STRATEGIZING DIGITAL INFRASTRUCTURES IN HIGHER EDUCATION

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Abstract
Higher education is a key pillar in constructing new knowledge economies for the 21st century, and digitalization of higher education is a central focus area for national authorities. In Norway, the strategy from the authorities holds the premise that the decision-making authority for digitalization should be at a strategic level. Digitalization is driven by key features of modern technology but may also lead to transformation of traditional educational methods as well as educational practices. Since the university contains several disciplines, different strategies can be used when products or processes within the discipline are digitalized. In what ways do different disciplines proceed to digitalize their educational practices? Based on these interests, our research questions are, what are the challenges IT addresses in digitalization of higher education, and what strategies are pursued to solve these challenges?

Our empirical evidence is two cases from respectively medicine and law, and our contribution is an investigation into the strategies pursued in the digitalization approaches, and the contextual differences that may explain the chosen strategies. We provide three process models to explain these differences, and consequently a way of understanding strategies within digital infrastructures in higher education.

1. DIGITALIZATION OF HIGHER EDUCATION

Digitalization implies using technology to simplify and improve processes or products (Norwegian Government 2016). This also involves configuring physical and digital artifacts in a way that may lead to major changes in an organization or an industry (Yoo et al., 2010). The transformational potential brought about by digital products and offerings has proven challenging within traditional industries (Henfridsson et al., 2014; Svahn et al., 2017). The literature on digitalization has demonstrated how industrial challenges in production of physical equipment as cars or phones can be addressed (Svahn et al., 2017), how services may be improved (Lusch and Nambisan 2015; Zacharidis et al., 2013) as well as how business models can be transformed (Loebbecke and Picot 2015). This also implies that digitalization is a strategic activity. This literature has, however, to a much lesser extent focused on digitalization of higher education. Exceptions are how to handle increased numbers of students, and increased demands for digital interaction between students and university as well as the challenges and solutions associated with the use of technology in educational methods (Scheepers et al., 2018; Henderson et al., 2015; Becker et al., 2017; Siemens et al., 2015).

Higher education is a key pillar in constructing the new knowledge economies for the 21st century (Sam and van Der Sijde 2014). This is why digitalization of higher education is a central focus area for the national authorities (Norwegian Government 2017). As digitalization of higher education poses new challenges to the sector, a strategic viewpoint is essential (Pucciarelli and Kaplan 2016; European Commission 2012). In Norway, the strategy from the authorities holds the premise that the decision-making authority for digitalization should be at a strategic level, and be integrated into all professional and administrative activities (Norwegian Government 2017). Digitalization is driven by key features of modern technology but may also lead to transformation of traditional educational methods as well as educational practices. Since the university historically has an "unlimited aggregation of specialties" (informatics, economics, medicine, law, various social sciences, language courses, pedagogy, psychology, and so on) (Clark 1983, p. 14), and each discipline has autonomous control regarding its organization, different strategies can be used to digitalize the various disciplines (Nicolescu 2009). Since each particular discipline primarily focuses on maintaining educational standards, high-level requirements from the authorities may experience counter-strategies (Pucciarelli and Kaplan 2016). A better understanding

of the chosen strategies is needed in order to understand how digitalization initiatives are balanced towards the independent assessments and decisions of each discipline. Based on these interests, our research questions are, *what are the challenges IT addresses in digitalization of higher education,* and *what strategies are pursued to solve these challenges?*

Since strategic approaches to digitalization may differ in each discipline, we investigate two classical disciplines, law and medicine, at the biggest university in Norway. Both have a historical tradition of the entrepreneurial mindset seen as an important fundament for digitalization of higher education (Pucciarelli and Kaplan 2016). To develop our argument, we frame the research within digital infrastructures theory (Henfridsson and Bygstad 2013, Hanseth and Lyytinen 2010), both to identify challenges that conditions the strategic approach, and to identify how strategy is contributing to align (or expand) the digital infrastructure with the internal organization. Our central contribution is three process models that may be used to explain understand and manage strategic challenges.

2. RELATED RESEARCH: STRATEGIZING IN DIGITAL INFRASTRUCTURES

A fundamental understanding of information systems requires taking into account both the technology, the organization and the individual agency (Orlikowski and Iacono 2001). In addition, the increasingly networked information and communication channels of modern organizations make it advantageous to see information systems as digital infrastructures (Henfridsson and Bygstad 2013; Hanseth and Lyytinen 2010), where systems, organizations, and agency are interconnected in a way that makes it important to see their contextual contingencies.

A central interest within this stream of literature has been to understand the patterns and mechanisms by which infrastructures evolve (Henfridsson and Bygstad 2013). While some instances of the literature frame the evolution as a managed alignment between technological capabilities and the business processes (Broadbent and Weill 1997; Broadbent et al., 1999), others are rather occupied with the radical emergence of evolutionary paths through serendipitous innovation outside management control (Ciborra et al., 2000). Work inspired by this last tradition often focuses on evolution as something that is formed inside the organization in the different practice environments that operate there and the role they have in shaping the evolution (Aanestad et al., 2017; Aanestad and Blegind Jensen 2011; Hanseth and Monteiro 1996). A third and relatively recent stream of research within this literature combines strategic planning with the centrality of the digital infrastructure in laying the foundations for innovation and evolution in strengthening competitive advantage (Henfridsson and Bygstad 2013; Henfridsson et al., 2014).

