Learning And Knowledge Management In Construction Projects

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ABSTRACT:

The aim of this paper is to examine the relationship between learning and knowledge management in construction projects. The paper is based on a case study. The material was gathered by qualitative research interviews, altogether 19 people who participated in a construction project were interviewed. It is shown in the papers that there is an important connection between learning and knowledge management in construction projects. If learning is not facilitated as a part of knowledge management of a project or does not happen otherwise, it may compromise the success of the project. This means that there is an important lesson for e.g. project managers to learn about acknowledging learning in projects. Most of the learning is closely related to knowledge management of the project: using knowledge, sharing and combining it, and creating new knowledge. Also, without learning it is often impossible to reach the objectives of the project.

Keywords**:** *Learning, Knowledge management, Inter-organizational projects, Construction, Case study*

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1.   Introduction

The number of projects is increasing everywhere. Many more or less project-based organizations in different industries, like high-tech, manufacturing, construction, and services, recognize that their competitive advantage is based on their ability to deliver projects successfully. One crucial part of this is managing knowledge in projects (e.g. Turner, 2005: ix-x; Pinto, 2005: xi). Bresnen et al. (2005: 81) wrote that comparatively little attention had been directed at examining specific problems associated with managing knowledge in project environments. Albeit a fair amount of research has been conducted in this area since then, there is still need for some case studies to find deeper understanding for how knowledge management works in practice in specific environments (see e.g. King et al., 2008).

Several types of problems caused by a lack of information sharing and knowledge management (amongst other reasons) have been identified in the construction industry: budgets are overrun, timetables are not accurate, and the needs of the end users are not fulfilled (e.g. Naaranoja and Uden, 2007; Love et al., 2004; Anumba et al., 2005: ix). Also Kanapeckiene et al. (2010: 1201) highlight the need for knowledge management in construction. The need for information sharing is emphasized due to the 'cross-functional' or 'inter-organizational' nature of these projects (see e.g. Nycyk, 2011). It is typical for these 'multidisciplinary' projects that the participants in the project team may have different backgrounds: education, working experience, organizational culture, and working procedures. It is, therefore, possible that they do not have 'a common language' (see e.g. Koskinen et al., 2003: 289). This may cause

misunderstandings and affect the end results of the project. One typical problem in knowledge sharing is that knowledge or information is not understood in the right way by the receiver of the message (see e.g. Burley, 2010 for the importance of understanding): the more specialized the issue at hand, the higher the risk that the message cannot be interpreted as was meant. Sometimes learning is needed in order for the information to be understood in the right way. As Fong (2005b:42) states: *"Project team members have to incorporate new information into their understanding to solve technical challenges they meet. Thus, learning is inherent in the work they do"*.

This paper illustrates the role of learning in knowledge management of construction projects. Most of the earlier researchers seem to be talking about either one or the other. However, many issues are the same, just with different labels (see e.g. Griffiths, 2011). This paper aims to combine these two approaches by exploring the connection between learning and knowledge management in construction projects. The focus is on learning that happens *during* a project not *after*, so this paper is not about the "lessons learnt". The paper is structured as follows: The theoretical background and key concepts of the research are introduced in the following section. This is followed by an introduction into the empirical research and the analysis of the research material. Next, the findings are presented and discussed, and, finally, some conclusions are drawn.

2.   The Jungle Of Concepts

This paper concentrates on knowledge management and learning in construction projects. Since there exist a great number of different projects in organizations and since so many definitions have been used for learning and knowledge management it is reasonable to have a look at this jungle of concepts.

2.1.   Projects

In comparison to traditional organizations, projects have some special characteristics that have an influence also on knowledge management and learning. Projects are temporary organizations; they bring people together to form a project team that will vanish when the project ends (see e.g. Pinto, 2005: xi; Fong, 2005a: 105). Thus, it is common that people in projects do not know each other's backgrounds, e.g. what kind of knowledge others do or do not possess. In construction projects, participating in a project may be a once-in-a-lifetime experience for some participants.

The special emphasis in this paper is on inter-organizational projects that bring people together from different organizations, people with different skills and knowledge, experience, and organizational culture (Bresnen et al., 2005: 81). Usually, this is the case when one organization is developing or producing something for clients in another organization, like in a product development project or a construction project. In product development, the client and suppliers are often involved in the process as early as possible to ensure that the product being developed is what the client wants. In construction or information system delivery projects, the basic situation is the same: clients are needed in order to discover their needs and wishes. Using the collective knowledge of the team to serve customers or clients is important in practice, because knowledge is a source of competitive advantage (Prahalad and Hamel, 1990). Also Newell and Huang (2005: 22, 36) find that 'common knowledge' is important for knowledge integration or creation of collective knowledge in projects, although it is not easy to create. 'Common' or 'shared' knowledge means knowledge that is uniform across all members of a team (Hakkarainen et al., 2004: 248).

