UNIVERSITEIT GENT

FACULTEIT ECONOMIE
EN BEDRIJFSKUNDE

HOVENIERSBERG 24
B-9000 GENT
Tel. : 32 - (0)9 – 264.34.61
Fax. : 32 - (0)9 – 264.35.92

WORKING PAPER

Effects of Organizational Design Dimensions

on Inter-unit Knowledge Sharing

Annick Willem [1]

Marc Buelens [2]

May 2006

2006/384

[1] Ghent University, Faculty of Economics and Business Administration, Department Management and Entrepreneurship, Hoveniersberg 24, 9000 Gent, annick.willem@ugent.be
[2] Ghent University, Faculty of Economics and Business Administration, Department Management and Entrepreneurship; and Vlerick Leuven Gent Mangement School

D/2006/7012/29

Effects of Organizational Design Dimensions on Inter-unit Knowledge sharing.

Abstract

The literature on knowledge sharing is extensive but organization design received little attention in this literature. A few useful exceptions are Birkinshaw e.a. (2002), Hansen (2002) and Tsai (2002). However, these attempts are yet too limited to fully understand the relationship between organization design choices and knowledge sharing. To contribute in filling this gap, we look at the fundamental organization design dimensions, specialization centralization, formalization, and coordination, in their relationship to the concepts of knowledge and knowledge sharing. While specialization creates firm-specific boundaries to knowledge sharing, coordination is the firm-specific mechanism to overcome these boundaries (Grant, 1996). A multiple case study approach was followed to collect our data, using a questionnaire in the Belgian divisions of two European companies active in the energy and finance sector. Based on a reassessment of the classic organization design literature, we assumed more inter-unit knowledge sharing when: decentralized and informal coordination is used, interdependency between units is low and specialization, reflected in knowledge complexity and unit differences, is low. Our findings indicated that interdependency and knowledge complexity, apart from having a strong direct effect on knowledge sharing, also had an important interacting effect in the relationship between coordination and knowledge sharing; suggesting a contingency view on organization design and knowledge transferability. Other expected relationships were not found, such as the negative effect of hierarchy or the positive effect of lower formalization. We made a comparison between the two cases and put the findings in their context. Apparently, the organization-specific context in which the

coordination is applied affects the potential of this coordination for knowledge sharing. Especially the role of formalization differed. Hence, organization-specificity questions again the contingency view.

Key words: case study, interdependency, knowledge sharing, organization design

Introduction

Although there is no doubt about the importance of knowledge sharing for organizations, the role of the organizations' design in knowledge sharing is neglected in the literature. To assess this role, we revisit classic organizational design dimensions. Traditionally, organization design literature has focused on balancing integration and differentiation in setting the organization design principles (Mintzberg, 1989). Birkinshaw e.a. (2002), Hansen (2002) and Tsai (2002) touch a few of the organizational design principles in their studies on knowledge sharing. Their empirical studies and several other recent advances in knowledge management prove the importance of an adequate organization design for knowledge sharing. Unfortunately, we still lack sufficient insight into how the integration-differentiation balance alters when knowledge is taken into account. Knowledge is here viewed as "*a product of human reflection and experience, located in an individual or a collective, or embedded in a routine or process"* (De Long & Fahey, 2000:114). Knowledge sharing is then best defined as *"the process through which one unit is affected by the experience of another"* (Argote & Ingram, 2000:151). In reviewing the differentiation-integration balance in organization design for the concept of knowledge, we analyze how each of the classic organization design dimensions relates to the concepts of knowledge and knowledge sharing. These organization design dimensions underpinning the differentiation-integration balance are: specialization, centralization, formalization, and coordination (Miller & Droge, 1986; Mintzberg, 1989); and although very classic, these dimensions are still frequently used in organizational design research (Argyres, 1995; Cunningham & Rivera, 2001; Tsai, 2002). Specialization is causing differentiation among units, while centralization, formalization and coordination are tuning and integrating units' tasks and behavior. This will then be further explored through a multiple case study research strategy.

The paper, thus, continues with explaining the relationship between knowledge sharing and the classic dimensions of organization design. Next, propositions on these relationships are developed. The next part describes the method of data collection and the results. The discussion and conclusion sections bring this paper to an end.

Organization design and knowledge sharing.

Specialization

Specialization is the extent to which the organizational tasks are divided into subtasks and people are allocated to execute only one of these subtasks (Mintzberg, 1979). It is the firm's task to create benefits by job specialisation and combine groups of people with similar tasks to obtain optimal local learning within the group (Levinthal & March, 1981). To obtain such learning and economies of scale among specialists in similar fields, differences within units are minimized and differences between units maximized. Specialization in units causes the development of specific knowledge uniquely held by an individual or group and the development of different languages and different views between the units (Grant, 1996). Such specific knowledge is then a source for differences between units, which create boundaries for the units. These boundaries are thus physical and structural due to geographical dispersion and departmentalization, as well as mental due to unique jargon and dispersed views on the environment developed by the specialists. Grant (1996) argues that organizations have an advantage over markets in knowledge specialization but this increases inter-unit boundaries and complicates integration efforts. The more specialization the more difficult to share

knowledge; however, low specialization reduces the benefits that firms have compared to markets.

Knowledge can be considered as a contingency element in organization design choices, with an impact and role comparable to technology (Birkinshaw, 2002). Technology (i.e. the collective instruments used to do the work in organizations) is a subset of knowledge and, therefore, the technology characteristics, complexity and analyzability (Perrow, 1970), are in fact referring to the complexity of the knowledge required to perform the task. The more complex the technology and thus the knowledge, the more difficult to integrate units and the more there is a need for complex integration mechanisms (Galbraith, 1973).

In addition, as a consequence of specialization, tasks interdependency (i.e. the extent to which different units are dependent on each other to perform their tasks) is created. The level of interdependency is a function of how units are formed and tasks are combined. Classic organization theory literature teaches us that the need for sharing information between units is a function of the interdependency between the units (Argyres, 1995, Buckley & Carter, 1999, Thompson, 1967). However, high interdependent tasks that also involve task specific knowledge will not only require information but also knowledge sharing. Consequently, we will observe a higher need for knowledge sharing between units when these units are interdependent.

Knowledge management literature has paid thorough attention to the impact of knowledge characteristics on knowledge sharing. In doing so several closely related concepts are developed, such as tacit (Polanyi, 1997), embedded (Lam, 1997), sticky (Gabriel Szulanski, 1996), dependent (Birkinshaw et al., 2002; Morten T. Hansen, 1999), and complex knowledge

(Morten T. Hansen, 1999). These concepts all refer to the context-related character of knowledge and the difficulty to share knowledge between individuals or groups. A difficulty that is, among other things, created when knowledge is embedded in inter-dependencies between units (Birkinshaw et al., 2002). Here, we summarize specialized and unit specific knowledge, complexity of knowledge and embeddedness, into one concept of knowledge complexity. The higher knowledge complexity, the more difficult is knowledge sharing between units. Codifying knowledge reduces knowledge complexity; however, some knowledge is too complex to be fully codified.