These streams highlight three key challenges in IS implementation: to achieve alignment between strategy and IT capabilities; to take into account the internal organizational activity systems; and to align the use of the system with the related practices to obtain actual alignment (Arvidsson et al., 2014). This also implies that the infrastructure must solve the practical challenges in order to facilitate innovation and evolution. Consequently, when strategies are developed, internal capabilities must be considered. The internal capabilities can be framed as sub-communities or activity systems (Henfridsson and Lind 2014), or as epistemic cultures (Knorr-Cetina 1999; Mørk et al., 2008), with particular epistemic practices (Nerland and Jensen 2011). The orientation towards these internal capabilities as a central core for strategizing may have huge implications for the chosen strategy. On the other hand, digitalization may have transformative potential, and strategies regarding digitalization are often driven by external factors (Sia et al., 2016; Hess et al., 2016).

Our goal in this paper is to understand strategies in digitalization of digital infrastructures in higher education, and the contextual challenges that form the strategy. To gain knowledge of how IS strategies are formed in order to solve particular challenges in higher education, we investigated two classical disciplines law and medicine. We were interested in four activities that formed the respective strategy approaches, and we will turn to these now.

3. THEORETICAL LENS: FOUR ACTIVITIES IN STRATEGIZING

Without some guiding vision, it can be extremely challenging to determine what is to be achieved (Peppard et al., 2014). Nevertheless, a limited amount of attention has been paid to implementation challenges in IS strategy discussions (Peppard et al., 2014; Teubner and Mocker 2008). Strategies that seek to address implementation challenges need to contain deep insight into the inner and outer context of the organization. The inner context refers to the structure, corporate culture and political context within the firm through which ideas for change have to proceed. Outer context refers to the economic, business, political and social formation in which firms must operate (Pettigrew 1987). This also means that strategizing activities needs to take into account that dynamic capabilities are built over time. Dynamic capabilities address the way organizations are able to integrate, reconfigure and release resources to match competition or even create new markets (Eisenhardt and Martin 2000). Taking these challenges into account, our framing of IS strategy and strategizing includes four central activities.

First, the planning activities and the activities related to preparing the organization for digitalization. The "planning literature" within IS (Ansoff 1980; Henderson and Venkantraman 1993) is occupied with how management takes care of new trends and tendencies. Recently a similar business oriented stream of literature (Hess et al., 2016; Sia et al., 2016) claimed that strategies must be initiated and managed, controlled and planned by some form of central leadership. On the other hand, if the activity systems (Jarzabowski 2003) have a rather autonomous culture, the strategies chosen must be aligned accordingly (Henfridsson and Lind 2014). In both cases, there is a need for aligning the strategy with the activity system in a way that triggers participation. Incentives will be important in these endeavors. As digitalization requires extra effort for the organizational actors, a clear rationale may motivate the extra work burden. In summary, then, although there is a difference between strategy (something we have), and strategizing (something we do), they must in some way be aligned.

Further, in order to identify particular challenges, we are interested in the content that is digitalized, that is, the nature of the objects that are made digital during the digitalization activity. This work will also be conditioned by the various epistemic practices (Nerland and Jensen 2011). Especially in fields where the decentralized autonomy is notable, transparency may be low, and degree of uncertainty high. Uncertainty (Townsend et al., 2018) may involve several features like technology, economics, time and culture that make strategic planning from central management challenging. Text and references are less challenging to digitalize than images and sound. Visual representations like 3D require intensive computation and complex implementation (Teysere and Campo 2009). In addition, the transition from classroom teaching to virtual learning raises a number of additional challenges that have to be taken into account (Violante and Vezzetti 2011). At the same time, these factors may be secondary if the faculty has a plan where these uncertainties and challenges are taken care of, as the planned benefit may exceed the disadvantages.[1]

Then, the implementation relies on one or more inclusion and participation criteria (Hautz et al., 2016). Inclusion criteria deal with the extent to which different departments and groups are required to participate in the digitalization process. While participation is seen as the active use of participants from different disciplines in the implementation, the inclusion criteria are about creating a community where different stakeholders "move forward using their differences, in a productive rather than in a fractious way." (Quick and Feldman 2011, p. 283). Again, the epistemic practices and objects (Nerland and Jensen 2011; Mørk et al., 2008) are important in that some disciplines have a professional culture where change requires a high degree of participation and inclusion.

Lastly, we have the follow-up, how the system is taken care of and further developed to secure continuity and to control interruptions (Cerullo and Cerullo 2004). This is also a management issue since emergent requirements like new educational standards or new research areas, as well as the requirements digitalization introduce, need to be taken care of continually (Wiltbank et al., 2004). Requirements emerging

[1] According to Violante and Vezzetti (2011) there may be up to 75% savings in training budgets by switching from classroom to web-based training.

from the inner or from the outer context of the organization can be difficult to manage on limited resources. Reliance on enthusiasts may create a less robust strategy since technological competence is limited within the organization. The four strategizing activities are summarized in table 1.

