INTERNATIONAL DESIGN CONFERENCE - DESIGN 2012
Dubrovnik - Croatia, May 21 - 24, 2012.

DESIGN 2012

KNOWLEDGE SHARING IN PRODUCT DEVELOPMENT– EXPLORING THE EFFECTS OF POWER STRUGGLE AND TASK CONFLICT

A. Karlsson and K. Lund

Keywords: knowledge sharing, debate, conflict, hoarding of information, innovation

1. Introduction

For organizations that strive to generate new products and processes, creating and sharing new knowledge are central activities. These activities are, however, not new phenomena, and for centuries, master craftsmen have passed on their knowledge to apprentices and workers have exchanged ideas and know-how on the job. Yet lately, the foundation of economies has shifted from natural recourses more towards intellectual assets, leveraging the importance of knowledge management [Hansen 1999]. Still, knowledge is fundamentally different from other resources because it is not "owned" by the company but rather by the employee, leading to new challenges for today's organizations.

Two main strategies can be discerned regarding knowledge management (KM): codification (knowledge is codified and stored in databases for easy retrieval and reuse) and personalization (computers are mainly used to help people communicate knowledge) [Hansen 1999]. Consequently, a personalization strategy can be implemented without the support of computers. A distinction has also been made between different categories of knowledge, in that explicit or codified knowledge refers to knowledge that is transmittable in format whereas tacit knowledge has a personal quality that makes it hard to formalize and communicate [Nonaka 1994]. Because tacit knowledge cannot be communicated, understood or used without the person possessing the knowledge, this type of knowledge does not lend itself to be captured via the use of IT networks [Swan 1999]. Therefore, the KM strategy chosen by a company has implications on the type of knowledge shared. McMahon et al. [2004] examined codification and personalization in an engineering design context and stated that the important tasks in engineering design KM involve both personalization and codification. This means that personalization and codification should not be seen as excluding but rather as complementary [McMahon 2004], in the same way as tacit and explicit knowledge are complementary and can grow over time in a process of mutual interaction [Nonaka 1994]. Therefore, the success and impact of knowledge sharing should at least, to some extent, depend on the fit between exchange mechanism and type of knowledge. However, KM theory has perhaps focused too much on knowledge characteristics and exchange mechanisms, neglecting other factors that affect the creation and sharing of knowledge in an organisational context, *e.g.* hoarding of information [Magnusson 2004]. Hoarding happens when people take ownership of information due to a fear of not receiving just recognition or lack trust in people because they may misuse knowledge [Riege 2005]. Therefore, the purpose of this study is to investigate the role of organisational factors, such as time, debate and potential conflict, which may lead to a hoarding of information and thereby harm the innovative ability.

2. Theoretical framing

The objective of KM strategies can be either to enhance exploitation, *i.e.* reduce problems with "reinventing the wheel", or exploration, *i.e.* knowledge is shared and synthesised and new knowledge is created. Although efficiency in the reuse of existing knowledge is important (exploitation), it is largely the exploration through knowledge sharing that allows the development of genuinely new approaches in innovation [Swan et al. 1999]. It is also argued that tacit knowledge rather than explicit knowledge is more valuable to innovation processes [Gant 1996]. Therefore, when sharing knowledge to achieve product innovation, a personalization strategy best supports this goal. This is because employees seeking innovation need to share knowledge that would not allow itself to get captured in document form [Hansen 1999]. Riege [2005] identified several barriers to knowledge sharing that relate to either individuals or groups within or between business functions. Some examples of barriers include communication skills, hoarding, lack of time and trust. Therefore, with knowledge sharing from a more holistic view, the challenge goes beyond the design, implementation and use of different IT tools. Instead, other factors regarding the social context, such as the levels of debate and conflict, hoarding and time for knowledge sharing should be considered.

