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Enterprise Architecture adoption challenges: An exploratory case study of the Norwegian higher education sector.

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Abstract

IT is a challenge to implement Enterprise Architecture (EA) in an organisation. This is also the case in the public sector, like public universities and colleges. There is a very limited research on such issues. It is therefore important to investigate how AE is implemented in various sectors, which benefits are realised and which challenges are most prominent. This interpretive case study investigates the efforts taken towards a common EA in the Norwegian higher education sector. We find that the progress was severely impeded by the lack of top level directions from the ministry, the lack of an overarching architecture council, and the lack of EA competence at the top management level at the individual institutions. The perceived most important benefits were business agility, economies of scale and better decision making.

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Keywords: Enterprise Architecture; adoption; Higher education

1. Introduction

IT and information systems plays a very important role in modern organisations. Huge amounts of money are invested in IT to make organisations more effective and efficient. However, it is a tremendous challenge to realise the full potential of such investments, and it is an important premise that IT strategy must be aligned with the

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business strategy. Enterprise Architecture (EA) is a description of an organisation from an integrated business and IT perspective. Ross et al.[1] pointed out that: "*EA provides a long-term view of a company's processes, systems and technologies so that individual projects can build capabilities – not just fulfil immediate needs*". This is also true for any organisations, including Higher Education (HE) institutions. While universities and colleges do compete for funding and student enrolment, they also struggle with the same IT and EA issues. There are therefore substantial incentives for EA cooperation and standardisation in this sector.

The Norwegian HE sector has started the process toward a common enterprise architecture. The Norwegian Association of Higher Education Institutions (UHR) is a cooperative body for Norwegian universities and colleges. All higher education institutions are members of this association, who aims to be a central provider of input to the Parliament and Government and an essential education and research policy participant. It is also a purpose to promote cooperative solutions for the higher education sector. There are 39 independent institutional members of UHR, whereof 8 are fully accredited universities, and 33 are public institutions.

The Government has expressed intent to achieve higher quality in higher education and research, and more robust research communities, where the resources are better focused toward the core tasks. One of the initiatives has been to establish a work group that should create a holistic strategy for more effective utilisation of the institutions' systems portfolios. The individual institutions and their systems have developed relatively independently, and the systems are usually different, and have not always been designed to interface with each other. This makes it difficult and expensive to cooperate. The sector has achieved some progress with some administrative and research registration systems, that are now utilised as resources at a national level. However, there is still a large untapped potential related to a common enterprise architecture, such as common functions, processes, systems and data models.

The initiative to improve the enterprise architecture in this sector is very challenging. So far, little research has focused on the adoption of a common AE for a whole sector, and little is known about the challenges. It is also interesting to investigate the perceived benefits. We have therefore focused on the following research questions:

- *Which challenges do higher educational institutions face when adopting a common Enterprise architecture?*
- *Which benefits are perceived to be the most significant?*

The rest of the paper is organised as follows: we present related work, then the research method, we then present the results, and then discuss the findings. Finally, we present the conclusion.

2. Related work

There are several definitions of EA, and from a number of perspectives, and there is no universally accepted definition[2,3]. Tamm et al.[4] define EA as: "The definition and representation of a high-level view of an enterprise's business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise". Gartner takes this one step further, and defines EA as: «The process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key principles and models that describe the enterprise's future state and enable its evolution»[5]. EA can thus be seen as a holistic view of the organisation, where the interaction between business and IT is emphasized, and EA can be viewed as the process of developing and transforming the organisation. "*Enterprise architecture (EA) implementation refers to a set of activities ultimately aiming to align business objectives with information technology infrastructure in an organization. EA implementation is a multidisciplinary, complicated and endless process"*[6]. Large organizations, with complex IT environments, and with extensive standardization and integration can expect to benefit most from an EA[4]. Harrell and Sage[7] found that focusing on the whole picture is related to success with an EA initiative.