Activity	Content	References
Preparation and Planning	There is a need for a guiding plan to know what to achieve, but the plan must be mapped onto the activity systems.	Peppard et al., 2014; Teubner and Mocker 2008; Ansoff 1980, Henderson and Venkantraman 1993; Henfridsson and Lind 2014
Implementation content	Text and references are less challenging to digitalize virtual learning tools in 3D. This creates uncertainty (Townsend et al., 2018) that may affect several parameters like economics, technology, time and culture.	Teysere and Campo 2009, Violente and Vezzetti 2011, Townsend et al., 2018,
Implementation inclusion	Inclusion criteria regard the extent to which the internal stakeholders of the organization must be aligned with the plan	Hautz et al., 2016; Nerland and Jensen 2011; Mørk et al., 2008; Jarzabowski 2003.
Maintenance and follow-up	The follow-up, how the system is taken care of, secured and further developed. This is also a management related issue since emergent requirements like new educational standards or new research areas, as well as the requirements digitalization introduce, need to be taken care of continually	Wiltbank et al., 2004; Cerullo and Cerullo 2004

Table 1: Four activities in strategizing

In order to investigate how these four aspects – planning, content, inclusion, and maintenance – conditions digitalization of various disciplines, we will proceed by investigating two classical disciplines: medicine and law. First we will describe our methodological approach.

4. METHOD

In order to shed light on the strategies by which digitalization projects in higher education are performed, we investigated two cases. We chose a longitudinal process study (Langley 1999) in order to study the phenomena over time and to investigate the longitudinal interaction between organization, humans and technology. Our case study research approach is based on engaged scholarship (Mathiassen 2017) where informants are not only sources of empirical data, but also helpful in constructing narratives and discuss theoretical and practical implications.

Case	Trigger	Aim	Result	Outcome
E-learning in medicine	Teachers want to improve students' mastery of communication, practical procedures, visual analysis, and clinical decision-making. Students want increased feedback.	To facilitate a better and faster learning process in order to educate better doctors	The number of users is not known	(emergent) Digital innovation
Digital sources of law	The market requires more digital competency amongst the students of law	To educate law students with more digital competency	4500 users by the end of 2019	Digital transformation

Table 2: Two cases from higher education

The data collection was done between January and June 2019. We have performed 13 interviews, analysed documents as well as web pages. Two of the authors are central in identifying and analysing material as a part of their regular work tasks. The first author is working as a researcher and is responsible for interpreting and analysing the data. In the analysis, we first established a chronology of important events, before we investigated in detail what it takes to establish and maintain analytics activities. Building on Langley's (1999) approach on process data, we analysed the historical background for the projects and were especially interested in the technology initiatives and how they were related to specific

key events. The analysis revealed four central activities: planning, content, inclusion and follow-up, and these were used to address specific challenges in the projects. Based on the findings we propose three descriptive process models, one generic and one for each discipline.

We see both cases as performed within *digital infrastructures* since a huge amount of students, teachers, administrators, and developers, as well as resources, routines, processes and activities from a range of stakeholders are involved. In the case of law, more than 4500 students use the system on a regular basis, while in medicine there are over 1000 students using the e-learning infrastructure.

Step	Description	Output
1	Identify key events, key objects in the history of the faculty	Timeline for each project
2	Analyze cases: planning, internal content, inclusion, and follow-up	Section 5
3	Propose descriptive process models	Section 6

Table 3: Data analysis

5. FINDINGS AND ANALYSES

In order to shed light on digitalization strategies for higher education, we chose two classical disciplines within the university. Both of them have a rich and interesting history with continual use of technology to solve core challenges within the respective areas. Since the two disciplines' inner workings make a significant impact on the strategy, the various strategies may deviate from the ones espoused by the ministries. In 5.1 and 5.2, we will describe digitalization initiatives at respectively medicine and law.

5.1 Digital education in medicine

Digitalization of the education at the Faculty of medicine spans a wide range of activities – from developing and implementing a student information system to digital exams, support systems for lecturing and group work, and a large portfolio of e-learning programs mainly for self-study. This analysis will focus on e-learning programs.

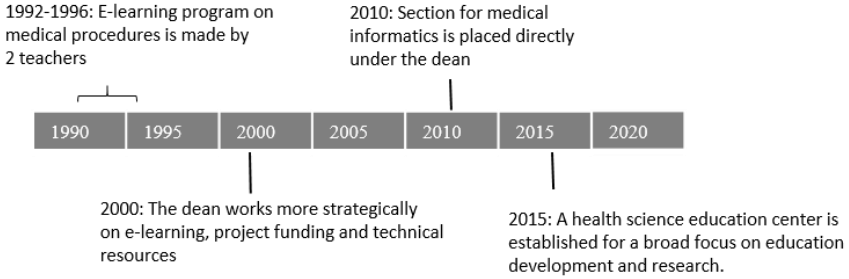

Figure 1: History of e-learning in the faculty of medicine

The e-learning activity started in 1992 when two teachers developed a series of text and image based programs to teach students basic medical procedures like taking a blood sample. The programs were developed in Macromedia Director and won prices for their innovativeness. The teachers continued their work on these programs until about 1996. In 2000, the Dean of studies funded and launched a new initiative to employ IT in education, focusing on establishing and studying net-based collaboration during clinical placement. A year later e-learning was included as a target area. The professor of medical informatics was put in charge of IT in education. This is now a full-time activity. Two technical positions were funded as well as an annual project call targeted at the teachers. In 2010, the section of medical informatics was established directly under the Dean to emphasize the over-arching responsibility of the team. E-learning programs are openly published in a national portal loosely shared by the Norwegian medical faculties. Today the portfolio comprises approximately 50 smaller or larger programs that include several hundred videos and links to server-based functionalities like formative tests and virtual

microscopy.[2] The development of new programs can best be described as an educated development in collaboration with educational scientists and the faculty's newly appointed psychometrician.