Leonard-Barton (1995: 4–5) and Fong (2005b: 42) state that knowledge-creating skills are particularly important in contexts where new products or processes are being created or the existing ones enhanced. According to Fong (2005b: 42), the development of a constructed facility can be viewed as a new product development with customers or end users purchasing or using the facility. As Fong (2005b:42) lists, there are several similarities between new product development projects and construction projects. The existing or new knowledge must be utilized to create the 'new product' in a situation where each project is unique, at least to some extent, in terms of both design and construction. The project team also faces several constraints like limited budgets and tight timetables that increase project complexity.

2.2.   Knowledge And Knowledge Management

Davenport and Prusak (1998: 5) see knowledge as something individual: *"it originates and is applied in the minds of knowers"*; but they also say that *"it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms"*. They define knowledge as *"a fluid mix of frame experiences, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information"*. Liebowitz (2005) defines knowledge on the basis of information: when information turns actionable, it is transformed into knowledge. Liebowitz also (2005: 3–5) emphasizes the importance of the context of information and knowledge and the learning process that happens when knowledge is being utilized. Bhatt (2001: 69) defines knowledge as meaningful information. The difference between information and knowledge is the interpretation (Bhatt 2001: 69). Nonaka and Takeuchi (1995:57–58) state that the difference between knowledge and information lies in three issues: *"First, knowledge, unlike information, is about beliefs and commitment. Second, knowledge, unlike information, is about action. And thirds, knowledge, unlike information, is about meaning"*. The first issue means that knowledge is related to a certain perspective or intention of a person. The second issue means that knowledge is related to a specific action which, like the third, emphasizes the idea that knowledge is context-specific.

Another issue that is often connected to knowledge is understanding. Chakravarthy et al. (2003: 306) state that most authors define knowledge *"as a type or degree of understanding that exists at a point of time"*. Chong and Pandya (2003) define knowledge as an understanding one gains through experience, reasoning, intuition, and learning. We expand our knowledge when others share their knowledge. New knowledge is born when we combine our knowledge with the knowledge of others. For the purpose of this research, knowledge is defined as follows: knowledge is information that is understood by a person so that it can be utilized. For example, blueprints that are delivered to customers in construction projects represent information. If customers understand the blueprints so that they can comment on them, then these customers possess knowledge of the issue. Blueprints that are not understood by customers are not very valuable in creating common understanding within a project team.

Knowledge management includes all necessary processes for all the parties in the project to possess all the needed knowledge at the right time. These processes refer to knowledge creation both at the individual level as well as the team level (see e.g. Nonaka and Takeuchi, 1995), knowledge sharing (see e.g. Liebowitz, 2005; Fong, 2005b), which may involve learning, and utilizing knowledge (see e.g. Fong, 2005b). These processes can be realized by organizing meetings, sharing some documents to different parties, facilitating learning by some parties, etc. Also, different media, e.g. face-to-face meetings, e-mail, project databanks, and so on, can be used in knowledge management.

2.3. Learning

The definition of learning used in this paper is strongly based on the social construction perspective on organizational learning. DeFillippi and Ornstein (2003: 27) state that theories with a social construction perspective *"assume that learning is embedded in the relationships and interactions between people. Learning is thus social and is grounded in the concrete situations in which people participate with others"*. Learning always has a context, which means that it is 'situated' (Orr, 1990; Brown and Duguid, 1991). Without a context information or knowledge is hard to learn and difficult to use. As Elkjaer (2003: 44) says: *"the learning content is context specific, and it implies discovery of what is to be done, when and how according to the specific organizational routines, as well as knowing which specific artifacts to use where and how"*.

