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EUNIS
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D U N D E E 2 0 1 5

BOOK OF ABSTRACTS

THE JOURNEY TO DISCOVERY



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The Organising and Programme Committee of EUNIS 2015 is responsible for all the massive planning and logistical effort required by such a significant event. A great many people have worked very hard on venue logistics (registration, rooms, technology, exhibition etc.), delegate arrangements (marketing, bookings, accommodation, airport transfers etc.), speaker management, programme design, sponsorship, congress materials and much, much more. I am very grateful for all their contributions over the past two years, and I would like to record my special thanks to Eleanor Greig, Claire McCurley and Tracy Duncan without whom this would have not been possible.

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Without the Scientific Committee there would, quite simply, be no Congress. It is their hard work, professionalism and diligence that produced the exceptional variety and quality of ideas, knowledge and creative thinking presented in this year's Congress. I have great pleasure in thanking all the listed individuals below for assessing so carefully and critically all of the presented materials from all our many contributors; for scoring each offering against agreed criteria, and finally for selecting the exciting programme of speakers and papers that will make up the 72 parallel sessions of the 21st EUNIS Congress. It is because of the Committee's efforts that we are able to enjoy and appreciate the selected abstracts contained within this book. I would like to offer special thanks to Professor Louis Natanson who performed the duty of Scientific Committee Chair. He was responsible for the agreed Congress themes and the call for papers as well as managing the scoring process; he was also responsible for the overall paper selection and programme construction.

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Preface

Dear Reader,

It is with great pleasure that I preface this book of abstracts for the 21st EUNIS Congress at Abertay University in the city of Dundee. We at the University were delighted when we were chosen to host this event and have put a lot of effort into making it a memorable experience. It was a proud moment when the call for papers went out and the abstracts, extended abstracts and full papers started rolling in; with over 90 submissions we were well provided for. This book contains all the abstracts selected for the Congress in June 2015 and we hope you enjoy not only reading the abstracts but also taking the opportunity to extend your contacts by engaging with the authors on topics that interest you.

EUNIS as an organisation spans the length and breadth of Europe covering many nations and many cultures; this encompasses a vast spectrum of ideas and innovations. These ideas and innovations are shared freely by those contributors to the annual Congress and are captured within this book of abstracts. This is what makes EUNIS special and why your support at these events and other initiatives is important.

Finally, the 21st Congress is entitled the “The Journey to Discovery” and it has many meanings. Every EUNIS congress involves two journeys, firstly a journey of the body in which you transport yourself physically to the host institution, secondly a journey of the mind through which you discover new and interesting things both professionally and personally. The title also has a meaning for the host city in that Dundee is known as the City of Discovery, thus your journey is to our city.

So it just leaves me to say welcome to Abertay University, welcome to Dundee and welcome to Scotland - may your journey here be one of many discoveries that will remain with you for many years to come.

Michael Turpie

Chair of the Organising and Programme Committee

EUNIS

21st Congress

Dundee 2015

“The Journey to Discovery”

European University Information Systems Organization

Background

EUNIS is the European University Information Systems Organization, it was formed in 1993. It was registered as a non-profit organization in Paris, France in 1998 and brings together those who are responsible for the management, development and the policy for Information Technology in Higher Education in Europe. The objective of EUNIS is to contribute to the development of high quality information systems.

To achieve this, the aims of EUNIS are:

1. Encourage exchange, cooperation and debates between those responsible for information systems in higher education or research institutes/organizations within Europe;
2. Establish relationships with supervisory organizations in charge of information systems in higher education and in research institutes in each country as well as at European level.

The congress consists of around 70 individual speakers with 250 to 300 delegates from 129 Higher Education Institutions over 31 Countries.

Abertay University

Abertay is a modern University, with a long history of educating students dating back to 1888. With a reputation for developing innovative, exciting courses, Abertay has become well-known internationally in the fields of computer games technology, computer arts, environmental management and biotechnology, and offers a wide range of courses in fields as diverse as psychology, ethical hacking, forensic science, business, civil engineering and sports across its four academic Schools: Dundee Business School; the School of Arts, Media and Computer Games; the School of Science, Engineering and Technology, and the School of Social and Health Sciences.

Every year, students of over 70 nationalities choose to study at Abertay University. Its location, facilities, reputation for innovative, employment-relevant courses, and its friendly, supportive environment are just some of the reasons why international students choose to study with the University year after year.

Academic Achievements

As Dundee itself has grown from a city reliant on traditional industry towards a focus on new technologies, so has Abertay University. We are continually evolving to meet the educational needs of our population and the skills requirements of business communities. Abertay is the best modern university in Scotland for research in environmental sciences, law and psychology and launched the world's first computer games technology degree.

In 2009, Abertay became the UK's first ever university Centre for Excellence in Computer Games Education, owing to a three million GBP investment from the Scottish Government. This development recognised and highlighted more than a decade of leading the world in providing advanced undergraduate and postgraduate courses in computer games technology, computer arts and related fields.

The Dundee Business School (DBS) at Abertay offers business and management education. It trains graduates to ensure that they are equipped with the competencies and skills essential to succeed in the business world. The courses offered by the School provide industry experience to students and enable them to work with successful business professionals. Its courses include: oil and gas management, finance, management, human resource management, marketing, web design and development, and law.

The School of Arts, Media and Computer Games encourages innovation and enables students to achieve in the fields of computer games and digital media industries. Its links with major industries strive to fulfil the career aspirations of students. It offers a wide range of courses, ranging from games programming at the science and technology end, to narrative-based animation at the arts end. The School has active links to over 50 computer games studios who mentor students and offer professional advice on projects.

The School of Science, Engineering and Technology (SET) believes that science has the potential to improve everyone's lives. SET stands out in environmental science, civil engineering and

construction, food and health science and forensic science, amongst others. It offers a wide range of undergraduate, postgraduate and research courses. It is also home to pioneering degrees in ethical hacking and digital forensics as well as computing, computing and networks.

The School of Social and Health Sciences (SHS) offers dynamic programmes that focus on present-day employment needs. Research students of this School enjoy the tutelage of teachers who are acknowledged experts in their subject areas. The School offers a wide variety of courses in the areas of psychology, sociology, nursing, counselling and sport and exercise sciences.

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“sciebo – theCampuscloud” for NRW

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Keywords

cloud services, cloud storage, information infrastructure, collaboration, cooperative project

1. ABSTRACT

More than two years after its conception and after intensive preparatory work, a large scale cloud service for the academic community in the German state of North Rhine-Westfalia (NRW) has become operational at the beginning of February 2015. Under the brand name “sciebo – theCampuscloud” (derived from “science box”), the sync & share NRW project (Vogl et al. 2013, Walter et al. 2014) is now ready for the registration of potentially 350,000 users from 22 (out of 33) research and applied science universities in NRW. A powerful system platform with five Petabyte of net storage space and 77 servers, hosted at three university data centers providing sync & share cloud storage in compliance with German data protection legislation, has been set up, elaborate contractual frameworks have been developed, scientific studies for preparation and evaluation have been and will subsequently be conducted and a mainly student driven state-wide marketing campaign has been staged. Just ten days after its launch, sciebo has already found 5,000 users and functionality, performance and availability have been well received. Starting with the much anticipated data privacy compliant sync & share functionality, sciebo offers the potential to become a more general cloud platform for collaboration and research data management which will be actively pursued in upcoming scientific and infrastructural projects.

2. THE SYNC & SHARE NRW PROJECT AND CONSORTIUM

2.1. Project History

In early 2012, long before the disclosures on NSA activities by Edward Snowden in May 2013, concerns about the protection of private and sensible data in public cloud services were already manifest. Services like Google Mail and Dropbox were widely used, the academic and research community making no exemption. These convenient, easy und mostly free to use services had already secured their place within collaboration settings in research and learning, and catered well for the growing community of users with multiple mobile devices, allowing to keep data in sync across multiple system platforms. Terms and conditions that force users to virtually surrender all data transmitted to these services to the companies operating them were duely ignored, even if that meant that using those services was in violation of university regulations for the use of cloud services, national data protection laws or terms of articles of employment. But compliant solutions were hard to find.

Against this background, in April 2012, a student motion in the IT commission of Münster University asked the university computer center (ZIV) to come up with a sync & share storage solution provided by the university for its students. A representative user survey held at Münster University (Vogl et al., 2013) in May 2012 reassured the demand for such a service amongst both students and employees.

With this and similar input, ARNW, the board of IT directors of the 14 research universities in the German state of North Rhine-Westfalia (NRW), decided to launch a project to create an on-premise private sync & share cloud storage service as a joint effort of all universities in NRW (with potential-

ly 500,000 employees and students as its users) in June 2012, with the ZIV of Münster University as the project lead. First considerations for systems architecture, possible software solutions and capable system integrators were done in summer and fall of 2012, resulting in two vendor proposals in late 2012 and in early 2013.

Talks with the Ministry of Innovation, Science and Research NRW (MIWF) in late 2012 showed the willingness of MIWF to support this effort under the grant program for university IT infrastructure. A kick off meeting to start the formation of the sync & share NRW consortium was held on January 15 2013, which led to Letters of Interest from 16 research and applied science universities by April 2013. Accompanying scientific studies were launched at the beginning of 2013 to provide an empirical foundation for the sizing and features of this future service (Meske et al., 2014). A project proposal was prepared by the project lead and filed with MIWF in May 2013 for submission to peer review by the German Research Council (DFG).

While waiting for the results from peer review throughout 2013, preparatory work went on with continuous monitoring and evaluation of software solutions for on-premise sync & share (showing very good progress for the open source ownCloud project), suitable hardware platforms (with a very promising proof of concept by IBM with its GPFS storage server (GSS) platform and ownCloud — demonstrating scaling for a 100,000 user per site setup) and a revised multi-university survey on user expectations in cloud services and on demand for storage space and features, answered by over 10,000 employees and students at three major universities (Stieglitz et al., 2014).

Additionally, a framework for contract agreements to constitute the sync & share NRW consortium had to be developed. This was initiated in July 2013 by grant funding from MIWF for a joint research proposal from ZIV and Münster University's Institute for Telecommunication and Media Law (IMT), resulting in a set of template contract agreements for multi-university cooperative IT projects, consisting of a consortium agreement, an agreement for data processing outsourcing, and end user terms and conditions of use. The resulting templates were presented in March 2014 and distributed amongst the committed consortium members for feedback in April 2014.

By the end of January 2014, a positive review from DFG was in, recommending a total project volume of 3,1 Mio Euro with a possible increase when further demand becomes manifest. The corresponding funding was made available by MIWF by March 2014, and the procurement process was initiated.

A final evaluation of available software solutions led to the decision that ownCloud was covering all features required for the project and was uniquely positioned as an open source solution, enabling the universities to incorporate inhouse developed enhancements and having the prospect of long time sustainability and prosperity due to the active community supporting the project. Thus, the contract for the software solution and services for five years was awarded to ownCloud in May 2014. An EU tender for the hardware platform was launched in April 2014 and the contract was awarded for an IBM GSS storage platform in July 2014, with hardware delivery in September.

Coordination efforts to enable all participating universities to join the Shibboleth-based Authentication and Authorization Infrastructure operated by German Research Network (DFN-AAI), which was required for the envisioned self enrollment portal, were also started at Münster University in April 2014. Onsite system integration at the three data center sites took place in October and November 2014, and software setup and tests were done in December 2014 and January 2015.

In fall 2014, a student marketing team was recruited by the Marketing Center of Münster University to set up an online viral marketing campaign preparing for the planned public launch on February 2 2015, reaching a wide audience mainly through approx. 400 Facebook groups at the participating universities. For better brand recognition, the synthetic, easy to memorize name "sciebo" (short for "science box") was coined by the ZIV public relations team, along with trademark and domain registration and the conception of the sciebo elephant logo (Figure 2).

Despite an abundance of unexpected last minute challenges, the preannounced date for public launch on February 2 2015 could be met.

2.2. Legal Framework of the Sync & Share NRW Consortium

The considerations on the legal framework resulted in the decision that the formation of a dedicated legal entity for sync & share NRW was futile, and that Münster university as consortium lead should conduct all legal businesses.

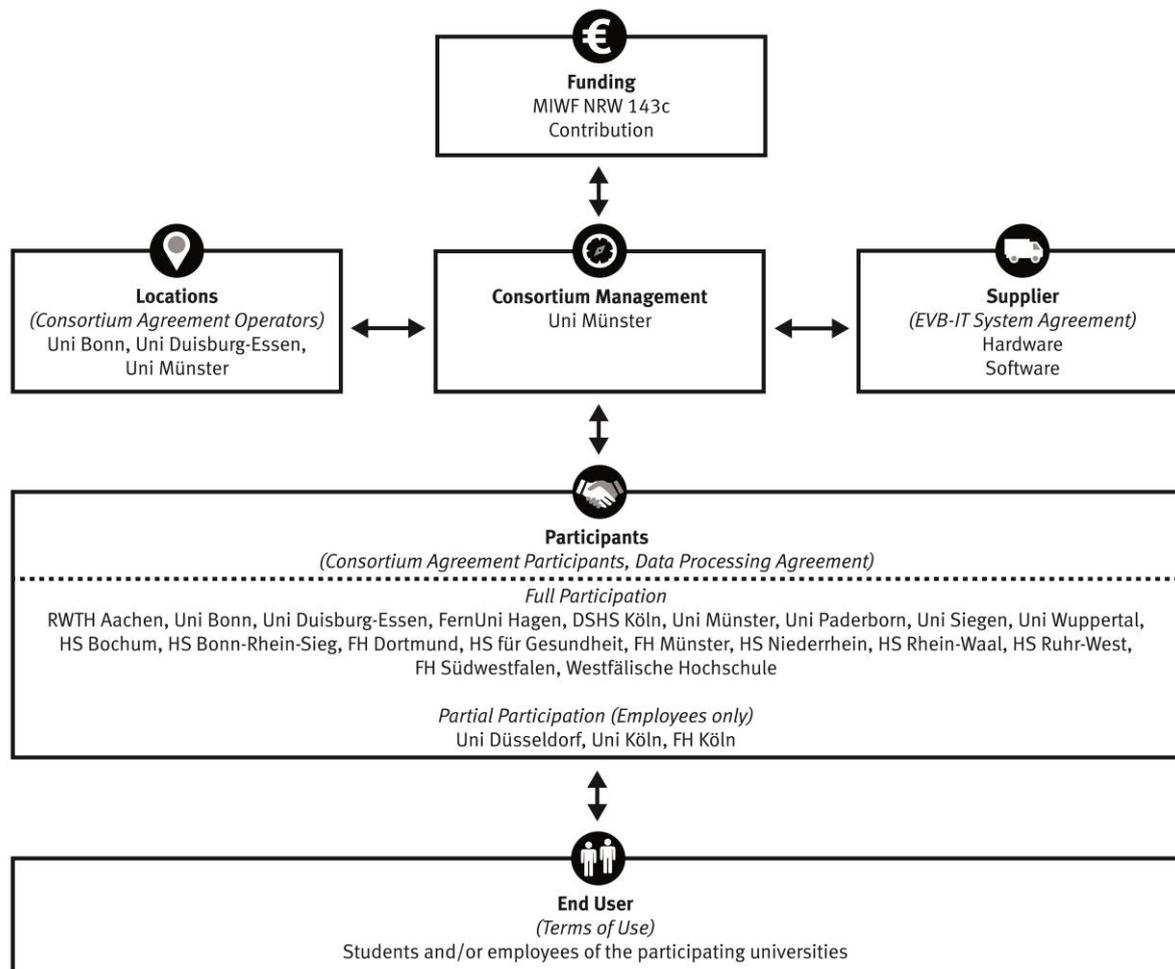


Figure 1: The framework of the sync & share NRW consortium.