Preparation and planning

The ultimate goal of the e-learning and teaching as a whole is to produce highly qualified doctors. Many if not most teachers are constantly looking for ways to improve the learning outcome and the learning process. Medicine is a "handicraft" full of human interaction and sensory input – visual, auditive, tactile – and complex and intertwined life processes. Learning this through books can be quite hard, whereas IT through its ability to handle multimedia, dynamics, information networks, and interactivity facilitates this type of learning. Students are constantly complaining about the lack of feedback on their learning progress. This is partly due to limited resources, and automated formative tests with extended feedback on the answers are seen as a partial solution to this problem. Today's students are "computer savvy" from early childhood and accustomed to IT as a natural part of their learning toolbox. An educational institution that does not employ these tools is seen as thwarting. Finally, studying is becoming a more and more distributed and asynchronous activity, enforced by e.g. the advent of "flipped classrooms". IT is a superior tool for delivering material distributed in space and time. Students are expecting digital resources that facilitate individual self-studies, but which also gives a stronger interaction. Examples are tests, quizzes, etc. but also other forms of resources that activate the learning ability of the student.
The section for medical informatics is appointed by the faculty to take care of these issues and does this partly by funding and participating in teacher-initiated projects to develop e-learning programs. Approximately USD 150000 is annually allotted to these projects.

> "The initiative does not come from the departments, but from the ground floor: the teachers. We try to involve students in all projects - their view is important because the product is for them, but students are usually far more than "viewers" - they often produce most of the resources under the guidance of teachers."

Even though the e-learning initiative is very popular, the resources are limited. The activities related to establishing e-learning are also demanding for each discipline. Each discipline must, together with the three employees in the section for medical informatics, do all the project work in addition to their regular work. The funding is therefore used almost entirely for e.g. freelance hiring, student part-time employment. The strategy, then, is based on some sort of "cultivation" as it depends on independent activity from each subject area. This creates challenges in that good initiatives rely on the discipline itself and is less anchored in faculty management.

Implementation – content

Figure 2: Ultrasound: Example of digitalized education

The strategy from the faculty of medicine is twofold. First, it is to digitalize where IT has special advantages. This applies to images, such as X-rays, eye diseases and skin diseases, and sound, for example, auscultation training. Furthermore, movies are used for case histories, e.g. in psychiatry and clinical communication, and for procedure visualization. Animation can be used to visualize process dynamics such as physiology and disease processes, and simulation helps to understand the processes and consequences of interventions.

[2] The digital infrastructure (http://meddev.uio.no/elaringsportalen/) is currently housing an extended amount of resources spread within the 52 disciplines.

Thus, both practical and cognitive skills are developed. Furthermore, technology is used to "link together material in learning hierarchies so that one can go seamlessly from overview learning to in-depth learning." [informant] Through e-learning fragmented disciplines can get virtual homes that bind the fragments together in an integrated presentation. E-learning can also be a tool for "faculty development" where e.g. teaching consistency is developed from a common knowledge base of procedures. E-learning is also used for student activating teaching through the use of virtual patients and interactive quizzes. These many facets make e-learning an integrated knowledge system.

Figure 2 is an example that demonstrates how to place the probe and to inspect the resulting ultrasound pictures. E-learning programs are developed and tested through trial and error. The section for medical informatics is trying to build educational tools based on what is useful from an educational perspective to make teaching relevant. It must be closely matched to the learning methods that exist. A short example may shed light on this:

> "We wanted to make a video about "forced entry into psychiatry" with a script where a hiker at Hverven Bay discovers a man in bare torso and who clearly has problems. We connect all the activities that are included if this happens: we record a bit at a time, the man calls the police, which then arrives and talks to the patient: how can we know if he is sick? The movie stops at key points and merges discussion into the movie playback, the patient is taken to the emergency physician, what should we ask him? We retrieve further information, what is the diagnosis and does he need treatment now? Is there any indication of forced entry? We needed someone who could come up with a police car at the beach, so we asked the police academy if they wanted to participate and their contact - it turned out - was also a scriptwriter. We needed help from a professional to cast the role of the patient and direct the movie, and the couple Per Gørvell (doctor, but also an actor) and Liv Bernhoft Osa (an actress) was attracted to this small project and helped us with the development of the film. The film makes the case alive in a way that strengthens the learning in a more relevant way than any textbook."

In this context, e-learning complements teaching through the use of images (visualization), communication (talking to people), manual procedures, decision trees (symptoms and how to interpret this, making hypotheses, revising hypotheses), complex physiological processes, integration of various diseases (integrative approach).

Implementation – inclusion

As mentioned above, the individual teachers from each discipline are the starting point for the use of e-learning. Since the digitalization of the education relies heavily on these disciplines, the inclusion criteria – the extent to which the internal core of the organization is aligned with the strategy – is very important. As is emphasized by a central person in the e-learning project.

> "The question of management's ability/opportunity for "strategic management" is not specifically related to digitalization. I think Henry Mintzberg's description of universities as comparable to "pigeonholes" of diverse autonomous groupings, is relevant. This characterizes everything we do. Teaching has traditionally been "owned" by the individual teacher. Perhaps central units, in the faculties may wish for something else, but still with respect for the individual teacher's hegemony."

An example is given in this short vignette:

> "In a project on implementing the BIO model[3] we spent over a year creating a common academic understanding of clinical communication - a job that the project explicitly took on because it was not done anywhere else. This was also the case in the first edition of the movement apparatus[4] where the project created consensus between four subjects on how joints should be examined - a consensus that was not there before, but which should have been there. Thus, these projects can be catalysts for processes that should have been completed already"

[3] The BIO model is a way of describing the process of learning through gaining contact with the patient (beginning), gather information and summarize/plan (oppsummering in Norwegian) further treatment

[4] This is a particular project within faculty of medicine where e-learning resources for learning about movement apparatus (bevegelsesapparatet) were created.

