991), has been successfully applied to the elicitation of expert knowledge (e.g., Boose, 1988; Ford et al., 1991; Gaines & Shaw, 1992). It allows to externalize personal constructs representing the way individuals think about the world. For externalizing tacit knowledge the set-up of repertory grids has to be designed in a way that leads to adequate knowledge (Fromm, 1995). Focussing on tacit knowledge about work, the activity-theory framework, put to practice through critical-incident interviews (cf. Flanagan, 1954) facilitates to relate repertory grids to work activities. In addition, according to activity theory it is required to reflect the externalized knowledge in the context of work processes, i.e. to feed it back to communities context-sensitivly.

In *section 4*, we report on putting the framework and methods on trial in two case studies. The repertory grids succeeded in both cases in the field of customer-relationship management. We conclude the paper in *section 5* summarizing the achievements in light of the objectives and identifying topics for further research.

2 Activity Theory as a Context-Sensitive Conceptual Framework

In the following we introduce activity theory (Leont'ev, 1982; Vygotsky, 1978) as conceptual framework for the methodological support of the context-sensitive externalization of tacit knowledge in a work environment. Activity theory provides a "unique lens" (Jonassen, Tessmer & Hannum, 1999, p. 159) for analyzing working activities with special focus on the dynamics of knowledge in its context. The context comprises social, individual as well as physical factors. We use activity theory as a basis and a guideline for the selection of elements that are the subject for the actual elicitation process, and for the identification of conditions under which the elicitation should take place. Due to the consideration of context, the elicited knowledge can be understood by other workers performing different tasks and having different backgrounds as well.

2.1 Historical Background

The concept of *activity* (in the sense of the German *Tätigkeit* or the Russian *dejatelnost*) has its initial roots in idealist German philosophy of the 18th and 19th century. The basic ideas of the active and constructive role of humans and of the historism of development stem from this tradition of thinking. The concept of activity was then further developed by Karl Marx in the 19th century, conceptualized as a mediating entity between subject and object. The category of activity was introduced to change the passive, unidirectional relationship between subject and object into an active, bi-directional relationship (Leont'ev, 1982). Activity is seen as the "content-bearing process" that establishes the real connection of the subject with the world of objects (Leont'ev, 1974). Soviet psychology adapted the category of activity from Marx. First, Vygotsky elaborated his approach of cultural-historical psychology. He emphasized the mediation of language and signs between subject and object. Leont'ev, one of his pupils, developed the concept of activity further into the actual *activity theory* (Leont'ev, 1982).

2.2 Description of the Activity System

Activity. Activity theory suggests human activity rather than human action as elementary unit of analysis. Activity theory provides a "lense" to analyze the relationship of practical activities within broader cultural, social, and physical contexts they are part of (Boer et al., 2002). Nardi (1996, p. 76) also remarks: "…the activity itself is the context."

Using the category of activity the characteristics of knowledge change from a stable entity into a dynamically changing process of knowing (Leont'ev 1982). "Activity theory

holds that the constituents of activity are not fixed but can dynamically change as conditions change" (Nardi, 1996, p. 75).

Raeithel (1992, p. 396ff.) summarizes five qualities of the category of human activity:

(1) Human praxis must be understood as living, sensual activity that produces and changes the physical and social world by the use of bodily means.

(2) The "natural" body can be extended by the use of technical, semiotic and social means.

(3) Activity transforms objects and is transformed by them: Humans produce a new objective reality, by which, in turn, the activities of people are co-determined.

(4) Activity is itself an object for other activities: Communication, coordination and (self)reflection are enabled through language and other signs.

(5) Activity is essentially social, i.e. the analysis of the structure and dynamics of activities of individuals must consider the historical, social, and cultural context.

Mediation. Raeithel (1992) and Engeström (1987) suggested very similar models of activity systems. An activity system is a model to analyze an activity in its social and physical context. It focuses on the mediated character of activity. An activity system consists of six main elements and their interrelations (see Figure 1). Knowledge and context elements according to activity theory (cf. Engeström, 1987; Raeithel, 1992) include actors (individuals or groups), objects (ideal or material), tools (in a very broad sense including language, symbols as well as machines), formal and informal rules, social and self-constraints, community, and division of labour as well as their interrelationships.

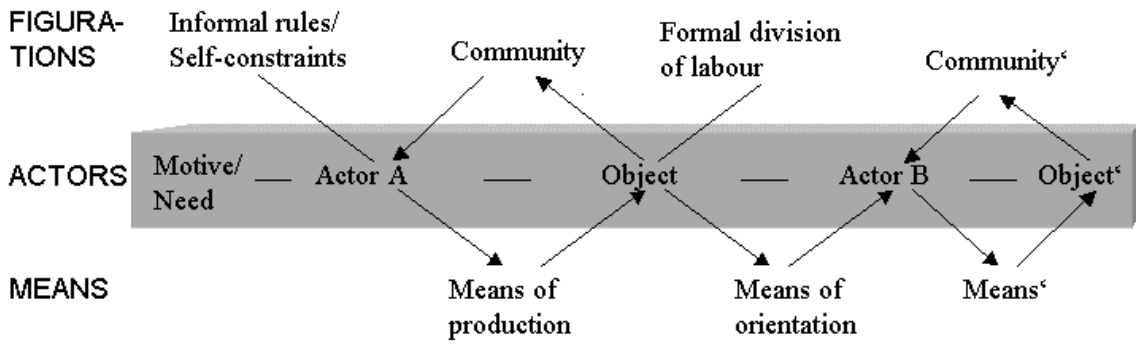

Figure 1: Three process levels of activity of two interacting activity systems (based on Raeithel, 1992, p. 407; Clases & Wehner, 2002, p. 43)

Three process levels have been distinguished by Raeithel (1992): (1) the level of *figurations*, which means the cultural and social structure of work (the concept of "figuration" originally authored by the German sociologist Elias), (2) the level of the *actors* from their point of view the activity is considered, and (3) the level of *means*, which is a historical and social constrained pool of tools, symbols, and signs.

