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Käytä viittauksessa alkuperäistä lähdettä:

Kauppinen R., Lagstedt A., Lindstedt J.P. (2020) Expert-Oriented Digitalization of University Processes. Teoksessa: Popescu E., Hao T., Hsu TC., Xie H., Temperini M., Chen W. (toim) Emerging Technologies for Education. SETE 2019. Lecture Notes in Computer Science, vol 11984. Springer, Cham. DOI: 10.1007/978-3-030-38778-5_8

PLEASE NOTE! This in an electronic self-archived version of the original article. This reprint may differ from the original in pagination and typographic detail.

Please cite the original version:

Kauppinen R., Lagstedt A., Lindstedt J.P. (2020) Expert-Oriented Digitalization of University Processes. In: Popescu E., Hao T., Hsu TC., Xie H., Temperini M., Chen W. (eds) Emerging Technologies for Education. SETE 2019. Lecture Notes in Computer Science, vol 11984. Springer, Cham. DOI: 10.1007/978-3-030-38778-5_8

The final authenticated version is available online at: http://dx.doi.org/10.1007/978-3-030-38778-5_8

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Expert-Oriented Digitalization of University Processes

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Abstract. Digitalization challenges the way business processes are seen. The potential for enhancement is recognized even in business areas that traditionally have little to do with IT. Even though universities have long traditions of how work is organized, they have not been eager to adopt digitalized processes. Because core processes of universities rely on highly skilled experts, digitalizing processes is not as straightforward as in more mechanical work. We developed an expert-oriented digitalization model (EXOD) for university processes' digitalization and tested it using a case study. After digitalizing a core process, we interviewed the experts involved. The results show the usefulness and adaptability of the model. Based on the results, we recommend future studies be done to refine and test the model more comprehensively. Also, based on the adaptability of the model, we recommended it as a baseline for university process digitalization projects in general.

Keywords: digitalization, university, expert, process, model, thesis

1 Introduction

Due to digitalization, the importance of information systems (IS) has grown in business areas that are not normally considered to be IT-oriented (Borg, Olsson, Franke, & Assar 2018). Universities are no exception, even though some university processes have a long and rather changeless tradition, inherited from as far back as the 15th century. Long traditions could be seen as an obstacle for digitalizing university processes, but there are also other obstacles. The core education processes of universities rely heavily on expert work; the amount of mechanical work is rather small. Experts with strong opinions and expertise combined with high autonomy have to be taken into account in university digitalization projects.

In this study, we selected one of the core processes of every university: the thesis process. Even though the thesis process is critical for universities, it is not usually considered as a systematic process, but more as the repetition of unique handicraft done with the supervisors' best skills and will.

The challenges of the thesis process have been recognized, and some related work has been done in the areas of both quality improvement and ICT system support (Aghaee 2015; Karunaratne 2018; Lagstedt 2015). One of the tested thesis process support systems is SciPro (Hansson 2014), which has been studied from the viewpoints of the student and supervisor interaction and the effective implementation of the process (P. Hansen & Hansson 2015; Karunaratne 2018). Scaling the process for a larger scale implementation has also been studied from a quality (Larsson & Hansson 2011) and resource management viewpoint (Hansson 2014).

However, in addition to the quality and resource aspects, the issues in scaling the process include integrations with other (core) processes and both manual and ICT systems. Existing work identifies the thesis process as a core activity in universities (Hansson 2014), but the process and systems integration at the organizational level has not been discussed in detail. These have a considerable impact on, for example, the level of automation as well as information availability and quality of the organizational level. In addition, it seems that prior literature considers the thesis process only as a research process (see e.g. Karunaratne 2018), which is not the reality in all universities. Other types of theses are also used (see e.g., Lagstedt 2015), and in different disciplines, different aspects are emphasized within the same type of thesis. Furthermore, if Davenport's (Davenport 2010) knowledge work classification is applied, thesis supervising can be classified as an expert model of knowledge work, where experts organize their work individually and are not ready to consent to a mechanical, “cookbook” approach (Davenport 2010). The IS supporting thesis process have to be flexible enough to allow efficient supervision of different types of theses.

Since prior literature considers the process–system integration on a limited organizational and individual level, we developed an expert-oriented digitalization model (EXOD) for digitalizing universities’ learning supporting processes.

To test the developed model, we formulated the following research questions:

RQ1: What are the experiences of the expert-oriented digitalization model?

RQ2: How was the user involvement realized in the digitalization project?

To answer these research questions, we studied a thesis process digitalization project at Haaga-Helia University of Applied Sciences, conducted in 2016–2019.