This tight connection between discipline and changes in the discipline creates several possible tensions during IT driven changes and may explain some of the difficulties in implementing changes very fast. In our framing, we may call this *high inclusion*.

Maintenance and follow-up

It is very difficult to obtain specific figures on how many people use e-learning within the faculty of medicine. The section for medical informatics does not have these numbers, and it is also very difficult to get specific usage figures on the solution from USIT (the central IT unit at the University of Oslo). There are about 1000 medical students at the University of Oslo at any time, and they use e-learning to varying degrees. The medical education consists of eight learning modules, and there are about 50 different e-learning programs of varying sizes and sophistication available, covering parts of all modules. Some usage figures are available for two technically more advanced Model-View-Controller (MVC) applications. The first delivers virtual patients and quizzes to e-learning programs in ophthalmology, orthopedics, nephrology, and genetics. In 2018, approximately 77000 quizzes and virtual patient cases were delivered. The second system delivers slides for web-based virtual microscopy in pathology. In 2018 approximately 170000 slides were delivered. Usage varies very much and peaks when the programs are employed or referenced during teaching and before exams. Teachers who have carried out an e-learning project are more likely to start a new project than novices are, and there are many disciplines with no e-learning activities at all.

An explanation could be the amount of work required by each medical area to develop an e-learning solution. First, there is a need to acquire the needed resources (money and personnel). Then they have to prioritize and focus. This is challenging given all the other tasks medical personnel is expected to do.

> "We had a meeting a month ago, and everybody is interested in e-learning, but there are not many who use it systematically. There is a lot of work to do in order to establish a solution. We had to apply for money, and then Hannah [student] got money to do it…and now we have to apply for more money for a new project we are planning."

The expansion and diffusion are based on communication within the network:

> "The network is used to identify potential stakeholders. It is primarily driven by enthusiasm. However, there is always scarcity of resources, and it is difficult to identify the amount of use. Resources for e-learning can remain unaudited, there are few resources spent on follow up. We should have had a more continuous follow-up. There will always be a cost/benefit measurement between new projects and maintenance. An example of the vulnerability is that we had an ophthalmologist who was unstoppable in creating e-learning, but when she quit, all the modules and systems fell away for many years until a new enthusiast appeared. Thus, there is a major problem related to management and follow-up."

As we can see, the planning and maintenance rely on the proactivity of the internal organization. This can be understood in the light of the complex content of medicine (images, sound and video, and 3D), and the importance of high inclusion. This type of "emergent strategy" has however also some disadvantages. The faculty has limited insight into the amount of use, and how much effort is done to digitalize areas of each discipline. The digital infrastructure currently consists of material from 52 disciplines, but only some of the web pages are maintained on a regular basis. The faculty has a governance challenge in facilitating and maintaining constructive projects and builds on experience from this in order to expand the solution. The coupling between strategy and implementation is not strong enough. In addition, the initiative has some challenges related to knowledge building amongst the faculty management since a very limited amount of the personnel is familiar with the technology used. Some teachers are hoping for improvements, saying that "In practice, it will be like that (like law) here also in a couple of years ... where we establish learning goals for each module ... I think this is going to be the way one chooses to acquire knowledge ..."

In summary, the digitalization of education at medicine is fundamentally based on an emergent bottom-up strategy where teachers within each discipline decide what to do and when. This can partly be explained by the complexity of the content, and the high inclusion criteria. There are, however, some shortcomings in the lack of continuity and follow-up, as well as the limited amount of competency on

the core technology. The reliance on enthusiasts or knowledge brokers (Meyer 2010) may create a less robust strategy.

5.2 Digitalization of sources of law

The history of Lovdata, which is a digital infrastructure system were sources of law can be searched and interlinked through a reference system, can be led back to the innovative activity of Jon Bing and Knut Selmer in 1970. They started an initiative called "law and data", which in 1971 was organized in a separate IT department. Lovdata, a self-financing private foundation owned by the Ministry of Justice and Faculty of Law at the University of Oslo, was established in 1981. Using Lovdata, Norway was the first country in Europe to make electronic announcements of law regulations. Students and employees at the faculty of law have used Lovdata in education since the late 1990s, but the classic paper collection of Norwegian acts was in 2017 still the most central object for the faculty.