On the level of *figurations*, there are two elements which influence (working) activity: Informal rules and formal division of labour. Within activity theory, the concept of community appears in different facets: In a broad sense, community means society (Leont'ev, 1973; Raeithel, 1992). The society provides the motives and goals for an activity, its means and modes (Leont'ev, 1974). In a narrower sense, all participants in a certain activity build the community (Engeström, 2001). The relationship between participants of an activity system is mediated by social rules, self-constraints, and the formal division of labour.

On the level of *actors*, there are the actors themselves and the object of their work, as well as the product into which the object is transformed by human activity. The subject (or actor) of an activity is a human being engaged in the activity (Rubinstein, 1968; Leont'ev, 1973, 1982). The subject's characteristics enable to understand the personal sense of the activity and, thus, the dynamics of the activity system (Jonassen et al., 1999). The object (in German: Gegen-stand, in Latin: objectum) is a material or mental "thing" which "opposes" the subject (Leont'ev, 1973, 1982). The object provides the specific direction for a concrete activity. For each object is a need/desire which is met by the object (Leont'ev, 1973, 1982).

Finally, on the level of *means*, Raeithel (1992) distinguishes means of orientation and means of production. Means are the mediating material or ideal tools in an activity. Means (or tools) either belong to the human body or are external tools that help to perform certain actions. Material tools might be a hammer or a software, ideal tools might be symbols, language, theories or models. Tools are reification of socially established operations (Leont'ev, 1973). Means of orientation are operations that serve for orientation in a particular action like the ability of perception, tacit knowledge, or software programmes. Means of production are operations that result in producing an outcome, it includes, for instance, skills, artefacts, and machines.

Dynamic Structure. In addition to the concept of social and material mediation, an activity can be described by a certain macrostructure which is common for all forms of concrete and specific activities (Leont'ev, 1974, 1982; see Figure 2). This structure is also necessary for the analysis of the dynamics of activity.

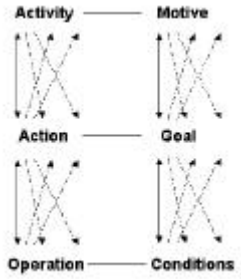

Figure 2: Dynamic structure of human activity

Activity is a holistic unit of human life. The main two principles of activity are its objectiveness (in German: Gegenständlichkeit) and its subjectiveness (Davydov, Zinchenko & Talyzina, 1983). Objectiveness means that the activity is oriented towards an object. Subjectiveness means that "the activity of the subject is always directed toward the transformation of an object that is able to satisfy some specific need" (ibid., p. 32). The *motive* of an activity is the reason why the activity is initiated. It arise from personal needs of a subject (Rubinstein, 1968).

Actions are the main „components" of human activity. "We call an action a process that is structured by a mental representation of the result to be achieved, i.e., a process structured by its conscious goal" (Leont'ev, 1974, p. 23). Actions are directed towards conscious goals. The *goal* gives a direction to an action. It is always a conscious anticipation of the action's result and depends on social constellations (Rubinstein, 1968; Leont'ev, 1973).

Operations are the „components" of actions. They always develop from an action through an automation process, i.e. through practice (Rubinstein, 1968; Leont'ev, 1982). They are understood as unconscious procedures that implement an action under certain conditions. *Conditions* are former goals of an action which turned into an operation (Leont'ev, 1973). Working conditions can be tools, objects, organizational structure, process rules, conditions of space and time, i.e. conditions include characteristics of the context of work (Hacker, 1998).

A main characteristic of activity theory is its consideration of *dynamical changes* in an activity: "Moreover, an activity is a process that continuously undergoes transformations" (Leont'ev, 1974, p. 28). An activity might convert into an action by losing its original motive. The action then is part of another activity being motivated by another motive. In return, an action might become an activity through conversion of a goal into a motive. Furthermore, an action can become an operation through automation, or, if conditions change, an operation can turn into an action (several actions).

2.3 Expansive Co-operation and Co-Construction

In the context of knowledge management or organizational learning, it is not sufficient to analyze an activity system from the point of view of a single actor (Engeström, 2001). It is rather required to analyze the relationships of activity systems, i.e. the relationships of several cooperating subjects engaged in several activities. Raeithel (1983) argues that knowledge is transferred, transformed, and created only through interaction. Consequently, it is essential for knowledge management to focus on the interaction between actors, its development, and its influencing factors.

According to Raeithel (1983), three modes of a subjects' interaction can be distinguished: co-ordination, co-operation, and communication. *Co-ordination* is considered to be an integral part of every work activity. The historically grown objects determine the formal division of labour and therefore the initial or minimal co-ordination between actors. Division of labour influences human activities and, inversely, is influenced by them. *Co-operation* is the second mode of interaction that is materialized through the relations of activities, it is activity itself. Finally, the third mode of interaction between subjects is *communication*. It concerns the exchange of ideal reflections of interacting subjects. More recently, Wehner et al. (1996) call the third mode of interaction in the context of work situations co-construction.

Co-construction is considered to be the highest form of communication wherein roles, rules, work objectives, and patterns of interaction are subject to discussion and common re-definition. Co-construction occurs outside everyday work practice, e.g., in future workshops or inter-organizational workshop circles. The result of any co-construction process has to be evaluated in work practice in the phase of expansive co-operation when new ideas are tried out. Expansive co-operation serves for the actual reintegration of changes in work processes. The feedback process between co-construction and expansive co-operation can be seen as a dialectical one: While, new emerging ideas are developed in co-construction and tested in practice, the gained practical experience serves as an input to the next co-construction phase such that ideas can be approved.

The idea of that dialectical process of knowledge creation forms the background for our concept of feedback of the externalized knowledge into the actual work process. For co-construction tacit knowledge, e.g., unconscious pattern of interaction, has to be reflected by the actors, in order to be able to develop a new common understanding of the patterns of interaction. On the one hand, the elicited individual knowledge should be made transparent to the other actors and, on the other hand, the partly overlapping, partly conflicting knowledge of the actors should be consolidated in the whole group.

The consolidation comprises discussions and re-definitions, and the evolvement of new group constructs. We consider co-construction as a means to initiate expansive cooperation.