Centralization and formalization

Centralization refers to the extent to which the decision-making power is concentrated at the top management level in the organization (Alexander and Bauerschmidt, 1987; Hage and Aiken, 1967). Although centralization achieves integration and coordination among units in the organization, it is not considered to be positively related to knowledge sharing. Centralized decision-making is criticized within the knowledge sharing context for two reasons. First, decisions about the sharing of specialized knowledge can only be effective if the centralized decision-maker knows which knowledge is held individually. Decision-making power on knowledge issues is best delegated to the owner of the relevant knowledge (Jensen & Meckling, 1992). Hence, centralized decision-making driving the knowledge sharing process can be ineffective, especially when complex knowledge is involved. Second, centralization and especially hierarchy have a negative effect on knowledge sharing between units in organizations because of the control embedded in centralized systems (Tsai, 2002). Top-down directives can reinforce an environment of fear, distrust, and internal competition reducing collaboration and integrative actions (P. M. Senge, 1997). Kramer (1999) confirms

the distrust that can arise from centralized systems, especially when these systems also impose an arbitrary control on peoples' behavior.

Formalization indicates the extent to which the rights and duties of the members of the organization are determined and the extent to which these are written down in rules, procedures, and instructions (Schminke et al., 2000). Formalization has similar disadvantages as centralization for knowledge sharing. It creates an environment of control and reduces flexibility in knowledge sharing. Hence, formalization is again ineffective to reach integration from a knowledge sharing point of view (Van den Bosch, Volberda, & de Boer, 1999).

Coordination

Integration choices must take into account the possibilities to integrate the different types of knowledge, and to develop inter-unit linkages for knowledge sharing (Ghoshal, Korine, & Szulanski, 1994; Gupta & Govindarajan, 2000; Zack, 1999). Organizations obtain integration among their units through the use of firm-specific coordination mechanisms (Martinez & Jarillo, 1989). It is argued in the following paragraph that the impact of the coordination on knowledge sharing depends on two aspects. First, the extent to which the coordination is formalized and oriented towards centralized decision-making makes this coordination more or less fit for inter-unit knowledge sharing (hypothesis 1). Second, the effectiveness of coordination mechanisms for knowledge sharing depends on the level of specialization, in particular, the levels of interdependency and knowledge complexity (hypothesis 2). These relationships form the basis for the sub-hypotheses that will be developed in the next part and will be explored further in the empirical part.

Hypotheses

Our previous arguments on centralization and formalization suggest that other mechanisms, less based on centralization of decision-making and formalization, are more appropriate for knowledge sharing (Grant, 1996). Hierarchical coordination (centralized and formal) and formal systems, such as plans, procedures, standards and goals (formal and mostly centralized), determine which and how much information and knowledge should be exchanged (Egelhoff, 1991; Galbraith, 1973; Makhija & Ganesh, 1997). They determine for instance the knowledge flow in the different steps of a sequentially organized production process. Such kind of coordination is considered to have a low cost but has limited possibilities for enhancing knowledge sharing in a flexible way (Grant, 1996). There might be inflexibility in knowledge sharing between units, when the relation is based on planned systems, due to unlearning (Levitt & March, 1988; Peter M. Senge, 1994). Furthermore, both kinds of coordination have a negative effect on knowledge sharing between units in organizations because of the control embedded in these systems (Tsai, 2002). Therefore, we can state that coordination based on hierarchy and formal systems are ineffective for intensive knowledge sharing.

Horizontal coordinaton, consisting of teams, mutual adjustment, networking and integration roles (less formal and decentralized), allows flexible coordination during task execution and can deal with ad hoc communication and information needs (Galbraith, 1973). The liaisons and coordinators can play the role of knowledge brokers for knowledge sharing with other units. Teams can be composed whenever a need for knowledge sharing crossing unit boundaries arises (Ayas & Zeniuk, 2001; Grant, 1996; Van den Bosch et al., 1999). Communities of practice, for instance, are examples of teams or project groups, reaching high

levels of knowledge sharing (Ayas & Zeniuk, 2001). For even more urgent and less intensive sharing, mutual adjustment can solve the communication and knowledge sharing problem. In general, horizontal coordination will result in more communication and knowledge sharing among units of large organizations (Ghoshal et al., 1994).

Informal coordination, i.e. any form of personal contacts between people and units in the organization that is not intended or imposed by management (informal and decentralized) (Mintzberg, 1989; Perrow, 1970; Van De Ven, Delbecq, & Koenig, 1976), can have a major impact on knowledge sharing and can even have knowledge sharing as their raison d'être. Hence, this informal coordination is as much a knowledge sharing facilitator, as it is a coordination mechanism. Informal interactions between units constitute an important means for integrating diffused expert knowledge in organizations and to cross internal and external organizational boundaries (Hislop, Newell, Scarbrough, & Swan, 1997; Mintzberg, 1989). This informal coordination is based on trust and voluntary cooperation creating a high willingness for cooperation and knowledge sharing based on non-reciprocal pro-social behavior (Jarvenpaa & Staples, 2001).

Hence, coordination mechanisms, required for cooperation and knowledge sharing between units, should not be based on strong formalization or centralization but on horizontal and informal interactions. We can formulate the following hypotheses.

Hypothesis 1a. The more decentralized coordination, the more knowledge will be shared between the units.

Hypothesis 1b. The more informal coordination, the more knowledge will be shared between the units.

As mentioned, specialization in units results in differences in knowledge between units, which increases the knowledge complexity and impedes knowledge sharing. Knowledge complexity is influencing the effectiveness of the coordination mechanisms. In organization theory, it is emphasized that complex technology, respectively complex knowledge, are best dealt with through the use of horizontal and informal coordination (Galbraith, 1973; Gargiulo & Benassi, 2000; Ghoshal et al., 1994; Grandori, 1997b; Morten T. Hansen, 1999; Van den Bosch et al., 1999). Thus, the higher specialization is -creating knowledge complexity-, the higher the need for decentralized and informal inter-unit coordination.

Hypothesis 2a. The higher knowledge complexity, the more decentralized and informal coordination is required for the sharing of knowledge between the units.