2 Theoretical Background

2.1 Business Process Development

If digitalization is done just by automating processes as they are, the existing problems are fixed with IS, and the potential of IS is not exploited. In addition, as Argyris (Argyris 1977) points out, people seldomly do exactly what they claim to do, and automating the assumed process brings out this discrepancy: the new IS may follow the known process model exactly but is not suitable for use (Lagstedt & Dahlberg 2018b). Thus, automating the processes could be one part of functional stupidity (Alvesson & Spicer 2012), but as Venkatraman (Venkatraman 1994) points out, in some cases, it could be the rational choice of an organization to avoid radical changes in processes. An organization may choose to automatize existing practices only, instead of attempting big re-engineering projects. According to Venkatraman (Venkatraman 1994), IT-enabled business transformation can be classified roughly into two categories: evolutionary levels and revolutionary levels, where the former needs minimal changes to business processes, and the latter requires fundamental changes to existing processes. Venkatraman claimed that with the revolutionary approach, organizations could benefit more, but the costs (efforts) of the change would be higher as well. So, there is no right or wrong or optimal level of business transformation; the cost and potential benefits, as well as the enablers and inhibitors of the organization, should be taken into account, and each case should be discussed separately (Venkatraman 1994).

Davenport and Short (Davenport & Short 1990) present a five-step model for process redesign. In their model, the first step is to develop a business vision and process objectives. This is a rather general level step and should be done as a part of strategic planning. The second step of the Davenport and Short (Davenport & Short 1990) model is to select a suitable process(es) to be redesigned. They point out that it is not necessary to go through all processes of organization exhaustively; it is enough to identify the most important or most problematic process to be developed. The third step is understand and measure the selected process(es) to find out current problems and set a baseline for improvements. The fourth step of the Davenport and Short (Davenport & Short 1990) model is to identify IT levers, i.e. how IS can enhance the current process or enable totally new kinds of approaches. The last step is to design and build a prototype of the process by implementing the new process on a pilot basis and modifying as necessary (Davenport & Short 1990).

In process development, it is not enough to consider the organizational level: individual levels have to be taken into account, especially in knowledge work (Davenport 2010). When Taylor composed his principles of scientific management, the assumptions about humans were rather mechanistic: replaceable components doing simple, repeatable tasks, and by optimizing the tasks, the maximum efficiency is achieved (Taylor 1913). This, however, is shown to be an oversimplification, and later process-development models, such as business process management (BPM), emphasize the role of people and culture (vom Brocke & Sinnl 2011). People are more complex than just parts of a machine; they are not fully rational (Alvesson & Spicer 2012; Simon 1997), nor are they are always reliable. According to Argyris (Argyris 1977), there is a difference between what people say they do and what they really do. This kind of cover-up culture, or inhibiting loops of organizational learning, as Argyris (Argyris 1977) calls them, hides the real causes of the problems (Argyris 1977).

As Davenport (Davenport 2010) points out, knowledge work is difficult to structure and seldom seen as a process. In addition, knowledge workers easily resist instructions and models given outside and view a formal process approach as a bureaucratic, procedural annoyance (Davenport 2010). Even though knowledge workers resist change, there are examples in which knowledge work is significantly improved through process management (Davenport 2010).

Davenport (Davenport 2010) formulated a model of four approaches to knowledge work to clarify different knowledge work situations (see Fig. 1).

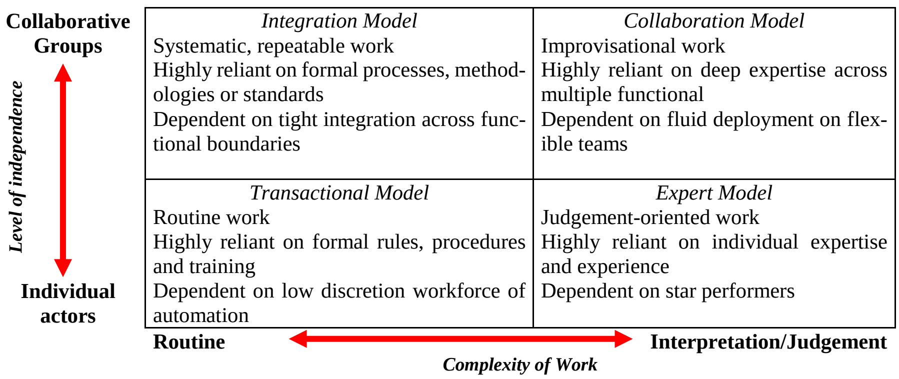

Fig. 1. Four approaches to knowledge work (Davenport 2010)

As thesis supervising, like many other university processes, is clearly more about judgement and interpretation done alone, we place thesis supervising in the “expert model” category. According to Davenport (Davenport 2010), expert work can be improved with processes, but workers themselves easily resist the change and strict, cookbook-type process models. So, instead, expert model processes should consist of higher level guidelines, giving expert workers enough flexibility to decide how to do the actual work (Davenport 2010). To overcome the expert workers’ resistance and to structure their work, Davenport(Davenport 2010) recommends finding a way to embed a computer in the middle of the work process. However, IS should not be an obstacle for experts to reach their full potential (Wenger & Snyder 2000).