2.4 Knowledge in Activity Systems

Based on the framework of activity theory, we consider knowledge of individuals always to be embedded in social and material systems. Moreover, knowledge has to be seen as a dynamic entity that changes over time. Taking the above described activity system and its interactions into consideration, we can distinguish knowledge of actors in knowledge about

- means in order to orient oneself in practice (termed: means of orientation),
- the use of tools in order to produce an outcome (termed: means of production),
- social rules and patterns of interaction (termed: social rules/self-constraints),
- the coordination of activities and actions according to the formal division of labour (termed: formal division of labour),
- the object and its material characteristics (termed: object in production processes),
- the co-worker/customer (another human subject) and his/her personal characteristics (termed: “object” in communication or cooperation processes).

Because of the “multi-voicedness” of activity systems (Engeström, 2001), each actor has a different point of view and interest in the activity and different knowledge that he/she uses in action. “Different subjects, due to their histories and positions in the division of labor, construct the object and the other components of the activity system in different, partially overlapping and partially conflicting ways. […] An activity system is therefore always heterogeneous and multi-voiced requiring some interpretive flexibility (existence of different interpretations of a particular phenomenon at a certain moment)” (Boer et al. 2002, p. 5).

In our procedure for externalization presented in the next section, all these kinds of knowledge can be elicited.

3 The Procedure for Externalization Embedding Repertory Grids

Accounting for the multi-voicedness of activity systems, we use an elicitation technique that is built on the theory of personal constructs (Kelly, 1955/1991) as the major cor-

nerstone for the externalization procedure. The theory of personal constructs assumes that individuals construct the world by verifying hypotheses which they derive from their own experience. Each individual has a particular view of the world, and therefore an individual view on/in the activity system. This is even the case, when – from an observer's perspective – two persons seem to have made the same experience.

3.1 Psychology of Personal Constructs (PPC)

The psychology of personal constructs developed by Kelly (1955/1991) is based on the philosophical background of constructive alternativism. There are two main presumptions: first, the universe is considered to be real, and second, people create their own way of seeing and interpreting it. These ways of seeing the world, called construct systems by Kelly, are alternative constructions that are more or less viable. Construct systems serve for predicting future events. As such they enable individuals to control their interaction with the world. Constructs are created by an individual categorization process of experienced events: similarities of events are called constructs, differences are called contrasts. "A construct is like a reference axis, a basic dimension of appraisal, often unverbalized, frequently unsymbolized, and occasionally unsignified in any manner except by the elemental processes it governs. Behaviourally it can be regarded as an open channel of movement, and the system of constructs provides each man with his own personal network of action pathways, serving both to limit his movements and to open up to him passages of freedom which otherwise would be psychologically nonexistant" (Kelly, 1969 quoted by Fransella & Bannister, 1977, p. 3).

We learn about the world only by acting in the world, and in doing so, develop constructs. Construct systems depend on the experiences individuals make during their lifetime and, moreover, depend on the public socio-cultural construct systems. "No two people can play precisely the same role in the same event, no matter how closely they are associated" (Kelly 1955/1991, p. 38). Constructs enable to anticipate future events and outcomes. Kelly often compared individuals' way of life with scientists' way of acquiring knowledge about the world. Scientists develop hypotheses and test them against "real-world" events. From the position of PPC, every person behaves mainly in the same way as a scientist, in order to orient him/herself within the complex world: he/she develops constructs, relates them mutually in hierarchical structures, and uses them to anticipate future events. In case the prediction of an event was not adequate, parts of the construct system (the construct itself or the realm to which constructs are applied) has to be revised. In case the prediction was successful, the construct system is strengthened. Consequently, construct systems change over time, i.e. that con-

structs are dynamic entities. The implications of the PPC on the understanding of knowledge are as follows:

(1) Knowledge is nothing stable but something dynamic.

(2) Knowledge cannot be true, but only viable for a certain person in a certain physical and social context.

(3) Knowledge is an individual as well as a social category.

(4) Experience influences our constructs (knowledge).

3.2 Repertory Grid Technique

The repertory grid technique is a method for eliciting personal constructs. Having the understanding of knowledge as personal constructs in mind, it is meaningful to know how individuals 'construct' their work activities. In this realm, it makes sense to elicit partly overlapping, partly conflicting knowledge, since the same activity might be 'constructed' differently by different workers. To know about differences in perception of activities helps to know what is actually important for the inter-individual transfer of the elicited codified knowledge, especially across intra- and inter-organizational boundaries.

The repertory grid technique was developed by George A. Kelly in 1955 in the context of psychotherapy. It was designed to help therapists understand his/her client. The results can be the starting point for the therapist's dialogue and intervention with the client. In an organizational setting, repertory grids might be used in the same way. They might help to elicit divergent points of view of organizational members or entities, and following that, they might be the starting point for organizational interventions like co-constructions. In our procedure, we want to focus on the latter application and demonstrate its utility.

Moreover, repertory grids can make individual or collective changes in knowledge transparent. Empirical evidence for the application of repertory grids as a tool for the measurement of change can be again found in psychotherapy research. There, repertory grids are successfully used to measure client's changes during therapy (e.g., Willutzki, 1993; Catina, 1993).

The repertory grid technique consists of four steps: (1) choice of elements, (2) construct elicitation, (3) rating, and (4) analysis.

(1) Choice of Elements. The elements of the repertory grid determine the subject of investigation (Fromm, 1995). Originally, the elements of the Role Construct Repertory

Test (Rep Test; Kelly, 1955/1991) have been role descriptions. With the original Rep Test, it is possible to investigate the client's relations to other persons and to him/herself. In the course of time, repertory grid technique has been further developed and applied in various domains. During the development, the set of element types has been enlarged. Depending on the chosen elements, it is possible to elicit statements about a certain domains of investigation. According to Thomas and Harri-Augstein (1985, quoted by Fromm, 1995), examples for element types are physical entities (e.g., products), living things (e.g., customers), events in a timeline (e.g., critical incidents in customer relationship), social entities (e.g., teams in a firm), behaviour and activities (e.g., techniques in bread baking), appraisals and abstractions (e.g., „positive" events in a seminar, criteria for student essays) and emotions (e.g., emotions during professional socialization). Furthermore, elements should have certain properties in order to support the elicitation of meaningful constructs (Stewart, Stewart & Fonda, 1981):

- *discrete* (i.e. the element choice should contain elements on the same level of hierarchy, and should not contain sub-elements),
- *homogeneous* (i.e. it should be possible to compare the elements, e.g., things and activities should not be mixed within one grid),
- *comprehensible* (i.e. the person from whom the constructs are elicited should know and understand the elements, otherwise the results will turn out meaningless), and
- *representative* (i.e. the elicited construct system will reflect the individually perceived reality, once the element choice is representative for the domain of investigation).