Task interdependency is also a major determinant of the choice of coordination mechanisms (Grandori, 1997a; Thompson, 1967). High interdependency, for instance, requires more horizontal coordination (Galbraith, 1977). Daft and Lengel (1986) explain that it is the combination of interdependency and differences between departments that requires the use of rich media to allow sufficient inter-departmental coordination. This argument should be extended to knowledge sharing between units because of the above mentioned interrelatedness between the concepts of knowledge, interdependency and unit differences. Hence, following Daft and Lengel (1986), it is the combination of interdependency and unit differences that requires informal and decentralized coordination. The following hypotheses propose the relationships between interdependency, unit differences, coordination and knowledge sharing.

Hypothesis 2b. The higher the interdependency between the units, the more decentralized and informal coordination is required for the sharing of knowledge between the units.

Hypothesis 2c. The higher the interdependency and differences between the units, the more decentralized and informal coordination is required for the sharing of knowledge between the units.

Method

We opted for data collection in a case study research strategy, because a case study approach is appropriate for the testing of context embedded relationships (Stoecker, 1991; Yin, 1994). Following Yin (1994), our research design can be described as an embedded multiple case design, including multiple units of analysis per case study. Two organizations were selected, which were active in two different sectors of industry. A comparison between the two organizations allows the exploring of the context-specificity of the relationships found. Although two organizations do not allow for generalization, the data is more robust and allows a literal replication of the study (Yin, 1994). The organizations were large allowing us to select a sufficient number of inter-unit interactions. These interactions, in particular inter-unit cooperations, were the unit of analysis. Analysis on the level of interaction is preferred when knowledge sharing embedded in interactions is studied (Grant, 1996; G. Szulanski, 1998). However, the unit or level of observation and data collection were the individual in our study. We asked individuals to give their perceptions on an inter-unit cooperation in a Likert scaled questionnaire. Additional information on the working of the two case companies was obtained from key sponsors of our study in the companies.

The two companies were medium-sized companies in Europe with respectively 13,600 and 15,000 employees. Both companies had international activities but our study focused on the Belgian and main parts of the companies. Respondents in the energy company were selected in the production sites of the company. All people on the management level and the level of senior staff were selected, excluding manual labor workers. Those respondents indicated a cooperation with another unit in the production part of the company. In the finance company, the respondents were selected through different steps. First, cooperation of the department head was asked for. Those heads indicated cooperations between a unit of their department and another unit in their or another department. The people involved in such cooperations received a questionnaire. This method resulted in a much larger response rate (53%) than in the energy company (15%) were no particular support of the department heads could be obtained. The final sample consisted of 408 correctly completed questionnaires, respectively 253 in the finance company and 155 in the energy company.

A questionnaire was developed based on existing and newly developed scales. See appendix for the scales used. We measured four independent variables related to the integration dimension of organization, viz formal systems, formal hierarchy, horizontal coordination and informal coordination, and three independent variables related to the differentiation dimension of organization, viz knowledge complexity (impossibility to easily articulate and transfer knowledge), interdependency (task dependency between units) and unit differences (dissimilarity in tasks and background). The dependent variable knowledge sharing is hard to measure and, therefore, proxies might be more appropriate. Such proxies were also used in similar empirical studies (Morten T. Hansen, 1999; Hoopes & Postrel, 1999; G. Szulanski, 2000). Supported by those studies, we decided to measure knowledge sharing by proxies in a more subjective and in a more objective way. The first variable, satisfaction with knowledge

sharing, measured the perception on the intensity and quality of knowledge sharing between the units, among others by looking for indications of non-sharing or insufficient sharing. The second dependent variable is measured in terms of time spent on knowledge sharing and is an attempt to quantify knowledge sharing in a more objective way. Respondents were asked to stipulate the inter-unit cooperation and to answer the questions only for that particular cooperation, considering only knowledge relevant for the tasks for which the cooperation was developed. Cooperations ranged from routine to rare and from operational to highly strategic, resulting in a wide variation of knowledge implicitly referred to in the answers, such as daily work experiences, predictions for future planning or best practices.

Several tests were taken in the development phase of the questionnaire to assure the reliability of our measurement instrument (Nunnally, 1978). Pretests were done in two smaller companies, and in a group of management students. Cronbach alphas were used as a measure of reliability (Nunnally, 1978). Although a cut-off value of 0.7 for Cronbach alphas is recommended, 0.6 has been accepted as well (Hair, Anderson, Tatham, & Black, 1998; Peterson, 1994). One scale did not reach an adequate level of reliability ($\alpha>0.6$). The scale on informal coordination only had reliability above 0.5, risking type II errors in the conclusions (Lipsey, 1990; Peter, 1979). To estimate the risk of common method variance, we used the Hartman's one-factor test (Podsakoff & Organ, 1986). The test indicates that common method variance is present when one factor counts for a majority of the covariance in the variables. Applying the test to our data indicated that three factors arise (eigenvalues higher than one) and not one factor counting for the majority of the variance. Table 1 and 2 list the intercorrelations, means, standard deviations and Cronbach alphas for the two case studies.

Insert Table 1 about here

Insert Table 2 about here

Results

We analyzed our data using descriptive statistics and linear regression analyses. Two models were constructed, one with regression on 'satisfaction with knowledge sharing' and one with regression on 'time spent on knowledge sharing'. Interaction effects were assessed by significant changes in adjusted R^2. The analyses were performed for the two cases separately. As will be described further, the results of the two cases showed similarities but also several differences.

Descriptive statistics revealed a high average score for the variable informal coordination. The units were on average not very interdependent and rather differentiated. Respondents did not spend a lot of time on knowledge sharing but were on average rather satisfied with the knowledge sharing. Interesting was the fact that time spent on knowledge sharing and satisfaction with knowledge sharing were not correlated. Hence, it is useful to differentiate in our further analysis between quantity (time spent on) and quality (satisfaction with) of knowledge sharing.

The standardized regression coefficients, t-values and R^2 for the finance case are listed in table 3. Satisfaction with knowledge sharing was significantly varying with the use of horizontal coordination mechanisms and the level of complexity. Less complexity and more use of horizontal integration was related to higher satisfaction with knowledge sharing. Interdependency and differentiation between units were not affecting knowledge sharing

separately but these two variables resulted in higher satisfaction with knowledge sharing when both were combined. In particular, higher satisfaction existed when interdependent units were not too different. Moreover, satisfaction was further increased when such situation was accompanied with informal coordination.

Insert Table 3 about here

Time spent on knowledge sharing was related to the use of formal systems as coordination type, horizontal coordination and interdependency. In particular, higher dependency was related to (read: required) more knowledge sharing and such sharing was best organized by horizontal inter-unit coordination. Very formal systemic coordination was clearly related to less time spent on knowledge sharing. There were several interaction effects revealing that the relationships between the organizational characteristics and knowledge sharing were more complex.

