Digital strategies in Higher Education: A comparative study of digitalisation at law and medicine

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1. ABSTRACT

Higher education is a key pillar in constructing new knowledge economies for the 21st century, and digitalsation 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 digitalisation should be at a strategic level. Digitalisation is driven by key features of modern technology but may also lead to the 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 digitalise their educational practices? Based on these interests, our research question is what strategies do university faculties pursue to solve challenges regarding digitalisation of higher education? Our empirical evidence is two cases from respectively medicine and law, and our contribution is an investigation into the strategies pursued in the digitalisation approaches, and the contextual differences that may explain the chosen strategies. We provide two models that describe and clarify the chosen strategies, thus providing a way of understanding strategies within digital infrastructures in higher education.

2. INTRODUCTION

Digitalisation implies combining physical and digital artifacts to simplify and improve processes or products (Norwegian Government 2016; Yoo et al. 2010). The consequences of this reconfiguration will vary. In some cases, entire sectors or organisations can be transformed (Hess et al. 2016). In other cases, the change will be less dramatic (Arvidsson et al. 2014). The source of the requirements for change can also vary; sometimes the requirements come from the outside (Henfridsson et al., 2014; Øvrelid and Bygstad 2019), other times they may emerge as requirements from the inside of the organization (Aanestad and Blegind Jensen 2011). The literature on digitalisation has demonstrated how physical equipment in cars can be digitalized (Svahn et al., 2017), how services may be improved (Lusch and Nambisan 2015) as well as how business models can be transformed (Loebbecke and Picot 2015), but also the organizational cost of these activities (Henfridsson et al., 2014). This also makes digitalisation is a strategic activity, but the stream of literature has to a much lesser extent focused on digitalisation of higher education where organizational issues may be different than in the competitive industry.

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 digitalisation of higher education is a central focus area for the national authorities (Norwegian Government 2017). As digitalisation 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 digitalisation should be at a strategic level, and be integrated into all professional and administrative activities (Norwegian Government 2017). Since the activity of digitalisation has transformative potential, traditional educational methods and practices may change. Bearing in mind that 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). For instance, each

particular discipline may prioritise maintaining educational standards, and the high-level strategies from the authorities may, thus, experience counter-strategies (Pucciarelli and Kaplan 2016). A better understanding of the chosen strategies is needed to understand how national digitalisation initiatives are balanced towards the independent assessments and decisions of each discipline. Since strategic approaches to digitalisation may differ in each discipline we ask, *what strategies do university faculties pursue to solve challenges regarding digitalisation of higher education?*

We investigated 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 digitalisation 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 contextual challenges that conditions and forms the strategic approach, and to identify how these challenges changes or transform the digital infrastructure. Our main contribution is two models that contribute to understanding, explaining, and managing strategic challenges.

3. RELATED RESEARCH

3.1. Digital infrastructures

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

A central interest within infrastructure 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 IT 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). A third and relatively recent stream of research within this literature is occupied with how strategic planning and the digital infrastructure is aligned to enable innovation, adoption and scaling (Henfridsson and Bygstad 2013; Henfridsson et al., 2014).

3.2. Addressing strategic challenges in digital infrastructure evolution

The digital infrastructure literature highlight three key strategic challenges in IS implementation: to define a competitive strategy and achieve alignment between strategy and IT capabilities; to align the strategy with the related practices to obtain actual alignment; and to ensure that strategy is a sustained activity (Arvidsson et al., 2014). This has several implications for digital infrastructure strategy.

First, there must be a clear strategy that takes into account the opportunities afforded by the IT portfolio. The "planning literature" within IS (Ansoff 1980; Henderson and Venkantraman 1993) is occupied with how management identifies new trends and tendencies. Recently a similar business oriented stream of literature has claimed that strategies must be planned, initiated, managed, and maintained by some form of central leadership (Hess et al., 2016; Sia et al., 2016). The management will also have to take into account the digital resources, which are the existing IT components, architectures, and products (Nambisan 2018) when defining and implementing strategic plans.

Secondly, an organization is adapted to different purposes and is in possession of different properties to solve these purposes. This implies that strategy must take into account the internal organization of the existing firm and the various knowledge workers' epistemic practices (Nerland and Jensen 2011). Moreover, in fields where specialized professional knowledge dominates, the decentralized autonomy is notable, transparency may be low, and degree of uncertainty high (Mintzberg 1983). If the internal

knowledge workers or activity systems (Jarzabowski 2003) have a rather autonomous culture, the strategies chosen should be aligned accordingly (Henfridsson and Lind 2014).

