Digitized information management: The dynamic information system

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ABSTRACT: *This research focuses on the change process that led to a digitized information system in academia. The development was carried out in a project where the participants represented their universities. The biggest issue to manage was to define the electronic process that was to be coded to support student mobility between universities. Action research was chosen as the research method because of the strong involvement of the researcher in the case. The output was evaluated satisfied, even excellent by the users and the goal was achieved despite minor knowledge about designing information systems in the project group.*

Introduction

Information technology has become an inevitable part of our society. Technology enables interaction between people and organizations without need to physical attendance. The interaction is enabled with inter-organizational information systems and this article explores how this information system is achieved.

Our research shows that before any process can be transferred to digitized form, the process must be known thoroughly. This knowing requires one kind of experience from the people who are involved in the design and other kind of experience when the process is digitized. We emphasize that despite being able to act according to the routines there may be problems when writing the routines down and when explaining them in depth to other people. However, exactly this is needed when turning a manual process into digitalized form especially in cases when the implementers are not the actors in the manual (legacy) process.

This article discusses a case where an inter-organizational information system was developed and piloted by several universities involving actively in the development project. The aim of the information system was to support the management of student mobility between universities. Student mobility happens when students perform studies in other universities as a part of their academic degree.

Despite the independent nature of the universities and despite the several ways of managing student mobility in their universities, the participants aimed to a joint information system that supported a joint process of student mobility. This collaboration between universities was based on trust and high felt need and there were no written agreements to support the collaboration. In addition, it was the will of the Ministry of Education to support student mobility and it participated in paying for the development work.

The research material is gathered from official project documentation like memorandums added with memorandums from encounters and phone calls. In addition, the researcher has written a personal diary (Coghlan & Brannick 2002) during her working in the project. Her chosen role was that of an involved researcher instead of an outside observer (Walsham 1993). The means of action research and case study are used in this research and the approach is highly subjective and interpretive (Walsham 1993).

Because of the inter-organizational nature of the project, the role of collaboration is emphasized in this research. In addition, we emphasize trust and stress that without trust there would be no collaboration or – in our case – any information system to support student mobility between universities.

2. Literature review

Implementing information systems has been described in several studies. Information systems are implemented in organizations to improve the effectiveness and efficiency in those organizations (Hevner et al. 2004). Further, developing information systems is an effort that involves expertise, insights and skills of several individuals (Tiwana & McLean 2005). Lyytinen and Lehtinen (1987) argue that the information systems development is both a political and a symbolic process. Literature knows research about implementing information systems in distributed organizations (Kotlarsky & Oshri 2005, Munkvold 1999), but information system acquisitions made by several users representing different organizations are not much described.

Ragowsky et al. (2000) state that information systems are vital to the operation and management of every organization. The authors have studied how to analyze the benefits of using information systems.

Developing and implementing information systems are instances of organizational change (Davis & Olson 1985, Lyytinen 1987) and they often lead to changes in work processes and even structures of personnel Eason 1988, Sahay & Robey 1996). Viitanen and Piirainen (2003) describe how culture affects on efforts to organizational changes. Moving from printed media to electronic information forms and formats is a change that has been highly predicted by theorists (Lamb 1997).

The concept of organizational change leads us to think more about organizational settings. Organizational conflict literature has identified three forms of conflict: relationship conflict, task conflict and process conflict (Panteli & Sockalingam 2005). These forms refer to their appearance in the organizational setting. Relationship conflict reduces open communication and knowledge sharing. Panteli and Sockalingam (2005) continue that well-managed process conflict provides the foundation for relationships and trust between partners to develop.

The role of user participation in information system developments and implementations has been under discussion (Sahay & Robey 1996, Markus 1983, Markus & Benjamin 1996, Kumar et al. 1998, Cairns & Beech 1999, Dewulf & van Meel 2002). User involvement is needed especially in the very beginning of an information system project in order to find out the needed requirements where to build on (Halonen 2004, Jiang et al. 2002).