(2) Construct Elicitation. The construct elicitation is based on comparative questions. The triad method is the original and still most common form of construct elicitation (Kelly, 1955/1991; Scheer, 1993; for a description of further techniques see also Riemann, 1991). In the triad method, three elements are compared to each other according to their similarities and differences. The person is asked to specify "*some important way in which two of them are alike and thereby different from the third*" (Fransella & Bannister, 1977, p. 14). The elicited similarity between the two elements is recorded as the construct. Subsequently, the person has to detail the contrast with the following question: *In what way differs the third element from the other two*? The construct elicitation continues as long as new constructs can be elicited.

(3) Rating. The third phase of a repertory grid session is the rating of the elements according to the elicited constructs. The mutual relations of elements and constructs can be explored by using a rating procedure. According to Kelly (1955/1991), the rating is dichotomous, i.e. the element can be described by the construct *or* by the contrast (0/1). Nowadays, the rating normally ranges on a 5 to 7 point scale (cf. Riemann, 1991).

(4) Analysis. The goal of the analysis of a repertory grid is to represent the construct system in a way that the interviewee gets new insights about his/her own view about the corresponding elements. Finally, other individuals should come to an understanding about the interviewee's way of thinking. The most common form of visualization are bi-plots (derived from principal component analysis) and dendrograms (derived from cluster analysis). In bi-plots the relations of elements *and* constructs can be displayed whereas in dendrograms only the relations of elements *or* the relations of constructs can be visualized. However, it is not necessary to use computer programmes for analysis, especially when the results of a single person are subject to analysis. Applying content analysis (e.g., Fromm, 1995), the researcher can cluster the constructs according to a category system.

3.3 Externalization Procedure

We have developed procedural support for externalization meeting the above mentioned requirements. Our procedure consists of three main steps establishing our procedural framework:

(1) Getting an overview of the individual perspectives on the activity system within the organizational context,

(2) Elaborate elicitation of tacit knowledge, and

(3) Joint co-construction involving representatives of all partners of the activity system.

Before starting with step 1, a dedicated work process, task, or relationship within or between organizations has to be determined by the company for the externalization of tacit knowledge. In the procedure all individuals who are directly or indirectly involved in the concerning activity might participate.

(1) Getting an overview of the activity system. We have developed a semi-structured interview based on critical incident technique (cf. Flanagan, 1954) and daily or weekly routine questions to elicit an overview of the work tasks in its organizational,

individual and physical context. The interviewer begins with questioning about daily or weekly work routines, and continues with questioning concerning critical events along these routines.

Work Routine Questions: The interview guideline for the daily or weekly work routine questions has one major question and several additional questions (see Table 1). The questions and the scheme of analysis have been developed with respect to activity theory.

Table 1: Interview guideline for the work routine questions

Please tell me something about your work, and describe a typical working day or week? What is characteristic for your work routine?
Conditions: Are there special conditions for your work, namely physical (sounds, light, etc.), technical (Characteristics of machines, tools, etc.), organizational (time constraints, etc.), social (professional status, relationships between colleagues, etc), and financial conditions (salary, etc.)?
Goals/Tasks: Overall, what are the tasks you have/want to accomplish, what are the goals you have/want to achieve?
Motive: Why do you do this job/perform this activity? What is your personal motive for that?
Community: Who are your (in)direct co-workers?
Division of Labour: Are there intra- or extra-organizational departments that your task obliges you to co-operate? Where do boundaries limit or open up possibilities in your activity?
Social Rules: When you think about the way you collaborate with A, B,... (based on answers to the questions above), are there formal or informal rules you can recall? How are processes and relationships in your work regulated?
Means: Which tools, symbols, etc. do you use to work on task X, Y,…?

Critical Incident Interview: According to Flanagan (1954, p. 327) an incident is „… any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act.“ An incident is critical if "…it deviates significantly, either positively or negatively from what is normal or expected" (Edvardsson, quoted by Callan, 1998).

We suggest the elicitation of at least two critical events from a single interviewee. The critical-incident-question has to be adapted to the interviewee's field of work. In our case study 2, we asked, for example, the following question: *"Please remember a situation involving customers which you individually experienced to be very challenging and which results you perceived extremely positive (negative)! How did you think the customer(s) perceived the situation?"*

Activity theory has again been used for detailing the parameters of the situation (see Table 2).

Table 2: Interview guideline for the elicitation of parameters for the critical incident

"Please tell me about…"
Conditions: "…the general circumstances that have led to the situation! Where and when did the incident happen?"
Activity, actions, operations: "...the concrete chains of actions in the situation! What exactly did you do? What exactly have your interaction partners done?"
Community: "…the persons who were involved? Were there persons that helped or hindered you in your actions? Who?"
Means: "...the resources, tools, and aids which you have been using in the situation? Which means would you have used if they had been available in the situation?"
Rules: "...formal and informal rules, that supported or hindered your actions? Could you prepare yourself for the situation?"
Division of Labour: "…about the history and expected future of the event! Who has worked on the task/request before the incident occurred, who was the person/department that you expected to deal with the task/request in succession? What kind of division of labour did you experience (according to personal interests/strength, according to clearly defined rules,...)?"
Summary: "Did the event occur under any particular circumstances we did not talked about so far? Overall, which factors did you find particularly critical during the situation and for the situation's outcome?"