The consortium was established by consortium agreements between Münster University and all consortium partners. Additionally, agreements for data processing outsourcing for the operation of the sync & share cloud service were made between Münster and its partners. Common end user terms and conditions of use are provided for the participating universities, which are legally the institutions providing the sync & share cloud service to the end users.

3. SOLUTION ARCHITECTURE

3.1. Service Specifications and Features

The sync & share NRW consortium agreed on the following specifications for the sciebo cloud service:

- Focus on cloud storage:
 - o Up- and download of files to sciebo
 - o Synchronization of directories on personal computers
 - o Sharing of files and directories with other sciebo users or through anonymous links

- Additional features of ownCloud like calendar, collaborative document editing etc. (new features can easily be added through ownCloud apps) will initially not be supported due to better system stability and performance.
- Access to storage:
 - Desktop sync clients for Windows, Mac and Linux.
 - Mobile clients for Android and iOS; available free as “sciebo branded clients” in App and Play Store.
 - Web interface.
 - WebDAV to mount sciebo box as drive share.
- Accounts for sciebo:
 - Participating universities can offer the sciebo service to employees and/or students in their deliberation.
 - Self service registration through the sciebo enrollment portal. User authentication and authorization for use of sciebo is done via Shibboleth/SAML through the DFN-AAI service: sciebo accounts are created only for persons correctly authorized by their home university.
 - Compulsory re-authorization after six months to clear users no longer eligible for the service. When no timely re-authorization takes place, a six month grace period starts, after which access to sciebo will be blocked. All user data will be deprovisioned after further three months.
 - Sciebo personal boxes have 30 GB quota. Employees will be provided with self service tools to increase quota to 500 GB if needed.
 - Sciebo project boxes will be provided for working groups with quota ranges from 500 GB to 5 TB. Sciebo is currently not considered an adequate platform for projects requiring more than 5 TB.
 - Guest accounts with 0 Byte quota for users outside the sciebo community with whom data can be shared will be made available.
- End user support:
 - Best effort approach with no central phone support – only through online support form including integration with FAQs at www.sciebo.de (Figure 2).
 - Trouble tickets are assigned in the first level to the respective helpdesks of the participating universities, with escalation to the second level support provided by the central sciebo support team (two persons financed by the consortium for the five year project period). Third level support is provided by ownCloud for the Enterprise version license procured for the sciebo project together with five years of support.
 - File versioning and features for undeletion of ownCloud should prevent unnecessary support cases.
 - A web portal for sciebo users for self service is provided:
 - Self enrollment
 - Re-authentication (6 month intervals; email notification)
 - Password reset for the sciebo account (with authorization via DFN-AAI)
 - Account deletion (when deliberately and prematurely quitting sciebo)
 - Monitoring information on sciebo service availability
- Availability:
 - No explicit SLAs between hosting institutions and the participating universities.
 - Based on data center availability records of Münster university, a target availability for the sciebo service of 99,5% p.a. has been agreed, with monthly availability above 98% and a maximum of four hours of continuous service outage.

- Server and storage hardware are highly redundant with no single point of failure.
- The GSS storage system operates with triple-parity RAID 8+3 and is thus extremely unlikely to lose data.
- As precaution against operational errors that could lead to data loss, snapshots are taken daily and stored for 14 days.
- Backup to offline media (tape) is thus considered unnecessary and could not be realized due to the sheer amount of data.



Figure 2: the sciebo homepage, prominently featuring the sciebo logo.

3.2. System architecture and integration

From the beginning of the sync & share project it was clear that the hardware platform was to be distributed over several university data centers in NRW, due to the following reasons:

- rack space and power supply need.
- internet bandwidth that could be dedicated to the operation of sciebo.
- symbol for the multi-university cooperative effort.

The chosen software solution had to be able to realize this scenario in one cloud service with sharing of data being possible between all users, regardless of the actual storage location of their data. The universities Bonn, Duisburg-Essen and Münster were selected as locations for the sciebo sites, each hosting individual ownCloud instances for every single participating university (Figure 3).

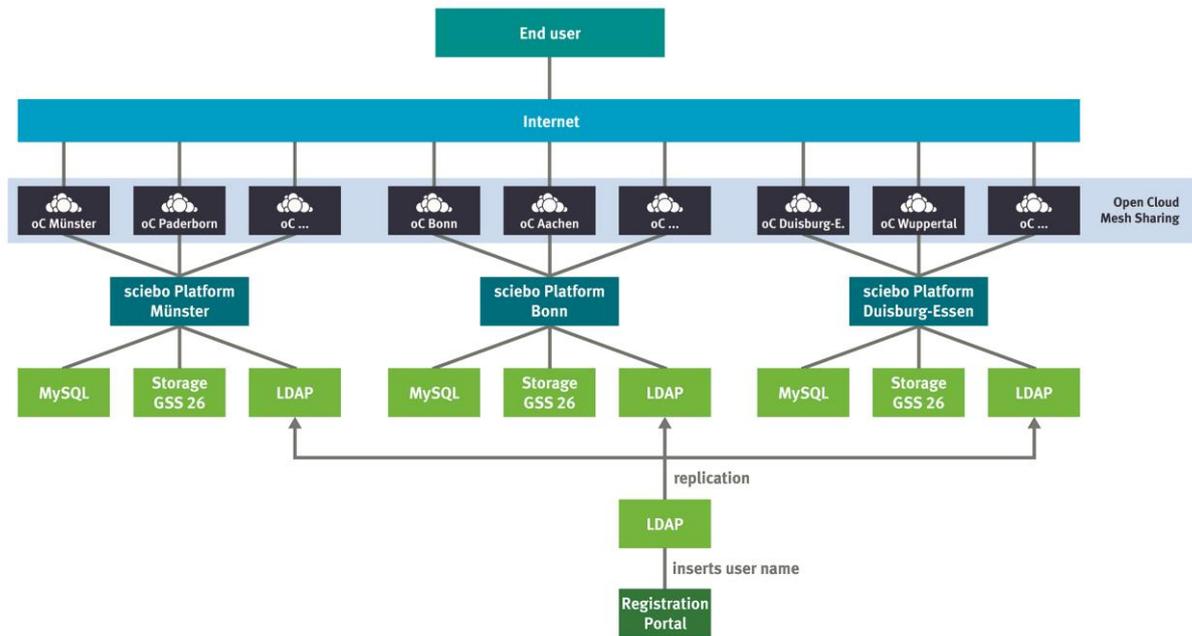


Figure 3: Schematic view of the multi site sciebo architecture.

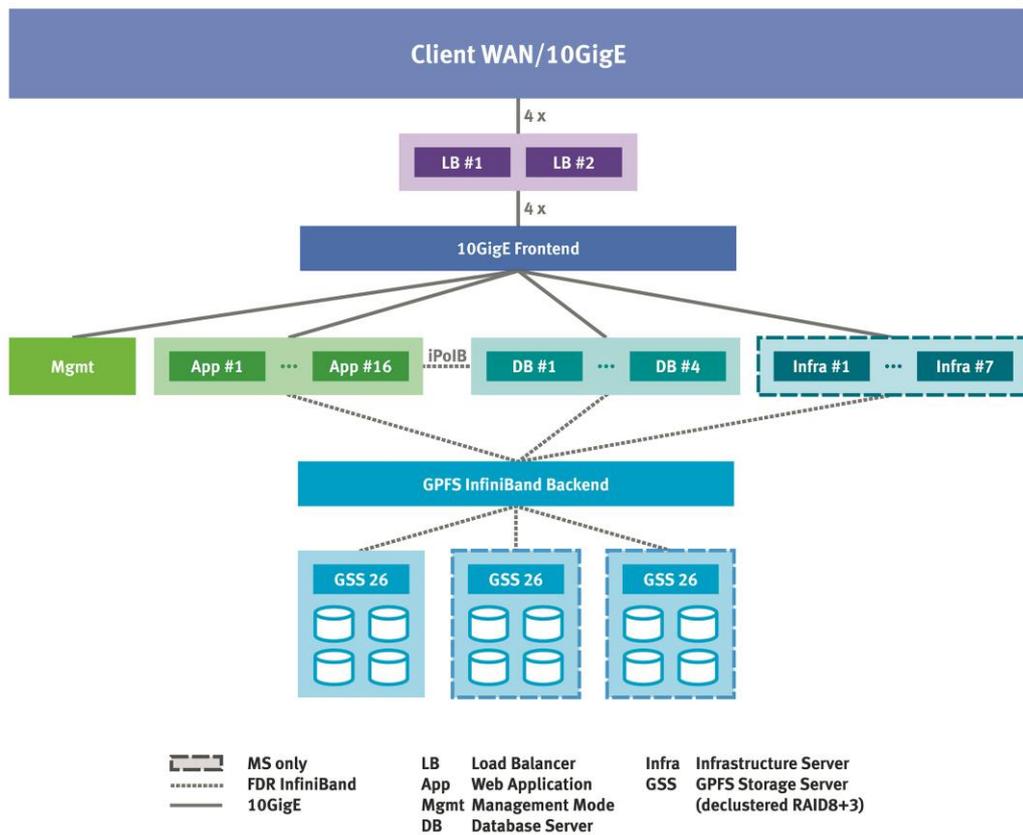


Figure 4: System architecture for a sciebo site installation.

The hardware platform at the 3 sites is virtually identical. At each site there are (Figure 4):

- 4 database servers (256GB RAM, SSDs) for a Galera MariaDB Cluster with MaxScale as database load-balancer (Figure 4).
- 16 apache web frontend server for ownCloud.
- 2 network load-balancers.
- 1 GPFS Storage Server (GSS26) system with 1 Petabyte of net storage (1,392 TB raw storage before RAID 8+3).
- 1 management server.
- 10 Gbps Ethernet for IP traffic to all hosts.
- 56 GBps FDR Infiniband for storage access.
- 2 additional GSS26 storage systems as capacity reserve and 7 servers for backend services (DFN-AAI SP, LDAP server, Web-Portal, ...) at the Münster site.

The software stack is comprised of a wide range of production quality open source tools (figure 5).

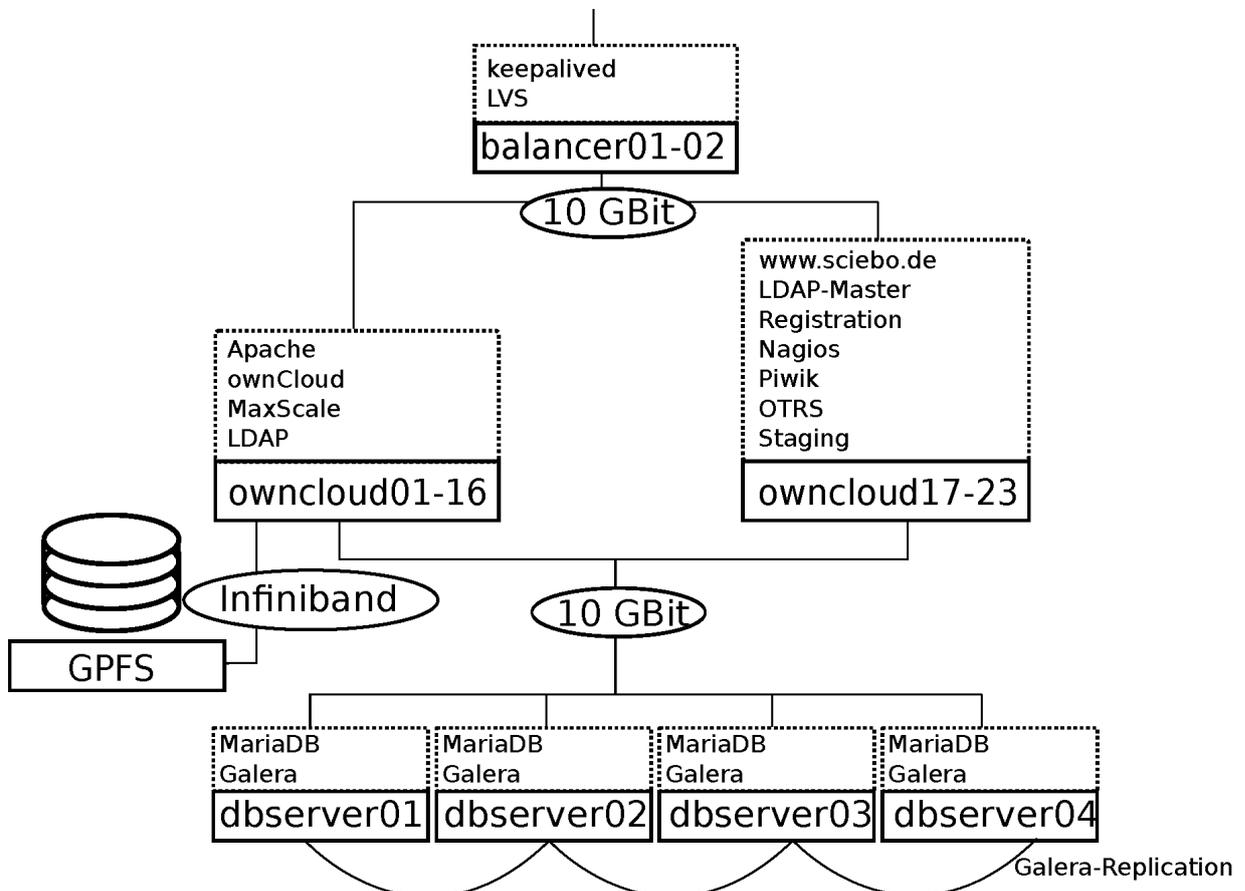


Figure 5: Detail on the software tools used in the sciebo installations.

