Organization of Knowledge Transfer in Clusters:

A Knowledge-based View

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Abstract
In this paper we develop a knowledge-based view on the organization of knowledge transfer in clusters. Starting from the information richness theory we argue that tacitness of the partners' knowledge determines the information richness of the knowledge transfer mechanisms in clusters. We examine the following hypotheses: (1) If the cluster partners' knowledge is characterized by a low degree of tacitness, knowledge transfer mechanisms with a lower degree of information richness are used; (2) if the cluster partners' knowledge is characterized by a high degree of tacitness, knowledge transfer mechanisms with a higher degree of information richness are used. We test these hypotheses by using data from the Green Building Cluster of Lower Austria. The data provide partial support for the hypotheses.

Keywords
Knowledge transfer, knowledge-based theory, tacitness of knowledge, cluster

1 Introduction

Clusters are networks of firms in related industries within a given region (Porter 1998, 2000; Malmberg, Maskell 2002). The success of clustering depends on the complementarity of resources and capabilities of the cluster firms (Araújo et al. 2003; Windsperger 2006). Hence the firms will gain competitive advantage when the knowledge transfer is efficiently organized between the cluster partners (Maskell, Malmberg 1999; Calantone et al. 2002). In previous years, a large number of researchers in organization theory and management examined knowledge transfer within and across organizational boundaries using the information (media) richness theory and the knowledge based view of a firm. The first attempt was the information richness theory that answers the question of how to reduce ambiguity in order to facilitate the transfer of information (Daft and Lengel 1986; Russ et al. 1990; Dennis and Kinney 1998; Sheer and Chen 2004). The knowledge based view of the firm (Barney 1991; Kogut and Zander 1992, 1993; Nonaka et al 1996; Conner and Prahalad 1996; Grant 1996; Nickerson, Silverman 2004) argues that gaining competitive advantage by setting up networks requires effective mechanisms to facilitate interorganizational transfer of tacit and explicit knowledge (Zander and Kogut 1995; Inkpen 1996; Hakanson 2005).

In this paper, we develop a knowledge-based view of the choice of knowledge transfer mechanism in clusters that integrates results from the information richness theory. We argue that the information richness theory offers a criteria (‘information richness’ (IR)) to differentiate knowledge transfer mechanisms according to their information processing (or knowledge transfer) capacity. In clusters, knowledge transfer mechanisms with a relatively higher degree of information richness are seminars, workshops, conference

meetings, telephone conferences, visits and video conferences. Knowledge transfer mechanisms with a relatively lower degree of information richness are written documents, fax, email, intra- and internet and other electronic media. According to the knowledge-based theory, the tacitness of partner knowledge determines IR of the knowledge transfer mechanisms. The thesis of our paper is: The higher the degree of tacitness of the partners' knowledge, the more knowledge transfer mechanisms with a higher degree of IR should be used to facilitate an efficient knowledge transfer between the cluster partners.

The article is organized as follows: Section two reviews the relevant literature related to knowledge transfer in networks. In section three we develop the knowledge-based view of knowledge transfer mechanisms and derive testable hypotheses. Finally, we test these hypotheses using data from the Green Building Cluster of Lower Austria.

2 Literature Review

Research on information and knowledge transfer in organizations started with the information richness theory in the 1980s (Daft and Macintosh 1981; Daft and Lengel 1984, 1986; Trevino et al. 1987; Daft et al. 1987; Russ et al. 1990; Sheer and Chen 2004). Recent studies extend this view to new electronic communication media (Lim and Benbasat 2000; Büchel and Raub 2001; Sexton et al. 2003; Vickery et al. 2004). According to this view, effective information and knowledge transfer requires a fit between task ambiguity/equivocality and 'richness' of the communication media. 'Information richness (IR)' consists of four attributes of the communication mechanism: feedback capability, availability of multiple cues (voice, body, gestures, words), language variety, and personal focus (emotions, feelings). The more of these attributes a mechanism possesses, the higher

is the degree of IR of the communication mechanism, and the greater is its capacity to handle ambiguity and hence the transfer capacity. Communication media with a relatively higher degree of IR refer to face-to-face interactions and team-based mechanisms (meetings, trainings, seminars, workshops, visits, video conferencing), and communication media with a lower degree of IR refer to written documents, manuals, reports, data base, written instructions and electronic media.

