How to Prevent Project Knowledge Management Failures in Construction – IT Enabled Communication Perspective

Naaranoja Marja[1], Haapalainen Päivi[1], Lonka Heikki[2]
marja.naaranoja@uwasa.fi, paivi.haapalainen@uwasa.fi, heikki.lonka@vaasa.fi

[1]The University of Vaasa, Finland
[2]Vaasa town, Finland

Summary

This article discusses how the failures of construction projects could be prevented. The focus is on using IT tools in communication. The article is based on the findings of the PROLAB-project. The project seeks to find solutions for how the information can effectively be used in project management, specially in construction projects, what kind of procedures help the management of the knowledge and how the obstacles for efficient ways of administrating the information can be removed. These obstacles can be either related to use of new technology or to organization culture.

The paper discusses e-mail as a medium of communication with the media richness framework (Fulk & Boyd 1991) based on the interviews done with the participants of construction projects. We found out that the emails were used in both rich way and not so rich way. Obstacles of rich use of IT communication were partly technical and partly psychological.

Technology acceptance model (TAM) is used to study the actual use of emails in communication. Obstacles of the use of emails were mostly individual differences like the skills to use the system or external variables like they did not have proper software to open the attachments. Also people talked about information overload. Emails often push too much information.

Keywords: IT tools, Communication, Knowledge management, Construction

1. Introduction

The use of IT is argued to enable construction companies to broaden the possibilities for the way in which activities are organized over time, geographic space and organizational boundaries. Communications and services especially through Internet are becoming increasingly popular on a global scale.

The focus of this article is on using IT tools in communication in construction projects. The study is part of PROLAB-project. PROLAB research group started the research in September 2003. We have started to analyze how knowledge management in projects is carried out and how it could be improved. The overall goal of the research project is to study questions like: How can information be efficiently utilized in project organizations and public decision processes? Which methods will contribute to effective knowledge management? How can the barriers of using the effective methods be removed? These barriers can be related to utilizing either new technology or learning supporting organization culture. This research will point out some problems a project team may face.

The research is been done by interviewing the key persons in different construction projects, both in public and private sectors. The research method is action research and one aim of the project is to have some new procedures of information sharing and knowledge management implemented in case organizations.

2. IT and knowledge sharing

Successful knowledge sharing is primary a matter of the existence and richness of transmission channels (Barlett & Ghoshal 1989), and the characteristics of the transferred knowledge in terms of such dimensions as tacitness and ambiguity. (Zander & Kogut 1995, Szulanski 1996). Sexton, Ingirige and Betts (2003) argued that the communication and knowledge sharing is at its most effective between people when the richness of medium matches the task relevance of the information being conveyed. Potentially task relevant means that the information is no use of the specific task undertaken but might be of use for another task at some stage in the future. Specific task relevance is when the information is needed for the specific task. They argue that we need high media richness when the information is specifically task relevant, but when the information is only potentially task relevant the information is better to have low media richness.
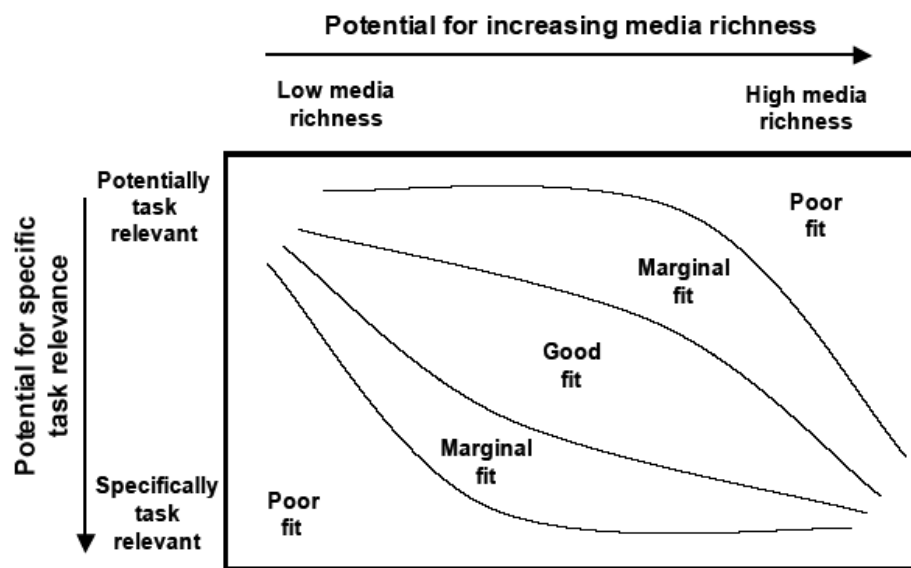

Figure 1. Media richness – task relevance model (Sexton, Ingirige and Betts 2003)

The concept of media richness consists of four attributes (Daft & Lengel 1984, Daft & Lengel 1986, Trevino et al 1987, Fulk & Boyd 1991):

- Feedback capability – refers to how quickly can communication medium enable the participants to ask for and receive information.