(2) Elaborated elicitation of tacit knowledge. For the detailed elicitation of the interviewee's tacit knowledge we suggest individual repertory grid interviews. The repertory grid technique is accepted to be a powerful instrument to turn tacit knowledge tangible for the interviewee him/herself and for the interviewer (cf. Büssing et al., 2002; Hacker, 1992). As we have mentioned in section 3.2, the repertory grid technique is an interview technique that is very flexible in application, but has also to be (re)designed for each purpose. In particular, the choice of elements is crucial for determining the area of investigation. As a result of the first step of our procedure, we know the context elements – analyzed according to the six elements of activity theory (cf. section 2.2) – that might be most crucial for accomplishing the investigated work task. Consequently, the repertory grid application is (re)designed according to this result. In the case studies presented in the next section we addressed social rules and self-constraints as subject of analysis. Therefore, we identified customers (as "objects" of the advisory service activity) and colleagues (as part of the community which is mediated through social rules and self-constraints) as elements for the repertory grids. The results of the repertory grid provide an insight in the individual construct systems of the interviewees. Step 1 and 2 have to be terminated before the Step 3 is started.

(3) Joint Co-construction. For the co-construction phase, we developed a procedure for group discussion based on a group application of the repertory grid technique (cf.

Stewart et al., 1981). Participants of joint co-construction are all people who had been interviewed in the former steps individually. The individually elicited tacit knowledge (i.e. the personal constructs) serves as major input for the group repertory grid. An overview of the group procedure is presented in Table 3. The result of joint co-construction should be a common understanding of activities (in the sense of activity theory) for different persons or communities.

Table 3: Procedure of the group repertory grid

1)	Choice of element types each participant is familiar with (e.g., roles, tasks/sub-tasks in the concerning activity)
2)	Choice of concrete elements (e.g., the role “the doctor I like most”) by every participant individually
3)	Choice of constructs (everyone rates his/her own constructs according to their personal importance and choses the 5 to 7 most important constructs)
4)	Explanation of personal constructs in turn, Questions from others are aloud (goal: getting a common understanding of other peoples’ constructs
5)	Individual Rating of all Elements and Visualization of the individual rating on the flipchart
6)	Consolidation of the results: Guided Discussion about similarities and differences in rating; Consolidation of consensual constructs/elements

4 Case Studies

For testing the framework and methods empirically, we have conducted two case studies in the context of customer relationship management.

4.1 Case 1

The first case study focussed on the evaluation of repertory grids as an elicitation method for knowledge at work.

Setting. The case study took place at a service company in the finance sector in Austria. This company has a long tradition in Austria and exists for more than 100 years. It has over 1200 branch offices. Over the last 10 years, there have been major changes in the organizational structure of the company, because of globalization and major fusions with other financial institutions. Due to those changes, the management of the firm had initiated changes in the division of labour and formal rules that affected the way people work. We focussed on three different branch offices in the customer advisory service that are located in rural and provincial areas. In those branch offices, four to nine employees worked. One third of the employees were men, whereas two third were women. Four men and two women work in leading positions. The average age

was 34 years ranging from 19 to 52 years. All employees worked at least two months in the concerning branch office, on average each employee worked there for 12 years.

Procedure. We conducted 21 individual repertory grid interviews with all the employees belonging to three different branch offices. Every interview took between one hour and three hours, on average two hours. We chose as elements for the repertory grids all the team members of the corresponding branch office including the interviewee him/herself, and a fictive ideal. We used the triad method for construct (and contrast) elicitation. Further, we added a qualifier (i.e. an additional part of the question that limits the answer in some intended way) to the elicitation question: *„Which two of these three people are similar in some way concerning their way of dealing with customers* [qualifier] *and thereby different form the third? Could you detail the similarity? What makes the third person different from the other two in that sense?“* As additional aid, we used paper cards containing the elements to activate the visual sense and the sense of touch in the elicitation process. In most cases, interviewees found it easy to group the elements because they are “somehow” (dis)similar by moving the cards in front of them and putting them together or away from one another. The description of the respective similarity or difference was often more difficult, but using moderation techniques (further described in Fransella & Bannister, 1977) we were able to elicit between four and nineteen constructs per person (on average twelve).

Results. The repertory grid technique proved to be a powerful method to elicit tacit knowledge. The interviewees often referred to their intuition (“Bauchgefühl”) while grouping cards, therefore the elicited knowledge can actually be seen as externalized tacit knowledge.

We analyzed the elicited constructs from two different perspectives. First, every repertory grid was analyzed individually in comparison with the repertory grids of the other team members. It was possible to understand the individual perception of colleagues’ ways of dealing with customers and colleagues. Most of the participants told us – partly during the elicitation interviews themselves, partly during the feedback of the results of analysis – that their view about their own way of thinking had never been so clear.

Second, the analysis focussed on differences of the three branch offices which could give an impression of the local socialization and common social rules and self-constraints. In the first branch office, the construct pair *balance vs. nervousness* (“Ruhe, Gelassenheit“, „Freundlichkeit ist nicht stimmungsabhängig“ vs. “Nervosität, Hektik, Erregtheit”, “Freundlichkeit ist stimmungsabhängig”) was the main characteristic in dealing with customers (elicited in 7 from 8 repertory grids). In the second branch of-

fice, the concepts of *extraversion vs. introversion* (“offen”, “aktiv auf Kunden zugehen” vs. “reserviert”, “zurückhaltend”) and *cordiality in the sense of personal relations to customers vs. coolness and business relationships* (“herzlich freundlich”, “private Kundenbeziehung” vs. “aufgesetzt freundlich”, “geschäftliche Kundenbeziehung”) dominated the constructs in dealing with customers (elicited in 8 from 9 interviews). In the third branch office, *self-confidence vs. no self-confidence* (“selbstsicher”, “Selbstwertgefühl” vs. “nervös beim Ansprachen halten“, „kein Selbstwertgefühl“) and *balance* (“Ausgeglichenheit”) were the major characteristics for dealing with customers (elicited in all four of the repertory grids). These constructs describe social rules specific for the respective teams. These rules were unconscious before eliciting them, but regulated the relations between employees and customers. After the repertory grid sessions, all three branch office leaders told us that the method of repertory grids had made diversity and silently burning conflicts in the team transparent and discussable. The elicited rules could have been used for team development, but we did not plan interventions at that point of our research.