Since the 1990s many researchers in the field of the knowledge based view of the firm have examined the problem of internal and inter-organizational knowledge transfer (Kogut and Zander 1992; Nonaka 1994; Szulanski 1995, 2000; Simonin 1999a,b; Argote 1999; Albino et al. 1999; Ancori et al. 2000; Argote et al. 2003; Bresnen et al. 2003; Nonaka et al. 2003; Gertler 2003; Jensen and Szulanski 2007; Szulanski and Jensen 2006; Haas and Hansen 2007; van Wijk et al. 2008; Paswan, Wittmann 2009). Starting from Polanyi's knowledge concept (Polanyi 1962), they investigated knowledge transfer in organizations and networks. According to the knowledge based view of the firm, tacitness varies positively with the difficulty of knowledge transfer. On the other hand, most of this literature does not investigate the relationship between knowledge attributes and knowledge transfer mechanisms. Inpken and Dinur (Inkpen 1996; Inkpen and Dinur 1998) and Hong and Nguyen (2009) are an exemption. They go further by analyzing the relationship between knowledge characteristics and knowledge transfer mechanisms in multinational corporations. However, they do not develop a more general approach that explains the relationship between knowledge types and knowledge transfer mechanisms in networks. Furthermore, although a large number of cluster studies have been published in

organization economics and management in the last decade, the problem of the organization of knowledge transfer between cluster partners remains largely unexplored.

To sum up, the existing literature has the following deficits: Firstly, it does not offer a theoretical framework for the explanation of the knowledge transfer mechanisms in inter-organizational relations, and secondly, it does not develop and test hypotheses about the design of knowledge transfer mechanisms in clusters. Starting from this gap, the objective of our paper is to develop a knowledge-based view on the choice of knowledge transfer mechanisms in clusters. Our main contribution to the literature is to combine the knowledge-based view with the information richness theory to explain the organization of knowledge transfer in cluster relationships. Furthermore, our study utilizes primary data from the Green Building Cluster of Lower Austria, which enables us to examine the factors influencing the choice of knowledge transfer mechanisms.

3 Design of Knowledge Transfer Mechanisms in Clusters

According to the knowledge-based theory of the firm, the firm is a bundle of resources and capabilities that consists of a system of organizational routines for the creation and transfer of knowledge (Nonaka 1994; Grant 1996; Antonelli 1999; Zach 1999). This view focuses both on explicit and tacit knowledge that must be created, processed and transferred. Tacit knowledge is the origin of competitive advantage, because it is highly personal, hard to formalize and hence difficult to imitate (Nonaka et al. 1996). Derived from this knowledge-based view, we use the term knowledge transfer mechanisms for organizational routines that enable the transfer of explicit and tacit knowledge (Pedersen et al. 2003; Inkpen 2008; Jasimuddin 2007).