Interdependency had clearly a large direct impact; however, our regression result showed that this independency was best dealt with informal coordination. The interaction term interdependency and informal coordination was positively related to time spent on knowledge sharing. When the complexity was low but interdependency high, informal coordination was still preferred, however, also other horizontal coordination resulted in more time spent on knowledge sharing. The existence of hierarchical coordination or unit differences did not seem to influence knowledge sharing, neither satisfaction, nor time spent.

The study was replicated in an organization in the energy sector, but with a lower number of respondents. The standardized regression coefficients, t-values and R^2 for the energy case are

listed in table 4. Again we saw that time and satisfaction, as the two dependent variables indicating knowledge sharing, were unrelated. This organization used the four different kinds of coordination mechanisms, but on average informal coordinating was used the most. Unit differences were again high. T-tests indicated that the energy case used significantly more horizontal coordination, and the cooperating units were less differentiated but more interdependent. Significantly more time was spent on knowledge sharing, but satisfaction with knowledge sharing was significantly lower in the energy case compared to the finance case.

Insert Table 4 about here

Satisfaction with knowledge sharing was not directly related to any of the coordination types. The lower the complexity, the higher was the satisfaction with knowledge sharing. Interdependency reduced satisfaction, and this was even more so when the inter-unit integration was informal. This contradicted the findings for the finance case where interdependency did not related negatively with knowledge sharing, especially not when complexity was low and when informal coordination was present. Our independent variables had little effect on time spent on knowledge sharing. Similar to the finance case, high interdependency and the use of horizontal coordination was related to time spent on knowledge sharing.

Discussion

The dimensions of organization design, specialization, formalization, centralization and coordination, are related to knowledge sharing but not fully to the extent and in the directions

suggested by the literature. Our data confirmed the expected effect of specialization on knowledge sharing, namely, more complex knowledge was making sharing harder and interdependencies were requiring more time spent on sharing. Knowledge complexity was leading to less satisfaction with knowledge sharing in both companies. This is in line with the literature that has pointed at the characteristics of knowledge influencing the extent to which knowledge can and will be shared (Morten T. Hansen, 1999; G. Szulanski, 2000). Task interdependency between units clearly urges the units to spend more time on knowledge sharing. This confirms the assumption that interdependency does not only require the sharing of more information but also of more knowledge (Daft & Lengel, 1986; Galbraith, 1977). Interesting is the fact that interdependency and knowledge complexity are uncorrelated, meaning that it is not the task dependency in which knowledge is embedded that makes knowledge more complex.

The effects of the other dimensions were far less clear. The negative effect of centralized coordination on knowledge sharing was only very weakly present. Hierarchy, for instance, seemed not to affect knowledge sharing at all. Hence, no evidence was found for ineffective knowledge sharing due to an agency problem or due to the control aspect (Jensen & Meckling, 1992; Tsai, 2002). The use of systems lead, in one of the cases, to less time spent on knowledge sharing, which indicated that centralized systems might have lead to less knowledge sharing. This was strengthened by the fact that more decentralized coordination (horizontal coordination) lead to more knowledge sharing. However, the combination of lack of evidence for hierarchy and the presence of evidence for systems, might indicate that it is not so much the centralization character of these two coordination mechanisms that is at play here, but more the inflexible and unfitted character of systems for facilitating processes, such as knowledge sharing, that can not be fully stipulated in advance (Galbraith, 1973; Grant,

1996; Peter M. Senge, 1994). Hence, some evidence is found to support hypothesis 1a; however, the evidence is weak because of the lack of relationships found with hierarchy.

Hypothesis 1b on the negative effect of formalization on knowledge sharing must be rejected because informal coordination did not increase knowledge sharing. This is surprisingly because informal coordination is mentioned as a true knowledge integrator (Burt, 1997; Morten T. Hansen, 1999; Jarvenpaa & Staples, 2001). It is especially the presence of horizontal coordination that made a positive difference to knowledge sharing. Our data, thus, showed clear evidence that horizontal coordination was bringing different knowledge stocks together as assumed in the literature (Boone & Van Olffen, 2000; Gold, Malhotra, & Segars, 2001; Morten T. Hansen, 1999; Nonaka & Takeuchi, 1995). Knowledge sharing is somewhat forced through literally putting people together and impose them to cooperate in a certain project or task group.

Informal coordination was affecting knowledge sharing only in combination with other variables. Especially the level of interdependency seems to be crucial. Interdependency was related to dissatisfaction with knowledge sharing in the energy case. This dissatisfaction became even larger when interdependency was high. Such relationship was not found in the data of the finance case. On the contrary, the combination of informal coordination and high interdependency lead to more time spent on knowledge sharing or, in other words, high interdependency was best dealt with using informal coordination. Hence, the effect of informal inter-unit coordination was context-dependent. In the finance case, the data indicated that the lower formalization, the more knowledge shared; while in the energy case, the data indicated no clear relationship between formalization and knowledge sharing. Additional

insights into the working of the energy company might provide an –although not tested- explanation. This insight taught us that formalization was perceived differently.

In the finance case, the strong formalization led to some levels of bureaucracy with the usual inefficiencies. Even horizontal coordination was still rather formal. Systems were not used for knowledge sharing but only for planning, control and standardization (Makhija & Ganesh, 1997), reducing the need and possibilities for more ad hoc communication and personal inter-unit relationships (Grant, 1996). Consequently, it also reduced time spent on knowledge sharing. In this case, the less formalization, the better it seemed to be for knowledge sharing. In the energy case study, this was not the case. Systems did not have a negative effect. Systems were also highly negatively correlated with informal coordination in the energy case, indicating that the two were not used together. We assume that informal coordination was just too informal to share enough knowledge required for an adequate working of the organization; especially, when a high need for knowledge sharing was present due to high interdependency. In this case study, the need for complex inter-unit cooperations raised a lot in the recent years before our study was conducted; an organizational change that caused problems. Only horizontal coordination was sufficiently decentralized and reached an adequate level of formality to facilitate the required knowledge sharing. Recent literature on inter-unit coordination have indicated that the less tight and formalized the horizontal coordination, the better this would be for knowledge sharing (Ayas & Zeniuk, 2001). The communities of practice literature e.g. mentions that communities can be formally established as a kind of formal networking but should be sufficiently loosely organized to allow spontaneous and rich sharing of information and knowledge (Ayas & Zeniuk, 2001; Wenger & Snyder, 2000). Hence, this 'the more informal, the better' idea is not fully supported by our

data. This parallels the findings of Brown and Eisenhardt (1997) on the need for an intermediate level of structure to achieve successful organizational change and innovations.