Learning is often most effective when it has a connection to the learner's own experience, which means that learning is 'practice-based' (Gherardi, 2000). It is possible to learn also from books or experiences of others, but transferring that knowledge to one's own work may then be difficult or even impossible. Learning also has a cultural and social aspect: the culture and other people around the learner have a huge effect on the learning process (Cook & Yanow, 1993; Yanow, 2000). According to Elkjaer (2003: 49–50), *"This means that the organizational actions directed to develop organizational learning cannot solely be focused on chancing individuals' ways of thinking but should be focused on the organizational context, its patterns of participation and interaction"*. Both knowledge and learning are seen in this paper as situated and distributed phenomena. Learning happening in projects is connected to different issues within the projects, and it originates from the needs of the project and project participants. That is, learning is a process of creating understanding in interaction between people. It can happen both at an individual and organizational level.

2.4. The Relationship Of Projects, Knowledge, And Learning

Easterby-Smith and Lyles (2003) examine the connections and the differences of organizational learning and knowledge management. They claim that research in both fields has developed quickly during the last decade and, at the same time, their diversity and specializations have increased. However, there are different overlapping sub-areas, which should be identified for potential synergy. The distinction between learning and knowledge is defined as follows: *"knowledge being the stuff (or content) that the organization possesses, and learning being the process whereby it acquires this stuff"* (Easterby-Smith et al., 2003: 3).
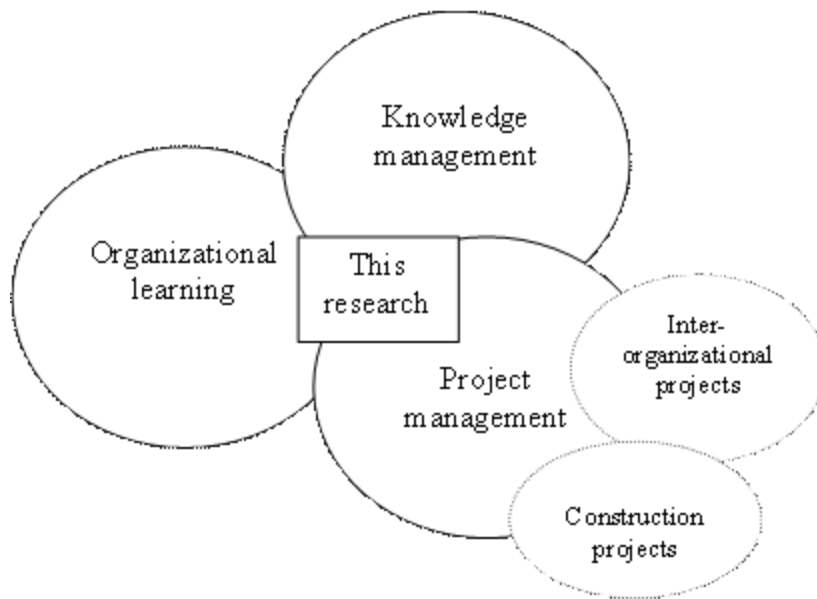
Figure 1: Connection of Learning, Knowledge Management, and Projects.

As depicted in Figure 1, project management, knowledge management, and learning are not detached phenomena, instead they are partly connected with each other. There is a huge amount of required knowledge (being the 'stuff') in the projects. There is usually also some learning happening in the projects, but a great deal of it seems to be incidental. However, if learning is seen as the process of acquiring knowledge as suggested above, this means that learning should be an integral part of knowledge management.

3. The Empirical Research

Since the aim of this research is to understand and describe the connection between learning and knowledge management in construction projects, the research method used is qualitative. Qualitative research methods are typically used when a deeper understanding of a topic is needed. Qualitative research also provides insights on how and what people think and how they react in real-life situations. The case project was a construction project in which a nursing home for senior citizens was thoroughly renovated. The project was introduced because the facilities did not meet today's requirements. There were problems with the condition of the facilities as well as some functional problems. For example, the bathrooms were too small, as most of the patients need nowadays either some aids or assistance. The size of the facilities is about 7 000 m2, and there were places for 120 patients in the building before the renovation. The renovation reduced the number of patient places by a few. The total budget of the project was around 5 700 000 euros.

The interviews were carried out at three different points of time during the project to get a holistic picture of it. Altogether 19 persons were interviewed; five of them twice at different phases of the project. Qualitative research interview was used as the

interviewing instrument so that the interviewees were able to express their opinions freely. This way, also some issues that the interviewer may not have understood to ask in a more formal interview emerged. The sampling technique used to gather the interviewees was snowball sampling (Weiss, 1994:25). The first interviewees were asked for referrals, which then provided further referrals. In practice, the group of interviewees consisted of the design team of the project and some extra representatives of the end users. This method seemed to work well, as a couple of interviewees that the interviewer thought to be important actually had nothing to add to the subject. The interviewees were: two project managers, one of them an architect, five other designers, seven representatives of the end users, three contractors, and two supervisors.