This means that the strategy must take the knowledge workers and activity systems into account in the digitalisation activity, but since the practices have a different impact on digital strategy, the degree of inclusion and participation in the change process will vary (Hautz et al., 2016). However, it is a management challenge to ensure that different stakeholders contribute to the change process by moving "forward using their differences, in a productive rather than in a fractious way" (Quick and Feldman 2011, p. 283).

Third, the strategy must be a sustained activity, where the governance of the infrastructure at the administrative level, secures continuity, and controls interruptions (Cerullo and Cerullo 2004). Management has a particular responsibility since emergent requirements like new educational standards or new research areas, needs to be taken care of continually (Wiltbank et al., 2004).

Our goal in this paper is to understand strategies in digitalisation of digital infrastructures in higher education, and the contextual challenges that form the strategy. To gain knowledge of how IS strategies are formed to solve particular challenges in higher education, we investigated two classical disciplines law and medicine. We will describe our findings after the method chapter, which is next.

4. METHOD

To shed light on the strategies by which digitalisation projects in higher education are performed, we investigated two cases. We chose a longitudinal process study (Langley 1999) to study the phenomena over time and to investigate the longitudinal interaction between organisations, 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.

Table 1: The cases

Case	Trigger	Aim	Result
E-learning in medicine	Teachers want to improve students' mastery of communication, practical procedures, visual analysis, and clinical decision-making. Students want more digital feedback.	To facilitate a better and faster learning process to educate better doctors	The number of users is not known
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

4.1. Data collection

The data collection was done between January and June 2019. 13 interviews are conducted in addition to document and web-page analyses. A range of documents and digital resources like web pages, short films, and slides were analyzed. Finally, several discussions regarding findings and possible interpretations were performed in seminars and workshops, Moreover, two of the authors were 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.

4.2. Data analysis

In the analysis, we first established a chronology of important events. 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 three central activities. First, we inspected the planning activity and identified the existing digital resources. Then, we focused on the various activities performed to align the plan

with the professional workers and the students. Lastly, we were able to see how the strategy took into consideration systematic follow-up and maintenance of the digital infrastructure.

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 regularly, while in medicine over 1000 students are using the e-learning infrastructure.

Table 2: Data analysis

Step	Description	Output
1	Identify key events, key objects in the history of the faculty	Timeline for each project
2	Analyze cases: planning and digital resources, align strategy and professional workers, follow up and maintain	Section 5
3	Propose two models two describe the core content of strategies	Section 6

5. FINDINGS AND ANALYSIS

The two investigated cases 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 digitalisation initiatives at respectively medicine and law.

5.1 Digital education in medicine

Digitalisation 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.

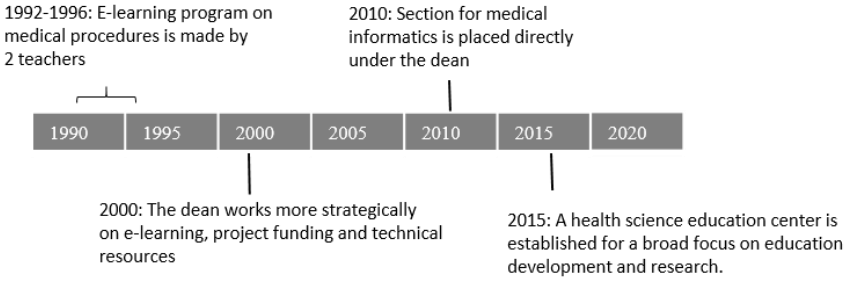

Figure 1: History of e-learning in the faculty of medicine

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. 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 infrastructure loosely shared by the Norwegian medical faculties. Today the digital resources comprise approximately 50 smaller or larger programs that include several hundred videos and links to server-based functionalities like formative tests and virtual microscopy.[1] 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.

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

Strategic planning of e-learning

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 process and the learning outcome. 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, and the making of e-learning is 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 as part-time employment by students or freelance resources. The strategy is based on “cultivation” as it depends on independent activity from each subject area. This is challenging in that good initiatives rely on the discipline itself and is less anchored in faculty management.

Digital resources

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. 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 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. 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 activated teaching through the use of virtual patients and interactive quizzes. These many facets make e-learning an integrated knowledge system. In 2018, approximately 77000 quizzes and virtual patient cases were delivered. In addition, approximately 170000 slides were made available.