- Availability of multiple cues – refers to the number of channels of communication available to the participants.

- Language variety – refers to the use of different types of language. For example, written media supports more precise, textual language; whilst oral media imparts understanding of a broader range of concepts and ideas.

- Personal focus – refers to the degree of individual attention and socio-emotional content a message contains.

The media richness theory postulates that the more of the above attributes an IT media possesses the richer the medium, and greater potential for effective knowledge sharing between the participants.

Sulankivi (2003) studied the benefits of the centralized digital information management in multi partner projects. According to her the aimed communication benefits of centralized information management are:

- More communication facility options and better information exchange
- Increased awareness of project changes and news
- Increased individual accountability
- Easier to deliver information to late parties joining the project
- Improved quality of discussion.

She found out that the centralized documentation system helped substantially in being aware of project changes and news; also the respondents found the awareness very important. Her studies also pointed out that the centralized system helped somewhat to gain the other above benefits, that were as important as the awareness. She found out that the designers and contractors found the benefits somewhat helpful and the supervisors found the system substantially helpful in document and project management.

3. Technology acceptance model (TAM)

Even very simple building project contains an enormous amount of information. One reason for failures of the projects is certainly the problems with knowledge management. The IT tools have not been utilized as widely in construction projects as could be possible though it looks like that the tools are considered to be either somewhat or substantially helpful (Sulankivi 2003). In the last two decades, a number of studies have provided theoretical frameworks for research in the acceptance of information technology and information system (IT/IS) (i.e. Ajzen, 1985, 1991; Davis, 1989; Davis *et al.*, 1989; Mathieson, 1991; Moore, 1987; Taylor and Todd, 1995). Among them, the technology acceptance model (TAM) is believed most robust, parsimonious, and influential in explaining IT/IS adoption behavior (Davis, 1989; Davis *et al.*, 1989; Igbaria *et al.*, 1995; Mathieson, 1991).
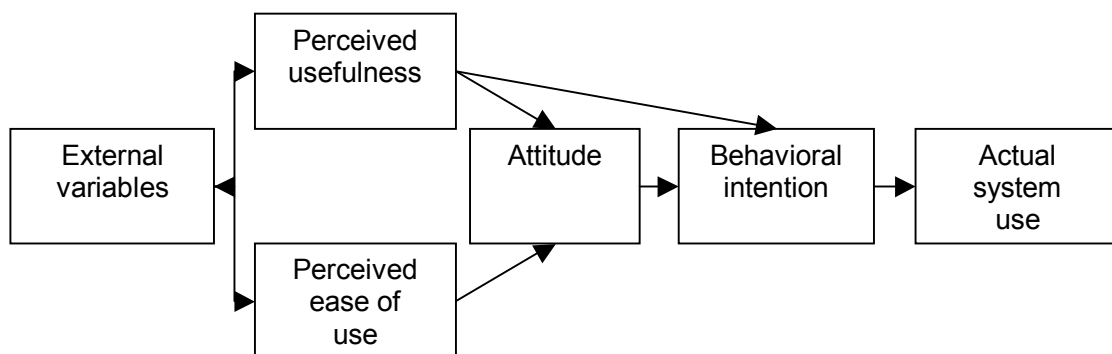
Figure 2. Technology acceptance model (TAM)

TAM was rooted in the theory of reasoned action, a model concerned with determinants of consciously intended behaviors (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). Theory of reasoned action proposes that beliefs influence attitudes, which in turn lead to intentions, and then generate behaviors. TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of IT/IS adoption in organizations. According to TAM, these two determinants serve as the basis for attitudes toward using a particular system, which in turn determines the intention to use, and then generates the actual usage behavior.

Perceived usefulness is defined as the extent to which a person believes that using a system would enhance his or her job performance. Perceived ease of use refers to the extent to which a person believes that using a system would be free of mental effort (Davis, 1989). A key purpose of TAM is to provide a basis for discovering the impact of external variables on internal beliefs, attitudes, and intentions. The TAM model is provided in Figure 1.