The following themes were discussed in the interviews:

- What kind of phases has there been in the project?

- What kind of successes and failures were experienced during the project?

- How was the cooperation arranged?

- What kind of cooperative tools have been used?

- Who are the important persons in the project (for sampling)?

These themes were chosen to get a holistic picture of the project and its development. However, these themes themselves were not the main research subject. It is important also to note that learning or knowledge management issues were not directly mentioned in the interview questions. However, the informants talked about learning-related issues, and this has been pointed out in the analysis. The reason not to ask about learning and knowledge was the assumption that interviewees would talk about those issues they felt important or problematic. The interviews lasted from 30 minutes to two hours, and they were taped and transcribed word for word.

4.   Analysis

As often in qualitative research, the analysis and material gathering are not totally separate processes in this research either. Some interesting issues did certainly come up already during the interviewing and transcribing process. However, as Weiss (1994: 151) states, often only after the interviews have been carried out, the researcher can fully concentrate on the analysis. The analysis process began after the transcription of the interview material by coding and sorting the transcribed material. Some categories had come up during the interviewing and transcribing process, and some extra categories were added during the coding and sorting process. The aim was to code everything the informants had said that had something to do with knowledge sharing, understanding different things, and learning. These issues were chosen because they are all somehow related to the fact that the knowledge of all project parties should be utilized in order to reach a good end result for the project. It is important to acknowledge also that during the whole analysis process the theories the researcher

had read earlier were affecting the analysis; in other words, theory and empirical findings were in dialogue.

After the phase of the analysis and renaming some categories, there were three main categories left: 1) 'Learning', 2) 'Understanding', and 3) 'Knowledge' (see Table 1). The 'Learning' category consists of only a few quotations that are related to doing a similar thing more than once and learning from the first time how to do things better next time. For example, a contractor says: "This part of the building is similar to the one we renovated at first, I guess we have learnt something from our mistakes, or I don't know if they are mistakes but we have noticed that something can be done in another way". The other two categories consist of several sub-categories that will be introduced in more detail in the following sections.

Table 1. The Main Categories Formed In The Analysis.

Category	Subcategories	Contents
Learning	-	Doing same/similar things again, and learning from the first time(s) how to do things better next time
Understanding	Problems, tools	The difficulty of understanding issues from the field of another party, and how different tools can be of help in these situations
Knowledge	Knowledge in general, knowledge transfer, knowledge brokers, sharing tacit knowledge, etc.	Various different knowledge issues regarding especially the sharing of knowledge between the parties on different occasions and via different media

The 'Understanding' category consists of two sub-categories: 'Problems' and 'Tools'. In the 'Problems' category people talk about how they themselves or somebody else did not understand something or may not have understood something, which may cause some problems with the end result of the project. Both the end users and the 'technical side of the project' talk about how difficult it is for the end users to understand technical drawings. In the 'Tools' category people talk about several tools and methods that helped them or someone else to understand something. For example, one end user representative comments on the importance of the mock-up room that was built during the design phase to see what kind of bathroom/toilet combination would work well. This category is further divided into several sub-categories based on the different tools.

The third category, which includes issues related to knowledge, was the most difficult one to divide into clear sub-categories. People talk about issues like 'knowledge in general', 'knowledge transfer', 'problems and tools related to knowledge transfer', 'sharing the tacit knowledge', 'knowledge brokers', and 'routes for knowledge

transfer'. These were the original categories for coding, and they formed the main category of 'Knowledge'. However, the sub-categories were so overlapping that the division was pretty artificial and did not serve any real purpose. Therefore, the 'Knowledge' category was analysed as one large category, even though issues within it vary quite a lot. The view on the same matter may also vary depending on if it is the view of an end user or of a designer.

At this point of the analysis, it seemed clear that some learning has been happening in the case project (for more information, see Haapalainen, 2008). However, the attitudes towards learning and also ways to facilitate learning seem to vary a lot between different parties and occasions: some of the designers think that they already know everything they need to and that the end users are not needed so much in the project. Some project managers are eager to find ways to facilitate learning, and some think that it is not necessary. (Haapalainen, 2008: 485–487).