The knowledge which we were able to externalize has neither been documented in the company so far nor has it been transparent to the participants themselves before.

4.2 Case 2

The second case study was designed to test the entire procedure for externalization we presented in section 3.3.

Setting. The second case study was conducted in a large insurance company in the health sector in Austria. The main purpose of the company is the insurance of members in case of illness or maternity, and the treatment and prevention of members independent of their financial possibilities. The company is divided into four main sectors: (1) strategy and management, (2) customer care and health, (3) resources and information, and (4) contracting partners. For our purpose, we focused on the sector for customer care and health. It is characterized through the duality of administrative tasks and medical care tasks. Many important decisions can only be made by cooperation of medical doctors and administrative managers.

Procedure. First, we conducted individual interviews based on the critical incident technique and daily routines (see section 3.3) with two leading representatives from medical care and one administrative manager. We structured the answers with the help of activity theory and identified conflicting perceptions in social rules and self-constraints between administrative and medical staff as subject for further elicitation. Using

these results, we were able to specify the element type for the repertory grid for the further elicitation: We used adapted role descriptions (for example, “the medical doctor in the firm you (dis)like in his/her way of dealing with patients or colleagues”, “an administrative partner you work with and you (dis)like in his/her way of dealing with clients or colleagues” etc.) as elements in the subsequent three repertory grid interviews with the same interviewees. We conducted the construct elicitation with the help of the triad method, used similar material and a similar question as in the first case study. Using the results from the first two steps of our procedure, we started the co-construction session with the help of a group repertory grid as explained in section 3.3. The co-construction took two half-days and involved all three interviewees.

Results. The experience during the repertory grid sessions was identical to the first case. The interviewees appreciated the method as respecting their individuality. The results of the repertory grids were individually analyzed with the help of principal component analysis (by SPSS, Statistical Software Package for Social Sciences). The principal component analysis helps to reduce the dimensions of variables and to span a two dimensional space enabling the visualization of all constructs and elements. In Figure 3 we show an example of one of the individual construction of social rules mediating between employees and customers.

According to the feedback of participants, the individual start in the whole procedure for externalization was a key factor for the success of the final repertory grid-based group discussion where the co-construction took place. Participants would not have been able to discuss their controversies about their different ways of working in customer care without having reflected work procedures and social rules at the individual level before. As a result of the co-construction meeting, the three interviewees had agreed on several social rules which they perceived as crucial for certain important tasks in customer service (the tasks were identified at the beginning of the co-construction meeting during the step of choice of elements by the participants of the meeting). One of the tasks was “counselling customers in insurance questions”. For that task, the participants of the co-construction agreed on three different social rules in dealing with the customer: (1) an employee performing that task must have the adequate professional qualification; (2) he/she has to be empathic with the customer, should try to solve the problem for the customer with courage and engagement and be decisive, be friendly, appreciative, authentic and polite and have an ability to set up and lead dialogues, should be objective in his/her decisions and his/her way of dealing with the customer,

and be quiet and balanced; (3) he/she should identify with the organization, with the firm's goals and be loyal.

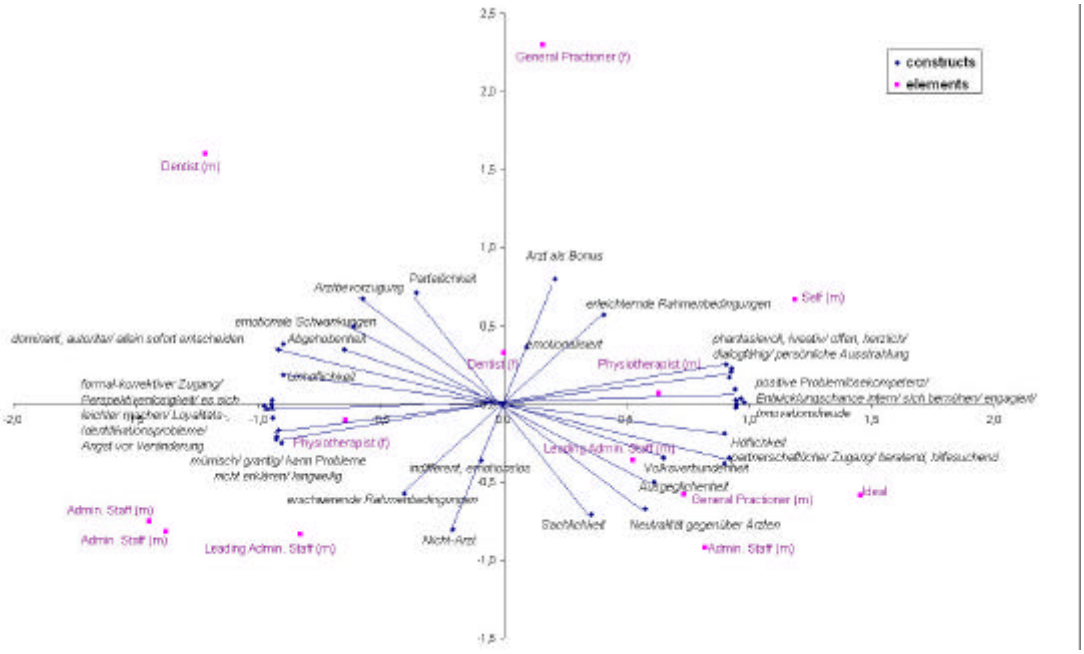

Figure 3: Individual construction of the social rules mediating between employees and customers

Remark to Figure 3: The data of our case study are in German. We only translated the elements (which correspond to the above mentioned role descriptions). We did not translate the personal constructs, otherwise their personal flavour would vanish. To that respect, we illustrate the expressiveness of the graphical display by giving two examples. Near the horizontal line, we find a pool of construct pairs (i.e. construct vs. contrast) which are very similar (note that the smaller the angles between two vectors the more similar are the constructs): the construct pair *imaginative, creative* ("phantasievoll, kreativ") vs. grumpy ("mürrisch") is very similar to the construct pair of *ability to set up and lead dialogues* ("dialogfähig") vs. *not being able to explain problems* ("kann Probleme nicht erklären"). Another construct pair near the vertical axis is *objectivity* ("Sachlichkeit") vs. *subjectivity in the sense of preferring customers without any objective reason* ("Parteilichkeit"). The construct *objectivity* is independent on the construct *imaginative, creative* (vectors' angles is about 90°). The properties of the elements positioned along the direction of the construct vector are identical, but of different weight (the farer the element is located from zero, the more it is characterized by the corresponding construct).