2.1 Debate, conflict and hoarding of information

Good communication is central in most design activities and affects creative performance. However, communication sometimes involves disagreements between colleagues. According to Isaksen and Ekvall [2010], who studied the influence on innovation of two distinct kinds of tension within the creative climate, namely debate and conflict, the management challenge for innovation is to find the right level of debate without incurring the negative cost of conflict. They describe debate as the exchange of different or opposing points of view. Conflict is also defined as disagreements, but carries a more negative and personal meaning. Debate and conflict coexist when people interact [Isaksen and Ekvall 2010], making it difficult to tell what would be the right level of debate. It also matters what the reason for conflict is. Jehn [1995] studied relationship conflict and task conflict. She showed that relationship conflict was detrimental to performance, regardless of the type of task performed by a group [Jehn 1995]. The effect of task conflict on performance, however, differed depending on the level of routine in the task. Groups with routine tasks were negatively affected by task conflict because of the interference to their routines and standardized processes, causing employees to be distracted from their main work. Still, for groups performing non-routine tasks, conflicts in some cases could even be beneficial. Open discussions and conflict about task content promoted a critical evaluation of problems and decision options, considered important for non-routine tasks [Jehn 1995]. Van Engelen et al. [2001] found a third group of factors in their study of conflict (team polarity) on team performance, besides those that either worsen or improve team performance. This third group of factors showed a typical inverse U-shape, indicating a more sensitive control of team conflict or even a further decomposition of the factors involved [Van Engelen 2001]. The fine line between expressed diversity in opinion and conflict is therefore a paradoxical situation for managers when it comes to supporting innovation. The phenomenon of hoarding, when presumptive knowledge providers keep information to themselves instead of sharing it with others, is another challenge in knowledge sharing [Magnusson 2004]. The phenomenon of hoarding may be a remnant of the old school of thinking (when profitability was reflected by an organisation's output), and knowledge hoarding rather than sharing was believed to benefit career advancements. This is because knowledge sharing was often considered to weaken an employee's corporate position, power or status within the company [Riege 2005].

2.2 Trust and time for knowledge sharing

The phenomenon of hoarding highlights the key factors of trust and openness within the organization when it comes to sharing knowledge. According to Riege [2005], most people are unlikely to share their knowledge if they do not trust that the knowledge will be used correctly or that knowledge is accurate and credible due to the information source [Riege 2005]. Trust is also an important dimension in the creative climate and leads to open and straightforward communication, whereas a lack of trust leads to suspicion between individuals and a fear of being exploited and robbed of their good ideas

[Ekvall 1996]. The level of trust also seems to have a direct influence on the flow of communication and thus the amount of knowledge sharing within and between business functions and subsidiaries [Riege 2005]. Lack of time is another issue regarding knowledge sharing [Magnusson 2004]. Insufficient time to perform work tasks will probably affect how much time is spent on knowledge sharing activities. According to Riege [2005], time can actually be one of the reasons why employees may potentially hoard information, since it takes time to share knowledge with others (transferring it from one person to another or from a tacit into an explicit format). Therefore, people focus instead on tasks that are more beneficial to them [Riege 2005].

3. Research questions and aim of paper

Organisational factors for knowledge sharing and innovation are highly relevant to consider from a design perspective, due to the high knowledge intensity and tacit nature of knowledge that characterises product design [Cantamessa 1999]. This paper aims to explore how organisational factors such as time, debate and conflict (potentially leading to a hoarding of information) relate to knowledge creation, knowledge sharing and ultimately innovation. The research questions that guide our explorative study are:

RQ1: How are conflicts stemming from power and territorial struggles related to knowledge sharing?
RQ2: What effect does trust have on the relationship between conflict and knowledge sharing?
RQ3: How is lack of time related to knowledge sharing?
RQ4: How is knowledge sharing related to the perception of innovativeness among employees?

4. The case companies

Both case companies are Swedish-based multinational corporations that were founded over 100 years ago. Although they invest heavily in R&D and are both product oriented, they also provide services for their customers:

Company A: is a large automotive manufacturer, active in approximately 100 countries and with more than 30,000 employees. The company is an interesting case to study due to its work in implementing lean inspired philosophies in R&D, where the roles of formal and informal leaders as teachers are central. The company develops a highly integrated product, putting stress on the interdisciplinary communication and integration.