The next step of the analysis was to carefully read through all the material related to different categories. An interesting observation was made: there are a lot of quotations that are either already in more than one category, or they could be placed in more than one category. For example, the following quotation is both in the 'Understanding' and the 'Knowledge' category: *"And then, it's us who possess the expertise related to the people living here, and that is what's irritated us the most, because about colors and materials and things like that, it hasn't worked like it should have worked, because our expertise has not been utilized".* An end user representative describes here some problems with the interior designer: on the one hand, it is about knowledge (expertise) that should be transferred from one party to another, and, on the other hand, it is about the interior designer not understanding the situation and the feelings of the end users. This shows that the categories are interrelated. The 'big picture' of the phenomena was beginning to appear when the case material was analysed.

5.   Findings

On the basis of the analysis, the learning process is related to the issue of understanding new things, especially in the case of the representatives of the end users. This is related to knowledge and knowledge management, because without understanding issues under discussion proper decisions cannot be made. The framework for the relationships of knowledge, understanding, and learning in the projects is presented in Figure 2. There are many decisions to make and problems to solve in projects. In many of them, knowledge from several parties of the project team is needed in order to reach a satisfying end result for the project. For example, when designing a new building, knowledge of the end users of the actual needs for the building has to be combined with the technical knowledge of the designers as well as the knowledge of the project manager about the project restrictions, e.g. the budget. If the end users do not understand, for example, the drawings of the architect, or if the electrical designer does not understand what kind of need there is e.g. for plug points in the facilities, wrong solutions can be made, and, in the worst case, it is noticed only after the construction, when the facilities are being used. One of the interviewed supervisors pointed this out: *"What is clear in this project is that there is a large risk in*

how well the end users have understood what is presented in the designs. Someone actually asked in a meeting if this is really what we will get".
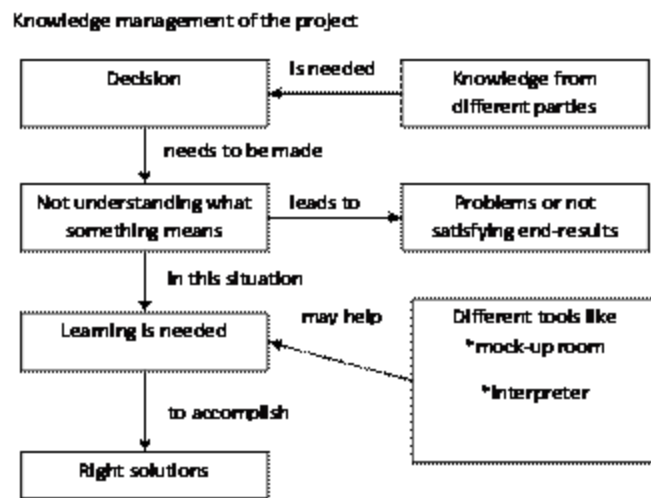
Knowledge management of the project

Figure 2. Framework For Knowledge, Understanding, And Learning In Projects.

In this situation, if things go as they should, some learning will occur. Different tools and methods can be utilized in the learning process. In the case material, people talk quite a lot about the mock-up room and interpreter. An interpreter is a person who has the knowledge of one party of the project team (e.g. the technical side) and who can see the issue also from the viewpoint of the other party in the project (e.g. the end users who do not understand the technical issues) and who can, therefore, explain the issue to the party that does not understand it.

Vision building and activity cards are examples of other tools that can be used to facilitate learning. In a vision building process, different parties of a project (e.g. school staff, designers, public administrators, a project manager, and parents of students in a school renovation case) are brought together in order to create a common vision for the project. This helps in motivating people to participate in the project, and the vision can later be used in prioritizing different needs and wishes (for a more detailed example of vision building, see Naaranoja et al., 2007). Activity cards can be used in transferring knowledge from end users to designers. The end users are simply asked to think of different parts of the facilities and to describe what type of activities happen there: who uses the room, is some large equipment needed, what kind of connections should there be from one room to others, etc. Activity cards prevent the end users from just tossing out wishes. Instead, they have to concentrate on the activities.

The learning process helps people understand matters, so that right choices can be made. This way, a good and satisfying end result for the project can be achieved. For example, as one end user representative comments on the importance of the mock-up

room that was built during the design phase to see what kind of bathroom/toilet combination would work well: *"when decisions this large are made, it is worth building, in this case, if we would have seen the drawings for the first option, we would have said that it works but in practice it would have not worked* (which was seen during the testing of the mock-up room)". In this case, the end users did not understand what the drawings meant in practice, but the mock-up room performed as a teacher and helped them understand, and, so, right decisions were made.