All user accounts are created through the self enrollment portal (with authentication and authorization via DFN-AAI), maintained in an LDAP database replicated between the three sites. Each participating university has a separate ownCloud instance. These ownCloud instances are distributed over the three sites to achieve balanced hardware utilization.

Sharing data between sciebo users from different universities is done by means of the server-to-server sharing mechanism (also known as Open Cloud Mesh) which allows to create this “cloud of clouds” and was developed by ownCloud in view of the sync & share NRW project.

4. SCIENTIFIC STUDIES ON USER ACCEPTANCE AND SERVICE ADOPTION

The design and management of such an infrastructure is a challenging and complex task — and empirical information with scientific scrutiny is crucial for an optimized design and appropriate sizing. Furthermore, users need to be persuaded to change their working routines and to adopt a new solution. Therefore, not only do the technical aspects have to be considered, but also the actual individual demand for a new solution, as well as the willingness and ability to use it. Accompanying the preparatory work for the sync & share NRW project, scientific research to provide a solid foundation for the choices to be made on core functionalities and sizing was initiated.

Researchers have already developed various models to address these questions, for example, models for technology acceptance like TAM, UTAUT (Davis 1989, Venkatesh 2003) and for adoption processes such as Diffusion of Innovation Theory (Rogers 2003), which we will not discuss in detail. A crucial first step is to gather data on the potential users' requirements. Based on the understanding of cloud services as an infrastructure according to Pipek and Wulf 2009, as well as on Masud and Huang's (2012) service-centered approach, we conducted an online survey at three large German universities (RWTH Aachen, University of Münster, University of Bonn) in 2013 with a total of 10,367 completed questionnaires (7,623 students and 2,744 employees). In our study (Meske et al. 2014, Stieglitz et al. 2014), we concentrated on the system components (features/functionalities, data storage volume) and attributes (such as interoperability and privacy policy) that are recognized and of immediate interest to the (potential) users. The design of these components and attributes has a direct impact on employees' and students' decisions to use the system, keep using it, or avoid using it. This aspect is especially meaningful because potential users can easily compare the characteristics of each component or attribute to those of profit-oriented services.

Data shows that sciebo will face a major challenge: 81% of the students and 72% of the employees already use commercial cloud services like Dropbox. Despite the high market share of these potential competitors for sciebo, 81% of respondents state their willingness to use the sciebo campuscloud additionally or even exclusively.

The survey results clearly show that security and privacy concerns play an important role and will most probably be one of the major drivers for the adoption of sciebo. For example, 60-70% of the students at all the universities and approximately 80% of the employees mentioned that the physical data storage should be located in Germany. We also found that a lack of trust is the major reason for not using cloud computing. Universities in their role as cloud service providers substantially benefit from being perceived as trustful organizations. More than 80% of the students and more than 75% of the employees confirmed that they would trust the cloud computing that a university provides more than one provided by enterprise-operated services.

Our survey data shows that the university students and employees expect to need more data storage volume than they currently use on commercial cloud computing. The reasons for this could be:

- (1) users' higher trust in university provided cloud services and their plan to store additional data,
- (2) users anticipating they would require a higher data storage volume in the future,
- (3) users already facing profit-oriented providers that limit the data storage.

Our data shows that about three-fourths of the students and approximately two-thirds of the employees at all the universities stated that they would require data storage volume of between 1 and 20 GB. Based on a maximum user base of 350,000, this would give a wide spectrum between 0.35 and 7 petabytes. Given the users' growing demands, data storage should be sized with the upper boundary in mind to offer each employee and each student as much volume as possible. This could also positively affect the service's perceived attractiveness. However, investment decisions are very complex in this area, since it is difficult to estimate the actual demand. Additionally, the design of such an infrastructure needs to be seen as an ongoing dynamic process (for example, the required data storage volume might significantly increase over time, and other commercial services could extend their offering).

Our survey also shows that there is a high demand to integrate collaboration features into sciebo. For example, employees want to share documents (91%), collaborate with each other in real time (76%), and comment on other employees' documents (59%). Surprisingly, these features are not only demanded by employees, but by students on an even larger scale. Taking this finding into account in

the design process could result in higher user satisfaction and workforce and student productivity. Furthermore, it could increase the attractiveness of the service compared to that of profit-oriented competitors.

All user groups mentioned PCs as the most important device from which to access cloud storage. However, our survey results confirm the success of smartphone usage at universities. Two-thirds of the students stated that they plan to access sciebo via smartphone if possible. More than half of the employees shared this intention.

The integration of sciebo with other services has also been mentioned as an important design issue. For example, 64% of the employees and 43% of the students wish to integrate their calendars and task lists into sciebo. More than half of the students and half of the employees want sciebo to be integrated into the existing e-learning system or work environment.

By our study, we gained insights into what students and employees expect from sciebo. Even though we draw on a solid database, it is important to state that the design of such an infrastructure is a continuous process. Further, different changes in the environment (such as technical, political, and legal) affect the cloud infrastructure service. Therefore, all of the relevant stakeholders, such as representatives of different user groups, should be involved in the ongoing process of development and adaptation. As mentioned before, it is essential to continuously adapt the system to the changing environment (for example, storage requirements, new working routines, new tasks, improved technologies). In order to do so, we need to regularly gather information on the system's statistics and user behavior.

5. FIRST RESULTS

Despite an abundance of unforeseen challenges in setting up the multi-site hardware platform and software solution, with extensive tests needed for integrating the identity management systems of the participating universities with the sciebo self enrollment portal through DFN-AAI, the preannounced launch date of February 2, 2015 could be met. User registrations in the first three days amounted to 3,000, with 5,000 users registered after 10 days — in good agreement with the 2,5% ration of “innovators” according to the Theory on Diffusion of Innovation (Rogers, 2003) and proving the effectiveness of the online marketing campaign. Only partial and rarely noticed service interruptions occurred on the first two days due to a small software issue with the LDAP user account data interface in ownCloud (duely fixed), performance issues occurring because of an erratic storage device defect and the need for advanced database tuning for heavy user load. User-support interaction through the feedback forms provided on www.sciebo.de and through Facebook and Twitter proved to be effective and provided valuable information for service improvements and on user satisfaction. Awareness for sciebo in the technology-savvy online community showed to be high, with hacking-activist students volunteering to provide input for improved security, which was openly accepted.

Of the 22 universities committed to the project, 15 managed to overcome all technical (DFN-AAI integration) and organizational (signing of contracts in university presidia, consent of personell representatives, etc.) challenges on time for the launch, with the rest working to join in the next weeks. Further universities not yet committed are now considering to join the consortium.

6. FURTHER ACTIVITIES

In continuation of the well established scientific evaluation of the project work, a survey on user satisfaction and input for service improvement will be conducted three month after the launch. Non-personal data on the usage of sciebo will be closely monitored to confront predictions from theory (e.g. Diffusion of Innovation, Rogers 2003) and to established updated projections for resource utilization in order to timely initiate funding proposals and tendering for necessary expansions of the system platform.

Since we comprehend sciebo not just as a sync & share cloud storage service (a “one trick pony”, so to say) but as the seed for a versatile information infrastructure (Pipek et al, 2009), further research will especially focus on user demand for and adoption of novel usage scenarios, based on a powerful, elastic, well established and widely used cloud platform. Amongst these additional usage scenarios, research data management and e-learning are the most concrete. For research data management, we see huge potential for addressing the collaboration domain in the curation domain

model (Treloar et al. 2007, Klump 2011) and creating further benefits for researchers by providing easy to use interfaces to the publication domain. In the field of e-learning, close integration with the most common e-learning systems at NRW universities (Moodle, Ilias) are planned, making it possible to easily distribute digital materials to student mobile devices for paperless learning.

The sync & share NRW project was seminal for ownCloud to develop their Open Cloud Mesh approach towards interconnected private clouds. Based on this upcoming standard, we expect to create interoperability with other cloud storage services similar to sciebo in academia and research.

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5/10 'Must try harder': applying technology to the management of assessment and feedback.

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Keywords

Assessment, business processes, educational principles, feedback, feed forward, formative, integration, life-cycle, online submission, online marking, pedagogy, summative.

1. ABSTRACT

This paper focuses on the information systems that are being used in support of assessment and feedback activities. It takes a generic 'life-cycle' view of the overall process and looks at how systems (particularly commercial off-the-shelf systems) relate to academic practice. Throughout the paper the term electronic management of assessment (EMA) is used to describe the way that technology can be used to support the management of the whole assessment and feedback lifecycle, including the electronic submission of assignments, marking, feedback and the return of marks and feedback to students. We look at common issues in the fit between systems and practice and measures that are being taken to address the issues and fill the gaps.

2. INTRODUCTION

This paper is the third in a series looking at the enhancement of assessment and feedback practice in UK universities. A paper to EUNIS 2013 (Ferrell & Sheppard 2013) presented a review of the overall landscape and noted that, although assessment and feedback lies at the heart of the learning experience and forms a significant part of both academic and administrative workload, it remains the single biggest source of student dissatisfaction with the UK higher education experience. The review looked at a body of work aimed at defining the educational principles and good pedagogic practice that institutions were looking to achieve. A subsequent paper to EUNIS 2014 (Ferrell and Stewart 2014) further analysed the issues in relation to pedagogy, process and people and looked at tools and approaches that were being successfully applied to tackle all of these issues.

This paper focuses on the information systems that are being used in support of assessment and feedback activities. It takes a generic 'life-cycle' view of the overall process and looks at how systems (particularly commercial off-the-shelf systems) relate to academic practice. Throughout the paper the term electronic management of assessment (EMA) is used to describe the way that technology can be used to support the management of the whole assessment and feedback lifecycle, including the electronic submission of assignments, marking, feedback and the return of marks and feedback to students. We look at common issues in the fit between systems and practice and measures that are being taken to address the issues and fill the gaps.

The paper draws upon the work of the UK wide [Jisc Assessment and Feedback programme](#) (2011-2014) and work currently being undertaken under the auspices of the [Jisc Electronic Management of Assessment project](#).

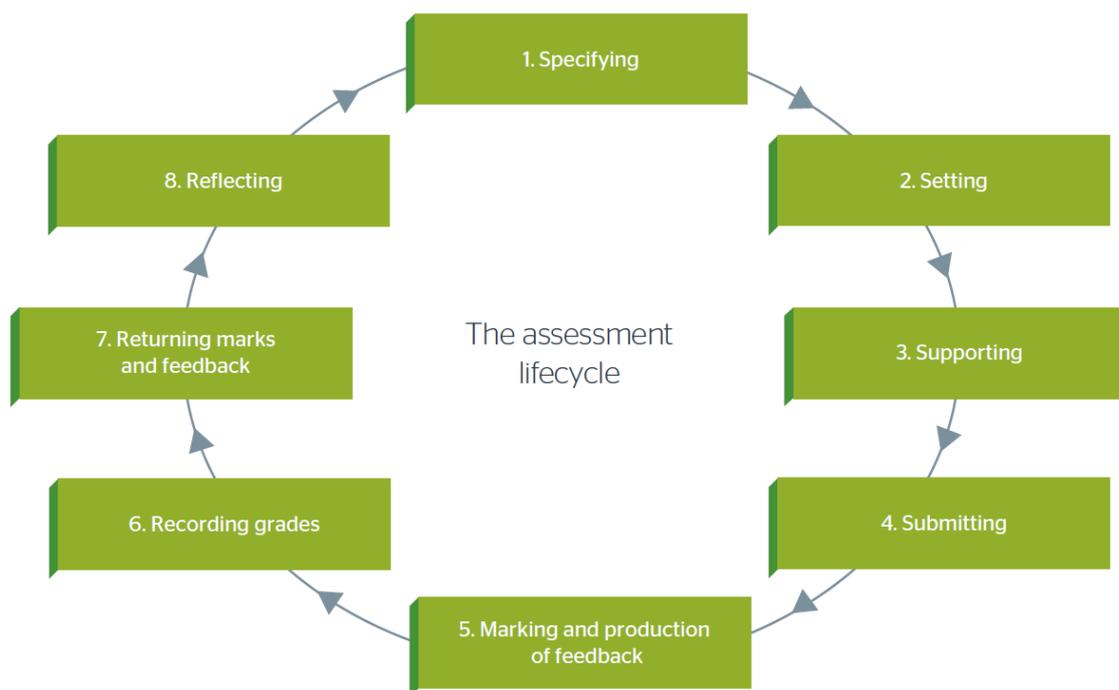
Recent research has highlighted the need for effective assessment and feedback practice to be underpinned by a shift from assessment *of* learning to assessment *for* learning as evidenced by a shift in the balance from summative to formative assessment and greater learner ownership of the processes related to their own learning such that they are better able to make evaluated judgements and gauge their own progress.

Technology plays a fundamental role in achieving these goals and increasingly colleges and universities are seeking to integrate institutional information systems to provide a single coherent point of access to assessment and assessment-related data. The aim is to minimise the administrative overhead involved in handling of paper and input of data and to allow students

personalised access to information about assignment types and deadlines, assessment records, feedback from previous assignments and their e-portfolios. The idea of a fully integrated suite of systems that support the most effective learning and teaching practice and minimise routine administrative tasks remains however a 'Holy Grail' for most institutions. Many institutions still have discrete systems which are not able to exchange data and many assessment related processes remain almost entirely manual or paper-based whether through staff choice, lack of available technology tools or a combination of the two.