2.2 Information Systems Development

From a control point of view, IS development methods can be classified roughly into two categories: plan-driven and change-driven methods (Moe, Aurum, & Dybå 2012). Plan-driven IS development models (ISDMs) dominated selections at the end of the 20th century, whereas the popularity of change-driven ISDMs has grown during the last two decades and appears to be a current mainstream (Theocharis, Kuhrmann, Münch, & Diebold 2015). In plan-driven IS development, planning and development are divided into separate phases. The assumption is that every aspect of development work—objectives and their required metrics, tasks, money, and resources—can be planned thoroughly in advance. Development starts immediately after the planning phase is completed.

The plan-driven methods, such as the waterfall method, are a straightforward way to develop software, but there are many known problems, e.g., early mistakes are found late and are difficult (and costly) to solve. The assumption is that no changes happen during software development, i.e., what is defined in the beginning will be implemented in the later phases. Even if all the definitions are done correctly, this does not guarantee success in IS development since circumstances might have changed (S. Hansen & Lyytinen 2010).

In change-driven development, such as agile methods, the idea is that the whole information system is not planned at once, but planning and development are done in small steps. After each step, the situation is re-evaluated, and necessary changes are made to the objectives. Each development step results in a new IS release after each cycle. Despite the good success rate of projects done with agile methods, 61% of agile projects are still not considered to be successful (Hastie & Wojewoda 2015); an agile ISDMs do not guarantee success for ISD projects (Dahlberg & Lagstedt 2018).

One alternative is to use a hybrid approach, where parts of plan-driven and change-driven development are combined (Theocharis et al. 2015). Since no method fits all cases, it is important to discuss (and select) a method on a case-by-case basis (Lagstedt & Dahlberg 2018a).

2.3 Change Management

The role of individuals in process change is remarkable, especially in knowledge work. One part of the change is change management. It is natural for humans to resist change, and if the change is not managed well, a new process and the IS supporting it may not be used, no matter how efficient the new systems are. Some change management models are rather mechanical, where organizations are seen more or less as machines (Cameron & Green 2009). Some see organizations as evolving organisms and believe different social aspects should be considered. A rather famous example of the latter belief is Kotter's eight-step model (Kotter 1995), in which the change sticks only when "new behaviors are rooted in social norms and shared values" (Kotter 1995). In Kotter's eight-step model, the idea is that the change process goes through change steps, and skipping steps creates problems. The steps of the model are 1. establishing a sense of urgency, 2. forming a powerful guiding coalition, 3. creating a vision, 4. communicating the vision, 5. empowering others to act on the vision, 6. planning for and creating short-term wins, 7. consolidating improvements and producing still more change, and 8. institutionalizing new approaches. (Kotter 1995)

As process change often manifests itself as a new IS, the success of the new IS represents the success of the process change. It is, therefore, natural to consider how new IS are taken in use. There are related theories, for example, technology acceptance model (TAM), which can be applied as well. According to TAM, the perceived usefulness and perceived ease of use affect the behavioural intention to use a system (Davis, Bagozzi, & Warshaw 1989). So, to get users to use a new system, a user has to be made to see that the system increases work performance and can be used without additional effort.

As mentioned, not all problems in process change are easily seen (Alvesson & Spicer 2012) or recognized (Argyris 1977). Thus, it is not possible to deal with them early, and Kotter's eight-step model is hard to apply as such. Cooper and Zmud (Cooper & Zmud 1990) proposed an IT implementation process, where diffusion of IT does not happen all at once, but as a gradual process. We claim that Cooper and Zmud model is useful when actual process change (and the supporting IS) is implemented, whereas Kotter's model is effective when the change is communicated to users, keeping the objectives of TAM (usefulness and ease of use) in mind.