Engler (1996) gives a step-by-step approach when identifying the right user to represent all users in the implementation project: 1) identify the correct user, 2) involve the user early and often, 3) create and maintain a quality relationship, 4) make improvement easy. By these steps the designer should ensure that the user wants to progress the implementation, the feedback is continuous, commitment holds the system's entire life cycle, and among other things, that the designer could learn the user's language.

All the same, Nonaka and Takeuchi (1995) explained that most customers' needs are tacit, meaning that they cannot tell exactly or explicitly what they need or want. According to Nonaka and Takeuchi, tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Furthermore, continuous changes in requirements suggested by users influence the proceeding of the development project (Halonen 2005a).

Users need reasons to use new applications. Keefe (2003) writes about the importance to focus on the user, who must not be forgotten in any phases of the system development. Systems that improve business processes and deliver information faster to users are not enough – the users using the new application must be motivated to do the tasks that are needed to get the information available. Without motivated users there is no traction to get the implementation project to succeed, Keefe thinks.

Markus (2004) has reported about three different ways to carry out the organizational change when implementing information systems: 1) letting users not notice the change, 2) users noticing the new information systems and 3) both information system and process change and users notice that.

Information systems and their implementations are expected to meet resistance to change (Halonen 2004). Halonen studied three information system implementations and she found several common obstacles that impeded the implementations. Resistance to change was found regardless of the environment or business branch of the organizations.

In distributed projects the problems even grow (Evaristo 2003). Furthermore, user involvement is more difficult in distributed environment and thus increases the risk that relationship management may be faulty in distributed projects. Erickson and Evaristo (2006) add that organizational distance increases the complexity of relationships and thus increases the risk of failure. They also note that different organizations develop their own corporate culture and approaches to development, thus increasing the possibility to misunderstand and mistrust between the distributed sub-teams.

Distributed projects influence also decision-making (Halonen 2005b, Halonen & Heiskanen 2005). Especially in universities that traditionally have a strong autonomy (Mintzberg 1983, Hearn 2003) and that have developed their own processes this may evolve a problem. In case there is no official command line between actors the actions are based on collaboration and good will.

The importance of collaboration between organizations representing same business area is known especially from the commercial branch. The driving force is described to be financial and the benefits are calculated in money (Johnston & Vitale 1988). Our case comes from the university world where the organizations are independent and the benefit of the collaboration is not pure financial but also practical.

3. Research path

This study is qualitative research and it enables the researcher to explain and understand social and cultural phenomena. Action research is said to be applicable in different environments (Schön 1983). Further, action research is ideal for studying information systems in practice (Baskerville & Wood-Harper 1998). Doing action research in academic environment enables generating new scientific knowledge (Lallé 2003).

Action research is characterized by 1) its multivariate social setting, 2) its highly interpretive assumptions about observation, 3) intervention by the researcher, 4) participatory observation and 5) the study of change in the social setting (Barkerville & Wood-Harper 1998). Our research meets these characteristics with e.g. its many participating organizations including departments from universities and vendors added with the researcher acting as a project manager. Further, the researcher intervened the environment bringing her experience with her and when reporting out the case the output is highly interpretive. Also the study of change is considered in the research when observing the changing relationships and atmosphere in the project.

Mathiassen (2002) notes how action research is difficult to differentiate from field experiments because the same research activity can be considered both from practice and research. He continues that the greatest weakness of action research is the limited support that it offers for structuring the research process and findings. On the other hand, action research provides a link between scientific understanding and social action.

The researcher acted as a project manager in the information system project. Her role was to facilitate the project work and to carry the project to its goal – to implement and pilot an information system that was to support the management of student mobility. In this sense she was able to influence the issues and encounters in the project and to use her experiences from previous implementation projects.