In addition to that task, we discussed five other tasks in customer service separately and identified the rules that everyone agreed on and made also aware of conflicting rules. Although the participants were not able to resolve all controversies, they felt confident to proceed in discussing unresolved but now transparent ones constructively.

In both studies, the participants did not only experience the procedure to satisfy their need for discussion but also the favourable atmosphere that is crucial to knowledge sharing.

5 Conclusions

Dealing with knowledge as a crucial asset of organizations requires the creation and sharing of knowledge within and between different communities. Due to the increased division of labour and social character of work, knowledge sharing between communities is difficult to support. It has to occur partly decontextualized from the actual work practice and background of the involved communities. Such a process can only happen when the socially embedded tacit knowledge can be externalized and encoded by explicit knowledge. The results of a contextualized externalization process enables stakeholders with different backgrounds to share the former tacit knowledge.

In this paper we have tried to overcome the limitations of existing techniques for externalization of tacit knowledge. We have defined and instantiated a procedural framework that embodies repertory grids for the identification of personal constructs. The preparation phase of the actual externalization procedure processes elements from activity theory in the course of critical incident analyses. They capture the personal, historic-social and material context of knowledge. The externalization procedure is an instantiation of the repertory grid technique and allows to address both, the individual and collective working practice. The results can be used to feed back elicited knowledge to communities directly. Members of the involved communities might engage in the generation of new knowledge co-operatively leading to the co-construction of knowledge.

The technique is adaptable to the dynamics of knowledge in work activities, since it can be applied at any time. It is also applicable in various organizational settings, since it can be performed in any domain. Based on the two successful trials in the field of customer relationship management we intend testing and reworking the externalization procedures in more general domains, such as process-based knowledge management. In this case, dedicated representation schemes, such as business process models, are put on trial with respect to capturing community knowledge and various contexts of work practice.

6 References

Becerra-Fernandez, I.; Sabherwal, R. (2001). Organizational knowledge management: A contingency perspective. *Journal of Management Information Systems*, 18 (1), 23-55.

Blackler, F. (1993). Knowledge and the theory of organizations: organizations as activity systems and the reframing of management. *Journal of Management Studies*, 30 (6), 863-884.

Boer, N. I.; van Baalen, P. J.; Kumar, K. (2002). An activity theory approach for studying the situatedness of knowledge sharing. *Proceedings of the 35th Hawaii International Conference on System Sciences (HICSS-35'02)*.

Boose, J. (1988). Uses of repertory grid-centred knowledge acquisition tools for knowledge-based systems. *International Journal of Man-Machine Studies*, 29, 287-310.

Bortz, J.; Döring, N. (1995). *Forschungsmethoden und Evaluation für Sozialwissenschaftler*. Berlin: Springer.

Brown, J. S.; Duguid, P. (1999). Organizing knowledge. *Reflection*, 1 (2), 28-42. [First printed in California Management Review, 40 (3), 90-111, 1998.]

Büssing, A.; Herbig, B.; Ewert, T. (2002). Implizites Wissen und erfahrungsgeleitetes Arbeitshandeln. *Zeitschrift für Arbeits- und Organisationspsychologie*, 46 (1), 2-21.

Callan, R. J. (1998). The critical incident technique in hospitality research: An illustration from the UK lodge sector. *Tourism Management*, 19 (1), 93-98.

Catina, A. (1993). Erfolgs- und Prozessforschung in der Gruppentherapie. In J. W. Scheer; Ana Catina (eds.), *Einführung in die Repertory Grid-Technik. Band 2: Klinische Forschung und Praxis* (p. 115-127). Bern; Göttingen; Toronto; Seattle: Huber.

Clases, C. (2003). Eine arbeitspsychologische Perspektive auf soziale Dynamiken kooperativer Wissensproduktion. In H.-W. Franz; J. Howaldt; H. Jacobsen; R. Kopp (eds.), *Forschen – lernen – beraten: Der Wandel von Wissensproduktion und –transfer in den Sozialwissenschaften* (p. 303-324). Berlin: Edition Sigma.

Clases, C.; Wehner, T. (2002). Steps across the border – Cooperation, knowledge production and systems design. *Computer Supported Cooperative Work* 11, 39-54.

Cook, S. D. N.; Brown, J. S. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization Science*, 10 (4), 381-400.

Davydov, V. V.; Zinchenko, V. P.; Talyzina, N. F. (1983). The problem of activity in the works of A. N. Leont'ev. *Soviet Psychology*, 21 (4), 31-42. [Originally published in Voprosy psikhologii, 1982 (4), 61-66.]

Engeström, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsulit.

Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work* 14 (1), 133-156.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, 51 (4), 327-359.

Ford, K.; Perty, F.; Adams-Webber, J.; Chang, P. (1991). An approach to knowledge acquisition based on the structure of personal construct systems. *IEEE Trans. Knowledge and Data Engineering*, 4 (1), 78-88.

Fransella, F.; Bannister, D. (1977). *A manual for repertory grid technique*. London.: Academic Press.

Fromm, M. (1995). *Repertory Grid Methodik: Ein Lehrbuch*. Weinheim: Deutscher Studienverlag.

Gaines, B. R.; Shaw, M. L. G. (1992). „Knowledge acquisition tools based on personal construct psychology.“ *Knowledge Engineering Review – Special Issue on Automated Knowledge Acquisition Tools*, 8, 49-85.

Hacker, W. (1992). *Expertenkönnen: Erkennen und Vermitteln*. Göttingen: Verlag für Angewandte Psychologie.

Hacker, W. (1998). *Allgemeine Arbeitspsychologie: Psychische Regulation von Arbeitstätigkeiten*. Bern; Göttingen; Toronto; Seattle: Huber.