3. A LIFE-CYCLE VIEW

In trying to review assessment and feedback practice overall it is easy to feel initially overwhelmed by the diversity of the landscape. Every institution develops its own policies, procedures and practices - usually the responsibility for this is highly devolved so there can be very different policies and practices between different departments or schools even within a single University. In trying to make sense of the overall picture, a tool that has proven very useful in providing a common starting point is the assessment and feedback life-cycle shown below.



Originally developed by Manchester Metropolitan University, the life-cycle is fundamentally an academic model and the way in which it shows a high level view of the academic processes offers a ready means of mapping business processes and potential supporting technologies against this. Use of the model has therefore been central to cross institutional research in terms of serving as a framework to gain a holistic picture of institution wide activity.

There are 8 main stages in the life-cycle: at a more detailed level the processes also include: assessment scheduling; submission of assignments; tracking of submissions; extension requests and approvals; academic integrity; academic misconduct processes; examinations; marks recording; moderation and external examining. The life-cycle is presented in a cyclical fashion to emphasise the iterative nature of many of these activities (even though many of the participants in Jisc research have highlighted the fact that some of their processes and information systems actually work in quite a linear manner).

The model is intended to be pedagogically neutral (more about asking the right questions and stimulating thought than having a basis in any particular pedagogic stance) and it can be applied to both formative and summative assessment and to any scale of learning e.g. from whole

courses/programmes of learning or to short pieces of learning such a short course that takes place over a single day. The model covers all assessment and feedback practice whether or not materials are in digital format and supported by information systems therefore it suits our purpose as a model for EMA as opposed to the narrower EAM (the term electronic assessment management is often used interchangeably with EMA - our thinking on this is that EAM implies the management of assessments that exist in digital format whereas EMA is a much broader term).

At the start of the research there was a general feeling that stages 2-4 are better understood and less problematic than some of the other components of the life-cycle, not least because many institutions are managing all of the related information within a single VLE system. Stages 5-8 were felt to be where we begin to open Pandora's box ... This proved to be borne out by the findings of the research.

4. USE OF TECHNOLOGY THROUGHOUT THE LIFE-CYCLE

In April 2014, 70 HE providers responded to a questionnaire about their use of EMA. It seems that while most institutions are using technology to support some elements of the life-cycle, very few yet have joined up institutional approaches. Many institutions are at a stage where they have piloted new approaches in particular parts of the University and are starting to think about a more strategic approach applying technology consistently across the institution.

Electronic submission of assignments appears to be considerably more widespread than other aspects of EMA: 32% of respondents had already mandated e-submission on an organisation-wide basis and only 3% of respondents told us their institution was not doing anything in this area.

There is widespread evidence of student demand for feedback in electronic format and 34% of respondents had e-feedback mandated in parts of their institution although only 20% had an organisation-wide mandate for e-feedback. The irony that this means some students are required to submit work electronically yet they receive handwritten feedback on paper, does not go unnoticed by learners.

Earlier research had indicated that students and administrative staff are generally more enthusiastic about EMA than academic staff so it is perhaps unsurprising that electronic marking of assignments is lagging behind other aspects of EMA. Some 32% of respondents did have local mandates for e-marking and 10% had made e-marking compulsory institution-wide. A similar number (11%) were however not actively investigating e-marking at all.

E-exams appears to be the most immature area in the UK: 26% of respondents told us they weren't currently looking at this area. 39% had undertaken small-scale pilots and 13% large-scale pilots. There is little mandatory use of e-exams and the practice seems best developed in health related subjects in HE. The picture is rather different in the further education sector where many awarding bodies stipulate the use of online exams. There is however widespread small-scale use of online assessment with a wide variety of tools in use. The current lack of activity in the area of e-exams appears to be one of the most significant differences between the UK and other parts of Europe especially the Netherlands and Nordic countries where e-exams are taking place on a large scale.

Despite the diversity of UK academic practice, there is a limited range of core technologies supporting EMA on an institution wide basis. The key systems are generally:

- student record system: as the home of definitive grading information.
- VLE: used for feedback and marking.
- dedicated assessment platforms: with the submission, originality checking, feedback and marking functionality in the Turnitin product suite being widely used.

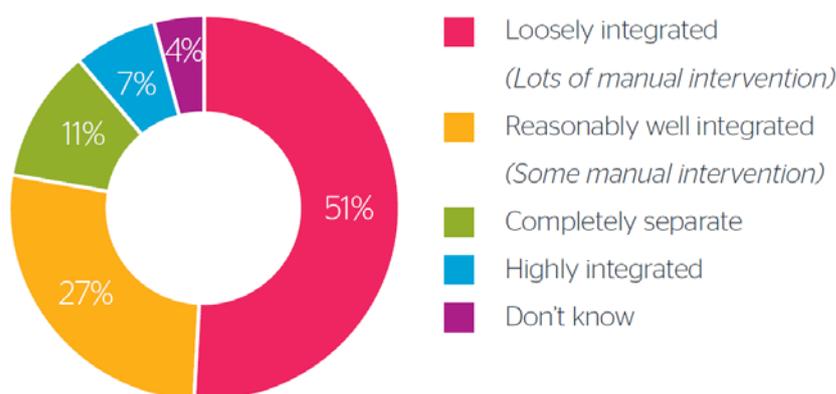
Looking at the combination of these systems, two main options predominate: and between them SITS/Blackboard Turnitin and SITS/Moodle/Turnitin account for almost half of institutions (the SITS/Blackboard Turnitin combination accounting for around 25% of HEIs being the most common. The rest of the variation is largely accounted for by the different student records systems in use although there are a variety of other VLEs (including Sakai, Canvas and Desire2Learn) and one

institution identified that it was using the Ephorus originality checker (this company has subsequently been bought out by the owners of Turnitin).

Many institutions do however have more than one tool that can potentially carry out the same functions therefore individual departments and staff often have considerable choice in selecting the most appropriate tools to underpin their day-to-day assessment practice. Of the 2014 survey respondents only 16% said that their institutional use of EMA technologies was 'highly standardised'. The largest proportion (54%) had a standard core supplemented by local variation and 28% had considerable localised variation (2% did not know).

Despite the relatively limited nature of the core product set, the key integration points between these technologies remain problematic and a source of considerable manual intervention. We asked about levels of integration between the core systems i.e. the extent to which data is held in a one system and passed to other systems that need it rather than manually input to each system: there were more respondents (11%) who said their systems were 'completely separate' than who said their systems were 'highly integrated' (7%). Interestingly only three universities said their systems were highly integrated (one of these was making relatively limited use of EMA) and the others in this category were all providers of HE in FE.

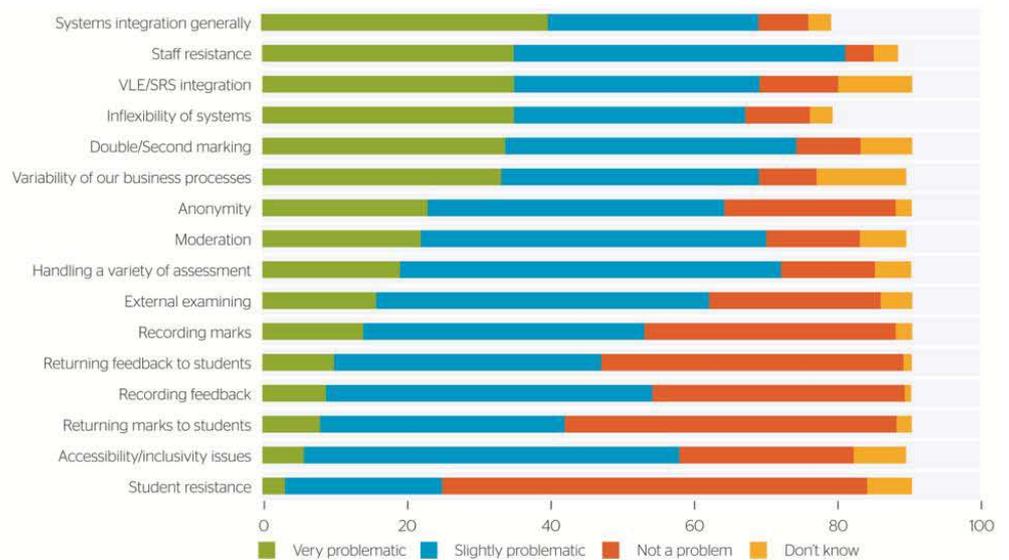
How integrated are the core systems that support EMA?



Aside from the sheer amount of administrative effort required to transfer data between systems, a number of other issues were identified such as problems caused by different systems storing marks in different ways and the risk of error due to rounding in multiple systems and the difficulty of supporting anonymous marking in that anonymity may be possible in one system but lost as soon as data is transferred to another.

5. PAIN POINTS IN THE LIFE-CYCLE

We asked about the key pain points in relation to EMA. Below is a summary of responses to the prompts provided. The chart shows the broad profile of 90 responses (not all respondents commented on all of the prompts). Grouping together the various points around systems integration and inflexibility of systems, it is clear that this is the biggest problem area for the majority of institutions. Issues relating to pedagogy and institutional culture and process do however feature very strongly: with over 80% of respondents indicating that staff resistance is problematic to some extent. Business process issues were also identified as a major source of pain: interestingly the response about business processes also had the largest number of 'don't knows' probably reflecting the general level of opacity around this topic.



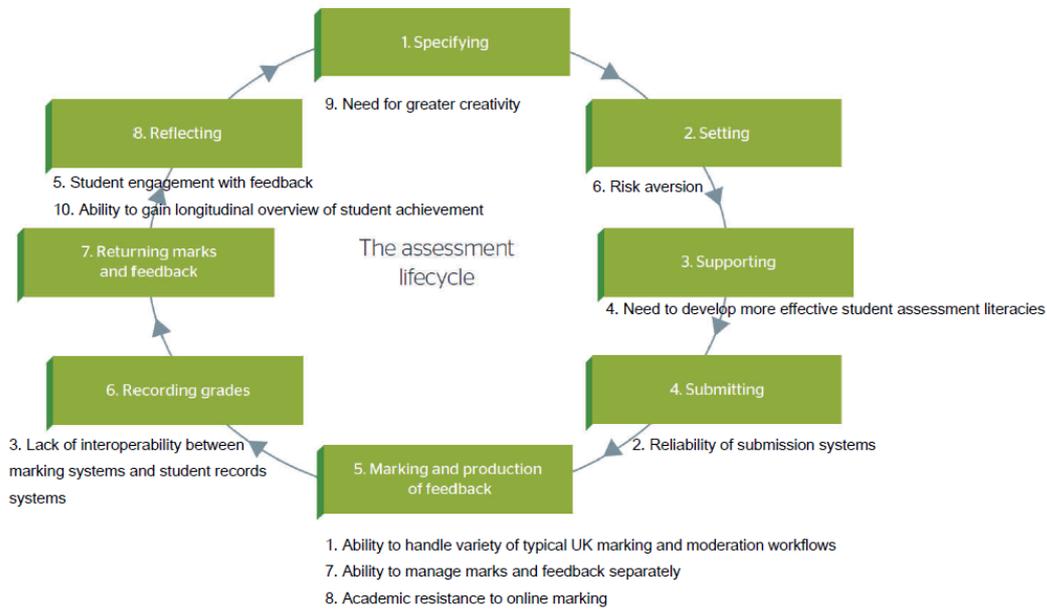
The interplay between the factors involved i.e. people processes and systems, is complex: it is evident that the existing commercial and open source systems do not effectively support all of the existing processes but there are equally some cases where process improvement could clearly be achieved. Similarly, we heard some quite harsh comments about institutional culture but it is clear that experiences with immature or unreliable technologies can turn neutral (or even slightly positive) early adopters into resisters.

Top-down approaches are very often at odds with the culture, certainly in higher education, and many institutions are taking the approach of strongly encouraging all aspects of EMA without the element of compulsion until the practice is strongly embedded.

We analysed the detailed responses to these prompts in order to identify 20 specific challenges commonly faced by institutions. We then undertook further work with a range of different stakeholder groups (mainly learning technologists, academic managers and staff developers) to identify which of the challenges were the most significant and had the greatest impact on stakeholders. We then mapped these challenges against the life-cycle.

Top 10 challenges mapped against life-cycle.

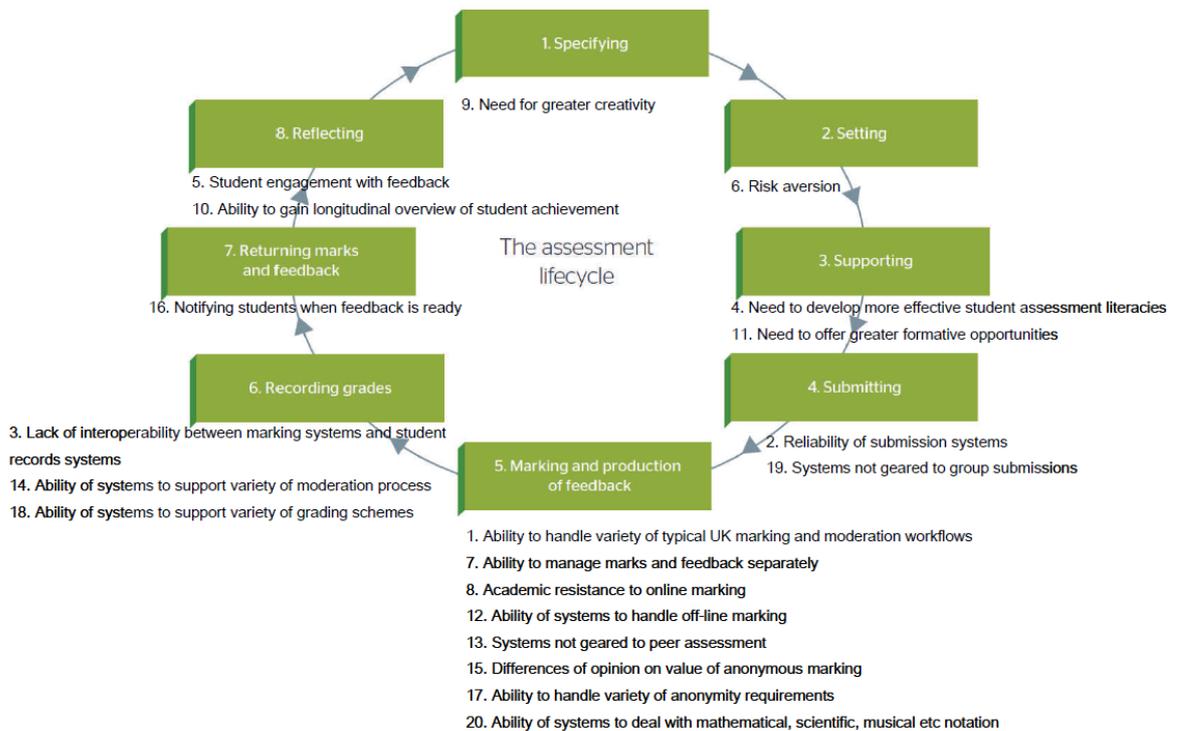
Top 10 EMA Challenges



Mapping the top 10 challenges bore out the initial suspicion that most of the problems arise during the period from submission onwards. The grouping of issues around areas 5 and 6 (the marking and production of feedback and the recording of grades) becomes even clearer when the top 20 challenges are considered.