Besides action research, the means of case study (Yin 2003) are used in this paper. It is essential to choose a case that offers possibilities to learn and to get better understanding about the issue that is concerned (Stake 2000). This case is described bearing in mind the notes by van der Blonk (2003): cases are written with a purpose that heads to the goal of the research project. He continues that the researcher is interpreting the case when writing it down.

The nature of the research material is subjective and interpretive and the validity is ensured by the relationships between the different sources as described in Fig. 1. Klein and Myers (1999) introduced seven principles for conducting and evaluating interpretive case studies and their principles act as a backbone for validating this research at hand. On the other hand, Klein and Myers also clarify the use of their principles and warn that researchers should not follow all their principles if they find them impertinent from their perspective of research.
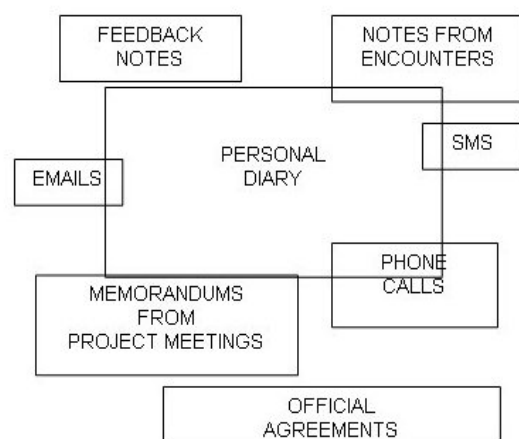

Figure 1. Research material

Fig. 1 describes how the research material is tied with each other. The diary written by the researcher includes emails and SMSs from other project members and notes about project meetings that can be combined with memorandums from project meetings. The project memorandums were circulated among project participants and officially accepted in the following meetings. Even if the diary is subjective, it reflects the atmosphere in project meetings. Likewise, some but naturally not all phone calls with the project manager are described in the diary. Only official agreements and feedback notes from the users are totally separate from the personal diary. However, the atmosphere of the diary reflects also the feedback notes.

As seen in Fig. 1, the research material is highly subjective. The past and experiences make people what they are (Frankl 1963). Following this, the experiences of the researcher influence the interpretations and writings when the study is written out. The role of the personal diary as research material is emphasized in this study because the researcher started her writing from the very beginning of the project. In the diary there are notes from about 350 days including personal observations from meetings and encounters and copied SMSs from vendors. However, the writing meets the criteria described by Schultze (2000): authenticity (the role and identity of the researcher is explained in the text); plausibility (the text is structured, following the timeline according to the empiric case) and criticality (the diary helps to understand the attitude of the researcher and is still questioning the objectivity of the data).

In addition, Fig. 1 describes that except the personal diary the research material is also influenced by other actors in the project.

4. From manual work to digitized system

The background of this information system project lays in the middle 1990's when student mobility started to increase between universities. Student mobility happens when students pass courses in other universities as a part of their academic degree. This mobility is based on agreements and the studies must be applied for and paid by the receiving university, respectively.

During the early years, the mobility was mutual and the universities had developed their own ways to perform and to manage student mobility. Because of the small amount of moving students, the student affairs officials were even able to know the students by name or by face. However, in their databases there were no markings about the students coming from different universities or going to another university, respectively.

This information system project was established to produce and pilot a nation-wide information system that would include all student mobility and support invoicing in every university. In addition, the students would use this information system when they applied for rights to study. In the future, the information system would have thousands of users consisting of student affairs officials and students.

This student mobility was specified in an earlier project owned by other stakeholders that produced a description of the process of the student mobility. However, this specification project is out of the scope of this article.

Previously, when a student wanted to perform studies in another university, an application form had to be found out and filled with needed information. The process was multi-phased and needed several encounters and manual checking in different departments in the universities. Due to manual work, the process used to spend a lot of calendar time.

The process of student mobility acted as a basis for the discussions and its importance in the information system development was not too much emphasized. Even afterwards it appeared to be difficult to write processes down and to describe them in detail.