Company B: belongs to one business unit of three in a large engineering group, with more than 40,000 employees, and is represented in approximately 130 countries. At the beginning of 2006, a large initiative was taken within the company to identify a new way of working to establish a faster flow for product development projects. The initiative focused on speed and innovation, value for the customer, and to create engagement and motivation among the employees.

5. Method

This research is built on quantitative data with an emphasis on how the employees themselves experience their work environment. While other areas *e.g.* work psychology often uses quantitative data, the field of engineering design research relies more heavily on qualitative data. This study may serve as a compliment, using quantitative tools, applied to the area of engineering design research.

5.1 Data collection

The study was conducted at both companies during the autumn of 2011. Hence, external factors such as recession should not affect the outcome. A self-administrated questionnaire was emailed to the respondents. The questionnaire remained open for a maximum of 21 days in company A and 15 days in company B. In total, 852 individuals received the questionnaire (667 in Company A and 185 in Company B), of which 75% chose to respond (the response rate was 78% in company A and 66% in Company B). Representatives from both companies reviewed the statements to ensure that the formulation was acceptable and would be understood by the respondents. The respondents were asked how well the statements corresponded with the way they experience their work climate. The questionnaire consisted of 11-12 statements regarding background variables, 50 statements to assess

the creative climate [Ekvall 1996] and additional 25-52 statements covering learning, work routines and innovation. For this particular study, the following statements concerning debate, conflict, trust, time, knowledge and innovation were selected for analysis (Table 1).

Table 1. Overview of variables, the statements formulations and scales

Variable	Statement formulation	Scale
Debate	Diversity in opinions is expressed here.*	1-4 Likert
Conflict	People struggle over power and territory*	1-4 Likert
Trust	Conflicts and opposing opinions are dealt with openly and usually solved*	1-4 Likert
Lack of Time	It is very difficult to complete my work tasks in time	1-7 Likert
Knowledge Creation	In our unit it is allowed to spend time on learning new things	1-7 Likert
Documentation of Knowledge	I document what I learn	1-7 Likert
Knowledge Sharing	I share what I learn with my colleagues.	1-7 Likert
Innovation (group level)	We are successful in implementing new ideas to obtain results in my work unit**	1-7 Likert
Innovation (organizational level)	In general my, organization has been successful at innovation**	1-7 Likert

*** These statements have been reformulated due to copyright reasons. The statements are part of the CCQ [Ekvall 1996]. **These statements have previously been used by Isaksen and Ekvall [2010]**

The respondents at Company A included engineers working with development, pre-development, testing and field quality induced re-design of products. Respondents from Company B included employees from product development or product management, application development, design automation or research. Additional respondent groups were managers, project and process managers, mechanics and business planning.

5.2 Variables and research model

A research model was constructed to illustrate the suggested relationships between the selected variables (Figure 1). "Knowledge Sharing" was chosen as the output variable to measure a prerequisite for innovation. The dependence between "knowledge sharing" and innovation was verified through a correlation analysis between the two variables. Two questions were used to assess the level of innovation (Table 1) previously used by Isaksen and Ekvall [2010].

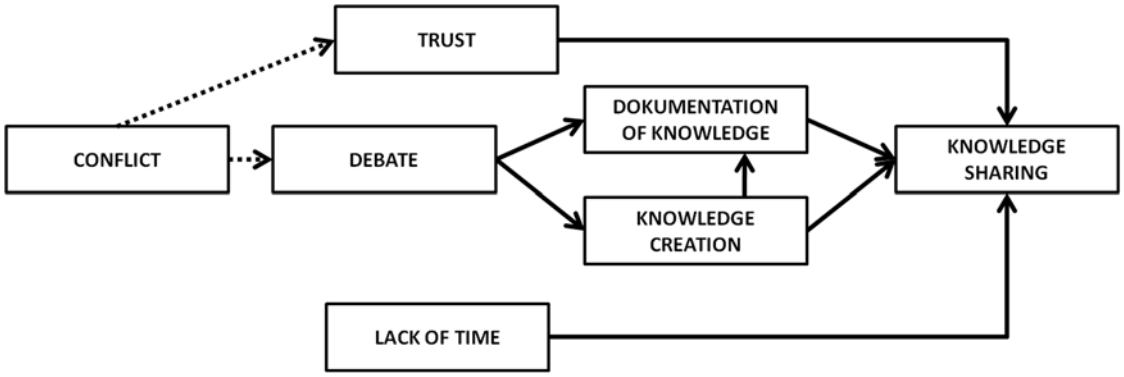

Figure 1. Model of relationship between variables (dotted line: negative relationship, continuous line: positive relationship)