Top 20 challenges mapped against life-cycle.

Top 20 EMA Challenges



Marking and production of feedback appears to be the most problematic component of the life-cycle as it is the area where variety of pedagogic practice results in a situation where the fit between institutional processes and the functionality of commercially available systems is least well matched. We heard a very clear message from universities that existing systems do not adequately meet institutional requirements in these areas. A basic issue is that marks and feedback are different things and need to be handled differently whereas technology platforms tend to conflate the two. It was also observed that systems seem too often to be predicated on an assumption that 1 student = 1 assignment = 1 mark. This model may usually be adequate for formative assessment but does not meet UK requirements for summative assessment processes. Systems would ideally offer a range of different workflows based on different roles e.g. first marker, second marker, moderator, external examiner etc. University participants in the research did however express some sympathy for the system suppliers' position in the sense that there appears to be such diversity of practice that is inconceivable that any system could meet all of the different requirements

6. WORKING TOWARDS SOLUTIONS

Following the articulation and prioritisation of the challenge areas, Jisc has been working with both institutions and suppliers to identify feasible solutions to the most common problems. The community initially identified 30 solution ideas that group under five main headings.

Solution Group 1. - Common Workflows

Challenge/s addressed: Ability to handle variety of typical UK marking and moderation workflows/ Ability to manage marks and feedback separately.

A range of ideas were proposed around identifying, validating, specifying and gaining consensus around a common set of marking and moderation workflows. The idea was that if we are able to narrow down the diversity of approaches into a set of common models it could help to both inform systems suppliers to influence how systems develop to support those workflows; and also to inform new systems development. The ideas ranged from simply documenting these workflows in broad terms through turning them into more detailed specifications, to the idea of actually building 'plug and play' modules

Solution Group 2. Holistic Feedback Hub

Challenge/s addressed: Student engagement with feedback/ Ability to gain longitudinal overview of student achievement.

There was consensus around the need for a more programme level/holistic view of feedback, for both tutors and students, to enable a more longitudinal view of student development as well as potentially facilitating greater engagement with feedback. One proposed solution was to develop a 'holistic feedback hub', where students and staff can access a programme level view of student feedback. Another idea was for students to be empowered and enabled to take more ownership of pulling together a programme level view of their feedback by gathering this in their personal spaces (such as an e-portfolio).

Solution Group 3. Reliable Submission

Challenge/s addressed: Reliability of submission systems.

The ideas in this space focused around making the technical process of submission as simple as possible and clarifying policies and procedures to avoid stress and confusion when things inevitably do go wrong. It was suggested there is a need to analyse all of the possible points of failure and decouple the physical act of submission from the workflows within other EMA systems so that submissions can be acknowledged and held until other functions are in a position to proceed. Policies, procedures, guidance and examples need to encompass the workarounds to deal with points of failure.

Solution Group 4. Interoperability

Challenge/s addressed: Lack of interoperability between marking systems and student records systems/ Ability of systems to support variety of grading schemes.

The ideas relating to this topic covered both data management and technical interoperability. It was suggested there was a need to identify the minimum data storage requirement for each type of system and to consider whether each institution is carrying out functions in the most appropriate system and storing the data in the most appropriate place. There is a need to exchange good practice and existing solutions for common integrations and it was suggested we could go so far as to build some integrations where there are gaps.

Solution Group 5. Good Practice Toolkit

Challenge/s addressed: Need to develop more effective student assessment literacies/ Risk aversion/ Academic resistance to online marking/ Need for greater creativity.

A number of solution ideas were proposed relating to the development of guidance and examples to promote an 'assessment for learning' rather than 'of learning' approach. The suggestion is for some form of toolkit which should address the question 'what does good assessment design look like?' and enhance both staff and student assessment literacies.

7. NEXT STEPS

In April 2015 work began on a number of the solution areas outlined above:

- Solution area 1 - common workflows is proceeding as a project. The aim of this project is to review the workflows associated with the assessment and feedback lifecycle (particularly those around marking and feedback) and produce a set of visualisations that describe the main academic practices and the key variables that influence decisions. By reducing the 'noise' around differences and focusing on what is pedagogically significant the project hopes to provide institutions with a means to review and improve processes and help system suppliers better support common UK practices. It is hoped that institutions that have already undertaken process review in this space may find opportunities to replace frustrating 'workarounds' with better solutions. The work will be discussed with the EUNIS e-Learning Task Force at its next meeting (June 2015) to identify the extent to which UK academic practices relating to marking and feedback are shared in other parts of Europe.
- Solution area 5 - good practice toolkit is proceeding as a project. The aim of this project is to deliver an interactive online toolkit, based around the assessment and feedback lifecycle, that will provide examples of effective practice at each stage of the lifecycle. The toolkit will be written in an action-oriented way, to enable response and action by the institutions involved and will include resources such as: tools; case studies; shorter vignettes of good practice; policies and processes; information on technologies and integrations. A potential collaboration with SURF in the Netherlands is under discussion and the work will also be discussed with the EUNIS e-Learning Task Force at its next meeting (June 2015) to extend the scope of good practice to be included in the toolkit across the whole of the EUNIS community and to offer opportunities to pilot the resources.
- Further work on the feasibility and scope of solution areas 2 and 4 - feedback hub and interoperability is to be undertaken. In particular, a study will explore the potential development of a Jisc-funded tool that would deliver an aggregated view of feedback and marks, with both tutor and student views. By examining some of the pedagogic, technical and process factors involved in implementing a feedback hub, it will inform the business case and recommend the way forward that would offer most value.
- Solution area 3 - reliable submissions is being tackled by changes to the Turnitin system and further work is on hold pending a review of the outcomes.

The outcomes of the discussions with the EUNIS e-Learning Task Force about extending some of this work Europe-wide will form part of the presentation of this paper at the EUNIS 2015 Congress.

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Find out more:

Jisc EMA blog: <http://ema.jiscinvolve.org/wp/>

Jisc EMA briefing: <http://www.jisc.ac.uk/guides/electronic-assessment-management>

9. AUTHORS' BIOGRAPHIES



Gill has teaching and research experience and has held senior management positions in a number of university administrative functions as well as directing a UK support service enhancing the use of ICT in further and higher education. She acts as a consultant to universities and national agencies in both the UK and Europe and has been an invited speaker at many national and international events. Current interests include: data and information management, technology enhanced learning, assessment and feedback and learning space design.

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Lisa is a Senior Co-Design Manager within the Student Experience team at Jisc, providing leadership on the use of technology-enhanced learning and teaching in Higher and Further Education. For 10 years she has led a range of innovation and change programmes on the themes of technology-enhanced assessment and curriculum transformation. Lisa has spoken widely on the many ways that technology can enhance assessment and feedback and on the use of e-portfolios to support learning, and has orchestrated a range of highly regarded activities in these areas including the development of advice and guidance materials and a series of national workshops.

Mapping assessments to technology tools: Development of an Open Education Resource (OER) toolkit to assist with implementation of electronic management of assessment

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Keywords

Electronic management of assessment, online assessment, online feedback, staff development

1. Summary

Implementing electronic management of assessment brings many benefits for students including, time saving, eliminating cost of printing and the security of digital receipts and backups (Jisc, 2014). There are many benefits for the institution and for staff as well. The biggest learning curve however is perhaps for staff with online marking requiring a significant change in practice. The online tool-kit will help to familiarise staff with the different tools available for assessing online which are most suitable for the style of the assessment, hopefully leading to more holistic use of technology for assessment.

2. Extended Abstract

Online submission and online feedback is being fully implemented at Abertay University over the next two years. While for many assessments that simply means electronic versions of essays and computer based exams a recent survey of how our VLE tools were being used revealed pockets of innovation. Some staff are now using gradable discussion forums to engage students in critical debate and others are making use of wiki tools for group projects. This online assessment mapping toolkit aims to take staff through a brief decision making process to narrow down the details of a planned assessment and then suggest technology that could be used appropriately to help manage the assessment completely online through the entire assessment lifecycle (Manchester Metropolitan University, 2014). Ultimately the toolkit will contain case studies of best practice and how-to guides with links to booking internal workshops.

This tool aims to help staff feel encouraged and supported to embed technology fully into their assessment practices. Technology should be seen as an integral part of the module rather than a bolt-on addition at the end to return online grades to students. To fully implement EMA (Electronic management of Assessment) staff need to plan for it at the beginning of the assessment lifecycle. This toolkit is designed to help with the planning process.

Jisc has been coordinating a UK wide Electronic Management of assessment project, they have funded numerous projects and held 'think tanks' in various UK locations to find out more about the issues facing institutions as they attempt to implement fully online coursework submission, marking and return of feedback (Jisc, 2015). Many Universities across the nation have been involved in the conversations Jisc is facilitating.

Top 10 EMA Challenges

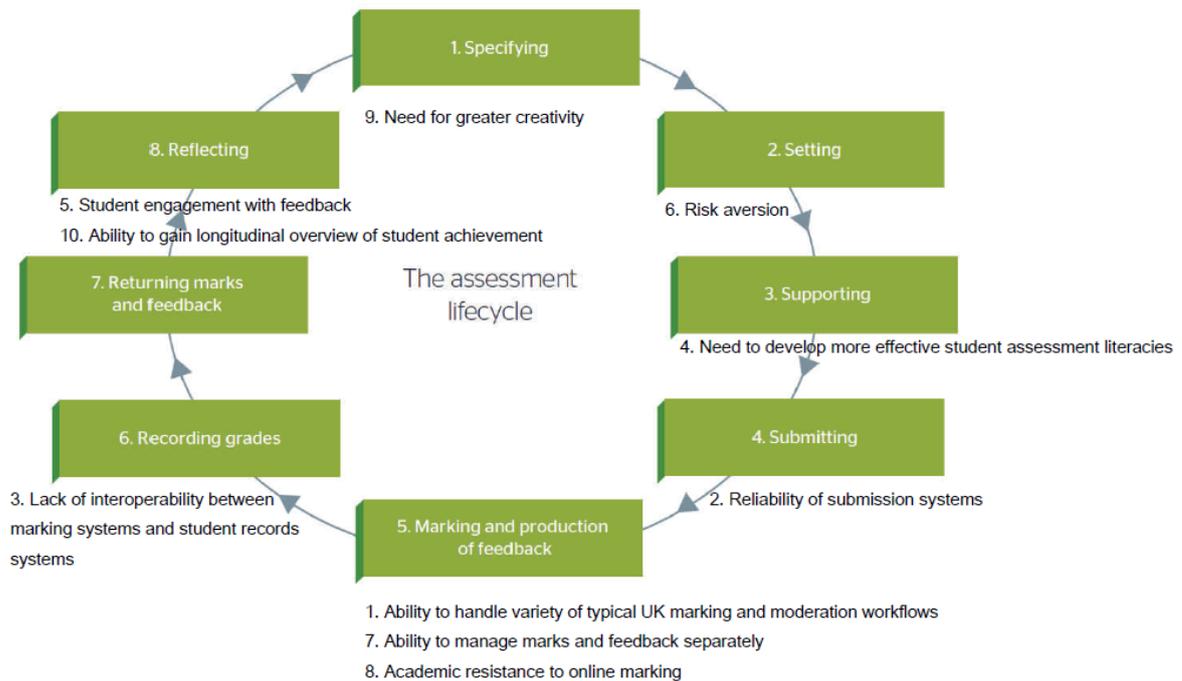


Figure 1: Jisc Assessment Lifecycle itemising issues and barriers to implementation of EMA

This Assessment tool-kit will hopefully help to overcome the following issues identified in Figure 1:

4. The need to develop effective student assessment literacies; This point will be addressed by having a variety of standard methods of assessing electronically that are embedded in modules throughout the programme. E.g more staff that are literate in EMA and therefore more consistency for students

6. Risk aversion; Planning for the EMA early on e.g. within module development and learning at this stage what options exist and which ones are best suited for the module should help allay concerns that that implemented EMA is risky.

8. Academic Aversion to Online Marking; giving the Academics a tool with which to plan how they will manage an EMA means they have options for deciding how it will be marked online, e.g. Turnitin GradeMark, or other feature in Blackboard or PebblePad. This forethought and hopefully buy-in to the process should help create a sense of ownership of the whole process of the assessment - rather than a sense of having planned it for paper and being forced to mark it online.

9. Greater Creativity; this tool will expose staff to options they may not have considered for an assessment e.g. They may have planned a group report where one word document is submitted for a group of 3 students however this tool will expose them to the idea of using a wiki or a blog as option instead.

The toolkit has been developed using PowerPoint as a template and is then published with interactions using Adobe Captivate. Although Captivate is being used the source material could be adapted by other institutions with any elearning authoring tool e.g. Articulate Studio or Articulate Storyline. Exerte is another option if an open-source solution is preferred.