The approach in the process was that of students, student affairs officials, user administration officials and other departments of both sending and target university. Only a small part of this process was to be supported by the new information system. In addition, before the information system could be designed, the process of applying for rights to study and to manage the process by the student affairs officials had to be specified. After the process of managing student mobility in universities was described it was time to transfer it into the view of an information system.

The approach of defining information system was different. Instead, the approach was that of the information system and its states when the application was managed or handled in the information system. Until now, the student affairs officials of the universities had managed the process in their ways independently. From now-on, a unified process had to be specified before a joint information system could be coded and taken into use in the universities.
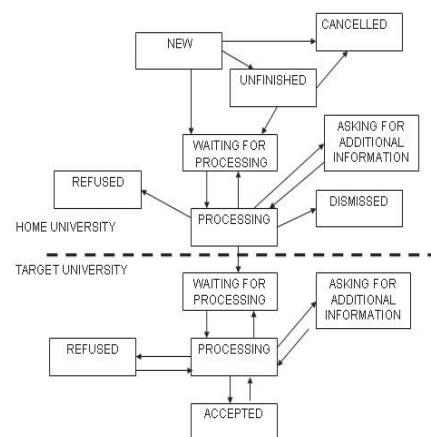

Figure 2. States of application in the student mobility process.

There were no students represented in the project group. However, the process was simple from their point of view. The students logged in the system, checked the pre-filled information coming from the university, filled the application and sent it to the university. After that they only read their email if any additional information was needed. Therefore, no training was needed for the students. On the contrary, the feedback from students explained that the information system was very intuitive and logical from students' view.

Fig. 2 describes the information system view of the mobility process when the study rights were applied for. The arrows in the picture stand for the information and its direction in the process. The new application is inserted in the first state [NEW] and at the bottom of the picture the application is either refused or accepted. The directions of the arrows had to be considered thoroughly.

The phases of the application process had to be specified carefully, including all possible interaction between students and student affairs officials. These specifications necessitated a lot of discussion, also including technological view and this approach did not always please student affairs officials. *"The whole meeting went with their [implementers] plan and it was good despite the feeling that some of the of the student affairs officials did not like the technical questions etc."* (Diary March 20, 2004).

It also happened that when the information system was under piloting, the implementer got emails from the student affairs officials: "*Could you please restore the application No. xxx that I rejected and put it back to the process?*"

(September 2005). The student affairs officials could not do all the actions themselves because they had to follow the procedure that was coded in the information system.

Describing the mobility process into a state diagram where the application was managed was surprisingly difficult. The student affairs officials were experienced in student affairs and student mobility, but knowledge about developing and designing information system was scarce in the project group. The information system view was introduced mainly by the vendor who tried to explain what the decisions meant "in IS". "*If anybody mentions 'interface' I'll scream*", warned one official in a project meeting.

The implementer had to explain very carefully what the decisions meant in practice before implementing the information system. Several pictures were used to explain the process from the view of student affairs officials and students. Fig. 3 was used when explaining the functions to student affairs officials in seminars. In the picture the application is managed in the home university and the student can follow the process by using the information system. There are two endpoints in this phase: the student affairs official refuses the support to study in another university or the application is supported and sent to the other university to be handled.

The discussions about the functionality and their coding were sometimes considered annoying by the student affairs officials: "*You may do yourself an information system that you can learn to use and then manage the student mobility for us.*" (Diary notes March, 2005).

Despite some annoyed notations of the project members, the collaboration and working routines in the development project were felt positive and fruitful. The project manager wrote her diary: "*The steering group had its meeting and it was again very nice and collaborative [….] even after the meeting he came to tell me that MoSu is proceeding on right direction and that we are doing right things.*" (Diary November 7, 2005).