Several other relationships, all influenced by the level of interdependency, appeared only in the finance case. Clearly, interdependency had a huge impact on knowledge sharing directly and indirectly through the interaction with the other organizational design dimensions. More time was spent on knowledge sharing, as already mentioned, when interdependency was high and when this was combined with informal coordination. This was even more the case when complexity was not too high. More complex knowledge was harder to share, which resulted in less knowledge sharing, even when, due to high interdependency, there was a high need for sharing. In such situations (low complexity and high interdependency), decentralized coordination was still preferred. This rejects hypothesis 2c for the finance case. Hypothesis 2b is only partly confirmed because there was no interaction effect found with interdependency and horizontal coordination only.

Hypothesis 2a is also rejected because no interaction effects were found with complexity and decentralized coordination only (i.e. without interference of interdependency) and, moreover, decentralized coordination was more effective for knowledge sharing when complexity was low. Hence, even decentralized coordination can not fully cope with the knowledge complexity. Horizontal and informal coordination are said to be useful for sharing complex knowledge because of the personal contacts in such interactions (Galbraith, 1994; Grant, 1996). However, we must conclude from our data that the fact that horizontal coordination can deal with complexity and allow richer 'information sharing' (Daft & Lengel, 1986) can not be extended to the sharing of complex knowledge. Sharing such knowledge is very difficult, slow and requires a lot of effort and good intentions (M. T. Hansen, 2002; O' Dell &

Grayson, 1998). Sharing knowledge with a low level of transferability is hard even when people have frequent personal contacts, such as in horizontal coordination. All coordination types are able to handle knowledge sharing better when the knowledge is better transferable but horizontal coordination is assumed to be better than other coordination types in sharing such knowledge. The fact that the use of horizontal coordination resulted in satisfaction on knowledge sharing is confirming this assumption. Another reason might be that horizontal coordination has clear operational goals, such as dealing with the task interdependency between the units, and that knowledge sharing is just another minor goal quickly neglected when the knowledge sharing is too hard and is taking too much effort away from the higher priority goals (O' Dell & Grayson, 1998). Finally, it is known that people have a tendency to share knowledge that is already in common and thus more easily shareable (Stasser & Titus, 1987; Stasser & Vaughan, 2000). Informal coordination is also referred to as being useful for sharing hard to transfer knowledge because of the larger commitment and willingness in informal coordination and the large social control forcing pro-social behavior even when great efforts need to be made (Granovetter, 1973; Morten T. Hansen, 1999; Jarillo, 1988; Jarvenpaa & Staples, 2001). However, none of our cases did reveal that informal networking was particularly used for dealing with complex knowledge.

Unit differences had no direct impact on knowledge sharing, but there was an indirect impact on satisfaction and again in combination with interdependency in the finance case. Thus, units that are highly interdependent will be more satisfied with the knowledge sharing when the unit differences are not that high. Satisfaction was further increased when informal coordination was also used.

Remarkable, however, is the fact that the time spent on knowledge sharing was not directly influenced by knowledge complexity. Time spent on knowledge sharing is measuring the time people spent on sharing the knowledge that is required in the particular cooperation but this can be a negative as well as a positive sign. More time spent on knowledge sharing can mean that the parties are more willing and interested in sharing their knowledge. It can also mean that the units, which absolutely need to share knowledge to perform the tasks, have to spend more time on sharing knowledge because of difficulties in the sharing process. However, the existence of an interaction effect with interdependency and complexity, indicating that more time is spent when complexity is low, even with high interdependency, does not support the latter argument.

Conclusions

Our results indicated in the first place that the organizational structure dimensions affect knowledge sharing. Hence, there is a need to reconsider the differentiation-integration balance in organizations to optimize knowledge sharing. The classic organization theory literature has paid attention to the role of coordination to handle the integration of differentiated tasks and interdependent tasks (Daft, 1995; Hatch, 1997; Khandwalla, 1977; Mintzberg, 1979). Classic organization theory has also linked coordination choices with technology characteristics (Perrow, 1967; Thompson, 1967). However, knowledge sharing was not yet considered as a determining factor in organization design, with an exception for the work of Birkinshaw e.a. (2002). They have already contributed to the classic organization theory through considering knowledge as a contingency variable and by empirically studying the impact of the embeddedness and observability of units' knowledge on unit autonomy and integration. We have build on this first step of a renewal of the classic organization theory. We provided

evidence of the importance of interdependency, knowledge complexity and unit differences, caused by firm specialization, in choosing the kind of integration, in terms of level of centralization and formalization of inter-unit coordination.

Horizontal coordination is preferable but can not compensate for high specialization increasing knowledge complexity and unit differences. The effect of formalization is clearly context dependent, depending on whether informal coordination still suffices to cope with the interdependency. Therefore, we suggest that there might be an optimum in the formalization required for knowledge sharing, because almost complete absence of formalization and strong formalization are both not optimal for enhancing knowledge sharing. The variable interdependency is clearly a neglected factor in knowledge management research. Our data suggested that interdependency remains crucial when we bring knowledge into the classic organization design choices. Interdependency determines the integration choices and plays an important factor in finding a balance in differentiation and integration of units in organizations (Grandori, 1997b; Thompson, 1967).

On the one hand, our data supports the contingency view on organization design and indicates that such view still has its benefits (Birkinshaw et al., 2002; Drazin & Van De Ven, 1985; Gresov, 1989; Schoonhoven, 1981). Even with knowledge in the picture, statements can be made about optimal design choices, for instance the need for horizontal and moderated formal coordination. On the other hand, our multiple case approach reveals that the relationships found are organization-dependent, suggesting that a contingency view might be limited. Knowledge is making the differentiation-integration balance more complex and the embeddedness of knowledge in its context might make it very hard to formulate general organization design principles that optimize intra-organizational knowledge sharing.

Organizations are also continuously changing, making organization design unstable, always under construction and under pressure (J. S. Brown & Duguid, 2001).

Nonetheless, practitioners are confronted daily with organization design choices and have to consider the consequences of these choices, among other, on the optimal use and sharing of knowledge. Insight into how knowledge changes our ideas about organization design is therefore relevant. There has been a strong emphasis on the sticky character of knowledge and the social aspect of sharing in the knowledge sharing literature, but the relationship with organization structure is underexplored. Our study intended to contribute in completing this gap in the literature.