Which factors influence the choice of knowledge transfer mechanisms in networks? According to the knowledge-based view, the characteristic relevant for the determination of efficient knowledge transfer mechanisms is the degree of tacitness of knowledge. If the knowledge is explicit and hence codifiable, knowledge can be efficiently transferred by using knowledge transfer mechanisms with a lower degree of information richness (IR). If the knowledge is tacit and hence difficult to codify, higher-IR-transfer mechanisms are needed to process and transfer the less codifiable component of knowledge. This is compatible with Teece's view (Teece 1985, 229): "Tacit knowledge is extremely difficult to transfer without…teaching, demonstration and participation". Therefore, as tacitness of knowledge increases by degree, a larger knowledge transfer capacity and hence more higher-IR-knowledge transfer mechanisms are required for an efficient knowledge transfer. In addition, Berry and Broadbent (1987), Argote (1999) and Almeida and Kogut (1999) argue that high-IR-mechanisms facilitate both the transfer of tacit and explicit knowledge because of the complementarity between tacit and explicit knowledge (Roberts 2000). To summarize the knowledge-based view on the choice of knowledge transfer mechanisms we can state the following proposition: The higher (lower) the degree of tacitness of the partner-specific knowledge, the more knowledge transfer mechanisms with a higher (lower) degree of IR are needed to facilitate an efficient knowledge transfer between the partners.

Now we apply this approach to the organization of knowledge transfer in clusters. We start with an example by comparing three knowledge situations and ask the question which knowledge transfer mechanisms should be used (see figure 1).

First, we assume that the cluster partner's knowledge is codified in reports, manuals and databases. With a low tacitness-component the knowledge can be easily transferred by

using lower-IR-mechanisms (for instance postal mailings, fax, intranet, chat, online forum, newsgroups, emails) (see FIT I in figure 1). *Second*, we assume that a large part of the partner-specific knowledge is tacit. In this case, most of the partner-specific knowledge and organizational capabilities reside within persons and groups of the cluster firms. With a high tacitness-component the partner knowledge can be only transferred by using more higher-IR-mechanisms (for instance seminar, workshops, meetings, video conferences) (see FIT II in figure 1).

If these alignment conditions are not fulfilled, the following inefficiencies may arise (Russ et al. 1990): (a) MISFIT I: If the partner-specific knowledge is mainly tacit, the knowledge cannot be efficiently transferred by using low-IR mechanisms. In this case, the cluster partners are unable to understand and adequately apply the high tacitness-component of the other partner's knowledge, because it is based on organizational capabilities of employees and groups in the other partner's firm. (b) MISFIT II: If the partner knowledge is codifiable, it is not efficiently transferred by using high-IR mechanisms. Although high-IR-mechanisms facilitate the transfer of codifiable knowledge, it is not efficient because high knowledge transfer costs arise due to the high set-up costs of high-IR-mechanisms. In addition, due to behavioural uncertainty, the risk of information selection and manipulation increases under personal knowledge transfer mechanisms.

Insert Figure 1

Third, we assume that the partner's knowledge is partly codifiable and partly tacit. Further we assume that the explicit part is codified in manuals, reports, and databases and

additional partner-specific knowledge resides within the managers, employees and teams at the cluster partner's firm. Although codified manuals, reports and databases exist, their utility for the cluster partners is relatively low because they cannot adequately apply the codified part of the partner-specific knowledge, as this requires specific organizational capabilities. If, in this case, only lower-IR-knowledge transfer mechanisms are adopted, the partners are unable to adequately understand and apply the requisite partner-specific knowledge. Consequently, since a large part of the knowledge, which is transferred to the partners, is characterized by a higher degree of tacitness, low-IR-mechanisms are insufficient to facilitate the transfer of the requisite knowledge. In this case, both low- and high-IR-mechanisms are needed to efficiently transfer the partner-specific knowledge. For instance, seminars, workshops and meetings would facilitate the transfer of the high tacitness-component of knowledge and thereby also improve the understanding of the more explicit component of the partner knowledge.

As a result, the knowledge-based view on the organization of knowledge transfer in clusters can be summarized as follows: The lower the degree of tacitness of partner-specific knowledge in clusters, the more lower-IR-transfer mechanisms are used for an efficient knowledge transfer; and the higher the degree of tacitness of partner-specific knowledge, the more higher-IR-transfer mechanisms are needed for an efficient knowledge transfer in clusters. We derive the following testable hypotheses:

H1: If the partner-specific knowledge in clusters is less tacit, more knowledge transfer mechanisms with a lower degree of IR are used.