Furthermore, a number of control variables were included in the analysis, including "Company", "Years of service, "Degree of autonomy", "Type of employment" (consultant or hired engineer) and

type of "Position" (design engineer and manager/project manager). Because the analysis was performed on the entire data set, it was important to check for differences between the companies. The difference in product architecture (number of groups working simultaneously with the same product) was a reason to screen for differences in the degree of autonomy between the different companies. The "Degree of autonomy" was assessed with a statement assessing to how large extent people experience that employees make decisions independently. The variables "Years in company" and "Position" were included as control variables, since insight in and knowledge about company processes and organization could possibly affect knowledge sharing behaviour. The distinction between employment types is only relevant for company A because company B generally does not hire consultants. However, Company A hires a significant number of consultants, especially for design engineering tasks, which makes this variable relevant to control for.

5.3 Analysis method

All variables were assessed on either individual or group levels, with the exception of the second statement in the innovation variable, which estimated the perceived level of innovation among the employees on an organizational level. The statement formulations for assessing the variables "Debate", "Conflict", and "Trust" were all chosen to reduce the impact of personal tensions, and thus refine the measurement towards tensions that is dependent on the organisation or the product, and not the person, *i.e.* tensions connected to the actual context. The statistical investigation tool SPSS (IBM) was used to analyse the questionnaire data. A correlation of all analysed variables (including background variables) and between the variables relating to knowledge and innovation were performed to examine their interdependence. A linear regression analysis was then performed in seven steps, in the order described by the flow in Figure 1, with "Knowledge sharing" as the dependent variable. Model 1 includes the control variables alone. In model 2-7 the independent variables were added one by one in the following order: "Conflict" (power struggles), "Debate" (diversity in opinions), "Trust" (conflicts are handled) "Lack of time", "Knowledge creation", and finally "Documentation of knowledge". In addition, two more OLS regressions were performed, although the full result is not included in this paper. Those regressions were modelled the same way as the models 1-5 in the OLS regression described in Table 5, although the dependent variables were "knowledge creation" and "documentation of knowledge", respectively.

6. Results

Table 2 shows the descriptive statistics for the control variables. A total of 623 valid responses were included, whereof 19% of the respondents were from Company B and the average number of years of employment is 9.5 years for the entire population. Approximately 18% of the respondents were consultants, all of which are employed in company A. Of all respondents, 17.6% were managers or project managers with the largest part of the workforce, design engineers, accounting for 48.6%.

Table 2. Descriptive statistics of control variables

	N	Minimum	Maximum	Mean	Std. Deviation
If Company B	642	0.00	1.00	0.1916	-
Years in company	631	0.00	50.00	9.5293	9.75650
If Consultant	636	0.00	1.00	0.1792	0.38386
If manager or project manager	642	0.00	1.00	0.1760	0.38113
If design engineer	636	0.00	1.00	0.4858	0.50019
Valid N (list wise)	623				

Table 3 shows the descriptive statistics for the independent and dependent variables – a total of 602 valid responses (list wise). For the entire dataset, this number reaches 585 respondents. The independent variables use a mix of four-point and seven-point Likert scales.

Table 3. Descriptive statistics of independent and dependent variables

	N	Minimum	Maximum	Mean	Std. Deviation
Debate	622	1.00	4.00	2.8907	0.72517
Conflict	620	1.00	4.00	1.4629	0.70096
Trust	616	1.00	4.00	2.7744	0.74095
Lack of time	616	1.00	7.00	4.2841	1.65440
Knowledge creation	619	1.00	7.00	4.6801	1.51512
Documentation of knowledge	618	1.00	7.00	4.0405	1.49770
Knowledge sharing	616	1.00	7.00	5.0974	1.30550
Valid N (list wise)	602				

A correlation analysis for all control variables, independent variables, and the dependent variable was carried out. This analysis also included the statement regarding to what extent people make decisions independently. This variable was, however, not included in the regression analysis since there was no significant correlation between "Company" and the "Degree of autonomy". The only difference that could be seen between the case companies in the correlation matrix was (besides consultants only hired by company A) that employees in company B had been employed for a longer period (Average 8.89 years in company A compared to 12.22 years in company B).