According to Lu et al (2003) the external variables for wireless Internet via mobile devices are technology complexity, individual differences, facilitating conditions, social influences and wireless trust environment. They also split the perceived usefulness into long term and near-term usefulness.

4. Empirical findings

In this research different parties of construction projects were interviewed in order to model the communication process and means of communications as well as the problems in communication. The interviewees were end users, clients in public construction projects, designers, architects and constructors. In this paper we discuss use of e-mail in the construction projects researched and the attitudes of the interviewees towards the communication via e-mail. The interviews did not use centralized communication system – though for some professionals it was recommended. Technology acceptance model (TAM) (Ajzen & Fishbein, 1980) is used partly as a theoretical framework for the analysis.

Individual differences and age seem to be more important factor than professional background what comes to the acceptance and attitude towards e-mail as a medium of communication in construction projects. Within all the parties we can find people using e-mail in their every day work as well as people who try to avoid using e-mail as much as they can. In the following we will discuss other differences found in our research, differences that are related to external variables, perceived usefulness and perceived ease of the use of a-mail.

4.1 IT and knowledge sharing

Here we discuss e-mail as a medium of communication with the media richness framework (Fulk & Boyd 1991) based on the interviews done with the participants of construction projects.

Feedback capability of e-mail is generally seen as quite high. Interviewees referred to situations when they send inquires to other parties and got responds and they seem to feel that it was a fast way to communicate. Of course the feedback capability in personal contacts or by telephone is higher compared with e-mail but compared with regular mail, e-mail is faster. Though the receiver needs to be at least daily or on weekly bases utilizing email in order to get the information via email and respond to it. Some older professionals may have email address but they actually do not use it regularly.

Availability of multiple cues and language variety in e-mail communication is low, if it is only textual information. A person only sees what the sender of the message has written and has to interpret the message based on that. However, the message may be very rich when the designer emails their files to somebody and the receiver is able to open and understand the content. In theory it would be possible to add audiovisual parts into e-mails but in practice that is not very common. One problem with e-mails that the interviewees referred to is that all the users don't necessarily have all the different software the sender has and therefore we can say that using audiovisual attachments cannot be used in construction project e-mail communication.

Personal focus can be used to some extend in e-mails they can be very personal and tailored to the recipient. It's difficult to say how much this aspect of e-mail richness is really used in business communication. However, there is always the question of interpreting the message and using personal expressions and non official language may increase the possibility of misunderstanding if the sender of the message really doesn't know the receiver. The tendency to forward the emails without asking the permit from the sender has made us somewhat cautious when we write emails. One can even claim that the emails are not so very personal in business environments.

4.2 E-mail as a positive medium of communication

The most common explanation for the use of e-mail is that it is so easy and so fast way to communicate with other parties of the project. *"We tried to keep it all [the information from the end users to designers] going via me...but I have delivered all of it to the architect, it is so easy with the e-mail"* (a representative of the end users). People who are used to send and receive e-mails find e-mail fast to use and also as a quick way to get some information they need. *"We sent them [the end users] questions by e-mail... and they commented what they wanted and I think it worked well, it didn't take much time"* (a designer).

Some people also find e-mail a good way to follow the project even if they weren't so closely involved in it. They can easily keep in track about what is going on and comment if necessary. *"One positive thing has been that even I have been able to follow the project because I'm on the e-mail circulating list and I can read the minutes of the design meetings"* (a representative of city administration).

E-mail is found as a special useful medium of communication in such situations where information in visual mode, e.g. designs, needs to be sent back and forward between the different individuals. Using e-mail in these kinds of situations can save days and even weeks of time. *"E-mail is the most useful and also practical, we can send all kinds of information via it and it is easy to send the information back and forward"* (a designer). *"I would say that I feel more and more that the less paper, the better, e-mail is very powerful"* (a constructor). *"And then I sent the designs back to the architect by e-mail, we haven't send any paper copies via regular mail"* (a designer).

4.3 Negative viewpoints towards e-mail as a medium of communication

Many interviewees referred to the "gap between generations" when talking about use of e-mail. When "younger" generations are seen used to use computers since they were at school, "older" generations seem to have more negative attitude towards computers and e-mail. *"We use much pencils and calculators to count. To designs and papers. And when a younger guy comes, he uses Excel. There a difference between generations"* (a constructor).