Enterprise architecture management (EAM) is the management activities conducted to install, maintain and develop the EA in an organisation[8]. Kotusev et al.[9] identified three approaches to EA Management (EAM): the traditional approach, the MIT approach and the DYA approach. The traditional approach was introduced by Spewak and Steven[10] and can be described as a four-step sequential process[9]: document the current state, develop the desired

future state, develop the migration plan, and implement the plan and repeat the process all over again. The MIT approach was introduced by Ross et al.[1], and advocates the development of a long-term architecture vision at the enterprise level. The DYA approach was first published in Wagter et al.[11]. In this approach, EAM is seen as a reactive response to concrete business initiatives. EAM in practice is rarely follows any one of these approaches, but combines various elements from each method [9].

It is a significant problem that many organisations struggle to achieve the potential of EA, and literature estimates that perhaps only five percent of EA efforts succeed[2]. Several authors have pointed out that EA must free itself from its IT focus and become better entrenched at the executive level in order to realise its potential as a facilitator of strategic planning and business transformation[3,12-14]. Lucke et al.[15] found a number of challenges for EA management: missing management commitment, lack of experienced architects, difficulty for EA teams in understanding the requirements, insufficient tool support and rapidly changing environmental conditions. A significant part of the problem seems to be the ambiguity of the EA concept, and that a common understanding and methodological consistency are still lacking[3].

3. Setting and Research Method

3.1. Research Setting

In addition to the universities and colleges, a number of other public agencies and units are involved in the EA effort, and we will briefly mention the most significant ones. The Agency for Public Management and eGovernment (Difi) is a public agency that aims to strengthen the government's work in renewing the Norwegian public sector and improve the organisation and efficiency of government administration. It is overseen by the Ministry of Local Government and Modernisation (KMD). An important task is therefore also to promote coordinated and cost-efficient use of ICT within the public sector.

UHR, The Norwegian Association of Higher Education Institutions, is the central cooperative body for Norwegian universities and colleges. UHR aims to be a central provider of input to the parliament and government and an essential education and research policy participant.

UNINETT AS is the parent company of the UNINETT Group. It develops and operates the Norwegian national research and education network, a high-capacity computer network interconnecting about 200 Norwegian educational and research institutions. UNINETT is owned by the Norwegian Ministry of Education and Research.

FSAT, the Joint study administrative service centre manage, develop, maintain and operate administrative systems and services to the universities and colleges. It is an agency under the Ministry of Education and Research.

BIBSYS is a public administrative agency answerable to the Ministry of Education and Research. They provide common systems and services for education and research.

The work group for the creation of ICT architecture principles was established by the university and college sector's CIO forum, to propose ICT architecture principles for this sector. The work group consisted of representatives from universities and colleges, BIBSYS, FSAT and UNINETT.

3.2. Research methods

This exploratory case study has followed an interpretive case study approach[16]. Interpretive research focuses on the complexity of human sense as the situation emerges[17]. It is important to understand the context of the IS in information systems (IS) research, and the interaction between the system and the context[17,18]. Interpretive design gives a flexibility that allows for discoveries of new and unexpected empirical results and for growing sophistication. This gives the researcher an iterative design and the option of improvisation and flexibility in the research process.

Twelve open-ended and semi-structured interviews were conducted in nine universities and colleges. The institutions and the number of informants are presented in table 1. In addition, four documents related to the case were analysed. These documents were important to obtain a more comprehensive understanding of the AE project:

- "Common ICT architecture principles in the University and College sector" (Felles IKT-arkitekturprinsipper for universitets- og høgskolesektoren); Hearing draft (Universities CIO forum: Work group)
- "ICT architecture principles in practice" (IKT-arkitekturprinsipper i praksis); Hearing draft (Universities CIO forum: Work group)
- "Cooperation on ICT architecture for public universities and colleges" (Samarbeid om IKT-arkitektur for statlige universiteter og høyskoler), (Ministry of Education and Research; UNINETT).
- "Strategy, organisation and management of the common administrative IT systems in the university and college sector" (Strategi, organisering og styring av de felles administrative IT-systemene i universitets- og høgskolesektoren), (UHR: Committee for common administrative IT systems).