Important limitations to our study are the cross-sectional character of the empirical study and the fact that we need to be cautious when assuming causal relationships based on a cross-sectional field study. The first step in further research should therefore be longitudinal research, which is better to detect causal relationships, studying processes and change patterns (Leonard-Barton, 1990; Pettigrew, 1990; Stoecker, 1991). Knowledge sharing involves a change process because old knowledge and mental models often need to be abandoned to be able to absorb new knowledge (Argote & Ingram, 2000; Kim, 1993). We studied whether knowledge was shared, and how satisfied the people are with the sharing but we did not go a step further, namely looking to what extent the people involved in the sharing process are making continued use of the shared knowledge.

Further research should also include other organization design dimensions, such as size, strategic choices, culture and incentives. The changes in knowledge sharing behavior due to different incentive structures are touched in the knowledge literature but not fully developed

(Osterloh & Frey, 2000). Empirical research might reveal if incentives could overcome the drawbacks of particular design features.

REFERENCES

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes, 82*(1), 150-169.

Argyres, N. (1995). Technology strategy, governance structure and interdivisional coordination. *Journal of Economic Behavior and Organization, 28*, 337-358.

Augier, M., Shariq, S. Z., & Vendelo, M. T. (2001). Understanding context: Its emergence, transformation and role in tacit knowledge sharing. *Journal of knowledge management, 5*(2), 125-136.

Ayas, K., & Zeniuk, N. (2001). Project-based learning: Building Communities of Reflective Practitioners. *Management Learning, 32*(1), 61-76.

Bacharach, S. B., & Aiken, M. (1976). Structural and process constraints on influence in organizations: A level specific analysis. *Administrative Science Quarterley, 21*(4).

Baumard, P. (1999). *Tacit knowledge* (S. Wauchope, Trans.). London: Sage.

Becerra-Fernandez, I., & Sabherwal, R. (2001). Organizational knowledge management: A contingency perspective. *Journal of Management Information Systems, 18*(1), 32-55.

Birkinshaw, J., Nobel, R., & Ridderstrale. (2002). Knowledge as a contingency variable: Do the characteristics of knowledge predict organization structure? *Organization Science, 13*(3), 274-289.

Boone, C., & Van Olffen, W. (2000). Psychological team diversity and strategy implication: theoretical considerations and an empirical study. Maastricht University.

Brown, J. S., & Duguid, P. (2001). Knowledge and organization: A social-practice perspective. *Organization Science, 12*(2), 198-213.

Brown, S. l., & Eisenhardt, K. M. (1997). The art of continuous change: linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative science quarterly, 42*(1), 1-35.

Buckley, P. J., & Carter, M. J. (1999). Managing cross-border complementary knowledge. *International Studies of Management and Organisation, 29*(1), 80-104.

Burt, R. S. (1997). The contingent value of social capital. *Administrative Science Quarterley, 42*, 339-365.

Cunningham, G. B., & Rivera, C. A. (2001). Structural designs within american intercollegiate athletic departments. *The International Journal of Organizational Analysis., 9*, 369-390.

Daft, R. L. (1995). *Organization theory & design* (5 ed.). Minneapolis, St. Paul: West Publishing Company.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science, 32*(5), 554-571.

De Long, D. W., & Fahey, L. (2000). Diagnosing cultural barriers to knowledge management. *Academy of management executive, 14*(2).

Drazin, R., & Van De Ven, A. H. (1985). Alternative forms of fit in contingency theory. *Administrative Science Quarterley, 30*, 514-539.

Edelman, L. F., Bresnen, M., Newell, S., Scarbrough, H., & Swan, J. (2002, 5-6 April). *The darker side of social capital.* Paper presented at the OKLC, Athens.

Egelhoff, W. G. (1991). Information-processing theory and the multinational enterprise. *Journal of international business studies, 22*(third quarter), 341-367.

Galbraith, J. R. (1973). *Designing complex organizations*. Reading, Mass.: Addison-Wesley Publishing Company.

Galbraith, J. R. (1977). *Organization design*. Reading, Mass.: Addison-Wesley Publishing Company.

Galbraith, J. R. (1994). *Competing with flexible lateral organizations* (2 ed.). Reading, Mass.: Addison-Wesley Publishing Company.

Gargiulo, M., & Benassi, M. (2000). Trapped in your own net? Network cohesion, structural holes, and the adaptation of social capital. *Organization Science, 11*(2), 183-196.

Ghoshal, S., Korine, H., & Szulanski, G. (1994). Interunit communication in multinational corporations. *Management Science, 40*(1), 96-110.
Gold, A. H., Malhotra, A., & Segars, A. H. (2001). Knowledge Management: An organizational capabilities perspective. *Journal of Management Information Systems, 18*(1), 185-214.
Grandori, A. (1997a). Governance structures, coordination mechanisms and cognitive models. *The Journal of Management and Governance, 1*(1), 29-47.
Grandori, A. (1997b). An organizational assessment of interfirm coordination modes. *Organization Studies, 18*(6), 897-925.
Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 6*, 1360-1380.
Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17*(Winter Special), 109-122.
Gresov, C. (1989). Exploring fit and misfit with multiple contingencies. *Administrative Science Quarterley, 34*(3), 431-453.
Gresov, C., & Stephans, C. (1993). The context of interunit influence attempts. *Administrative Science Quarterley, 38*(2), 252-270.
Gupta, A. K., & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal, 21*, 473-496.
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis* (5 ed.). New Jersey: Prentice Hall.
Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterley, 44*, 82-111.
Hansen, M. T. (2002). Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science, 13*(3), 232-248.
Hatch, M. J. (1997). *Organization theory*. New York: Oxford University Press.
Hislop, D., Newell, S., Scarbrough, H., & Swan, J. (1997). Innovation and networks: Linking diffusion and implementation. *International Journal of Innovation Management, 1*(4), 427-448.
Hoopes, D. G., & Postrel, S. (1999). Shared knowledge, "glitches" and product development performance. *Strategic Management Journal, 20*, 837-865.
Jarillo, J. C. (1988). On strategic networks. *Strategic Management Journal, 9*, 31-41.
Jarvenpaa, S. L., & Staples, D. S. (2001). Exploring perceptions of organizational ownership of information and expertise. *Journal of Management Information Systems, 18*(1), 151-183.
Jensen, M., & Meckling, W. (1992). Specific and general knowledge, and organizational structure. In L. Werin & H. Wijkander (Eds.), *Contract Economics* (pp. 251-274). Oxford: Basil Blackwell.
Khandwalla, P. N. (1977). *Design of organizations*. New York: Harcourt Brace Jovanovich.
Kim, D. H. (1993). The link between individual and organizational learning. *Sloan Management Review, Fall*, 37-50.
Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity, and learning. *Organization Science, 7*(5), 502-518.
Kramer, R. M. (1999). Trust and distrust in organizations: Emerging perspectives, enduring questions. *Annual Review Psychology, 50*, 569-598.
Lam, A. (1997). Embedded firms, embedded knowledge: problems of collaboration and knowledge transfer in global cooperative ventures. *Organization Studies, 18*(6), 973-996.
Leonard-Barton, D. (1990). A dual methodology for case studies: synergistics use of a longitudinal single site with replicated multiple sites. *Organization Science, 1*(3), 248-266.
Levinthal, D. A., & March, J. G. (1981). A model of adaptive organizational search. *Journal of Economic Behavior and Organization, 2*, 301-333.
Levitt, B., & March, J. (1988). Organizational learning. *Annual Review Sociology, 14*, 319-340.
Lipsey, M. W. (1990). *Design sensitivity: Statistical power for experimental research*. London: Sage Publications.
Makhija, M. V., & Ganesh, U. (1997). The relationship between control and partner learning in learning-related joint-ventures. *Organization Science, 8*(5), 508-527.
Martinez, J. I., & Jarillo, J. C. (1989). The evolution of reseach on coordination mechanisms in multinational corporations. *Journal of international business studies, 20*(3), 489-514.