Heisig, P. (2003). Business process oriented knowledge management. In K. Mertins; P. Heisig; J. Vorbeck (eds.), *Knowledge management: Concepts and best practices* (p. 15-44). Berlin; Heidelberg; New York: Springer.

Johnson, D. W.; Johnson, F. P. (2000). *Joining together: Group theory and group skills.* Boston, London, Toronto, Sydney, Tokyo, Singapore: Allyn and Bacon.

Jonassen, D. H.; Tessmer, M.; Hannum, W. H. (1999). *Task analysis methods for instructional design*. Mahwah/NJ; London: Lawrence Erlbaum Associates.

Kelly, G. A. (1991). *The psychology of personal constructs*. London; New York: Routledge. [Reprint, New York: Norton, 1955.]

Klamma, R.; Peter, P.; Jarke, M. (2000). Vernetztes Verbesserungsmanagement. *Wirtschaftsinformatik*, 42 (1), 15-26.

Kuutti, K.; Virkkunen, J. (1995). Organisational memory and learning network organisation: The case of Finnish labour protection inspectors. *Proceedings of the 28th Hawaii International Conference on System Sciences*, 313-322 *(HICSS-28'95)*.

Lave, J.; Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge; New York; Melbourne; Madrid: Cambridge University Press.

Leont'ev (Leontjew), A. N. (1973). *Probleme der Entwicklung des Psychischen*. Berlin: Volk und Wissen Volkseigener Verlag.

Leont'ev, A. N. (1974). The problem of activity in psychology. Translated by Edward Berg. *Soviet Psychology*, Winter 1974-75, 4-33. [Originally published in Voprosy filosofii, 1972 (9), p. 95-108.]

Leont'ev (Leontjew), A. N. (1982). *Tätigkeit, Bewußtsein, Persönlichkeit*. Köln: Pahl-Rugenstein. Available at: http://userpage.fu-berlin.de/~zosch/leotbp [March 4, 2002]. [English Translation: *Activity, consciousness, and personality*. Englewood Cliffs/NJ: Prentice Hall, 1978.]

Lind, M.; Seigerroth, U. (2003). Team-based reconstruction for expanding organisational ability. *Journal of the Operational Research Society*, 54, 119-129.

Malhotra, Y. (2000). *Knowledge management and virtual organizations*. Idea Group Publishing.

Marwick, A. D. (2001). Knowledge management technology. *IBM Systems Journal*, 40 (4), 814-830.

Nardi, B. A. (1996*).* Studying context: A comparison of activity theory, situated action models, and distributed cognition. In B. A. Nardi (ed.), *Context and consciousness: Activity theory and human-computer interaction* (p. 69-102). Cambridge/MA; London: The MIT Press.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5 (1), 14-37.

Nonaka, I.; Konno, N. (1998). The concept of ‚Ba': Builing a foundation for knowledge creation. *California Management Review*, 40 (3), 40-54.

Nonaka, I.; Takeuchi, H. (1997). *Die Organisation des Wissens: Wie japanische Unternehmen eine brachliegende Ressource nutzbar machen*. Frankfurt/M.; New York: Campus Verlag.

Nonaka, I.; Toyama, R. (2003). The knowledge-creating theory revisited: Knowledge creation as a synthesizing process. *Knowledge Management Research & Practice*, 1, 2-10.

Raeithel, A. (1983). *Tätigkeit, Arbeit und Praxis: Grundbegriffe für eine praktische Psychologie*. Frankfurt/M.; New York: Campus Verlag.

Raeithel, A. (1992). Activity theory as a foundation for design. In C. Floyd; H. Züllighoven; R. Budde; R. Keil-Slawik (eds.), *Software development and reality construction* (p. 391-415). Berlin: Springer.

Riemann, R. (1991). *Repertory Grid Technik: Handanweisung*. Göttingen: Hogrefe Verlag für Psychologie.

Rogers, E. M. (1995). *Diffusion of innovations*. New York: The Free Press.

Rubinstein, S. L. (1968). *Grundlagen der allgemeinen Psychologie*. Berlin: Volk und Wissen Volkseigener Verlag.

Scheer, J. W. (1993). Planung und Durchführung von Repertory Grid-Untersuchungen. In J. W. Scheer; A. Catina (eds.), *Einführung in die Repertory Grid-Technik. Band 1: Grundlagen und Methoden* (p. 24-40). Bern; Göttingen; Toronto; Seattle: Huber.

Senge, P. M. (1996). *Die fünfte Disziplin. Kunst und Praxis der lernenden Organisation*. Stuttgart: Klett-Cotta.

Stewart, V.; Stewart, A.; Fonda, N. (1981). *Business applications of repertory grid.* Maidenhead, Berkshire, England: McGraw-Hill.

Tuomi, I. (1999). Data is more than knowledge: Implications of the reversed knowledge hierarchy for knowledge management and organizational memory. *Proceedings of the 32nd Hawaii International Conference on System Sciences (HICSS-32'99)*.

Wehner, T.; Raeithel, A.; Clases, C.; Endres, E. (1996). Von der Mühe und den Wegen der Zusammenarbeit: Theorie und Empirie eines arbeitspsychologischen Kooperationsmodells. In E. Endres; T. Wehner (eds.), *Zwischenbetriebliche Kooperation: Die Gestaltung von Lieferbeziehungen* (p. 31-58). Weinheim: Beltz Psychologie Verlags Union.

Wenger, E. (2000). Communities of practice and social learning systems. *Organization*, 7 (2), 225-246.

Willke, H. (1998). *Systemisches Wissensmanagement*. Stuttgart: Lucius und Lucius.

Willutzki, U. (1993). Veränderungsmessung in der Einzeltherapie. In J. W. Scheer; Ana Catina (eds.), *Einführung in die Repertory Grid-Technik. Band 2: Klinische Forschung und Praxis* (p. 97-114). Bern; Göttingen; Toronto; Seattle: Huber.

Virkkunen, J.; Kuutti, K. (2000). Understanding organizational learning by focusing on ‚activity systems'. *Accounting, Management and Information Technologies* 10, 291-319.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge/MA; London: Havard Univ. Press.