The users were able to give feedback by using an automated notepad that was emailed to interested project members. This notepad opened when the student sent the application form. The student affairs officials could give their feedback by using the same notepad but the feature was not automated

for them. The feedback was mostly positive and the students were satisfied with the system: "*Really much better than filling and sending paper forms!*" (May, 2005). "*Thank you for the good service with student mobility!*" (May, 2005). "*The electronic application form was excellent! The instructions were well planned and informative. Once for all – a really user-friendly experience.*" (May, 2005). "*Well done and a handy service!*" (June, 2005).However, we got also some negative feedback: "*That was not a user-friendly application form!*" (June, 2005).

The student affairs officials expressed their opinion by stating that they want to continue with MoSu even if the piloting will be over (Project memorandum May 9, 2005).

However, even if the feedback from the student affairs officials was mostly thanking, they wanted to develop the information system even during the last months of the project. The state diagram (Fig. 2) acted as a backbone of the information system when describing the functionality to the project members. It appeared that the wishes and suggestions done by the student affairs officials were to cause changes also to the state diagram.

Even when training the key users they started to express new features that were needed in the system. The project manager wrote her diary on March 17, 2006:"*I had to tell several times that we cannot take new features at this phase because there only are a few months left*".

Despite the strict approach of the project manager, all the suggestions were recorded and evaluated. In case they were not implemented they were listed as output of the piloting.

5. Discussion

The goal of this research was to discuss the change from using paper forms to electronic application form and how this change was managed in an implementation project. "Best practice" (Klein & Myers 1999) was used in data gathering, analysis and reporting.

The aim of the information system was to support the student affairs officials when they managed student mobility in their universities, and to enable students to apply for rights to study by using electronic system. Student mobility happens when students perform studies in other universities as a part of their academic degrees.
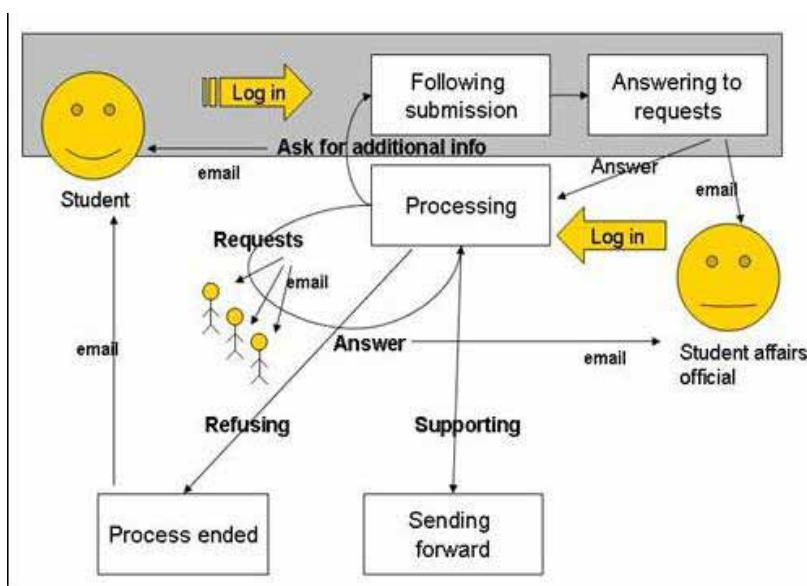

Figure 3. Modelling the process of student mobility.

The process to manage student mobility differed between universities and digitizing the management caused changes also to the management process. Despite the independent nature of the participating organizations the members were willing to unify their processes and to make changes in their processes because they wanted to get the electronic information system to replace the paper forms and to help them in their tedious workload. Thus, following Markus (2004) this organizational change was carried through by users noticing the change and by their active participation in the change process.

All the same, before the final information system was coded a lot of discussions and explaining had to be carried out in the project. E.g. filling applications on behalf of students was possible when paper forms were used but the specified process did not support that function (Email May 9, 2005). Halonen (2005b) has noticed how making decisions may be difficult when the decisions influence other participants and their organizations. Despite the autonomous approaches the project proceeded when transforming the processes into one digitized process.

Furthermore, coding everything in the information system produced also actions that were not thought through: "*Now the officials have done requests on additional information to themselves.*" (Phone call from the implementer to the project manager, June 1, 2005).