One clear factor is at least at some point related to "different generations" is the know-how, if a person doesn't have a basic knowledge how to use e-mail, then the use of it is seen very time consuming. *"And then I'm so slow in doing that [using computers], so I have decided that it's better to use that time to do something else"* (a constructor). *"It takes so much time to start to use IT-tools when one doesn't have the basic knowledge of it"* (a constructor).

Another problem related to time is the huge amount of e-mails some interviewees get every day. It may take even several hours every day to go through all the e-mails and reply them. This can mean that they simply don't read their e-mails and don't answer then which may frustrate other users of e-mail. *"I get so many e-mails that I feel that half of my time goes to reading them. And I should also have time to design"* (a designer). *"Some people just let the inbox come full of e-mails. And they don't answer e-mails. It's like everyday war against the e-mail"* (a city administrator).

The next two problems are related to possibilities to use e-mail. The first one is the fact that computers are still not everywhere yet. Some end users felt that even though they "under normal circumstances" liked e-mail and also used it as a communication medium, during their long vacations it was a problem because they didn't have an access to e-mails at home. *"I find e-mail suitable for me when I have access to e-mail. But e.g. during vacations when there had come some e-mail, there was something I didn't know... the assumption is that everybody has an access to e-mail all the time"* (an end user). Also the construction sites usually lack computer. *"Specially, in construction sites there are no computers, it's clear that printed designs will be used there for a long time in the future"* (a constructor).

Another problem related to proper tools is that in construction business many special software programs are used and if the receiver of the e-mail doesn't have the right software, it's impossible to send some attachments that might be needed. Specially, this is seen as a problem when talking about other parties than designers. *"E-mail is good, but it doesn't tell everything to everybody, if we think e.g. about designs, end users can't open them because they don't have the proper software"* (a client). *"I would say that designers discuss via cad, but the constructor doesn't necessarily have cad software"* (a constructor).

Some of the interviewees said that one of the problems related to use of e-mail is that they don't have anything on paper to be filed. *"So, anyway we print those [designs] here on the paper to be put in a project map"* (a designer). *"And one of the problems is filing. They must be printed and put in a map"* (a constructor). Some of the interviewees also felt that it is difficult or even impossible to have a proper look at the designs on computer monitor, because monitors are too small. *"But in practice it's difficult to read large designs on a small monitor. So that we have to get them printed on paper before we can see details"* (a constructor). Both of the above things mean that e-mails or attachments have to be printed anyway and this brings along the question why not use the paper copies in the first place.

5. Discussion

IT enabled communication may solve some problems of construction projects. IT enables effective pushing of information to the receivers – the only question is how to teach everybody to utilize the method and avoid the information overload. Emails may push the information to the receivers without explicit request of the person that receives it. Centralized project databanks is based more on the pulling mode. In pulling mode the receiver gets the information when he actively requests it. This system requires active project team. The databanks often are supported with pushing the emails to the participants like "*Please, check there is new information in the databank. Please, save into the databank the newest versions of the design*". Emails can be used in both ways pulling or pushing the information. The question is who should be part of the distribution list, how much we need to push information?

The media may help to communicate in a rich way but the communication does not depend so much on the media but more on understanding the capability of the receiver to understand the message or in practice ability to read the message - opening the attachments. Emails were used in both rich way and not so rich way. Obstacles to rich use were, for instance, lack of tools to open the attachments.

In addition, the IT tools can be used so that the communication is self organized. In self organized communication the project team communicates with each other randomly when questions appear; and they react to the messages and intervene in design process. The centralized mindset takes shape, for example, when a design decision is made with sending the question to only one person.

The professional background doesn't seem to be an important factor influencing the attitude towards the use of e-mail in construction projects. We can find some designers that see e-mail very useful and some designers that feel differently. The same phenomena can be found within other professions as well. However, there may be a difference between the generations. Younger people who are familiar with the computers find the use of e-mail more effective and would like to use it more than the older generation that has little experience on computers. So the basic knowledge about IT and earlier experience seem to have a great effect on the attitude towards e-mail.

It seems to be that most of the interviewees who had and positive attitude towards e-mail and who also used it, they reasoned it by perceived usefulness (e.g. time savings) and perceived ease of use. We couldn't find external variables like social influences or facilitating

conditions (Lu et al 2003) behind this attitude, at least not straight effect. But what comes to the negative attitudes, they were mostly reasoned by external variables. Many interviewees said that "e-mail could be useful" but they didn't know how to use it or didn't have an access to e-mail or didn't have proper software to handle the attachments. Therefore it is possible to say that technology acceptance model may be too straight forward, in addition to perceived usefulness and ease of use also external variables can affect straight to attitudes and in some cases even if the attitude towards use of e-mail is positive there may be some external factors that prevent the use.