6.   Discussion

The findings of the research have implications both for the theory of knowledge management and learning as well as management. Literature review provided ideas for understanding the nature of learning in inter-organizational projects and the reasons for it. The findings from the empirical research completed the picture of learning from the viewpoint of the learners themselves. The definition of knowledge forms the basis for understanding learning. For the purposes of this research, knowledge was defined as information that is understood by a person so that she can utilize it. This involves learning: *"Project team members have to incorporate new information into their understanding to solve technical challenges they meet. Thus, learning is inherent in the work they do"* (Fong, 2005b: 42), or as Chakravarthy et al. (2003: 306) state *"Both learning and knowledge have been defined in terms of new or greater understanding… to define knowledge as a type or degree of understanding… and learning as a process of acquiring this comprehension"*. The findings from the case studies strongly support the views of Fong (2005b) and Chakravarthy et al. (2003). The participants of a project team learn in situations in which their existing knowledge is not enough to contribute to the success of the project.

The definition of knowledge also reveals something about the nature of knowledge: knowledge is situated. In order to understand something, one must know the connection between knowledge and its context. Often a person with her knowledge is interacting with other people who may possess a different understanding about the issue at hand. In a situation of this kind, the 'final' knowledge is created through negotiations. For example, Orr (1990: 170) depicts this well: *"Definition of the problem, or the state of the machine, is accomplished through social interaction between technician, customer and machine"*. This view connects this research to social construction, which emphasizes the role of knowledge and learning as socially constructed phenomena (Brown and Duguid, 1991; Bresnen et al., 2005; Gherardi, 2000). It should be clear for all participants in a construction project that one person cannot struggle through the project alone, that there are views of several different parties that have to be taken into account.

Also, other literature with a social construction view to organizational learning brings up interesting perspectives on learning in projects. Araujo (1998: 329) emphasizes the important role of social learning on discussion: *"Technical discourse alone will not, in all likelihood, provide a framework for a dialogue between both parties. A process of social learning, involving the understanding of the social economic expectations of both parties can help the development of common, local rules restricting the potential for opportunistic behavior and fostering a climate for mutual trust"*. All parties should

acknowledge the expertise of other parties. It seems that typically in a construction project the end users are not considered to be experts. But which one knows better the requirements of a school: an electrical designer or a teacher?

The findings from the literature and the case study imply that learning is often related to communication and creation of understanding, which in turn makes knowledge management processes possible. For example, Taylor and Osland (2003: 213) have written about the issue: *"At the base of all theories concerning organizational learning… lies the assumption that communication must occur in order for knowledge to be created or disseminated".* This is why the necessary amount of learning needs to be ensured in projects. Certain practices can help in this, and the practices used should aim at improving communication among the participants of the project and increasing their understanding of issues related to the project.

It seems that there should be a more systematic way of dealing with knowledge management and learning in construction projects. Figure 2 provides a good framework for a project manager to clarify the issue for herself and also for the other participants of the project. According to Fong (2005b), the development of a constructed facility can be viewed as a new product development, and knowledge-creating skills are particularly important in this kind of context. This means that the 'traditional' view of knowledge management as mainly sharing knowledge is not enough, but special attention has to be paid to the process in which all the participants create new knowledge by utilizing the expertise of each other.

A project manager should create an atmosphere that encourages the project participants to share their knowledge and ask when they do not understand something. There are also several methods, or 'tools', that can be used in projects to facilitate learning and, thus, ease communication between different parties. As Styhre and Gluch (2010: 589) state: "*objects play an important role in organizations as vehicles for the sharing of knowledge*". Vision building can be used in the beginning of the project to motivate people to participate in the project and to ensure that all parties have a similar view on what is to be done. Activity cards can help the end users to describe their needs and, thus, help the designers to better understand what is needed in the facilities. Using an interpreter may help the end users to understand some technical issues. The interpreter does not have to be an outsider; for example, the project manager can take this role if she can understand the problems of the end users well enough. Whatever means are used, successful communication and knowledge sharing should not be taken for granted.

7.   Conclusions

A framework relating learning and knowledge management in inter-organizational projects was created based on the theoretical findings and empirical material from a case study. There are a great number of decisions to be made and problems to be solved in projects. Some of these decisions are such that one person of the project team cannot make them alone; instead, knowledge of different parties is needed. For example, the design phase of any construction project is typically full of situations of this kind: knowledge of the needs of the end user must be combined with the technical

knowledge of architects and other designers. This means that the new knowledge concerning the new building has to be constructed socially and mutually among the different parties.