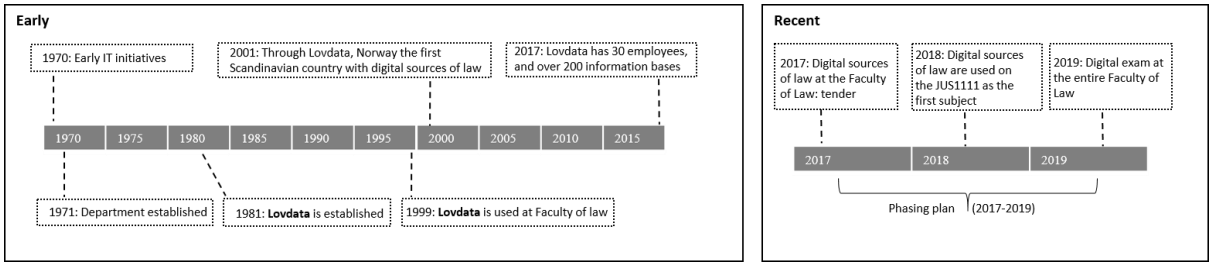

Figure 3: From emergent to planned strategy at the faculty of law

Preparation and planning: why digitalize sources of law

One of the main reasons for why there is a need to transform manual sources of law into digital sources of law are the requirements from the business world that there is a lack of digital competency amongst the law students. Legal sources are the central tool for a lawyer, and it is only in the database that you have updated sources of law. "You are not an ordinary lawyer until you use what is in Database" [informant]. A central "persona" for the faculty of law, thus, is the "regular lawyer who works in the business world." Students have been using Lovdata in education for some time, but only to a very limited degree. One of the challenges for the faculty of Law was that students could get excellent grades, even if they never entered Lovdata. One of the reasons for this is that while the education opened up for use of digital systems, the exam was still performed using books and writing with pen and paper. Since the students are strongly motivated by the grade and therefore the exam, the faculty of law decided to change the strategy. This happened in 2017 when the faculty of law went from being based on a combination of books and digital sources to an ambitious strategy where all the education including the exam was done using a digital system. This also meant that Lovdata, which in 2017 had 30 employees and over 200 information bases, had to implement specific changes in their system to be competitive in the tender arranged by the faculty of law. Through the tender in 2017, two specific things happened. The system got a sophisticated reference function where one could make annotations and personal notes, and incorporate them with sources of law. Moreover, the system became mandatory on the exam (digital exam is of special importance in this transition). Earlier the students "memorized" the textbook, made notes in the law collection and used the collection of legal judgments that were relevant to the subject. With Lovdata this practice has become more independent. Incentives are related to the increased quality of the study. Since the students invest in making entries and references, this also becomes a central part of the teaching.

Implementation – content: from manual to digital sources of law

Sources of law are laws, regulations, preparatory work, legal practices, conventions, treaties, other public practices, and guidance's, all of them part of a web of resources that constitute the role of law. The primary source of law is legal text. But, the law must be interpreted, there are ambiguities, we thus get a hierarchy of sources of law with preparatory work (investigations and propositions), case law (supreme court, 4 courts of law, district courts), and legislative text (case law, administrative practice, complaint).

Figure 4 is an example from "Forbrukerkjøpsloven"[5] and the different references (in yellow, red and blue) are related to sources that can strengthen the law practice regarding this particular paragraph in the law. The use of colors and drawings is comparable to previous paper aids but contributes by referring to related sources of law via links. This makes it much more dynamic and practical. The system also checks what comments and references that may be accessed on the digital exam.

Figure 4: Digital sources of law in a reference system

Throughout the semester, students work closely with sources of law, not just textbooks but also other sources of law (preparatory works like investigations and propositions), case law, legal text, preparatory work, case law, administrative practice, complaints and reviews.

> "The students individualize this material: and make it their own through the semester, through notes, cross-teaching, and so forth. The reward is that they have it available on the exam. The practice changes the subject. Earlier they used learning tools no one controlled, there was no clear learning strategy, and the preparation work (done through the semester) was not awarded. Now the practice of law is done more correctly, with less focus on memorizing and more reward given to use of juridical method through the semester. Even if the exam becomes a search competition, which rewards the nerds, the work done through the semester is rewarded. A lot of work needs to be done in advance; they cannot do everything on the exam."

According to the dean of education, "there is a difference between those who have been on the surface and those who seek the depth. Lovdata changes the practice."

Implementation - inclusion

Lovdata won the tender in 2017, and the implementation of the system started the same year. The Faculty did not have many resources, however, a project group was set up to plan the introduction together with the dean of education. The administrative manager at the library was central in the planning of the project's training of teachers and students. The plan was to implement the system fast, but only a limited number of students were chosen to use it the first year. The course "Juss1111" was chosen.

The strategy has met some criticism. A person said, "It is a shame if the legal faculty is in the lead to tearing down the symbol of the Norwegian state of law". However, the last book is to be printed in 2018. Also, two other universities, respectively in Bergen and Tromsø will soon arrange a bidding process."Another type of criticism comes from the student organization. They claim that they have been "overrun" and that their voice is scarcely heard. The students are primarily critical towards the speed in carrying out the implementation, rather than the digitalization in itself. According to an informant, "there has also been some resistance from some of the teachers, but this depends on the generation. The younger teachers use the system right away." Even though the regular units and groups were consulted before and during the implementation, there is a tendency to criticize the choice of strategy and the velocity of the implementation. This does not include the new students who use the digital system from the start.

Maintenance and follow-up

From autumn 2019, Lovdata will be used in all compulsory subjects in the law study, as well as Norwegian courses (some study programs such as criminology and some courses in English, as well as optional courses with other challenges that do not have an equally urgent need for legislative data, will not use it). This means that 70 courses and about 4500 students will use the Lovdata in the teaching and the

[5] Act relating to consumer purchases - Consumer Purchases Act. Section 27 *Complaints.*

exam at the end of 2019. As mentioned, this means that it is not what you remember, but the way in which you handle the sources of law, which will enable you to get an A. Since Lovdata is required for the exam, they will also use it through the semester. Difficulties and new requirements are taken care of by Lovdata in collaboration with the faculty of law. The faculty management addresses the various strategic challenges.