Table 1. Institutions and informants

Institution	Size	Size of IT department	Number of informants	Dats sources
University of Agder	11,000 students 950 employees	60	2	3 interviews
University of Oslo	27,000 students 6,000 employees	200	1	1 interview
Norwegian University of Science and Technology*	23,000 students 5,000 employees	160	2	2 interviews
University of Nordland*	6,500 students 650 employees	15	1	1 interview
University of Tromsø*	11,800 students 2,900 employees	130	1	1 interview
Telemark University College*	6,500 students 650 employees	20	1	1 interview
Oslo and Akershus University College	16,000 students 1850 employees	90	1	1 interview
Narvik University College*	1,850 students 200 employees	7	1	1 interview
Felles studieadministrativt tjenestesenter**	85 employees		1	1 interview

*These institutions has from January 1, 2016 merged with other institutions.** Joint study administrative service center, an agency under the Ministry of Education and Research.

The text transcripts were reduced and major themes were identified and classified into main categories[19]. The analysis was performed in the following steps based on Oates[20]. The data was categorised into the following categories: general information, relevant to the research context and information relevant to the research question. This included the main categories: benefits, challenges and EA maturity. The challenges category was then split into new categories: governing body, vision and strategy, EA approach and top management commitment.

4. Results

This chapter presents the results of the interviews. It is evident that there has been some confusion related to the use of the Enterprise Architecture term. The focus has primarily been on IT-architecture until the last five to six years. The EA term, and the need to see IT investments in a broader and strategic context, has slowly gained more acceptance. However, it is still a major problem that a lot of stakeholders have a too narrow understanding of how IT and strategic processes should be aligned.

4.1. Architecture initiatives in the sector

There have been efforts to create a formal cooperation related to IT and EA in the HE sector. UHR[21] appointed a committee in 2007 that should propose a strategy for the development of shared administrative systems in the sector. The committee recommended that a shared IT architecture should be developed, and that an integration platform needed to be created. It further recommended that an agency should be established, which should establish a mandatory architecture cooperation[21]. The shared architecture recommendation was endorsed by the sector, but not the establishment of the agency. The institutions felt that UNINETT would be sufficient, and it could become confusing with yet another cooperation agency[22]. The UNINETT alternative was then examined, and a key proposal was that the Ministry should appoint an architecture council with UNINETT as a secretariat. The sector did not want this solution either, but rather that it should be organised under the sector institutions through UHR[22].

The Ministry and UNINETT then carried out a project to assess a formalised cooperation on IT architecture. This assessment had a broader focus than UHR's recommendations, and included all IT related activities in the sector. The report recommended that all institutions in the sector should be included in the cooperation, and that an architecture council should be established, with a core group to work on establishing the EA[22]. Thus, at this stage the focus had broadened to EA.

While waiting for the establishment of the Architecture council, the universities' CIO forum in the spring of 2014 set up a work group to make a draft of IT architecture principles. This draft would serve to harmonise IT initiatives, and work as an input to the Architecture council's work[23]. These principles were based on an EA perspective, and would illustrate the entirety and how the institutions' operational models would interact. These principles thus contribute to the realisation of common EA for the sector[23].

4.2. Benefits from a shared AE

The informants reported that the lack of architecture principles and guidelines were impeding the daily work, and they all believed that this was an important initiative. Especially the small institutions feel that such principles would be supportive and useful for justifying architecture decisions. Informant 5 commented that "Part of the problem is that we are too small, we do not have any impact, but if we had had some ground principles, we could have leaned a little on them." The informants believed that the large universities can manage well, but that the small colleges are left to themselves. Informant 6 noted that "Many of the colleges will have much benefit from a stronger profile from UNINETT, and much clearer defined architecture and principles." Informant 3 corroborated this: "There are no general guidelines at all in this sector for how to build that kind of services and what you should choose, or how you write a requirement specification."

Many of the informants believed that there would be resource benefits from a common AE, and that it would lead to shared systems and common interfaces. They also believe that it would give benefits in the form of lower costs, scale advantages and reuse. Furthermore, that it would simplify things, and thus free up time to attend to other tasks. Many of the informants also noted that it is also a question of a proper use of limited resources at the national level. Informant 2 commented that: "Where there are no reasons for institutions to have different solution, [we should] look for common solutions, where we benefit from each other." Informant 3 corroborated this: "Perhaps hundreds of millions [NOK] are used unnecessary each year because we are not coordinated well enough."