If there is no mutual understanding among the members of the project team, some problems may arise either instantly or later on. In construction projects, this may happen, for example, if the architect does not understand the needs of the end users, or if the end users do not understand the plans of the designers and accept incorrect designs. These misunderstandings may lead to expensive changes during the construction phase or even to an end result that does not fulfill the needs of the end users.

If the project team and its participants are willing to learn and learning is facilitated, these problems can be avoided. Both willingness to learn and the level of facilitating learning seem to vary a lot in practice. Some of the project team participants are more open-minded and eager to learn than others, and this seems to be the case especially regarding the end users. Some of the designers seem to think that they know everything necessary without asking or learning anything, as if their knowledge alone would be enough for a good end result. Learning can be facilitated in many ways; at the very least open discussion among parties is needed. However, there are also several different tools to facilitate learning.

A lot of learning happens in inter-organizational projects. Different parties are learning different matters for different reasons. Most learning is closely related to the knowledge management of projects: using knowledge, sharing and combining it, and creating new knowledge. Without learning it is often impossible to reach the objectives of projects.

The main emphasis in this paper has been on learning and creating understanding in projects. However, many other issues, e.g. power dynamics, lack of trust, task uniqueness and significance, etc., also have an effect on cooperation in projects. A suggestion for future research would be to study how these factors are linked to learning and creating understanding within the project team. A limitation of the research introduced in this paper is the fact that learning has only been examined within one project. Transferring learning from one project to another would be an interesting topic for future research.

8.   References

Anumba, C.J., Egbu, C., Carrillo, P. (2005), Knowledge Management in Construction, Blackwell Publishing.

Araujo, L. (1998), Knowing and learning as networking, Management Learning, 29(3), 317-336.

Bhatt, G.D. (2001), Knowledge management in organizations: examining the interaction between technologies, techniques, and people, Journal of Knowledge Management, 5(1), 68-75.

Bresnen, M., Edelman, L., Newell, S., Scarbrough, H., Swan, J. (2005), A community perspective on managing knowledge in project environments, in Love, P.E.D., Fong, P.E.D., Irani, Z. (eds.) Management of Knowledge in Project Environments, Amsterdam etc.: Elsevier Butterworth-Heinemann, 81-102.

Brown, J.S., Duguid, P. (1991), Organizational learning and communities-of-practice: toward a unified view of working, learning, and innovation, Organization Science, 2(1), 40-57.

Burley, D. (2010), Information Visualization As A Knowledge Integration Tool, Journal of Knowledge Management Practice, 11(4).

Chakravarthy, B., S. McEvily, Y. Doz, Rau, D. (2003), Knowledge Management and Competitive Advantage, in Easterby-Smith, M., Lyles, M. (eds.) The Blackwell Handbook of Organizational Learning and Knowledge Management, Blackwell Publishing, 305-323.

Chong, X., Pandya, K.V. (2003), Issues of knowledge management in public sector, Electronic Journal of Knowledge Management, 1(2), 25-33.

Cook, S.D.N., Yanow, D. (1993), Culture and organizational learning, Journal of Management Inquiry, 2(4), 373-390.

Davenport, T. H., Prusak, L. (1998), Working Knowledge: How Organizations Manage What They Kno, Boston, Massachusetts: Harvard Business School Press.

DeFillippi, R., Ornstein, S. (2003), Psychological perspectives underlying theories of organizational learning, in Easterby-Smith, M., Lyles, M.A. (eds) The Blackwell Handbook of Organizational Learning and Knowledge Management, Blackwell Publishing, 19-37.

Easterby-Smith, M., Lyles, M.A. (2003), Introduction: Watersheds of organizational learning and knowledge management, in Easterby-Smith, M., Lyles, M.A. The Blackwell Handbook of Organizational Learning and Knowledge Management, Blackwell Publishing, 1-15.

Elkjaer, B. (2003), Social learning theory: learning as participation in social processes, in Easterby-Smith, M., Lyles, M.A. (eds.) The Blackwell Handbook of Organizational Learning and Knowledge Management, Blackwell Publishing, 38-53.

Fong, P.S.W. (2005a), Managing knowledge in project-based professional services firm: an international comparison, in Love, P.E.D., Fong, P.S.W., Irani, Z. (eds.) Management of Knowledge in Project Environments, Elsevier Butterworth-Heinemann, 103-131.