In summary, there is an increasing demand for digital competency amongst law students. The faculty of law had used Lovdata as a digital tool for some time, but insufficiently. From 2017 the strategy goes from being emergent to being planned. The relatively transparent textual content makes the implementation manageable with limited resources, and the requirement from the market is more important than including the students in the new strategy.

Theme	**Digital infrastructure for e-learning**	**Digital infrastructure for sources of law**
Trigger and driver	Internal sources. Professional culture	External sources. Technology
Implementation strategy	(Slow) Emergent strategy with bottom-up implementation	From emergent strategy to planned strategy with (fast) top-down implementation
The role of the faculty	Supportive regarding strategy, governing regarding technology	Governing both strategy and technology
Implementation content	Visualization and sound	Text. Sources of law and references
Implementation inclusion	High inclusion. Each medical area chooses whether to develop and use e-learning. Adaptation: trial and error.	Low/general inclusion. Centralized development and implementation. Adaptation through training.
Maintenance and follow-up	Section for medical informatics	Lovdata, an external foundation.
Result	"The students use e-learning to varying degrees"	"In autumn 2019, all exams at the Faculty of Law must be digital"

Table 4: Comparison between digitalization initiatives at medicine and law

Comparing the two cases (table 4), the relatively slow deployment and adoption rate at the faculty of medicine can most likely be explained by four factors. First, the faculty chose this strategy also out of respect for the teachers' teaching autonomy. The strategy is to facilitate rather than demand change. Since it is the various disciplines that have a full overview of its needs and requirements, the individual discipline is given the full responsibility for its e-learning resources. The faculty management uses a cultivation strategy where some funding is made available.

The fast deployment and adoption rate of digital sources of law at the faculty of law can be explained by the structured and planned strategy that is anchored in management in tight collaboration with key actors in the different departments. There is an increasing demand for digital competency amongst law students. The relatively transparent textual content makes the implementation manageable with limited resources, and the requirement from the market is more important than including the students in the new strategy.

6. DISCUSSION

In this section, we return to our research questions:

- *What are the challenges IT addresses in digitalization of higher education*
- *What strategies are pursued to solve these challenges*

We see digitalization as the activity by which digital technology is used to improve and make products or processes more effective (Norwegian Government 2016). Previous research on digitalization (Henfridsson et al., 2014; Loebbecke and Picot 2015; Lusch and Nambisan 2015; Svahn et al 2017) have primarily concentrated on traditional industries competing in the market and how either strategic goal or organizational activity systems form the strategic activity of digitalization. This literature has not inspected digitalization of higher education. Exceptions are a stream of literature that focus on how to

handle increased number of students, and increased demands for digital interaction between students and university as well as the challenges and solutions associated with the use of technology in educational methods (Scheepers et. al., 2018; Henderson et al., 2015; Becker et al, 2017; Siemens et al, 2015).

Further, earlier research on digital infrastructures have either been occupied with their structured alignment with the strategy (Broadbent and Weil 1997, Broadbent et al 1999); on how digital infrastructure is a result of the workings of practice environments inside the organization (Ciborra et al., 2000; Aanestad et al., 2017; Aanestad and Blegind Jensen 2011; Hanseth and Monteiro 1996); or how the digital infrastructure is flexible enough to obtain and maintain competitive advantage (Henfridsson and Bygstad 2013; Henfridsson et al., 2014). This also implies that digitalization is a strategic activity. According to Sia et al., (2016) there is a strategic need for alignment between IT capabilities (in our case the digital infrastructure) and the strategic goal (in our case digitalization of higher education). Less is known about how disciplines within higher education proceed to achieve this. In order to improve our understanding of how digital infrastructures and IS strategies are formed in order to solve particular challenges within higher education, we investigated two cases. We were interested in four particular activities (planning, inclusion, content, maintenance) that formed the respective strategy approaches.

We have seen that the two cases have similar intentions: to digitalize educational activities and to use sophisticated technology to obtain this goal. To this extent, both are organized according to strategies from the national authorities of education. There are however several differences in the cases. *First*, the origin of the strategic challenge differs. In the law case, the requirements come from the outside, from the market, while in the case of medicine the internal group of teachers and students defines the requirements. This leads to a *second* difference. In the law case, the faculty management created a planned strategy to deal with insufficiencies of the emergent one from the previous years. This planned strategy may be adequate since the information content of text and references are relatively transparent, and since the inclusion criteria of the organization are moderate. In the case of medicine, the information content of medical images, 3D and sound may be highly complex, and the inclusion criteria – the requirements from the students of medicine and the teachers – are substantial. A *third* difference is the maintenance and follow-up structure. While medicine uses an emergent strategy, where the faculty is at the mercy of the teachers and students in the sub-communities, the faculty of law implements the system top-down and push the technology into the educational plans. In addition, they include Lovdata as a partner to monitor all requirements for maintenance and upgrade.