H2: If the partner-specific knowledge in clusters is more tacit, more knowledge transfer mechanisms with a higher degree of IR are used.

4 Empirical Analysis

4.1 Sample and Data Collection

The empirical setting for testing these hypotheses is the Green Building Cluster of Lower Austria. This cluster is the new materials-independent economic hub for all areas of sustainable construction and living. It was established at the beginning of 2007, through a merger of the wood cluster of lower Austria, founded in 2001, and the Green Building Cluster of Lower Austria which was founded in 2003. The 175 partner companies are mainly seated in Lower Austria, whereas a fewer number is coming from the neighboring provinces and Salzburg.

The cluster functions as a link between its partner companies and prospective clients (developers, municipalities, etc.) and its aim is to connect the existing national competencies in the area of sustainable building and living. The cluster team is composed of architects, energy experts as well as professionals from the construction and interior furnishings industries. These experts are professionals involved in cooperative projects, R&D projects and in general project management. They provide information, support and advice to the partner companies – regardless of the type of building product or construction style. Cluster partners profit from each other and work jointly on innovative and added-value oriented projects. This cross-linking of individual companies in the cluster makes it possible for the consumer to obtain a healthy, comfortable structure and equally suitable interior furnishings at an affordable price. The cluster management supports this networking by offering tailored consultation and qualification packages, by initiating and

guiding innovative projects, and by organizing joint presence on national and international markets.

The main areas of focus of the Green Building Cluster of Lower Austria are:

- Restoration and upgrading of older homes to low-energy home standards
- Living in comfort – healthy interior environments
- New multiple-level structures built to passive energy home standards
- CVP and Quality Assurance

(see http://www.oekobaucluster.at/ecoplus/cluster/beuc_en/BEUC_EN_R2.htm)

We started our empirical work by obtaining the list of all network partners from ECOPLUS as a regional governmental institution in Lower Austria. ECOPLUS identified a total of 175 cluster firms in the Green Building Cluster in 2008. After several preliminary steps in the questionnaire development, including interviews with cluster partners at the Green Building Cluster of Lower Austria conference in St. Pölten, the final version of the questionnaire was sent out by postal mail and email to the general managers of the cluster companies in February 2008 and November 2008. The questionnaire took approximately 10 minutes to complete on the average. We received 48 completed responses; hence the response rate is 27.4 %. The general managers as respondents to the survey were the key informants of the cluster company. Key informants should occupy roles that make them knowledgeable about the issues being researched (John and Reve 1982). Since the general managers as top decision makers in the company are involved in the decision regarding the organization of the knowledge transfer between the partner firms, they were judged to be the most suitable respondents. We examined the non-response bias by investigating

whether the results obtained from analysis were driven by differences between the group of respondents and the group of non-respondents. Non-response bias was estimated by comparing early versus late respondents (Armstrong and Overton 1977), where late respondents serve as proxies for non-respondents. No significant differences emerged between the two groups of respondents.

4. 2 Measurement

To test the hypotheses the following variables are important: Information richness of knowledge transfer mechanisms, degree of tacitness of partner knowledge, and control variables (see Appendix).

Information Richness

Adapted from Daft and Lengel (1984) and Vickery et al. (2004), we differentiate the following knowledge transfer mechanisms in cluster relationships: Face-to-face (seminars, workshops, committees, formal and informal meetings), telephone, electronic media (emails, intra- and internet), written personal letters, written formal documents and manuals, numeric formal media (computer output). Face-to-face is the knowledge transfer mechanism with the highest information richness and numeric formal media with the lowest information richness. This hierarchy of information richness is confirmed by empirical research (D'Ambra et al. 1998). Consistent with IR-hierarchy, we differentiate knowledge transfer mechanisms with a relatively higher degree of information richness (seminars and workshops, committees, formal and informal meetings, video conferences) and knowledge transfer mechanisms with a relatively lower degree of information richness