The informants believe that if processes are well enough standardized across the sector, the institutions can create much better common systems requirements. They think that calls for proposals can cover the entire sector. Informant 9 noted that: "I would estimate that we use at least 20-30 millions [NOK] in internal costs on IT procurement annually. And the needs are very similar across [the sector]." The Informants also noted that an overarching AE is crucial for the sector to be effective in the future. The demands for quality assurance and improved processes are increasing, and it is required that everything should be documented. Describing quality assurance routines and describing the processes are substantial tasks, and "then you are dependent on doing things in cooperation" (informant 8). It was an agreement among the informants that the institutions could cooperate much more effectively through the use of more shared resources, and here architecture principles will play an important role. Most of the informants perceive that the realisation of an AE is important to make the sector agile and flexible, and this implies

the ability to change the processes. This can be illustrated by the following quote from informant 3: "To be agile, adaptive to what happens, move the focus rapidly, […] is almost impossible when the infrastructure is fixed."

4.3. Challenges

A number of challenges surfaced in the interviews. We will first present the main challenges related to the institutional level. We will then turn the attention to the challenges related to the sector.

First, looking at the institutional level, it was a significant concern among the informants that the EA understanding and commitment in the top management of the individual institutions are lacking. AE management is a long term process, and is perceived as difficult and technical. Informant 4 noted that: "It is difficult to make the top management at the institutions understand the necessity of an AE program, as this is not a concrete need at hand." Informant 5 noted that the top management, when presented with a draft of architecture principles, was not able to understand what AE was all about. Informant 9 commented that they had initially achieved some progress in the AE work, before a new leader was appointed who had a more operational focus. The AE process stopped, and the informant believed that the leader did not really understand the EA concept. Informant 6 corroborated this "AE is a strange term for very many people at this institution". Informant 4 also commented that: "The commitment of top management is a challenge. If one can achieve this in addition to obtaining an understanding for that this work is something one does in a 3-5, or perhaps ten year perspective, […] is the foundation for success."

Some of the informants noted that the small institutions have small IT departments, and that they are very busy with the daily operation, and that it is very challenging to lift the focus to a more strategic level.

A number of informants also believed that that there is too much focus on technology rather than enterprise architecture. They believed that it is too easy to fall in the trap of thinking only of systems. Several informants believe that the institutions have vested interest in keeping the existing solutions, because they represent substantial investments, and are tailored to the individual institution. The systems can be well tailored to the existing processes at one institution but totally incompatible with other institutions. For example, two universities run the same system, but went separate ways 5 years ago, and the systems are not compatible any longer. A service in one university, cannot be used by the other university. "In my head it is completely insane to go on like this" (Informant 5).

Second, the informants pointed to a number of challenges for the sector. No one has a clear mandate to take the control over the EA progress in this sector. There are many participants, and there are many projects that are led from various actors, and there are various opinions about who should be in charge. This can be illustrated by a comment from Informant 11: "If you take the parallel to the health sector, they have come further there. They have worked a lot more with coordination and cooperation within IT. There you have established a directorate that coordinates on behalf of the sector. In our sector you only have a lot of actors, and then you have the Ministry." It is a disagreement between the Ministry and the institutions about where the responsibility for the AE work should be placed, and how the costs should be allocated. While the Architecture council has not yet formally been established, the informants view this as a good initiative, and that it should get authority to instruct the sector institutions.

It is also a lack of agreement about what should be done, and the incentives to carry it through. Architecture charts and goal statements are made without a significant force behind it, and a lot boils down to voluntary work and ideology. The architecture principles that have been proposed are only advisory, and some informants voiced that it should be stated clearer that everyone must follow the AE principles. "Now it is based on a voluntary principle, if one views the sector in its entirety" (Informant 10).

The informants, however, all agreed that it is not really about a lack of competence. They think that UNINETT and the local IT departments together can muster the required competences and skills. Informant 6 commented that: "What would lack of competence, is competence about what one does for the sector [as such] ."

Several of the informants perceive that the sector is somewhat immature yet, both at the top management and at the organisational level. Several of the informants see TOGAF courses as a start to alleviate this. Many people have attended TOGAF courses, and the informants perceive this to be an useful framework. The informants note that this helps establish the necessary terms. "So, it is actually, when one talks with others who also know these terms, that one talks the same language" (Informant 10). Informant 3 corroborated this: "Everyone on the board and the top management should have had this course [TOGAF]. How one builds the basis for making decisions based on architecture principles…". In contrast, Informant 4 noted that it is more to it than a course: "We don't make a good

architecture by sending some people to a course. It is just as important to understand the organisation, and to be able to focus on the things that are important to create the needed architecture." It was evident that it was mainly people from the IT departments that attended such courses.