This presentation will demonstrate the tool-kit via an interactive tour of the learning object covering the following points:

- -Overview of the structure of the object which uses branching 'pick a path' navigation to help narrow down options and display only tools relevant to the planned assessment
- -Example of the interactive material that is being developed to demonstrate the tools
- -Discussion of when the tool could be useful e.g. when developing new modules or reviewing the assessments in existing ones
- -Demonstration of how the tool was made showing how it could be adapted for use in other institutions. Discussion on how it could be used as an Open Educational Resource (OER) available for adaptation by other institutions and what repository it might be found in for sharing in the near future.

This session will be of interest to E-learning managers, Learning technologists and other members of University staff with an interest in implementing electronic management of assessment more broadly at their institution.

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4. AUTHORS' BIOGRAPHIES



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Educational Background BA (Open) and PGCert (Online Distance Education) both from the Open University UK. Work Experience: Currently working as a Learning Technologist at Abertay University where I help staff use technology to enhance and administer learning activities. I work a lot with Blackboard and in particular help staff to set up and run tests and exams online. I help staff and students with online coursework submission, and feedback, as well as supporting PebblePad, Adobe Connect virtual classrooms and recording lectures. I have been involved in projects with academics investigating; the use of Twitter in Lectures and finding out what students think of learning technology through focus groups.

Assessing assessments: student evaluation of online and paper-based examinations at ETH Zurich

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Keywords

student evaluation of teaching (SET), e-assessment, online examinations, consequential validity, backwash effect

Summary

In this talk we will present the development and deployment of a questionnaire for assessing written examinations in the context of the regular student based course evaluation at ETH Zurich. In two pilot surveys, in August 2014 and January 2015, data from online and paper-based examinations were collected. In a review of preliminary results these two types of examinations are compared in the context of alignment, acceptance, validity and student study behaviour.

Extended Abstract

In accordance with the “constructive alignment” approach (Biggs, 1996), ETH Zurich aims to facilitate and encourage the alignment of learning objectives, instruction, learning activities, and performance assessments in its teaching. In constructive alignment all types of performance assessments - be they written or oral examinations, end-of-semester examinations or semester assignments - are to be regarded as integral parts of a course. Thus a consistent implementation of constructive alignment does not only take learning and instruction into account, but also the corresponding performance assessments. Student-based course evaluation is a component of quality management at most universities, stretching back to 1991 in the case of ETH Zurich (Alean-Kirkpatrick, Hänni, & Lutz, 1997). From 2011 to 2013 ETH Zurich harmonized its course evaluation across all departments by developing and deploying a universal questionnaire. This questionnaire focussed on teaching and learning activities that take place during the semester and included only three questions regarding the corresponding summative examinations. In order to further facilitate a refined evaluation of the alignment between courses and examinations an additional questionnaire is under development that is dedicated to the evaluation of examinations. The new examinations questionnaire is an important step in further establishing evidence-based quality assurance in teaching at ETH Zurich.

The examinations questionnaire emphasizes the following areas of interest: alignment, validity, student acceptance, student learning, and paper vs. computer-based delivery. For each of these areas of interest a number of question items were drafted, resulting in a preliminary version of the questionnaire containing forty-two closed-ended Likert-scale items. While alignment serves as the key criterion in assessing the course overall, validity, the degree to which a measurement corresponds to what it purports to measure, serves as the central criterion in assessing the quality of the examination by itself. Gathering data on student acceptance of examinations is an important goal because examinations are a frequent area of conflict between students and faculty. Regarding student learning, it is well established that examinations greatly influence how and what students study (Gibbs, 1992; Sambell and McDowell, 1998, Xie and Andrews, 2012). The ubiquitous question “will this be part of the exam?” illustrates this ‘washback’ effect nicely (Prodromou, 1995), and the questionnaire emphasizes this important aspect accordingly. In order to assess advantages of

computer-based vs. paper-based examinations, the questionnaire includes a number of questions regarding specific differences between or aspects of these two types of examinations, such as keyboarding versus handwriting or technical support during a computer-based examination. In order to enable more detailed qualitative feedback the questionnaire also contains three open-ended questions. Finally, students had the possibility to agree to their questionnaire responses being analyzed in conjunction with their examination grades. Student data was treated on a strictly confidential basis and made anonymous prior to analysis. The number of questions in the final questionnaire will be reduced based on student and examiner feedback to the questionnaire on the one hand, and statistical item analyses, most notably factor analyses, on the other.

Data was collected in two subsequent pilot surveys, the first in August 2014, the second in January 2015, with eleven computer-based and twenty-one paper-based examinations and a total of approximately 4'000 students of which 2'398 responded to the questionnaire. Preliminary results indicate that students' are surprisingly fair and honest in assessing examinations: their acceptance of an exam, as well as their assessment of the exam's quality is largely independent of their own performance in the exam. A close relationship between constructive alignment, examination validity and student acceptance is found. Comparing computer-based with paper-based examinations, evaluation results are largely consistent and comparable - with two exceptions. On the one hand computer-based examinations that consist of closed-format multiple-choice questions alone, show substantially lower acceptance by students, are considered to be more poorly aligned, less fair, less valid, and show more negative washback on student learning than other paper-based or computer-based examinations. On the other hand computer based examinations where students solve examination tasks by working with domain-specific software (e.g. R-Studio in a statistics exam or Matlab in numerical methods; cf. Halbherr et al., 2014), show the highest acceptance, as well as strongly improved washback on student learning and motivation, and are considered by students to be better aligned than other paper-based or computer-based examinations. Students' evaluation of computer-based examinations regarding technology-specific aspects such as usability and technical support, are predominantly neutral to positive, a small minority reported mildly negative attitudes.

The final examinations questionnaire will be launched as a part of the regular recurring course evaluations in August 2015. The findings reported here are preliminary and require further substantiation once data from the regular course evaluations is available.

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EUNIS Congress' 21st Birthday - A Historical Perspective on its Proceedings

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Keywords

Leadership, IT policy, strategy, Continuing Professional Development (CPD).

1. Summary

Established in 1993, the EUNIS organisation is Europe's equivalent to the United States of America's EDUCAUSE and Australasia's CAUDIT organizations. Its objective is "to contribute to the development of high quality information systems" by "bringing together those who are responsible for the management, development and the policy for Information Technology in Higher Education in Europe". EUNIS has adopted a number of approaches to achieving its objective, one being its well-established annual Congress alongside, for example, specialist Task Forces, the recently established EUNIS Research and Analysis Initiative (ERAI) and its e-Journal, the EUNIS Journal of Higher Education IT (EJHEIT) launched in quarter four of 2014.

2015 marks the 21st year of the EUNIS Congress, affording a timely opportunity to reflect on the range of issues addressed and to provide biographical summaries of topics presented, based on details extracted from available Congress programmes and other historical information sources.

The actual and projected work of the ERAI, through EJHEIT and the Congress, in analysis and dissemination of synopses of contributors' presentations is outlined. Complementing this information are some general findings from analysis of the accumulated abstract summaries from around 2000 authors from 41 countries provide over 1200 papers since the beginning of this century.

The contexts of "continuing professional development" (CPD) and of "what makes a good Chief Information Officer (CIO)" are qualitatively explored through an analysis of the available data. EUNIS' objective has a focus on senior IT professionals; on communications and social networking. Gartner research (2010) suggests "achievement through, by and with people"; "collaborative working"; "ability to inspire people both inside and outside their organization" as some key success factors for a successful CIO. "Focusing on leadership and people skills - the 'soft' things ... is in fact the biggest determinate of their success, or failure." This statement, whilst set in an organizational context has wider relevance with EUNIS' various initiatives playing an important role.

2. BACKGROUND

Sharing experiences and collaborative ventures are well established methods for the development and sharing of knowledge, for example, as a component of CPD. EUNIS, the European University Information Systems Organization, is a prominent pan-European forum whose aims incorporate "encouraging those with responsibility for higher education information systems (HEIS) in higher education (HE) and research establishments (REs) to exchange information, pursue co-operation and undertake debates around issues of common interest". EUNIS also seeks to establish European-level relationships with those organizations and organizational units responsible for information systems in HEs and REs at both country and European level. These aims support CPD in several ways including awareness raising at a pan-European level, peer-to-peer networking and through opportunities for collaborative working. In the absence of textual analysis of either abstracts or full papers it is assumed that Congress presentations need not focus specifically on the topic of CPD in order to be relevant to CPD; for example, technical content papers can contribute to CPD by increasing a delegate's knowledge in the specific technical domain or by creating a collaborative opportunity.

Since its inception, in 1993, EUNIS has developed into a comprehensive forum for information acquisition and exchange as well as having the capacity to undertake relevant research projects of

interest to its constituency. For example, the organization now executes its aims and objectives through Task Forces, the EUNIS Research and Analysis Initiative (ERAI), Awards to recognize excellence in various aspects of its interests, and events, the most notable being the annual Congress now in its 21st year. Its Rectors' Conference has an outreach targeted at senior management who are strategists and "top table" decision makers; to quote from its web page: "*the sessions will have a strategic rather than technical focus*". This venture reinforces the extent to which EUNIS strives to integrate senior IT and other "top table" influential figures through its work. Such undertakings afford excellent pan-institutional and pan-country opportunities for senior executive networking, collaboration and strategy-related dialogues.

Each facet of EUNIS' work, combined with its outreach and professional association with other like-minded organizations, benefits from the recently developed e-Journal, the European Journal of Higher Education IT (EJHEIT) and the ERAI web service, as further collaboration and dissemination vehicles whose content should appeal not only to a general HE IT readership but also to those interested in their personal development through reading relevant contemporary IT literature.

Through ERAI, work has commenced on digesting information on the historical detail of Congress activities in an effort to extract general trends and, possibly, also to inform further research topics.

Whilst EUNIS offers much in terms of CPD opportunities to various levels of staff seniority, nevertheless the focus of the paper is principally on roles with a managerial responsibility. The term CIO is used in a broad sense to refer to the "C-suite" or "C-level" of management within an IT organization; it may encompass terms like CEO, CTO and Director and is broadly defined by the "SFIA Level 7 description set strategy, inspire, mobilize" which may incorporate staff in the layer below Director in large Universities and large IT departments e.g. Assistant Director or Head of Team/Unit.

For example, Hein (2013) in his work on characteristics of successful Chief Information Officers (CIOs) identifies the need for:

- i. Constant "learning and growing", citing Burns who states "... top leadership expects the CIO to stay ahead of trends, and that type of info is not always available in a course or training program. In other words, you must make up your own course, *look around you and be aware of emerging trends*"
- ii. Being masters of *network and relationship building*.

Quoting Ibarra and Hunter (2007), "Leaders must find new ways of defining themselves and develop new relationships to anchor and feed their emerging personas. They must also accept that networking is one of the most important requirements of their new leadership roles and continue to allocate enough time and effort to see it pay off". The opportunity afforded by congresses and similar events contributes to the networking aspect of a manager's role. The HE IT sector benefits from a mature history of development opportunities; courses, conferences, peer organizations and domain-specific literature. The opportunities for HE sector senior IT management are, in part, facilitated through various EUNIS activities; the Congress is an annual opportunity for networking, learning and growing, being informed of trends and building or strengthening relationships.

3. AVAILABLE HISTORICAL DATA

The unavailability of a Congress data archive necessitated scavenging suitable content from those sources known to exist. Unfortunately a complete set of data has not been attainable however significant effort has resulted in an informative basis from which to mine relevant information. The dataset is principally established from paper references where paper title, keywords, associated conference theme, author(s) and country data has been extracted from official websites and other digital sources for each year of the Congress. Regrettably, some Congress web sites have been lost, thus requiring internet information excavation to find the required data. In most cases this secondary scavenge was facilitated by the "Web Archive" tool. There remains missing information,

especially digital versions of papers. As part of a data cleaning stage, corporate presentations have been omitted as far as is practical though some instances may have slipped through due to the absence of precise identification data. Also difficulty to differentiate between a full paper submission and an abstract may have led to the inclusion of some “abstract only” details. Initial investigative work, as presented in the paper, does not attempt “deep” text analysis; its interest is in extracting, first, some Congress biographical overviews, then attempt to associate topics, possibly using keywords alongside paper titles, to the broad EUNIS objectives especially associated with CIO and senior management CPD opportunities. *Most detail is available for years 1997 to date.*

4. CONGRESS BIOGRAPHICAL OVERVIEW

Since 1995 annual Congresses have taken place, in late June, involving 15 hosting countries, 5 on two occasions. Grenoble and Manchester have hosted the event each time it returned to their host country; in 1997 and 2007 (France) and 1996 and 2005 (UK). In 2014 EUNIS delegates visited Umeå, Sweden, the most northerly venue; in 2002 the host city Porto was the most westerly and southerly with Tartu (2006) being the most easterly. In its 21-year history delegates from 21 countries have presented papers with almost 1200 papers provided involving 2500 authors. The distribution of frequency of contributions by authors, as would be expected, is highly positively skewed; 80 percent of papers are by authors who have contributed once over the history of the Congress; 18% of authors have contributed 2 to 5 papers, with 1% contributing 6 to 9 and a further 1% contributing 10 or more. On average, ignoring 1997 when a “small” event was held, an average of 63 contributed papers have been presented, with 2007 (Grenoble, France) seeing the largest contribution of 105. 41 countries have been represented, including Australia and the United States of America as the most “far flung”. Attendance levels have varied with an average attendance of 270 and the 2001 event in Berlin, with over 470 delegates was the largest to date. Typically 25-30 nationalities attend each year. In 1996 the EUNIS organization decided to host alternating “small” and “large” events. That year’s Congress was “small” (100 delegates and a 2-day event); the idea was subsequently abandoned.

5. GENERAL OVERVIEW OF CONGRESS PAPERS

The Congress affords CPD opportunity irrespective of the delegate’s position within an organizational structure. Two broad modalities of CPD may be considered; *institutional* and *individual*, however here the distinctions are blurred as this review does not seek to identify the reasons associated with Congress attendance. The key tenet is that attendance contributes to CPD by affording learning whether in terms of “keeping up-to-date”, “sharing experiences and ideas”, “gap filling in terms of personal learning needs” or “continuing to develop” (keeping pace). Decisions to attend a Congress are assumed to align with these CPD-related strands. It is further assumed that Congress Organizing Committees seek to establish a content spectrum to meet the CPD and general interest needs of its attendees, whether as an individual or as a part of a wider institutional need or programme.