Figure 2: Ultrasound: Example of digitalized education

Figure 2 is an example that demonstrates how to place the probe and to inspect the resulting ultrasound pictures. E-learning programs like those demonstrated in figure 2 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.

The alignment between strategy and knowledge workers

As mentioned above, the individual teachers from each discipline are the starting point for the use of e-learning. Since the digitalisation of education relies heavily on these disciplines, the activity of aligning the internal core of the organization with the strategy is very important:

> "The question of management's ability/opportunity for "strategic management" is not specifically related to digitalisation. 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[2] 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[3] 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"

This tight connection between discipline and changes in the discipline makes it very challenging for the managing unit to implement changes very fast.

Strategic follow-up and maintenance

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. Usage varies very much and peaks 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 for this 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.

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[2] 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

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

> "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 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 development is 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 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 regularly. 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 improve in a couple of years ... we will establish learning goals for each module ... I think this is going to be the way one chooses to acquire knowledge ..."

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) makes the strategy vulnerable.

5.2 Digitalisation of sources of law

The history of Lovdata, which is a digital infrastructure where sources of law can be looked up 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.

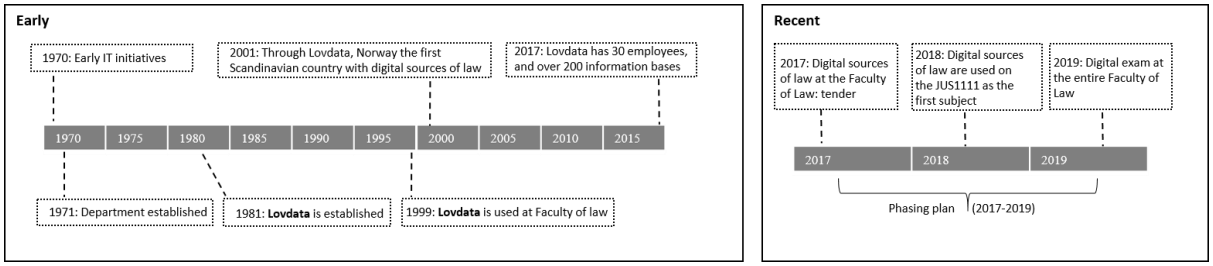

Figure 3: From emergent to planned strategy at the faculty of law

Strategic planning: why digitalise sources of law

The business world of lawyers requires a high level of digital expertise. For a professional lawyer legal sources are the central tool, and "you are not an ordinary lawyer until you use what is in Database" [informant]. A central "ideal" 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 until recently 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. The reason for this was that even though Lovdata was used in education, the exam was still performed using books, 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. In 2017 the faculty of law announced a tender, and Lovdata – which had 30 employees and over 200 information bases – needed to make changes to deal with new requirements. Specifically, Lovdata implemented a sophisticated reference system allowing annotations and personal notes concerning the laws. Moreover, Lovdata became mandatory on the exam. Earlier the students "memorized" the textbook, made notes in the law book, and used the collection of legal judgments that were relevant to the subject. Now they needed to use Lovdata also in education.

Digital resources

The primary source of law is legal text. But, the law must be interpreted, there are ambiguities, we 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, complaints). Figure 4 is an example from "Forbrukerkjøpsloven"[4] and the various references (in yellow, red, and blue) are 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 the use of the system 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

> "The students individualize the material through the semester, through notes, cross-teaching, and so forth. The reward is that Lovdata can be used on the exam. The practice changes the subject. Earlier the students 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. 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."

Alignment between strategy and knowledge workers

Lovdata implemented the system in 2017. 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 as a pilot. Then the solution was rolled out to most courses.

The strategy has met some criticism, not least from employees that protect the tradition: "It is a shame if the legal faculty is in the lead to tearing down the symbol of the Norwegian state of law – the body of law". However, the last book is to be printed in 2018. In addition, two other universities, respectively in Bergen and Tromsø will soon arrange a bidding process. This means that the most important universities in Norway will have digital law education. Another type of criticism comes from

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

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 need to digitalize the law education. 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."

Strategic follow-up and maintenance

From autumn 2019, Lovdata will be used in all compulsory subjects in the law study, as well as Norwegian courses (some courses like criminology, 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 exam at the end of 2019. Since Lovdata is required for the exam, the students will also use it throughout the semester. Difficulties and new requirements are taken care of by Lovdata in collaboration with the management at the faculty of law.