It was clear that the AE maturity was low. A clear symptom of this is that architecture initiatives were only located to the CIO level. The challenge is to engage top management. Informant 4 commented that: "It is mainly the CIOs that are involved, and who are the ordering party. This needs to be rooted in the sector and in the top management, and it still lacks a holistic effort to define processes." The informants think that it is futile to go ahead and define IT-principles, when they are not rooted in an enterprise architecture.

Difi has adopted architecture principles, which has been made mandatory for the public sector. Related to this, Informant 9 commented: "It is stated in a footnote, that if one do not follow these principles, one need to report to Difi with a reason for not following these principles" Difi is viewed as an agency with good visions, but it lacks the power to force institutions to make changes." One of the informants noted that it was strange to come from a private sector company to a university – and see that they did not know about Difi's architecture principles. In private sector companies there was a lot of focus on the issues of enterprise architecture. Informant 2 commented that: "While Difi has defined overarching principles for AE, the sector has chosen to establish principles for IT-architecture."

5. Discussion

This case explores the implementation of enterprise architecture (EA) in the Norwegian HE sector. We found that the informants expect a number of significant benefits. However, the initiatives that has been undertaken to realize a common EA are not well founded in the individual institutions and in the Ministry of Education and Research. We found a number of challenging issues that significantly impeded the process toward a common EA.

First, we saw the lack of an overarching governing body impeded the EA efforts. These efforts rely on the coordination between a large number of actors, and that the Ministry of Education and Research can mandate a set of principles. Therefore, an architecture council was to be established. But because of the disagreements between the Ministry and the institutions about the responsibilities and cost allocations, this architecture council had not yet been established at the time of this research. As a result, no entity has the formal mandate to take charge of the matter. The efforts are therefore led by a number of actors, and the informants experience a lack of overarching guidance and a coordination mechanism. The present initiatives are perceived as guidelines, while the informants believe that the architecture principles should be mandatory. While the literature has emphasized EA governance to provide direction[24,25] at the organisational level, this case illustrates the need for an architecture council that can establish the EA principles and governance for a sector.

Second, the lack of an agreement on a vision and the extent of the EA initiative impeded the progress. There was a lack of top management understanding of the EA concept and lacking support and commitment for EA efforts. A lot of work is being done tactically and operationally, but without a clear common vision. This is consistent with the Critical Success Factor "Scoping and Purpose" in Ylimäki[25], which emphasizes a clear mission, goal and direction. Some of the institutions have teams or departments that work with EA, while others do not. There are a number of initiatives related to IT-architecture and process management at the various institutions, but these are separate initiatives without a holistic EA perspective. EA should be business driven to make sure that EA initiatives are grounded in the business strategy and targeting an alignment between business and IT[25-27]. We conjecture that there must be a top management commitment and control over the EA efforts, consistent with Seppänen et al.[24], who found that there need to be a tight control over the EA work, exercised from a top-down business viewpoint.

Third, the CIOs from a number of institutions have taken a joint initiative for a common EA. As a result of this, common IT architecture principles have been described, but only the technical part of the EA. They have not been successful in including the top management level in these initiatives, and therefore not been successful in taking the business requirements into account.

The informants perceived several key benefits from a common EA. The most important benefits were: *business agility*, *economies of scale* and *a better decision making.* This is consistent with the literature, which point to reduced costs[4,28], better integration between business and IT[28,29], increased business agility[30], better decision making[7,31] and reduced development time and IT-related risks[1].

6. Conclusion

We have studied the EA work being done in the Norwegian higher education sector. Universities and colleges have often chosen very different solutions to their IT needs, leading to rigid and incompatible IT systems. These institutions struggle with the same EA challenges, and there are potential great benefits from cooperating and standardising on a common EA. We found that this is a quite challenging task, and the progress has been impeded by lacking policy from the Ministry of Education and Research. It failed to establish an EA council, which led to a lack of vision and direction in the local EA efforts. It is also a significant problem that the concept of EA is poorly understood among top managers, and often left to IT staff.

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