This study is built upon the notion that learning new knowledge and knowledge sharing have a positive influence on a company's innovative ability. Three variables related to knowledge (creation, documentation and sharing) and two measures of innovation (group and organizational level) are assessed in Table 4. A significant positive relationship is seen between all of the knowledge-related variables and both innovation-related variables, supporting the notion stated above.

Table 4. Correlation matrix of knowledge related variables and innovation related variables. **. Correlation is significant at the 0.01 level (2-tailed)

	1	2	3	4	5
1. Knowledge creation	1	0.335**	0.358**	0.393**	0.345**
2. Documentation of knowledge	0.335**	1	0.501**	0.303**	0.250**
3. Knowledge sharing	0.358**	0.501**	1	0.341**	0.220**
4. Innovation on group level	0.393**	0.303**	0.341**	1	0.509**
5. Innovation on organisational level	0.345**	0.250**	0.220**	0.509**	1

Table 5 shows the results from the OLS regression analysis (standardized coefficients) with the dependent variable "Knowledge sharing". From model 1 to model 7, the increase in explanation of the dependent variable is 31%, with the majority in model 6 and model 7. In model 1, none of the control variables have a significant impact on the dependent variable. In model 2 the independent variable "Conflict", here named power struggles, is added whereby the model answers for 1,2 % of the variation (adjusted R squared) in the dependent variable "Knowledge sharing". In model 3 "Debate" is included and in model 4 "Trust" is added. These models answer for 4.7 % and 6.4 % of the variation in the dependent variable respectively. "Lack of time" is added in model 5 which brings the adjusted R squared to 7.2 %. Finally "Knowledge creation" (model 6) and "Documentation of knowledge" (model 7) are added, answering for 15.3 % and 31.0 % of the variation in the dependent variable respectively. Even though model 1 does not explain any of the variance in the dependent variable there are some results worth mentioned with respect to control variables. Working as a "Design engineer" is significant in models four and five, and the number of years worked in the company is significant in models six and seven, indicates that these two variables are in turn related to variables with both a positive and a negative impact on the dependent variable "Knowledge sharing". The three knowledge-related variables are, as expected, highly connected. Still, there are indications of support to the left part of the model (Figure 1) in models 3, 4 and 5, further supported by additional OLS regression

analysis with "Knowledge creation" and "Documentation of knowledge" as the dependent variables; however these results are not included in this paper.

Table 5. OLS regression analysis (standardized coefficients). Dependent variable is "Knowledge sharing". *p<0,05, **p<0,01, ***p<0,001

	Model						
Variable	1	2	3	4	5	6	7
Intercept							
If Company B	0.015	0.016	0.022	0.011	0.009	0.024	-0.001
Years in company	0.056	0.056	0.047	0.046	0.049	0.107**	0.130***
If consultant	0.049	0.053	0.049	0.051	0.040	0.067	0.050
If manager or project manager	-0.031	-0.038	-0.053	-0.067	-0.053	-0.051	-0.032
If design engineer	-0.074	-0.088	-0.087	-0.101*	-0.096*	-0.066	-0.016
Power struggles (Conflict)		-0.114**	-0.084*	-0.048	-0.04	-0.023	-0.016
Diversity in opinions (Debate)			0.194***	0.15***	0.157***	0.069	0.028
Conflicts are handled (Trust)				0.152***	0.148***	0.107*	0.071
Lack of time					-0.095*	-0.024	0.012
Knowledge Creation						0.320***	0.209***
Documentation of knowledge							0.428***
No of observations	585	585	585	585	585	585	585
F	1.047	2.149	5.098	6.037	6.010	11.581	24.900
R-Squared	0.009	0.022	0.058	0.077	0.086	0.168	0.323
Adj. R-Squared	0.000	0.012	0.047	0.064	0.072	0.153	0.310
Adj. R-Squared change	0.009	0.013	0.036	0.019	0.009	0.082	0.155

The collected results have been summarized in an update of the model described in Figure 1. Figure 2 shows the connections which are significantly supported in either the correlation analysis (the connections between "Conflict", "Debate" and "Trust") or one of the three OLS regression analyses (remaining connections).