Each Congress has an associated set of Tracks around which invited papers are sought. For each Track a “Track expert” and the Programme Committee evaluate the submissions in order to select the most appropriate contributions; a peer review process. The Congress’ content is influenced by the choice of Track themes, these in turn being identified to reflect current issues known to be of particular strategic and operational interest to the EUNIS community. In analyzing available Congress programmes, two significant constraints are identified, namely:

- i. A full set of programme detail is unavailable for the 21 years of the Congress’ life
- ii. Analysis, as provided in the paper, is of a general qualitative type.

Based on analysis of over 120 unique Congress Tracks an arbitrary taxonomy of 10 major topic areas emerge with “co-operation and management” and “e-learning and mobility” themes dominating; see [%] values given in Table 1. The significant position of “infrastructure and security” as third in popularity may reflect the level of technical contributions, hence also the heterogeneity of the range of Congress topics and of attendees; strategists, managers and technical support. The “Best Paper” Award, presented since 2002, is broadly speaking dominated by papers focusing on software-centric initiatives with one award granted to work on transformational initiatives that improved the customer focus of a central IT department (Sunikka, 2013). Association between the Award and

Congress themes indicate corporate IT, information management and mobility to feature most. Since its introduction, in 1998, the Dørup E-learning Award has been presented annually, with the

Theme	Popularity
Development	[2%]
New and Emerging Technologies	[3%]
Information Management, Corporate IT and BI	[10%] (14%)
Web and Social Media	[5%] (3%)
e-science	[6%]
E-Universities	[6%]
Libraries	[6%] (7%)
Infrastructure and Security	[19%] (17%)
Co-operation and Management	[21%] (23%)
E-learning and Mobility	[24%] (27%)

Table 1: Taxonomy of Congress Themes

exception of two years. This award acknowledges “outstanding and innovative application of information technology (IT) in an educational setting” with the majority of successful submissions associated with innovative software solutions across a number of the themes listed in Table 1. An alternative view of the themes is obtained by examining the volume of submitted papers. With reference to the (%) figures shown in Table 1, the volume of submissions is broadly in line with the popularity of the themes as is to be expected given that the calculations are based on the total paper count of over 1200 whereas the theme-based figures are based on a total of almost 120. A

visual appreciation of the range of key words used in paper titles is illustrated using a word cloud as shown in Figure 1. In addition to the removal of non-significant words others that do not aid clustering with the focus on CPD were extracted e.g. university, higher, information and derivatives.

As anticipated, the dominant words demonstrate a strong association with the major tenets of EUNIS’ activities; teaching, learning and e-learning, and management. Those attendees with a specific interest in CPD obtain a comprehensive topics palette from which to select relevant papers.

6. C-Layer CONTEXT

Groysberg et al. (2011) reports upon research that sought to identify those abilities that aspiring executives should focus on developing as they decide on the direction of their career path, and on what skills current executives should hone as they aspire to the next tier of an organizational structure. An interesting synopsis is provided of the evolution of senior management in the IT sector, which may be summarized as illustrated in Table 2. Entries in italics are additional and intended to reflect the HE sector experience. In a recent British Computer Society (BCS) report on “What Digital Leaders want and need” (Runciman, 2015) the “people issues” were “broad ranging” in comparison to the “technology focus”, however a pertinent observation was that “the IT departments themselves were in danger of becoming the biggest blocker on effective organizational modernization”. The need to, for example, “having IT people properly involved in selling the organizational strategy and getting it over the line into delivery” illustrates the importance of understanding the business. Looking three to five years ahead the digital leaders cited “succession planning” and “performance management” as the two factors showing the greatest percentage increase since the conduct of the 2014 survey. These references whilst not specific to the HE

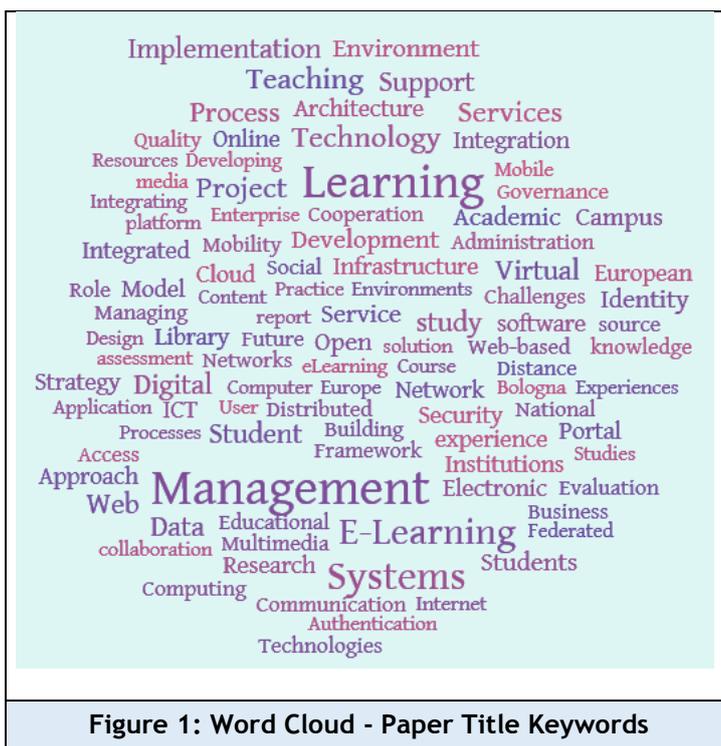


Figure 1: Word Cloud - Paper Title Keywords

sector, but inclusive of public sector organizations convey some relevant factors that are likely to be paralleled in the sector and which are important to the EUNIS community. These comments suggest, or reinforce, the notions of institutional and individual CPD modalities. The institutional context concerning “understanding the business” and “selling the strategy” may be non-IT in nature and best delivered as part of a CPD programme that includes senior management as presenters. This research sets a reasonable context in which to examine EUNIS’ opportunities for HE sector staff who are about to enter or are already in senior management roles including the c-strata.

In the first author’s experience the “managerial attributes” transition over the past 45 years has been from technical management, through relationship management, to project, programme and risk management and onwards to IT strategy and governance, then towards an integrated “business, finance and information” strategic hybrid. The latter BCS research highlights IT strategy and planning (46%), business transformation and organizational efficiencies (44%) and security (54%) amongst its “top concerns” either now or over the incoming 3 to 5 year period.

Strickland (2011) in his research states “It is crucial for the CIOs to be aware of what is going on in the outside world and find ways to bring this knowledge into their organizations. Hence, part of the CIO role is to scan the external environment.” Specifically, an interview with a CIO from within the HE sector included the quote “One way to achieve that is to utilize the universities’ alliances, build on those networks and look for ways to learn from each other and get join up” when asked about “collaboration with others from the same sector”. Conferences provide a collaboration vehicle; their programmes contain the “fuel” for ideas, collaborative ventures and extension of peer networks. EUNIS provides an ideal European platform to support these activities through its Congresses.

Ibarra and Hunter (2006) outlined a taxonomy for networking; for example:

- *Operational*; those needs associated with “What should we be doing?”
- *Personal*; forming professional alliances with peers with common interests and goals
- *Strategic*; knowing direction and knowing contacts with ability to assist in achieving a goal.

Given the spectrum of papers presented at Congresses, from technical to strategy and policy; from local to country-level collaborative ventures; combined with the breadth of experience and expertise in the attendees the taxonomy outlined maps conveniently unto what EUNIS provides for

Era	Career Ceiling	Attributes	Background
1980s to mid-’90s	Director	Logical thinking, technical focus, attention to detail	Business analysis Accounting Academic/Researcher
Mid-late’90s	CIO	Knowledge of IT for competitive advantage Capable of relationship building between business leaders and IT <i>Project and Programme management</i>	Leadership capabilities Relationship management New technologies and application to business strategy <i>Business and Process change management</i>
Late’90s - Late ’00s	“hybrid” CIOs	Analytics, organizational design, Business infrastructure	<i>Information analytics</i> , IT strategy, business complexity, financial and risk management

Table 2: Evolution of Senior IT Management Attributes and Backgrounds

its membership. C-layer opportunities, whilst not exclusive to keynote addresses, sit comfortably alongside a balanced programme that caters for informal continuing professional development opportunities for CIOs as well as the lesser layers of institution’s organizational hierarchies.

7. ERAI - AN OVERVIEW

The recently established EUNIS Research and Analysis Initiative (ERAI) seeks to develop applied research activities whose output will answer the question "Where can a European Higher Education CIO or University leader find information about the use and trends of IT for the European Higher Education system?". These questions and associated answers, drawn from known experts within the EUNIS community, will provide an excellent archive as well as a further CPD opportunity to those wishing to hone their technical writing skills or to have a further source of information at their disposal. Its principal forms of information dissemination include the EJHEIT, reports generated by EUNIS Task Forces and commissioned Case Studies. Early issues of the eJournal will concentrate on publishing Congress papers based around themes, however the intention is also to produce trends within themes incorporating relevant historical and contextual information by analyzing data from the 21 Congresses. Collaborative opportunities afforded through EUNIS to its member institutions result in the availability of, for example, the sharing of reports associated with fellow organizations e.g. the UK's Joint Information Systems Committee (JISC) and the Universities and Colleges Information Systems Association (UCISA). A quick examination of EUNIS' web site reinforces the extent to which "collaboration and sharing" of applied research is ongoing.

Current ERAI activity has a focus on "supporting teaching and learning" (first issue of the journal in late 2014); management and cooperation, and the chief information officer (second issue of the journal in early 2015). Benchmarking methodologies and ongoing work at a national level in this area is a further active topic. As ERAI is in its infancy there is opportunity for the EUNIS community to advise and to shape its programme of activities. The contemporary nature of planned ERAI activities as well as the cross between Congress output and ERAI input to Congress programmes further facilitate and develop CPD services and resources.

8. TRENDS AND PLANS

First considering the data set upon which the paper is based, the type, completeness and range of variables available in the present dataset limits the analysis that can be achieved, especially in terms of a statistical investigation. For example, an author's choice of keywords will be based on their interpretation of the paper's content and may therefore vary from a reader's interpretation. Furthermore, the extent to which a paper addresses each keyword may range from, say, "limited" to "in-depth". Such constraints will understandably limit the analysis and also require to be factored into any interpretation of findings. Also, a superficial examination of keywords indicates considerable variability in the words used (Figure 1), suggesting this variable is inappropriate to employ in any detailed analysis. The absence of electronic forms of the full portfolio of papers presented at Congresses limits the extent to which a complementary form of textual analysis can be undertaken, which would further develop the superficial findings now being reported.

Secondly, ideally as part of ERAI's work plan, is the need to consider complementary approaches to data acquisition and in a context of research that is considered invaluable to the EUNIS community. Typically, referring to the ERAI web pages, are opportunities to conduct focused surveys, to conduct Case Studies and to undertake interviews with expert persons in selected fields of research interest.

Returning to further investigations based on the Congress-related data some additional general trends are presented. As an elementary metric to assess the Congress participation rate, the ratio of "delegates to authors" is used, excluding those years for which the attendance data is unavailable. Clearly the metric does not accommodate other potential concomitant variables which may affect either delegate or author numbers or both, for example ease of travel to venue, overall cost to attend (as some European countries have significantly higher/lower cost of living rates than others) and "attendee institution's" interest in theme as well as their financial circumstances. The metric indicates an overall gradual decline for the period 1997 to 2014 (n=13), from "8+ to 3+". This decline represents a gradual increase in paper contributions relative to the overall attendance rate, which *may* be interpreted as "EUNIS is an event where formal delegate participation in paper presentation is actively encouraged" or it may be that "delegates view EUNIS Congresses as an ideal

forum in which to learn and socialize with persons holding similar interests". Either interpretation is consistent with CPD aspirations as well as with other objectives a delegate may have.

Examining trends in author participation patterns, the "top 5" authors (those associated with 10 or more papers recorded during the period covered by the data) represent "the Czech Republic (2 authors each with 10 papers), France (1 author with 10 papers), the UK (2 authors, one with 11 and the other with 12) and Poland where one author is represented 13 times. Apart from each author's specialist interests as indicated in keywords, little more can be stated about the papers contributed or whether there are factors associated with CPD or C-layer incorporated.

Returning to the "C-strata" focus and interpreting it as an interest in "leadership and management" contributions, the proportion of papers within this theme has been examined. The percentage of papers within the theme relative to all papers/themes varies from 15% to just over 40% and over the years there is a gradual upwards trend, though the year-on-year variation is possibly predicated on the specific range of topics sought by each year's Congress Programme Committee. The "top" contributing country for the theme is the UK which has provided the majority of papers in the category for 53% of the Congress' history, based on the 15-year period of records currently available. Spain (20%), Germany and Portugal (13%) have been the next most frequent "top" contributors. Interestingly, for the 15 years for which data is available, with the host country being the lead contributor for the theme one third of the time. Perhaps as has IT become more of a business enabler as opposed to a "technology issue or interest" one would expect such a trend. Runciman's (2015) and Strickland's (2011) research findings are interesting to reflect upon in this context.

9. CONCLUSIONS

The paper has sought to stimulate an interest in the development of EUNIS, first through a generalist review of its Congress presentations, and also by introducing the recently-established ERAI. With a specific interest in "continuing professional development" and "management and leadership" topics, the authors have attempted to identify aspects of EUNIS activities aligned to these topics. It is suggested, based on available data, that the EUNIS constituency is well served regarding a number of the attributes associated with CPD opportunities relevant to senior IT management and, furthermore, that these opportunities may be further matured through the conduct of focused applied research that will fall within the remit of the ERAI. Future Congresses are anticipated to continue to provide rich opportunities for the various activities within the sphere of interests associated with both CPD and management and leadership topics.