(email, intra- and internet, chat discussions, online forum). Therefore, our study conceptualizes information richness in accordance with Daft and Lengel's approach. Information richness is measured by the extent to which the partner firms use email, documents, chat discussions, online forums, newsgroups, intranet, telephone, seminars, workshops, meetings, conferences and workshops, committees and videoconferences (see table 1). The general managers were asked to rate the use of these knowledge transfer mechanisms on a seven-point scale. The higher the score, the higher is the company's use of a certain mechanism. Based on the information richness theory, we construct indicators for lower-IR-mechanisms (LIR) with intranet, chat discussions, online forum, newsgroups, email, internet, fax, formal letters and documents and for higher-IR-mechanisms (HIR) with seminars, workshops, committees, formal and informal meetings and video conferences (see appendix).

Insert table 1

Knowledge Characteristics

According to the knowledge-based view, tacitness of partner-specific knowledge determines the use of knowledge transfer mechanisms. Following Winter's (1987) taxonomy of knowledge and Kogut and Zander's argument (Kogut and Zander 1993; Zander and Kogut 1995), we use the following knowledge attributes to measure the latent construct of tacitness of knowledge: Codifiablity, teachability and complexity. Codifiability (COD) is the degree to which knowledge can be encoded and written down in manuals. When codifiability is high, the system knowledge is considered more explicit. Teachability

(TEACH) is the extent to which knowledge can be transferred through training, demonstration, participation. As Winter (1987) and Teece (1985) point out, transfer of tacit knowledge, if possible at all, requires teaching, demonstration and participation. Teachability is high when the company knowledge can be taught to the cluster parnter. However, if the company knowledge cannot be taught due to its high degree of tacitness, the cluster partner cannot acquire and apply the requisite knowledge. Hence highly-tacit system knowledge cannot be used and upgraded in cluster relationships. Kogut and Zander (1993, 633) define complexity (COMPLEX) "as the number of critical and interacting elements embraced by an entity or activity". Similarly, Sorenson et al. (2006) define complexity in terms of the level of interdependence inherent in the subcomponents of a piece of knowledge (see also Simonin 1999). When the system knowledge is more complex, it is considered more tacit. Applied to cluster relationships, complexity is high when the application of the partner knowledge requires a large number of heterogeneous, complicated and interdependent tasks, and when the cluster partners have to master diverse techniques in order to successfully apply the partner knowledge. In sum, when the knowledge of the cluster firms is more codifiable, more teachable and less complex, it is considered less tacit.

Adapted from Zander and Kogut (1995), we use a battery of fourteen items to measure codifiability, teachability and complexity of system-specific knowledge. We conducted a factor analysis to check for their dimensionality. The results of the factor analysis show that the items load on three factors referring to codifiability, teachability and complexity. Reliabilities of the final scales for COD, COMPLEX and TEACH pass the threshold of 0.7. To check convergent and discriminant validity of the constructs, we

estimated the average intra-construct correlation and the average correlation of each construct's items with each other construct's items. The results prove the discriminant validity of these constructs.

Control Variables

Trust (TRUST): According to the relational view of governance (Zaheer and Venkatraman 1995; Dyer and Singh 1998; Levin and Cross 2004; Gulati and Nickerson 2007; Mellewigt et al. 2007), trust may influence the use of knowledge transfer mechanisms in two ways: (a) Substitutability view: Trust is a substitute for the use of formal knowledge transfer mechanisms (Gulati 1995; Poppo and Zenger 2002; Yu et al. 2006). It mitigates the knowledge transfer hazards, due to lower relational risk (Roberts 2000; Liu et al. 2008), and hence reduces the extent of formal knowledge transfer mechanisms (Lo and Lie 2008). Consequently, the cluster companies are likely to use less higher-IR- and more lower IR-knowledge transfer mechanisms when trust exists between the cluster partners, and they use more higher-IR- and less lower-IR-knowledge transfer mechanisms when mistrust exists. (b) Complementarity view: Trust overcomes communication barriers and facilitates knowledge sharing and increases the use of all knowledge transfer mechanisms (Seppänen et al. 2007; Blomqvist et al. 2005; Bohnet and Baytelman 2007; Liao 2009). Consequently, under a high level of trust the cluster partners use both more higher-IR- and more lower-IR knowledge transfer mechanisms, because trust creates an incentive for intense and open communication. TRUST was measured with a