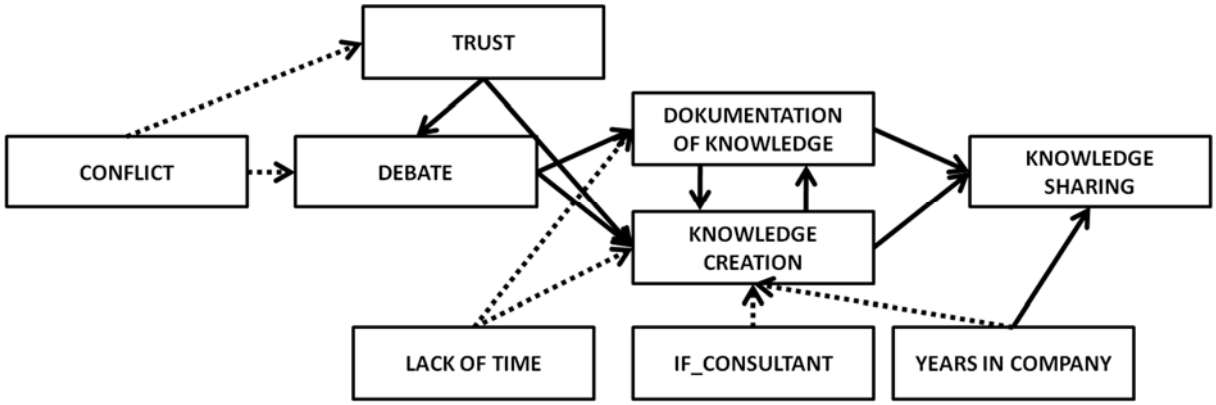

Figure 2. Model of relationship between variables showing all significant connections (dotted line: negative relationship, continuous line: positive relationship)

7. Analysis

As expected, "Knowledge Sharing" seems to depend heavily on to what extent one experience that there is time available to learn new things (Knowledge creation) and "Documentation of knowledge".

It is therefore interesting to study which preceding variables influence these two independent variables. As mentioned, the analysis of data also included two OLS regression analyses where the two variables "Documentation of knowledge" and "Knowledge creation" acted as dependent variables. These OLS regression analysis both supported and rejected parts of the original model described in Figure 1. In this chapter we will revisit the research questions and discuss what implications the analyses have as for supporting or rejecting the original model.

7.1 Revisiting the research questions

RQ1: How are conflicts stemming from power and territorial struggles related to knowledge sharing?
The "Conflict" variable in this study was chosen as a measure of conflict related to product rather than personal tensions, and thus addresses power and territorial struggles. If such struggles exist in an organisation, together with a decrease in knowledge sharing, it could lead to a hoarding of information instead of sharing. Our study shows that power and territorial struggles correlated negatively with "Knowledge sharing". In the OLS regression analysis (Table 5) "Conflict" is significant in model 2 and 3 but not in model 4-7, which indicate a mediating role of the variables "Debate" and "Trust". Conflicts in opinions ("Debate") correlate significantly positive with "Knowledge sharing". The additional OLS regression analysis (not included in this paper) indicates that "Debate" affects "Knowledge creation" and "Documentation of knowledge", which in turn has a positive effect on "Knowledge sharing".
RQ2: What effect does trust have on the relationship between conflict and knowledge sharing?
"Trust" correlates significantly positive with "Knowledge sharing", and its related variables "Knowledge creation" and "Documentation of knowledge". The OLS regression analysis (Table 5) indicates, as stated above, that "Debate" has a mediating role between "Conflict" and "Knowledge sharing". In the OLS regression analysis investigating the relationship between the "Conflict", "Debate" and "Trust" on the variables "Knowledge creation" and "Documentation of knowledge" (full table not included), "Trust" also has a significant effect on both "Knowledge creation" and "Documentation of knowledge".
RQ3: How is lack of time related to knowledge sharing?
"Lack of time" does not directly affect the degree of "Knowledge sharing", though in the OLS regression models where "Knowledge creation" and "Documentation of knowledge" are dependent variables, "Lack of time" was negatively related to both variables. This indicates that if you are struggling to complete your work tasks in time, finding time to learn new things and documenting what you have learned are also difficult. These aspects, in turn, affect how much you share your knowledge with others.
RQ4: How is knowledge sharing related to the perception of innovativeness among employees?
This study supports the ideas that knowledge creation and sharing are fundamental parts of innovation (Table 4). The correlation analysis between knowledge-related variables and innovation-related variables shows that all knowledge variables correlate with the two innovation variables (one on a group level, one on an organisational level). In particular, "Knowledge sharing" affects the perception of innovation on a group level, manifested in the ability to implement new ideas in the work unit.