Fong, P.S.W. (2005b), Co-creation of knowledge by multidisciplinary project teams, in Love, P.E.D., Fong, P.S.W., Irani, Z. (eds.) Management of Knowledge in Project Environments, Elsevier Butterworth-Heinemann, 41-56.

Gherardi, S. (2000), Practice-based theorizing on learning and knowing in organizations, Organization, 7(2), 211-223.

Grifiths, D.A. (2011), Knowledge & Learning At The New Frontier: A Case Study In An Emerging Market, Journal of Knowledge Management Practice, 12(1).

Haapalainen, P (2008), Organisational learning in projects: case construction industry, International Journal of Technology Intelligence and Planning, 4(4), 480-491.

Hakkarainen, K., Palonen, T., Paavola, S., Lehtinen, E. (2004), Communities of Networked Expertise, Professional and Educational Perspectives, Sitra's Publication series 257, Amsterdam etc.: Elsevier.

Kanapeckiene, L., Kaklauskas, A., Zavadskas, E.K., Seniut, M. (2010) Integrated knowledge management model and system for construction projects, Engineering Applications of Artificial Intelligence, 23, 1200-1215.

King, W.R., Chung, T.R., Haney, M.H. (2008), Editorial – Knowledge Management and Organizational Learning, Omega, 36, 167-172.

Koskinen, K, Pihlanto, P., Vanharanta, H. (2003), Tacit knowledge acquisition and sharing in a project work context. International Journal of Project Management 21, 281-290.

Leonard-Barton, D. (1995), Wellsprings of Knowledge. Building and Sustaining the Sources of Innovation, Boston, Masachusetts: Harvard Business School Press.

Liebowitz, J. (2005), Conceptualizing and implementing knowledge management, in Love, P.E.D., Fong, P.S.W., Irani, Z. (eds.) Management of Knowledge in Project Environments, Amsterdam etc.: Elsevier Butterworth-Heinemann, 1-18.

Love, P.E.D., Z. Irani, Edwards, D.J. (2004), A rework reduction model for construction projects, IEEE Transactions on Engineering Management, 1(4), 426-440.

Naaranoja, M., Haapalainen, P., Lonka, H. (2007), Strategic management tools in projects case construction project. International Journal of Project Management 25, 659-665.

Naaranoja, M., Uden, L. (2007), Major problems in renovation projects in Finland, Building and Environment 42, 852-859.

Newell, S., Huang, J. (2005), Knowledge integration processes and dynamics within the context of cross-functional projects, in Love, P.E.D., Fong, P.S.W., Irani, Z. (eds.) Management of Knowledge in Project Environments, Amsterdam etc.: Elsevier Butterworth-Heinemann, 19-39.

Nonaka, I., Takeuchi, H. (1995), The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation, New York: Oxford University Press.

Nycyk, M. (2011), Knowledge Management Practices On Large-Scale Construction Projects in An Australian Company: An Ethnographic Study, Journal of Knowledge Management Practices, 12(4).

Orr, J.E. (1990), Sharing knowledge, celebrating identity: community memory in service culture, in Middleton, D., Edwards, D. Collective Remembering, London etc.: Sage Publications, 169-189.

Pinto, J.K. (2005), Forewords, in Love, P.E.D., Fong, P.S.W. and Irani, Z. (eds.) Management of Knowledge in Project Environments, Amsterdam etc.: Elsevier Butterworth-Heinemann, xi-xii.

Prahalad, C. K., Hamel, G. (1990), The core competence of the corporation, Harvard Business Review May-June, 79-91.

Styhre, A., Gluch, P. (2010), Managing knowledge in platforms: boundary objects and stocks and flows of knowledge, Construction Management & economics, 28(6), 589-599.

Taylor, S., Osland, J.S. (2003), The impact of intercultural communication on global organizational learning, in Easterby-Smith, M., Lyles, M. (eds.) The Blackwell Handbook of Organizational Learning and Knowledge Management, Blackwell Publishing, 212-232.

Turner, J.R. (2005), Forewords, in Love, P.E.D., Fong, P.S.W., Irani, Z. (eds.) Management of Knowledge in Project Environments, Amsterdam etc.: Elsevier Butterworth-Heinemann, ix-x.

Yanow, D. (2000), Seeing organizational learning: A 'cultural' view, Organization, 7(2), 247-268.

Weiss, R.S. (1994), Learning from Strangers. The Art and Method of Qualitative Interview Studies, The Free Press.

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