Miller, D., & Droge, C. (1986). Psychological and traditional determinants of structure. *Administrative science quarterly, 31*, 539-560.
Mintzberg, H. (1979). *The structuring of organizations*. Englewood Cliffs: Prentice Hall.
Mintzberg, H. (1989). *Mintzberg on management*. New York: Free Press.
Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.
Nunnally, J. C. (1978). *Psychometric theory*. New York: McGraw-Hill.
O' Dell, C., & Grayson, J. C. (1998). If only we knew what we know: Identification and transfer of internal best practices. *California Management Review, 40*(3), 154-174.
Osterloh, M., & Frey, B. S. (2000). Motivation, knowledge transfer, and organisational forms. *Organization Science, 11*(5), 538-550.
Perrow, C. (1967). A framework for comparative organizational analysis. *American Sociological Review, 32*(2), 194-208.
Perrow, C. (1970). *Organizational analysis: A sociological view*. London: Tavistock Publications.
Peter, J. P. (1979). Reliability: A review of psychometric basics and recent marketing practices. *Journal of marketing research, 16*(Februari), 6-17.
Peterson, R. A. (1994). A meta-analysis of Cronbach's Coefficient Alpha. *Journal of Consumer Research, 21*(September), 381-391.
Pettigrew, A. M. (1990). Longitudinal field research on change: Theory and practice. *Organization Science, 1*(3), 267-292.
Podsakoff, P. M., & Organ, D. W. (1986). Self-reports on organizational research: problems and prospects. *Jounal of Management, 12*(4), 531-544.
Polanyi, M. (1997). Tacit knowledge. In L. Prusak (Ed.), *Knowledge in organizations* (pp. 135-146). Boston: Butterworth-Heinemann.
Schoonhoven, B. C. (1981). Problems with contingency theory: Testing assumptions hidden within the language of contingency theory. *Administrative Science Quarterley, 26*, 349-377.
Senge, P. M. (1994). *The Fifth Discipline: The Art & Practice of The Learning Organization* (1 ed.). New York: Currency Doubleday.
Senge, P. M. (1997). Looking ahead. *Harvard Business Review*(September-October), 30-32.
Simon, H. A. (1997). *Administrative behavior* (4 ed.). New York: The Free Press.
Stasser, G., & Titus, W. (1987). Effect of information load and percentage of shared information on the dissemination of unshared information during group discussion. *Journal of Personality and Social Psychology, 53*, 81-93.
Stasser, G., & Vaughan, S. I. (2000). Pooling unshared information: the benefits of knowing how access to information is distributed among group members. *Organizational Behavior and Human Decision Processes, 82*(1), 102-116.
Stoecker, R. (1991). Evaluating and rethinking the case study. *Sociological Review, 39*(1), 88-112.
Szulanski, G. (1996). Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal, 17*(Winter Special Issue), 27-43.
Szulanski, G. (1998). *Doing empirical research on internal stickiness.* Paper presented at the AOM, San Diego.
Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes, 82*(1), 9-27.
Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.
Tsai, W. (2002). Social structure of "coopetition" within a multinunit organization: Coordination, competition, and interorganizational knowledge sharing. *Organization science, 13*(2), 179-190.
Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal, 17*(Winter Special), 11-25.
Van De Ven, A. H., Delbecq, A. L., & Koenig, R. (1976). Determinants of coordination modes whitin organizations. *American Sociological Review, 41*(April), 322-338.
Van den Bosch, F. A. J., Volberda, H. W., & de Boer, M. (1999). Coevolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities. *Organization Science, 10*(5), 551-568.

Wenger, E. C., & Snyder, W. M. (2000). Communities of practice: The organizational frontier. *Harvard Business Review*(January-February), 139-145.
Yin, R. K. (1994). *Case study research: Design and methods*. Thousand Oaks, CA: Sage.
Zack, M. H. (1999). Developing a knowledge strategy. *California Management Review, 41*(3), 125-145.
Zander, U., & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test. *Organization Science, 6*(1), 76-92.

APPENDIX 1: OPERATIONALIZATION OF THE VARIABLES IN THE QUESTIONNAIRE

Satisfaction with knowledge sharing

Partly based on the research of Becarra-Fernandez and Sabherwal (2001) and Hoopes and Postrel (1999).

How satisfied are you with the exchange of information and experiences during cooperation between the units?

Was some specific information that was not shared or revealed the cause of delay or lower performance?

There was sufficient sharing of experiences and ideas during the cooperation

Lack of information has disturbed the task accomplishment and cooperation

scales used: not at all, rarely, regularly, often, continuously; not at all, to some extent, partly, to a great extent, completely.

Times spent on knowledge sharing

Objectification of intensity of knowledge sharing through objective measurement of times spent on the sharing of knowledge.

How much time did you spend on expressing your knowledge and experiences in oral communication to share it with the other units?

How much time did you spend on expressing your knowledge and experiences in written communication (exclusive the collection of information and writing reports) to share it with the other units?

scale: hardly any time spent, less than 2% of the time spent on the project, between 2 and 10%, between 10 and 25%, more than 25%

Operationalization of the Independent Variables

Formal systems

The scale on use of systems is based on the theory on coordination mechanisms (such as: Galbraith (1973) and Mintzberg (1979)).

Formal procedures determine how we work together with the other unit

Information is mainly held in and exchanged through a large number of reports and formal documents

We have clear goals for our daily work performance

In general, our work is subject to a large number of rules

The information that is required to do my job is laid down in procedures, goals and rules

Hierarchy:

The scale on hierarchy is inspired by the questionnaire of Bacharach and Aiken (1976) and the theory of Simon (1997).