8. Discussion, implications, and limitations

Isaksen and Ekvall [2011], in their study on the affect of tensions, *i.e.* the dimensions of debate and conflict, on innovation suggest that future investigations should include other climate variables such as trust. This is emphasised because trust might have a moderating or mediating effect between debate, conflict and a variety of outcome measures related to innovation and creativity. In the OLS regression analysis, model 4, it is seen that when trust (openness when handling conflicts) is added to the model, conflicts stemming from power and territorial struggles no longer affect knowledge sharing significantly. Hence, the results of this study indicate that trust in fact has a mediating effect between the conflict variable and knowledge sharing. Trust also contributes positively towards knowledge creation, *i.e.* to what degree is spending time on learning new things permitted. This could be explained by the fact that addressing conflicts openly provides a learning opportunity for the whole team.

According to Magnusson [2004] and Riege [2005] lack of time is a potential barrier for sharing knowledge. More specifically, time can actually be one reason for why employees may hoard information [Riege 2005]. However, the results from this study show that lack of time is not significant for knowledge sharing *per se*. Still, lack of time do affect both knowledge creation and documentation of knowledge (both important predecessors for knowledge sharing) negatively. For a manager aiming to increase knowledge sharing, this implies that he or she should support employees in creating new knowledge and in documentation of this. In product design, with its tacit nature of knowledge [Cantamessa 1999] both a personalization and codification strategy should be svaluable.
Of note, employment as a design engineer is significantly and negatively related to knowledge sharing in models 4 and 5 in the OLS, *i.e.* when the variables "Trust" and "Lack of time" are included in the analysis. When examining the additional OLS with documentation of learning as a dependent variable, engineers document less than other positions in the organisations. Since documentation of lessons learned strongly correlate with knowledge sharing, this may explain the observed behaviour in the OLS regression. This, however, does not necessarily imply that design engineers document too little. Rather, it is possible that other types of positions included in this study greatly document their knowledge, *e.g.* project managers. Also, design knowledge is in fact characterised by a high level of tacit knowledge [Cantamessa 1999] that is difficult to document. Employees who have worked with the company for a long time also seem to document what they have learned to a lesser extent. However, they also perceive that spending time on learning new things is allowed less, which is the most likely reason for their lower degree of documentation. In contrast, experienced employees share their knowledge to a greater extent than less experienced employees (model 6 in Table 5). If experienced employees do not feel that they are allowed to learn new things, this might affect their motivation level for sharing knowledge among other things. This implies that managers neglect the area of supporting experienced employees to learn new things.

8.1 Limitation and future research

In this study, a statement assessing conflict of a product-related nature was chosen. However, the rated level of conflict is very low in both companies, which may be one reason behind the lack of significance for this variable. Expanding the study to include more respondents could possibly give another result. Furthermore, in the study by Jehn [1995] on the benefits and detriments of intra-group conflicts, it was concluded that even if task-related discussions and arguments may assist groups with non-routine tasks to perform well, members of the group may be very dissatisfied with the situation and want to leave. This is a limitation in our study, since we have not assessed how satisfied the employees are with their situation. Another limitation is that only conflict stemming from power and territorial struggles was included in the study, other types of conflicts or a higher degree of power and territorial conflict might lead to a bigger impact on a hoarding of information. Future research should also consider if an inverse U-shape relationship exists for conflict and knowledge sharing, similar to Van Engelen et.al [2001] concerning team polarity and team performance.