We found the idea of inter-organizational information system to be the only possibility to support the aimed purpose. Because the student mobility took place between universities, it was self-explanatory that the new information system had to be inter-organizational. In our case, the findings by Johnston and Vitale (1988) about organizations justifying new applications of information technology only through cost reductions were not proven.

Our study follows the notes by Ragowsky et al. (2000) when they found that organizations may benefit by using specific information systems. In our case the benefit was not measured by money but by feedback from the users and it was mostly positive and satisfied.

Furthermore, our case proves that using non-professionals in information system developments is extremely important because they bring the system environment with their experience in to the development work. When in use, this new information system fits it its purpose and both the students and the student affairs officials are mainly extremely satisfied with it. That does not mean that there aren't any more wishes or requirements that come every now and then but so far the information system has proven to be a success. Even if the main goal was to support the student affairs officials in managing the student mobility, also the relief felt by the students was highly appreciated by the project owners.

The project group represented all student affairs officials who were to use the information system. In our project the collaboration was perceived inspiring and the members were committed to progress the implementation. Nevertheless, there were big changes in the structure of academic degrees due to international agreements (Bologna 2003) and they caused occasional delays in responding to the project tasks. In addition, due to the heavy workload of those changes also some fatigue with the information system project was observed. On the other hand, the unifying process of the European level degrees affected also the process of unifying nation-wide level degrees, thus possibly increasing the student mobility within the borderlines.

The users were involved and participating (Barki & Hartwick 2001) in the project. There were student affairs officials participating in the project work from the very beginning (Memorandum June 16, 2003) and students involved when the first version was to be tested. In addition, during the piloting the student affairs officials gave feedback whenever needed.

Using this feedback the information system was improved without delays. The project manager sent several emails to the implementer thanking for the flexible cooperation and understanding. However, several times the implementer had to explain to the student affairs officials what the intended changes meant in practice. It was not easy to understand what the decisions caused in the process of student mobility or how toilsome some of the changes were (Halonen 2006).

One of the findings of Tiwana and McLean (2005) was the compositional attributes of the project team - heterogeneity in team members' expertise, the quality of the working relationships within the team, and their collective absorptive capacity. Our case confirms that but also points out the need to express issues so that team members are able to internalize them. Good pictures offer a usable and easy tool here. We believe that this case serves both practice and science, giving better understanding about information system implementations and the importance of specifications that are used.

On the other hand, we want to highlight also the relatively free hand that was given to the implementer when modeling the process of applying for right to study (Fig. 2). It is the conception of the researcher that the project group with its student affairs officials would have needed much more time to specify the process without the help from the implementer. Moreover, it can be assumed that the project would have delayed without the background work done by the implementer. All the same, having "free hand" also caused a lot of explaining and discussions from both the student affairs officials and the implementer.

The principles introduced by Klein and Myers (1999) have been in the background when carrying out this research. Hermeneutic circle is concerned when trying to understand the relationships between project stakeholders in the context of the project organization. Interaction between researchers and subjects has been live in project meetings and encounters and its importance can be generalized to concern other inter-organizational information system projects. Multiple interpretations are realized in this research by using both project documentation and the personal diary written by the project manager when interpreting goings. The principle of suspicion leads us to evaluate the diary of the project manager and the short minutes that are written from meetings and encounters.

In this paper, we have discussed the change from using paper forms to using digitized information system. The aim of this research was to highlight the issues that rise when the digitizing is specified. We highlight the importance to know the process that is to be highlighted and especially the need to write the process down. We conclude that it is not enough to know how to act according to the process. In addition, it may be unexpectedly difficult to understand the difference between acting face-to-face and using electronic information system.

We point out that a high felt motivation may act as a facilitator for the change. In case the motivation is co-operated with trust between actors the difficulties in understanding may be forced to fall. In addition, we argue that good pictures serve as a concrete tool when explaining the functions of the forthcoming information system to its future users.

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