2.4 Expert-Oriented Digitalization Model

Based on the theories of business process and IS development and change management, we formulated an expert-oriented digitalization model (EXOD) for knowledge work, especially for university processes. EXOD has four main steps:

1. **Initiation**. Process identification and exploring development opportunities. Find the potential benefits of the digitalization of the selected process and communicate these to the users (experts) involved. Form an effective development group with experts in IS, process development, and the process in question. (Cooper & Zmud 1990; Davenport 2010; Davenport & Short 1990; Kotter 1995).
2. **Process re-engineering emphasis.** Major, high level changes to the process and main requirements for the IS. Select a suitable IS development method for the case. Develop a new process with users (experts), and implement it as far as possible without a new IS. Communicate the potentials usefulness of the IS, and empower the experts to act on the vision. (Davenport 2010; Davenport & Short 1990; Davis et al. 1989; Kotter 1995; Lagstedt & Dahlberg 2018a; Venkatraman 1994)
3. **IS development emphasis.** Develop a process-supporting IS based on requirements, in cooperation with the experts. Perform iterative development with pilot projects and make changes to the process when needed. Experts' work flexibility should be kept in mind and communicated to all parties. (Davenport 2010; Davenport & Short 1990; Kotter 1995; Theocharis et al. 2015)
4. **Stabilization.** Induce the experts to commit the digitalized process as a normal activity. Make minor refinements to the IS. (Cooper & Zmud 1990; Davenport 2010; Kotter 1995; Theocharis et al. 2015)

3 Methodology

3.1 Research Method

In the case study research, we followed the recommendations of Yin (Yin 2009). We used four data collection sources extensively that Yin (Yin 2009) recommends, namely documentation, archival records, participant-observation, and interviews. In the analysis, the main emphasis was on the interviews; the other sources were considered complementary.

Since one of the researchers was responsible for the thesis process development and another for the development of IS (Konto) supporting it, we had access to the thesis process development, as well as all of Konto's development documentation (process models, notes, product backlogs, version history, plans, e-mails, guidelines). We also utilized Konto's logs and registers as supporting data to understand the actual usage of the IS. In addition, as supervisors and thesis coordinators, we also used and guided the use of the digitalized process and made participant observations during the process.

The interviews were done by applying an interview method protocol developed by Dahlberg, Hokkanen, and Newman (Dahlberg, Hokkanen, & Newman 2016). During an interview, questions were presented on screen either face-to-face or via a video call to the interviewee. The interviewer recorded and presented the responses immediately before moving to the next question. Recording the responses gave interviewees the ability to validate the typed answers immediately. The interviews can be described as expert interviews (Bogner, Littig, & Menz 2009).

The interview had two parts; 27 participants were interviewed. Nearly half, 13 responded to the first and, almost all, 25 to the second part. The interviewees were chosen based on their above average activity around Konto. In this study, data from the first part, covering the process of digitalization, is analyzed. The second part, focusing on the resulting process and tool will be analyzed in our future work.

Of the 13 interviewees, 10 performed a single role, two performed two roles, and one performed three roles. The fields of expertise covered administration (4), degree program management (2), thesis coordination (5), and thesis supervision (6).

The digitalization part of the interview consisted of identifying the role of the interviewee and responding to six open-ended questions, as well as an opportunity to provide open comments. The answers were coded based on the theory presented in Chapter 2 (process development, IS development, and change management) and on RQ1 and RQ2 (expectations, experiences, and realization of involvement). One code (service promise) emerged based on the answers.

3.2 Case: Thesis Process

A thesis process as a core activity (Hansson 2014) is often considered relatively simple: the supervisor as the expert advices, and the student writes the thesis (Karunaratne 2018). In practice, the process is more complicated (Aghaee 2015; P. Hansen & Hansson 2015). For example, in our case study, the process at the Haaga-Helia University of Applied Sciences (HH) included other experts, such as the thesis coordinator (organizes information sessions, checks students' thesis ideas, and assigns supervisors), degree program management (oversees supervisors' and coordinators' workload), and the administration (publishes the resulting thesis and records the grade).

This process was digitalized using the EXOD model. In initiation (before 2014), HH described its core processes, revealing that the thesis process was the most complicated. The benefits of digitalization were apparent, so work started with experts on the process and IS development with a process re-engineering emphasis (2014–2017**).** The resulting process has six phases. The main requirements for the IS were integration with data sources, automatic data transfer and being a modern platform supporting mobile use.

A hybrid approach (Theocharis et al. 2015) that supported the expert involvement was selected, and the Konto tool was developed in the IS development emphasis (2016–2019) based on the requirements. Changes to the process were implemented and communicated. After the fall 2018 test period, the Konto tool was launched for full use with thesis projects starting from January 2019, resulting in stabilization (from 2019) where the digitalized process is being committed as a normal activity. Refinements are done as needed.