Strategic activity	Element	Digital infrastructure e-learning	Digital infrastructure sources of law
Planning	Trigger and driver	Professional culture	The professional Lawyer. Market. IT
	Role of the faculty	Supportive regarding strategy, governing regarding technology	Governing both strategy and technology
	Digital resources	Visualization and sound. Web pages	Text. Sources of law. Lovdata
Alignment	Alignment between plan and professional work	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	Governance	Section for medical informatics	Lovdata, an external foundation, and the management at the Faculty of law

Table 4: Comparison between digitalisation initiatives at medicine and law

Comparing the two cases (table 4), we see that although the strategy at the faculty of medicine is not without goals, the implementation and adoption relies and depends on the teachers and the various groups' ability to implement and adopt e-learning. 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, and based on a clear goal to improve the digital competency amongst law students. The textual content makes the implementation manageable with limited resources, and a professional firm operating in the market maintains the infrastructure. In the next section, we discuss our findings.

6. DISCUSSION

We see digitalisation as the activity of combining physical and digital artifacts to simplify and improve processes or products (Norwegian Government 2016; Yoo et al. 2010). Previous research on strategies in digitalisation and infrastructures have primarily concentrated on traditional industries competing in the market (Henfridsson et al., 2014; Loebbecke and Picot 2015; Lusch and Nambisan 2015; Svahn et al 2017). 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 digitalisation of higher education). To improve our understanding of how digital infrastructures (Henfridsson and Bygstad 2013; Hanseth and Lyytinen 2010) develop IS strategies (Arvidsson et al 2014) to solve particular challenges within higher education, we investigated two cases. We were interested in three main activities: the planning of the digital strategy, the alignment between the strategy and the knowledge workers, and the maintenance and governance of the digital strategy

To investigate our interests we asked, *what strategies do university faculties pursue to solve challenges regarding digitalisation of higher education?*

In the previous section, we saw that the two cases had similar intentions: to digitalize educational activities by using sophisticated technology. To this extent, both cases 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 may differ. It can be external (Hess et al. 2016), or internal (Aanestad and Blegind Jensen 2011). 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 previous emergent strategy. This can also be understood by the differences in complexity when it comes to digital resources (Nambisan 2018) as well as knowledge practices (Nerland and Jensen 2011). In law, digital resources are mainly text and references. In the case of medicine, the information content of medical images, 3D, and sound may be highly complex, and the need to include the internal activity systems are substantial (Henfridsson and Lind 2014). The *third* difference regards the activity of sustaining the digital strategy. While medicine relies on the internal groups and teachers, governed by the small section for medical informatics, the faculty of law include Lovdata as a partner to monitor all requirements for maintenance and upgrade. These differences allow us to define two different models for digital strategy in higher education.

The *first model* describes a *Top-down Digital Transformation Strategy* (Hess et al. 2016). 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), driven by the increasing need for digital competency required to become a professional lawyer. The strategic source, the digital resources, and the professional activity lay the foundations for a planned strategy.

We describe the *second model* as a process of *Bottom-up (emergent) Digital Innovation* (Aanestad and Blegind Jensen 2011). 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 digital products are predominantly very complex and requires much effort. Moreover, the strategy is conditioned by the internal organization and the requirements that emerge from this internal organization (either teachers or students).

There are also some obvious challenges with the models, especially seen in relation to the centralisation and nationalisation requirements provided by international and national authorities (European Commission 2012; Norwegian Government 2017). There is an urge 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 the *first model* 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 alignment between the knowledge workers and students and the strategy. The relatively fast change may cause stress amongst both the employees and the students leading to misalignments and lack of motivation.

The *second model*, on the other hand, relies on the internal organization to initiate innovation. The faculty aims at a loosely coupled "cultivation strategy" (Aanestad and Blegind Jensen 2011). This may be advantageous in that change is always anchored in the organization, and that the solutions once created are compliant with educational standards. A drawback in this approach is the slow implementation pace, and the lack of planned strategy for speeding up the tempo. This is also caused by the extensive autonomy granted to the various disciplines within medicine, and hence the difficulties of establishing a common digital foundation.

To this end, 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.

In conclusion, in this paper, we investigate digitalisation strategies in higher education in order to identify (i) the requirements various faculties are seeking to solve through digitalisation, and the challenges they encounter in these endeavors, and (ii) the strategies they established based on this insight. We contribute by proposing two models for describing strategies in higher education, driven

by respectively external and internal requirements, as well as providing some pros and cons related to each strategy.

7. REFERENCES

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