four-items scale (see Appendix) (Cronbach alpha = 0.93) (e.g. Zaheer, Venkatraman 1995; Dyer et al. 2003).

SIZE: The number of employees is a proxy for the size of the firm. The larger the firm size, the more person-based HIR- and the less information-based LIR-knowledge transfer mechanisms are used.

4.3 Results

Tables 2 presents the descriptive data for the sample in Lower Austria.

Insert Tables 2

To test the hypotheses 1 and 2 we carry out a regression analysis. We conduct an OLS regression analysis with HIR and LIR as dependent variables, measuring the extent of the use of higher-IR-mechanisms and lower-IR-mechanisms. HIR refers to the use of seminars and workshops, committees, videoconferencing, formal and informal meetings between the cluster partners, and LIR refers to the use of intranet, chat discussions, newsgroups, internet, email, formal letters and documents. The general managers of the cluster companies were asked to rate the use of higher-IR- and lower-IR-mechanisms (HIR, LIR) on a seven-point scale. By averaging the scale values we constructed HIR- and LIR-indicators. We conduct OLS regression analysis (1) without control variables and (2) with control variables. The explanatory variables refer to complexity (COMPLEX), codifiability (COD) and teachability of knowledge (TEACH). Control variables refer to trust (TRUST) and the size of the companies (SIZE). Table 3 presents the correlations of the variables used

in the regression analysis. In addition, the variance inflation factors are well below the rule-of-thumb cut-off of 10 (Netter et. al. 1985). In sum, we do not find any collinearity indication.

Insert table 3

(1) Hypothesis 1: HIR-Knowledge Transfer Mechanisms

We estimate the following regression equation:

$$\mathbf{HIR} = \alpha + \beta_1 \mathbf{TEACH} + \beta_2 \mathbf{COMPLEX} + \beta_3 \mathbf{COMPLEX*TEACH} + \beta_4 \mathbf{COD} + \beta_5 \mathbf{TRUST} + \beta_6 \mathbf{SIZE}$$

According to the knowledge based view, HIR varies positively with complexity (COMPLEX) and negatively with teachability (TEACH) and codifiability (COD). In addition, we include the interaction term TEACH*COMPLEX, because the cluster partners are only able to transfer tacit knowledge if it is at least partly teachable (Winter 1987). Furthermore, under the substitutability view, TRUST is negatively related with HIR, and under the complementarity view, TRUST is positively related with HIR. The larger the firm size, the more person-based HIR-knowledge transfer mechanisms are used. Table 4 reports the results of regression analysis for HIR. The coefficients of COMPLEX*TEACH is positive and significant. This is consistent with our hypothesis that an increase in teachable and tacit knowledge implies the use of more HIR. The coefficient of TRUST is highly significant supporting the complementarity view of trust. Trust facilitates knowledge

sharing and increases the use of HIR-knowledge transfer mechanisms (Seppänen et al. 2007). On the other hand, the coefficients of teachability (TEACH) and codifiability (COD) and SIZE are not significant.