9. Conclusions

The purpose of this paper has been to analyse the effects of organisational factors, such as debate, conflicts, trust and lack of time on the levels of knowledge sharing within organisational departments closely connected to design activities. The findings should therefore be valuable for design engineers and managers within product development. The most interesting findings from this study are related to the variables of trust, lack of time and how long an employee has been with the company.

- In the initial model we suggested that trust would have a direct and positive effect on knowledge sharing. However, neither trust, *i.e.* handling conflicts and opposing views openly, nor existence of power and territorial struggles, significantly affected knowledge sharing in this study. This type of conflict, therefore, does not cause a hoarding of information, at least not with levels as low as in this study. What is shown though is that trust serves as a mediating factor between conflicts and knowledge creation, which in turn strongly correlates with knowledge sharing.

- Lack of time is not significant for knowledge sharing *per se* but affects the important predecessors of allowed time for knowledge creation and documentation of new knowledge.
- Employees who have been with the companies for a long time share their knowledge more than newer employees, though experienced employees feel that they are not allowed time to learn new things to the same extent as others. Therefore, there is a risk that experienced employees will become less motivated since they are sharing their knowledge, but feel there is little room for learning new things.

Acknowledgement

The authors would like to thank the case companies and respondents for their valuable time. This research is provided for by SSF (Swedish Strategic Foundation) through the ProViking THINK project and supported by PIEp (Product Innovation Engineering program).

References

Cantamessa, M., "Design Best Practices, Capabilities and Performance", Journal of Engineering Design, Vol.10, No.4, pp. 1999, pp. 305-328

Ekvall, G., "Organizational climate for creativity and innovation", European Journal of Work and Organizational Psychology, Vol.5, No.1, 1996, pp. 105-123

Gant, R., "Toward a knowledge based theory of the firm", Strategic Management Journal, Vol.17, pp.109-122

Hansen, M. T., Nohria, N. and Tierney, T., "What's your strategy for managing knowledge?", Harvard Business Review, Vol.77, No.2, 1999, pp. 106-116

Isaksen, S. G. and Ekvall, G., "Managing for Innovation: The Two Faces of Tension in Creative Climates", Creativity and Innovation Management, Vol.19, No.2, 2010, pp. 73-88

Jehn, K. A., "A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict", Administrative Science Quartely, Vol.40, No.2, 1995, pp. 256-282

Magnusson, M., "Managing the Knowledge Landscape of an MNC: Knowledge Networking at Ericsson", Knowledge and Process Management, Vol.11, No.4, 2004, pp. 261-272

McMahon, C., Lowe, A. and Culley, S., "Knowledge management in engineering design: personalization and codification", Journal of Engineering Design, Vol. 15, No.4, 2004, pp. 307-325

Nonaka, I., "A Dynamic Theory of Organizational Knowledge Creation", Organization Science, Vol.5, No.1, 1994, pp. 14-37

Riege, A., "Three-dozen knowledge-sharing barriers managers must consider", Journal of Knowledge Management, Vol.9, No.3, 2005, pp. 18-35

Swan, J., Newell, S., Scarbrough, H. and Hislop, D., "Knowledge management and innovation: networks and networking", Journal of Knowledge Management, Vol.3, No.4, 1999, pp. 262-275

Van Engelen, J. M. L., Kiewiet, D. J. and Terlouw, P. "Improving Performance of Product Development Teams Through Manageing Polarity", International Studies of Management and Organization, Vol.31, No.1, 2001, pp. 46-63

Anna Karlsson
Industrial PhD student
Department of Business Administration, Technology and Social Sciences
Division of Innovation and Design
Luleå University of Technology
Email: kannar@LTU.se