References

Ajzen, I. (1985), ``From intentions to actions: a theory of planned behavior'', in Jkuhl, J.B. (Ed.), *Action Control: From Cognition to Behavior*, SpringerVerlag, New York, NY, pp. 11-39.

Ajzen, I. (1991), ``The theory of planned behavior'', *Organizational Behavior and Human Decision Processes*, Vol. 50 No. 2, pp. 179-211.

Ajzen, I. and Fishbein, M. (1980), *Understanding Attitudes and Predicting Social Behavior*, Prentice-Hall, Englewood Cliffs, NJ.

Barlett, C. & Ghoshal, S., (1989), *Managing Across Borders*, Harvard Business School Press: Boston.

Daft, R.L. & Lengel, R.H., (1984), "Information Richness: A New Approach to Managerial Behaviour and Organizational Design", *Research in Organizational Behaviour*, 6: 191 – 233.

Daft. R.L. & Lengel, R.H., (1986), "Organizational Information Requirements, Media Richness and Structural Design", *Management Science*, 32: 5: 354 – 567.

Davis, F.D. (1989), ``Perceived usefulness, perceived ease of use, and user acceptance of information technology'', *MIS Quarterly*, Vol. 13 No. 3, pp. 319-40.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989), ``User acceptance of computer technology: a comparison of two theoretical models'', *Management Science*, Vol. 35 No. 8, pp. 982-1003.

Fishbein, M. and Ajzen, I. (1975), Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research, Addison-Wesley, Reading, MA

Fulk, J. & Boyd, B., (1991), "Emerging Theories of Communication in Organizations", *Journal of Management*, 17: 2: 407 – 446.

Igbaria, M., Guimaraes, T. and Davis, G.B. (1995), ``Testing the determinants of microcomputer usage via a structural equation model'', *Journal of Management Information Systems*, Vol. 11 No. 4, pp. 87-114.

Igbaria, M., Pavri, F. and Huff, S. (1989), ``Microcomputer application: an empirical look at usage'', *Information and Management*, Vol. 16 No. 4, pp. 187-96.

Lu J., Yu C.-S., Liu C. and Yao J. E. (2003) Technology acceptance model for wireless Internet in *Internet Research: Electronic Networking Applications and Policy* Volume 13 . Number 3 . 2003 . 206-222

Mathieson, K. (1991), ``Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior'', *Information Systems Research*, Vol. 2 No. 3, pp. 173-91.

Moore, G.C. (1987), ``End user computing and office automation: a diffusion of innovations perspective'', *Infor*, Vol. 25 No. 3, pp. 214-35.

Moore, G.C. and Benbasat, L. (1991), ``Development of an instrument to measure the perceptions of adoption in information technology innovation'', *Information Systems Research*, Vol. 2 No. 3, pp. 192-222.

Sexton M, Ingirige B, Betts M (2003) Information technology-enabled knowledge sharing in multinational strategic alliances: media richness - task relevance fit, Amor R (editor) Proceedings of the CIB W78's 20th International Conference on Construction IT, Construction IT Bridging the Distance, CIB Report 284, ISBN 0-908689-71-3, Waiheke Island, New Zealand, 23-25 April 2003, pg. 294-302.

Sulankivi K (2004) Benefits of centralized digital information management in multipartner projects, ITcon Vol. 9, pg. 35-63, http://www.itcon.org/2004/3

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.

Townsend, A.M., DeMarie, S.M. & Hendrickson, A.R., (1998), "Virtual Teams: Technology and the Workplace of the Future", *Academy of Management Executive*, 12: 3: 17 – 29.

Trevino, L.K., Lengel, R.H. & Daft, R.L., (1987), "Media Symbolism, Media Richness & Media Choice in Organizations: A Symbolic Interactionist Perspective", *Communication Research*, 14: 5: 553 – 574.

Turban, E. McLean, E. & Wetherbe, J., (1999), *Information Technology for Management*, Wiley: New York.

Zander, U. & Kogut, B., (1995), "Knowledge and the Speed of Transfer and Imitation of Organizational Capabilities: An Empirical Test", *Organization Science*, 6: 1: 76 – 92.