Insert table 4

(2) Hypotheses 2: LIR-Knowledge Transfer Mechanisms

We estimate the following regression equation for LIR:

$$\mathbf{LIR} = \alpha + \beta_1\mathbf{TEACH} + \beta_2\mathbf{COMPLEX} + \beta_3\mathbf{COD} + \beta_4\mathbf{TRUST} + \beta_5\mathbf{SIZE}$$

We expect that LIR varies positively with codifiability (COD) and teachability (TEACH) and negatively with complexity (COMPLEX). In addition, TRUST is positively related with the use of LIR. The larger the size of the firms (SIZE), the more person-based knowledge transfer mechanisms and hence the less LIR are used. Table 5 reports the results of the regression analysis for LIR. The coefficient of teachability (TEACH) is positive and significant, which indicates that LIR supports the transfer of less tacit partner-specific knowledge. The coefficient of TRUST is slightly significant supporting the complementarity view of trust. Trust facilitates knowledge sharing and increases the use of both HIR and LIR-knowledge transfer mechanisms. The coefficients of COMPLEX and COD are not significant. The negative coefficient of SIZE supports the view that the firms use less information-based LIR, when the number of employees is large.

Insert Table 5

5 Discussion

In this paper we develop a knowledge-based view on the organization of knowledge transfer in cluster relationships. According to the knowledge-based view, the knowledge transfer between cluster partners is governed by more high-IR-knowledge transfer mechanisms if the partner-specific knowledge is more tacit, and it is governed by more low-IR-knowledge transfer mechanisms if the knowledge is more explicit. Using complexity, teachability and codifiability as measures for tacitness of the cluster partners' knowledge, the empirical results from Green Building Cluster in Austria partly support these hypotheses. Additionally, based on the relational view of governance, trust influences the organization of knowledge transfer between the partners. Our data support the complementarity view of trust: More trust facilitates information and knowledge sharing between the partners and hence increase the use of both lower-IR and higher-IR knowledge transfer mechanisms.

How does our approach extend the results in the literature? The major contribution of our study is the development of a knowledge-based approach on the choice of knowledge transfer mechanisms in clusters. Our study utilizes primary data from the Green Building Cluster of Lower Austria and that enables the estimation of factors the theory considers important to affect the organization of the knowledge transfer in clusters.

This study has some limitations: First, due to the small sample size the generalizability of the results is limited; further research analyzing data from other clusters with a larger number of cluster firms would help ascertain generalizability of our research

results. Second, the measurement of the knowledge of the cluster partners is not without limitations; it is a first step to operationalize tacitness of knowledge by different knowledge attributes. Third, we have captured trust as a control variable at a rather general level. Conceptually, trust could take at least two forms (Lazzarini et al. 2006): Knowledge-based or belief-based trust related to the history of inter-organizational experience and general trust related to the motivational characteristics of the partners. However, we did not differentiate between these two forms.

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	LOW Information Richness	***HIGH Information Richness***
LOW Tacitness-Component of System Knowledge	FIT I Postal mailings, documents, fax, email, intranet, chat, online forum, newsgroups	MISFIT II
HIGH Tacitness-Component of System Knowledge	MISFIT I	FIT II Seminars, workshops, committees, meetings, video conferences

Figure 1:
Relationship between Knowledge Transfer Mechanisms and Knowledge Attributes

Medium	Information Richness	
	LIR	HIR
Intranet	x	
Chat discussions	x	
Online forum	x	
Newsgroups	x	
E-mail	x	
Internet	x	
Fax	x	
Existing documents	x	
Formal letters	x	
Video conferences		x
Seminars/Workshops		x
Committees		x
Informal meetings		x
Telephone		x
Formal meetings		x

Table 1: Information Richness of Knowledge Transfer Mechanisms
LIR = Lower-IR-Knowledge Transfer Mechanisms
HIR = Higher-IR-Knowledge Transfer Mechanisms

	Mean	Std. Deviation	N
CODE	1,9333	,87843	48
TEACH	2,3500	,94125	48
TRUST	3,4375	,98641	48
COMPLEX	2,6632	,92476	48
NUM_EMPLOYEES	30,21	54,950	48