4 Results

Regarding the experiences (RQ1), the majority of interviewees (10 out of 13) had formed expectations early, after being involved in the digitalization. From administrative, management, and coordination viewpoints, as expressed in interviews (*translated to English*), process visibility (*on every level of the organization*), process automation (*automating parts of the process)*, and statistics recording (*getting rid of manually keeping track of supervisors and their resources*) were considered especially important. The supervisors and coordinators emphasized the change in communication and the usefulness of the single platform (*fewer e-mails when the communication and materials are in the same place*), and the transparency (*the supervision is visible*).

Of the interviewees, four out of 13 identified only positive experiences, eight identified both positive and negative, and one identified only negative. The experiences were higher in number and more detailed for coordination and supervision, while experiences of the administration and management were fewer and more general. The positive experiences were related to the model (*extremely useful, agile model that utilizes in-house competencies well and is generalizable to similar*, *well-scoped development efforts*), the involvement (*it has been valuable, being able to participate and try out, which also helps in commitment to the result*), and influencing the result (*the needs of the users have been taken into account*).

The negative experiences were doubts about the coverage of the involvement (*the piloting phase could have been longer, and more people could have been involved*), and coping with incompleteness (*some may have felt insecure due to the changes*). It is worth noting that the interviewee stating only negative experiences still felt the participation itself positive and considered related work on the service promise to be helpful. Another interviewee also mentioned the service promise as supporting the involvement.

The realization of involvement (RQ2) was difficult to pinpoint. While eight out of 13 interviewees acknowledged having development ideas, most comments were general and did not name concrete examples. Instead, they were showing trust in taking the ideas into account (*there may be something that I also have pointed out, but it is hard to specify a single one)*. Only a few could name a concrete and implemented idea (*it was not possible to send a message in a certain situation, but now it is)*.

However, involvement also meant interviewees were participants in change management since 10 out of 13 interviewees took an active role by communicating process- or tool-related changes (*answered the questions and provided instructions to the supervisors)*. The communication was two-directional as information and guidance were provided to users and feedback from users was relayed back to developers (*informed developers about the comments from the supervisors and the coordinator team)*.

Studying the available documentation and observations showed that there were some difficulties with terminology and combining old practices related to the process and IS development; some of these only came out during IS implementation. But, based on the Konto log files, the digitalized process has been taken into use comprehensively. Moreover, Konto is considered to be visually clear (perceived ease of use in (Davis et al. 1989)), and the thesis process improved (perceived usefulness in (Davis et al. 1989)).

As stated earlier, more detailed analysis of Konto and the digitalized process is a topic for further study.

5 Discussion and Conclusions

The interview data, Konto logs, documentation, and observations all confirmed that the EXOD model performed well in digitalizing the expert-driven thesis process. The findings met the goals set for the EXOD model: the experts felt that they had been listened (Davenport 2010; Kotter 1995), the developed IS decreased the workload of experts (Davenport 2010), it was easy to use (Davis et al. 1989), and it ensured that the process was followed (Davenport 2010). The level of process development was meaningful (Davenport & Short 1990; Venkatraman 1994) and gave a good basis for the development of the IS. The selected IS development method (Lagstedt & Dahlberg 2018a), the hybrid approach (Theocharis et al. 2015), was suitable in this case.

The best results were achieved in change management. Thesis supervision is considered to be personal expert work (Davenport 2010), and external interventions, such as process enforcing and automation, are often considered undesirable. However, in this case, the experts felt they could affect the outcome (Kotter 1995) and automation, for example, was seen useful as it reduced mechanical work and clarified information handling (Davenport 2010; Davenport & Short 1990; Davis et al. 1989; Kotter 1995).

However, there is still room for improvement. Some experts perceive continuously changing IS to be confusing, so, plan-driven development could be emphasized. In addition, some felt that pilots were short, so feedback could be collected over a longer period and from a larger user group. Also, in some cases, users claim to follow the process but implementing the IS revealed that they actually do not (Argyris 1977). While this cannot be fully avoided, it should be considered in EXOD model steps 2 and 3 by engaging experts to pursue objectives. In addition, some supervisors emphasize their expertise in supervising, while others see it more as routine work, so compromises need to be made.

Interestingly, the EXOD model seems to produce committed change agents (Cameron & Green 2009), even though it was not an explicitly pursued objective. This effect should be studied and further developed to make it more robust. Overall, we recommend future studies be done to refine and test the EXOD model more comprehensively. Also, based on the suitability for processes with high actor expertise and autonomy, we recommended it be used as a baseline for university process digitalization projects in general.

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