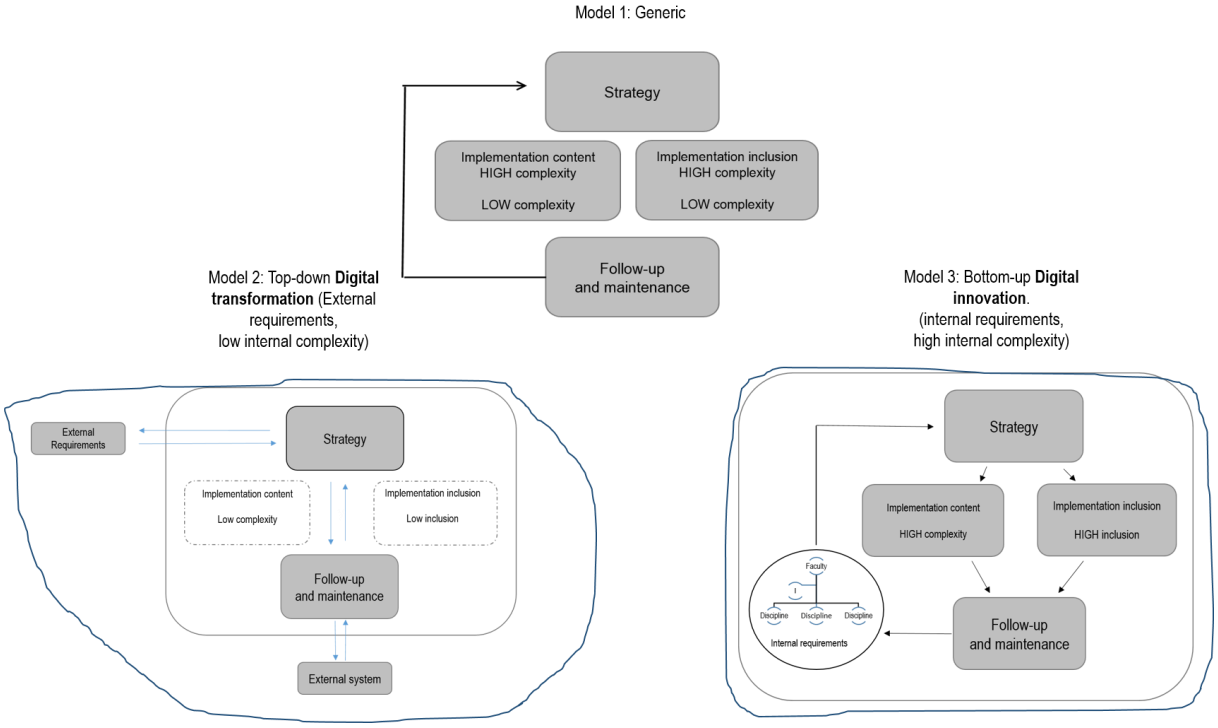

Figure 5: Three strategic models for digitalization of higher education

We illustrate our insight with three models, one generic and two more specific. One for faculties or departments with complex information content related to the discipline, and as a result, high inclusion criteria; and one for faculties or departments with moderate or low complexity regarding information content and low formal requirements related to inclusion. The *generic model* consists of the elements we have taken into account in this study (strategy, content, inclusion, and maintenance). The strategy initiates the development and implementation loop that also includes the information content and the inclusion criteria. The maintenance and follow-up are important elements in the strategy since new requirements may emerge continually.

Model 2 describes a process of *Top-down Digital Transformation.* We use *transformation* as an outcome to depict the substantial changes in education as well as the exam introduced by the full implementation of Lovdata. In addition, the strategy is conditioned by requirements emerging from the outside (for example the market), where the implementation content has low complexity and the formal inclusion criteria are low. This lays the foundations for a planned strategy.

Model 3 describes a *Bottom-up (emergent) Digital Innovation.* We use *digital innovation* as an outcome to emphasize that despite the emergent and slow adaptation rate, the digital infrastructure provides a substantial amount of new digital products. The strategy is, however, conditioned by the internal organization, and the requirements emerge from this internal organization. Especially if the implementation content has high complexity and the inclusion criteria are high, the strategy always needs to be anchored in the internal organization. This anchoring can also be understood by the epistemic practices (Nerland and Jensen 2011, Mørk et al., 2008) since the practice both will indicate the degree of autonomy, but also the complexity of the practice objects.

There are also some obvious challenges with the models, especially seen in relation to the increasing requirements from international and national authorities (Norwegian Government 2017; European Commission 2012) to establish more effective digital relations between students and universities (Becker et al 2017) and between the universities and the market (Pucciarelli and Kaplan 2016). While model 2 has the advantage that it defines a strategic goal and creates a solid infrastructure to support and maintain this goal; it is less occupied with inclusion criteria's, and with the possible side effects of digitalizing the education. The relatively fast change may cause stress amongst both the employees and the students since several IT related failures might happen during important events like the exam. To learn from

errors is also a process. Model 3, on the other hand, is very cautious towards initiating anything without making sure that the internal activity systems agree. This has its advantages in that change is always anchored in the organization, and that the solutions once created are compliant with educational standards. A problem with this is, however, the slow implementation pace, and the lack of planned strategy for speeding up the tempo. This is also caused by the complex challenges of organizing disciplines within medicine to create a common foundation for digitalization. The relatively loose coupling between the faculty management and the disciplines may cause another challenge. When the initiatives are taken care of individually, there may be some challenges in using positive experiences from one project in another project. Even though the experiences may be shared and maintained, the maintenance of the actual digital systems is not secured. Through this, we can say that while the law infrastructure is expanding to include the market (external requirements) through a more integrated and structured digital infrastructure, the e-learning infrastructure at medicine remains (very) loosely connected and within the same borders as before (see figure 5).

In conclusion, in this paper, we investigate digitalization strategies in higher education in order to identify (i) the requirements various faculties are seeking to solve through digitalization, and the challenges they encounter in these endeavors, and (ii) the strategies they established based on this insight. We contribute by proposing three models for describing strategies in higher education: one generic and two driven by respectively external and internal requirements, as well as providing some pros and cons related to each strategy.

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