Our work methods follow from the decisions of our supervisors.

Our direct supervisors decide how we should execute our tasks

Decisions of our supervisors determine how we work

Our bosses have large impact on our way of working

Horizontal coordination

The first two items are copied from Miller and Dröge (1986), while the other three items are newly developed and tested.

Inter-unit teams are set up to allow for cooperation and joint decision-making

Task forces (project teams) are set up to facilitate inter-unit collaboration

Information and experiences are often shared in meetings or during teamwork

The person responsible for the cooperative activities is authorized to make all the necessary agreements with the other unit in order to facilitate cooperation

Informal coordination

The scale is based on the theory on personal networking, such as Edelman (2002) and Hansen (1999).

We coordinate the activities with the other unit informally via personal contacts

We confer directly with our personal contacts without consulting our supervisors

We contact directly the colleagues who we know well in the other unit when we need information

Cooperation with the other unit is based on personal contacts in that unit

Items are on a 5-point scale: totally disagree, disagree, neutral, agree, totally agree.

Interdependency

items copied from Gresov and Stephans (1993) (α=0.8), except last item

To what extent are the members of your unit depending on the other unit for doing their respective jobs?

To obtain the information and materials needed to do their tasks, how much do members of your unit have to rely on the other unit?

After your unit members finish their part of the task, how much do they rely on the other unit to perform the next steps in the process before the total task or service is completed?

For your unit to accomplish their objectives, how much do you need services, resources or support from other unit?

scales used: not at all, rarely, regularly, often, continuously; not at all, to some extent, partly, to a great extent, completely.

Knowledge complexity

Based on Hansen (1999), Zander and Kogut (1995) and the literature on tacit knowledge, such as Baumard (1999); Polanyi (1997) and Tsoukas (1996).

Is the information that your unit acquired from the other unit written down?:

Is the information that your unit received from the other unit clearly explained and clarified, in order for your unit to be useful?

(Scale used: no, limited, partly, mainly, completely)

Everyone in the other unit easily understands the know-how and information that we are sharing with them

Sharing experiences with the other unit is a quick and easy job

Even without specific skills, the other unit can understand the work and experiences of our unit

A brief explanation is sufficient to understand the information that we share with the other unit.

We can share our experiences with each one of the other unit

We can explain to the other unit what competencies and skills we have

It is possible to express what we know in order to explain it to the other unit

Explaining how we do things to the other unit is possible

We can express and explain what we know to the other team

Unit differences

based on theory on common knowledge and absorptive capacity, such as Augier e.a. (2001); Cohen and Levinthal (1990); Kogut and Zander (1996)The daily tasks are very similar in the two units

People in the two units have similar skills

People in the two units have comparable jobs

Our backgrounds (such as experience or training) are similar to the ones in the other unit

Table 1: Means, Standard Deviations and Bivariate Correlations of the variables for the financial case study (Cronbach alphas in italic on diagonal).

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9
systems	3.34	0.61	*0.67*								
hierarchy	3.15	0.70	0.34**	*0.83*							
horizontal	3.23	0.76	0.16*	-0.02	*0.61*						
informal	3.73	0.61	-0.05	-0.11	0.18**	*0.54*					
interdependency	2.60	0.80	0.02	-0.07	0.31**	0.04	*0.74*				
complexity	2.49	0.45	-0.21**	+0.03	-0.25**	-0.13*	-0.00	*0.77*			
unit differences	3.67	0.70	-0.12	-0.11	+0.06	-0.00	+0.21**	-0.16*	*0.79*		
time	2.61	1.08	-0.17**	-0.06	0.30**	0.10	0.46**	-0.03	-0.10	*0.73*	
satisfaction	3.75	0.59	0.11	-0.07	0.28**	0.19**	-0.03	0.52**	0.13*	0.06	*0.71*

n=249
** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 2: Means, Standard Deviations and Bivariate Correlations of the variables for the energy case study (Cronbach alphas in italic on diagonal).

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9
systems	3.39	0.64	*0.63*								
hierarchy	3.23	0.65	0.36**	*0.70*							
horizontal	3.44	0.69	0.18*	0.14	*0.58*						
informal	3.73	0.57	-0.24**	-0.11	-0.09	*0.53*					
interdependency	3.10	0.80	0.15	0.10	0.01	-0.23**	*0.76*				
complexity	2.51	0.43	-0.26**	+0.09	-0.40**	-0.10	+0.13	*0.78*			
unit differences	3.39	0.85	-0.21**	-0.10	-0.09	-0.02	+0.19*	-0.30**	*0.83*		
time	3.22	0.93	0.02	-0.04	0.20*	0.01	0.17*	0.08	-0.13	*0.74*	
satisfaction	3.44	0.66	-0.03	-0.21**	0.26**	0.12	-0.26**	0.60**	0.16*	0.00	*0.73*

n=152
** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 3: Regression analysis (finance case)

	regression on satisfaction with knowledge sharing		regression on time spent on knowledge sharing	
	beta	t-value	beta	t-value
systems	0,01	0,19	-0,22	-3,59**
hierarchy	-0,06	-1,01	0,04	0,72
horizontal	0,17	2,81**	0,22	3,56**
informal	0,10	1,79	0,04	0,77
interdependency	-0,07	-1,27	0,40	6,86**
complexity	-0,45	-7,95**	+0,04	+0,72
unit differences	-0,06	-1,04	-0,03	-0,48
interdependency*informal			Δ R^2: 0.014*	
interdependency*complexity			Δ R^2: 0.012*	
interdependency*related	Δ R^2: 0.019*			
interdependency*related*informal	Δ R^2: 0.017*			
interdependency*complexity*horizontal			Δ R^2: 0.016*	
interdependency*complexity*informal			Δ R^2: 0.025**	
	adj. R^2: 0.30		adj. R^2: 0.26	
	n=250		n=250	

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Table 4: Regression analysis (energy case)

	regression on satisfaction with knowledge sharing		regression on time spent on knowledge sharing	
	beta	t-value	beta	t-value
systems	-0.14	-1.82	0,01	0,11
hierarchy	-0.11	-1.50	-0,06	-0,74
horizontal	0.07	0.92	0,20	2,31*
informal	-0.02	-0.31	0,06	0,72
interdependency	-0.16	-2.42*	0,17	2,05*
complexity	-0.58	-7.56**	-0,04	-0,41
unit differences	+0.01	+0.14	+0,12	+1,45
interdependency*informal	ΔR^2: 0.016*			
	adj. R^2: 0.40		adj. R^2: 0.05	
	n= 155		n= 145	

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)