Table 2: Descriptive Statistics

	CODE	TEACH	TRUST	COMPLEX	NUM_ EMPLOYEES
CODE	1				
TEACH	,590	1			
TRUST	,427	,440	1		
COMPLEX	,499	,516	,318	1	
NUM_EMPLOYEES	-,051	,256	-,050	,179	1

Table 3: Correlations

HIR	
Intercept	1.942*** (0.074)
COD	-0.063 (0.106)
TEACH	-0.032 (0.131)
COMPLEX	0.147 (0.127)
TRUST	0.310*** (0.086)
COMPLEX*TEACH	0.374** (0.184)
SIZE	-0.098 (0.083)
	F=5.438 Adj.R Square = 0.362 N = 48

*** p < 0.01; ** p < 0.05; *p < 0.1; values in parentheses are standard errors.

Table 4: Regression results for HIR

LIR	
Intercept	1.355*** (0.322)
COD	-0.017 (0.122)
TEACH	0.321** (0.119)
COMPLEX	-0.161 (0.105)
TRUST	0.170* (0.092)
SIZE	-0.003* (0.002)
	F=4.276 Adj.R Square = 0.258 N=48

*** p < 0.01; ** p < 0.05; *p < 0.1; values in parentheses are standard errors.

Table 5: Regression results for LIR

APPENDIX: MEASURES OF VARIABLES

Lower-IR-Knowledge Transfer Mechanisms (LIR)	To what extent does the cluster company use knowledge transfer mechanisms with a lower degree of IR: (Intranet, chat discussions, online forum, newsgroups, email, fax, formal letters, existing documents) (1, no extent;…7, to a very large extent)
Higher-IR-Knowledge Transfer Mechanisms (HIR)	To what extent does the cluster company use knowledge transfer mechanisms with a higher degree of IR: (Seminars, workshops, video conferences, committees, informal meetings, formal meetings, telephone) (1, no extent;…7, to a very large extent)
Complexity (COMPLEX) **Coefficient alpha: 0.88**	The general manager has to evaluate complexity on a 7 point scale (1,strongly disagree; …7, strongly agree): Complex 1: Cluster partners must master many diverse activities and tasks, in order to be able to apply the partner knowledge successfully.
	Complex 2: The tasks and activities for the application of partner know-how are very difficult.
	Complex 3: The tasks and activities for the application of the partner know-how are very heterogeneous. Complex 4: The tasks and activities for the application of the partner know-how are very interdependent. Complex 5: The partner know-how can be easily divided in separate tasks (reverse coded).
Teachability (TEACH) **Coefficient alpha: 0.92**	The general manager has to evaluate teachability on a 7 point scale (1, strongly disagree; …7, strongly agree): Teach 1: The cluster partners can easily learn the most important activities of the relationship by talking to skilled employees of the partner firm.
	Teach 2: The partners can easily learn the most important activities of the relationship through personal support with skilled employees of the partner firm.
	Teach 3: The employees of the cluster firms can master the new knowledge of the cluster partner through trainings.
	Teach 4: Training to apply the new knowledge is a quick and easy job. Teach 5: The cluster partners can easily learn the most important activities and tasks through job rotation between the cluster firms.
Codifiability (COD) **Coefficient alpha: 0.80**	The general manager has to evaluate codifiability on a 7 point scale (1,strongly disagree; …7, strongly agree): Cod 1: Large parts of the business processes between the partner firms can be carried out by using information technology.
	Cod 2: Critical parts of the business processes between the partners can be extensively documented in written form.
Trust (TRUST) **Coefficient alpha: 0.93**	The general manager has to evaluate trust on a 7 point scale (1,strongly disagree; …7, strongly agree): Trust 1: There is great trust between us and partners. Trust 2: There is an atmosphere of openness and sincerity. Trust 3: The mutual cooperation is on a partnership basis. Trust 4: Information sharing between the partners exceeds the level stipulated in the contract.
Firm Size (SIZE)	Number of employees