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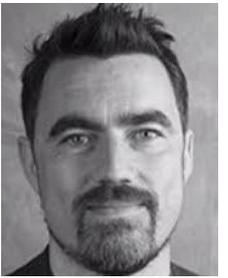
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11. ACKNOWLEDGEMENTS

The data gathering exercise associated with this paper has benefitted from that information that has remained on the various erstwhile EUNIS Congress web sites, including archived web pages. The authors formally acknowledge these historical sources as well as other contributions, direct or indirect, that have resulted in the current state of completeness of the data.

12. AUTHORS' BIOGRAPHIES

	<p>Noel Wilson holds a Masters degree in Mathematics from Ulster University. He is a Chartered IT Professional and a Fellow of the British Computer Society. In December 2013 he decided to retire early from a 41-year career in the HE sector. He was last employed by Ulster University as their Head of ICT Customer Services. Throughout his career he held various management positions associated with customer-facing aspects of IT service provision. In July 2005 the University awarded him a Distinguished Learning Support Fellowship for his contributions to IT and media service developments. His LinkedIn reference is: http://www.linkedin.com/pub/noel-wilson/15/476/91a</p>
	<p>Johan Bergström manages the EUNIS ERAI project and is employed as a Project Manager and International Business Co-ordinator in the University of Umeå. He graduated from Upsalla University with a Bachelors degree in Computer Science and Linguistics, following which he has held various positions in industry and higher education. Johan's expertise includes project management, consulting, business analysis, coaching and training. His LinkedIn reference is: https://www.linkedin.com/profile/in/johanbergstrom?</p>

EUNIS 2015: Camera-ready template for Extended Abstract

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...

Keywords

Digital capabilities, digital literacies, information literacies, media literacies, strategy, BYO

1. Summary

The extended abstract should contain a short summary subsequently used in the program. It contains enough information for the readers to become acquainted with the extended abstract without reading it. The summary should not include tables, figures or illustrations.

The UCISA User Skills Group conducted a survey during August and September 2014 on how UK higher education (HE) institutions are developing and supporting staff and student digital capabilities. A total of 156 HE institutions in the UK and Ireland were invited to respond via an online questionnaire containing quantitative and qualitative questions. Sixty three responses were received; a response rate of 41%.

Digital capabilities were defined as *those that fit an individual for living, learning and working in a digital society*. This definition also includes the infrastructure and digital environment in which individuals live and work, and a range of other capabilities including information literacy, digital professionalism, ICT skills, digital scholarship and electronic collaboration and communication.

This presentation will summarise some of the key findings from the survey in the following areas: strategy, delivery, implementation and practice, bring your own, differentiation and inclusion, looking to the future. This presentation also provides recommendations to the sector.

2. EXTENDED ABSTRACT

UCISA DIGITAL CAPABILITIES SURVEY 2014 - RESULTS

The UCISA User Skills Group conducted a survey during August and September 2014 on how UK higher education (HE) institutions are developing and supporting staff and student digital capabilities. A total of 156 HE institutions in the UK and Ireland were invited to respond via an online questionnaire containing quantitative and qualitative questions. Sixty three responses were received; a response rate of 41%.

Digital capabilities are *those that fit an individual for living, learning and working in a digital society*. This definition also includes the infrastructure and digital environment in which individuals live and work, and a range of other capabilities including information literacy, digital professionalism, ICT skills, digital scholarship and electronic collaboration and communication.

be by far the most progressive, most often making use of new communication methods such as Twitter, social media and videos, in addition to established communications channels.

Section 4: Supporting Bring Your Own

Easy and secure access to campus networks seemed to be largely available across the sector, but challenges remain around the flexibility of space and furniture, the provision of power to both permanently installed hardware and the use of personal devices (BYOD), wifi saturation and bandwidth, accessible wifi printing, and the support provided to users.

Section 5: Supporting differentiation and inclusion

Some institutions indicated that all their teaching, research, institution and system websites are device friendly, but where institutions still need to implement device friendly sites, most are prioritising institution websites over others. Strategies for providing open research content were more developed than those for teaching content.

Documents and software for students were generally more accessible and inclusive than those for staff, but it may be that software and platform suppliers limit control over this.

Nearly as many institutions were working towards accessible and inclusive guidelines for the release of student created digital materials as were not. This is fraught with difficulties which may be difficult to resolve.

Section 6: Looking to the future

Institutions overall seemed relatively positive about their ability to develop students and staff digital capabilities over the next two years. However, the most significant barriers for future development of student digital capabilities were felt to be lack of money, department culture, competing strategic initiatives and institutional culture. The most significant barriers for future development of staff digital capabilities included competing strategic initiatives, institutional culture, lack of money, and department culture.

Key initiatives being implemented, scoped or investigated in the next two years included developments and reviews of teaching and learning systems, and a range of digital literacy related projects. Infrastructure and training and development projects were also frequently identified.

The most important departments for effecting change included IT services, Academic development/Learning Technologies, and the library, with most institutions citing between one and eight different services, departments or groups. A small minority of institutions listed job titles or units that specifically feature digital literacy. It will be necessary to involve academic staff and students in this development too; working together effectively within institutions and across the sector will continue to be beneficial and essential for driving this agenda of change.

Section 7: Concluding remarks

Keeping pace with the pressures arising from the rapid development of technology requires innovative responses. Clearer descriptions of skills and competencies required for roles and disciplines will help frame and focus activities and provide motivation and direction for culture change, employability and competitiveness.

More information

The full survey and executive summary can be found online at www.ucisa.ac.uk/digcap.

3. AUTHORS' BIOGRAPHIES



Gillian Fielding is Chair of the UCISA User Skills Group, a national body of universities and colleges involved with providing staff and student training in digital skills/literacies.

Gillian's day job is the Digital Skills Manager at the University of Salford, Gillian is also module leader on the PGCAP module, Flexible, Distance and Online Learning. The Digital Skills team provide training and support in a wide-range of learning technologies and digital literacies such as Blackboard, Turnitin, learning technologies, MS Office, AV equipment, etc.

Previously Gillian has been a lecturer in further education and has held institutional-wide roles managing the implementation of learning technologies. Gillian an early FERL ILT Champion.

Gillian has presented at conferences nationally and internationally: Blackboard World, Solstice, CLTR, LILAC, UCISA, JISC.

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Rebecca McCready is the Learning and Teaching Advisor in the Faculty of Medical Sciences at Newcastle University and has been in post delivering IT and digital skills teaching and support to undergraduate and postgraduate students for the last ten years. This role has also seen her involved in the development and delivery of an innovative assistive technology loans scheme for all, a novel software program which analysis and provides assessment and feedback on document formatting, and other institutional-wide projects relating to digital literacy and IT facilities development. Rebecca has completed a PG Certificate in Academic Practice, is a Fellow of the Higher Education Academy since 2005, and has been a member of the UCISA User Skills Group since 2013. She has presented at local and national conferences including ALT-C, and published in a variety of journals including PESTLHE and ALT-N. Her interests lie in innovation in teaching technologies and methodologies, usability and accessibility, and the development of the digital capabilities agenda.

CIOs at German Universities – a Survey by ZKI

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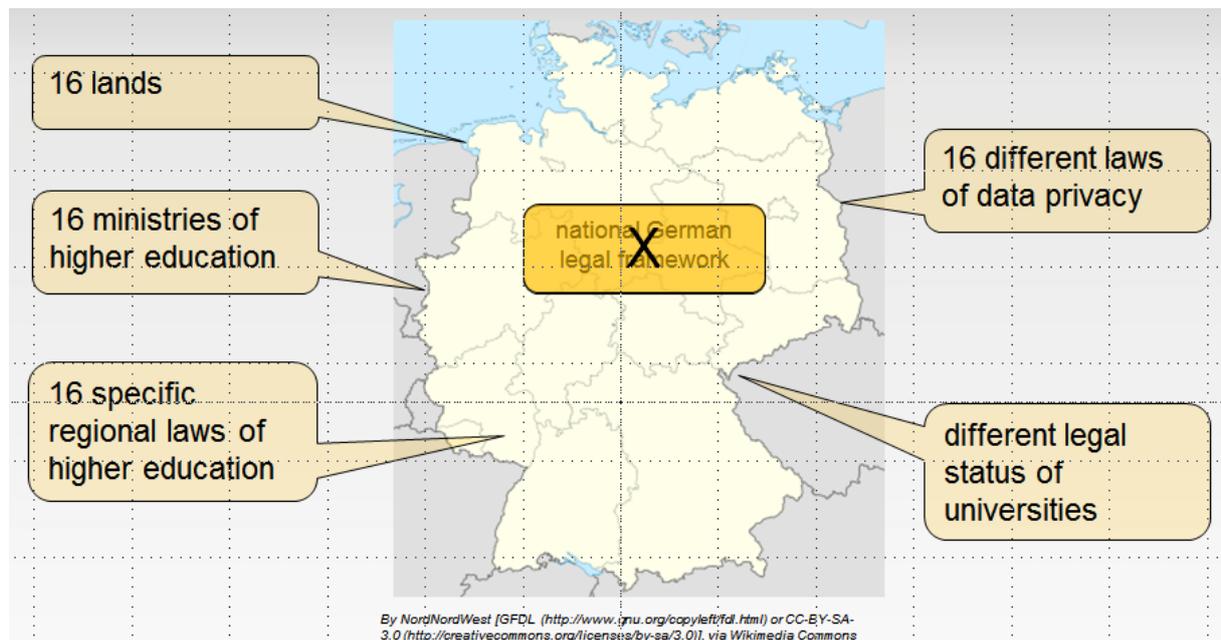
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The ZKI e.V. (Zentren für Kommunikation und Informationsverarbeitung in Forschung und Lehre, centers for communication and information processing in research and HE) is the German consortium of HE IT service and public funded research centers. Members of ZKI are universities, universities of applied sciences and big research facilities with public funding, represented by the directors of the IT-centers as well as companies with a high interest in HE IT. ZKI was founded in 1994.

Since 2001 the rectors' conference [HRK13], the „Deutsche Forschungsgemeinschaft“ (DFG, German research foundation) in [DFG01, DFG 06, DFG10], the ZKI [ZKI03, ZKI08, ZKI12] and others [vdH08, Fer09, Gör11] recommended to establish a general manager for the ICT at universities called Chief Information Officer (CIO). Between 2005 and 2010 some of the German ministries of higher education (Germany has a different ministry of HE in each of the 16 lands) requested the designation of a university CIO.



In 2014 the ZKI planned to review these recommendations:

- How was the CIO-concept transformed into practice?
- What is good practice?
- Is it possible to measure whether the CIO's work is successful or not?

What is a CIO?

German DFG specifies four different „types“ of CIOs (see [DFG01]):

- CIO as a member of the executive committee with strategic tasks
- CIO allocated to executive committee with strategic tasks
- CIO with operative tasks, such as a director of an IT-service center
- a CIO-panel

Blueprint for the CIO's of the universities was the way industrial enterprises establishes a powerful IT-Governance headed by a CIO in the early 1990ies. The assumption was that CIOs are responsible for or at least part of all decisions concerning IT within an organization. Only rarely all powers are transferred to a CIO at universities, we only found four examples in our survey.

A CIO should have the decision-making authority or be at least part of the decision making for most of the IT-domains even in non-profit organizations or government bodies [Wei04, Chapter 7]:

- IT principles
- infrastructure strategy
- IT architecture
- business applications
- IT priorities and investment

Within the survey we included all persons which are publicly documented as "CIO".

The ZKI-survey

Looking for CIOs at German universities, we examined official announcements of universities like the websites. Unofficial or unpublished structures within the university were not part of this survey. We contacted everyone mentioned as CIO asking to participate in the ZKI-survey by 60 to 120 minutes interviews via phone. The managing board of ZKI and Markus von der Heyde, who had been appointed to render the survey, prepared a list of questions.

Interview guidelines:

- IT-Governance
 - CIO-model
 - self-concept
 - effectivity of CIO implementation
- inauguration of a CIO
 - reasons for implementing a CIO
 - changes and activities
 - operative criteria
 - challenges
 - recommendation
- strategy
 - institutional strategy
 - contents
 - CIO's input to strategy
 - cooperation between HE institutions
 - research and synergies

- IT costs
 - awareness
 - trend
- communication
 - standard communication channels
 - external networking
- concepts in decision making
 - transparency
 - handling of decisions / CIO's role
 - what would have failed without a CIO
 - awareness of IT-domains
- awareness of IT
- future development of CIO (implementation)

Markus von der Heyde also did the complete analysis and offered basic interpretations. Ulrich Lang, Martin Wimmer and Hartmut Hotzel, being representatives of ZKI, interpreted the results.

Results

Most of the German HE institutions did not yet implement the recommendations of DFG, ZKI and others. The ZKI-survey did not involve questions like „why not“, since only CIOs participated. However, the different HE types show a very distinct pattern, indicating that universities are further on the track of implementation (see Table 1).

type of HE institution	owned by churches	private schools	government funded	total sum
universities of applied science	22	97 (0 of 1)	104 (6 of 14)	223 (6 of 15)
art and music colleges	8	3	46	57
universities	11	12	88 (22 of 41)	111 (22 of 41)
total sums	41	112 (0 of 1)	238 (28 of 55)	391 (28 of 56)

Table 1: HE institutions in Germany (from HRK-compass). The number of participating institutions is given in brackets; first, the number of participants and second the total number of known institutions with a CIO in the specific category.

Types of CIOs

Only 16 out of 28 CIOs correspond to the four types of CIO described by [DFG01]. The other 12 do not correspond and often present a mix of types.

- CIOs as a member of an executive committee with strategic tasks:
 - Only three CIOs are responsible for decisions in IT-domains.
 - Four are vice presidents for administration (US: provost, Germany: Kanzler).
 - All these CIOs assigned the interviews to the directors of their IT-centers.
- CIOs allocated to executive committees with strategic tasks:
 - Four CIOs are allocated to executive committee.

There are also seven CIOs with a professorship and part-time CIO tasks.

Two CIOs are chairmen of a CIO-panel (see below).

- CIOs with operative tasks:
Nine CIOs are directors of an IT-unit (IT-center).
- CIO-panel:
Eight universities established a CIO-panel, but all of these are missing the essential parts of the recommendations, because they are not held responsible of any decisions.

Relationship between CIO and director of the IT service center

In nearly every university there is an IT service center providing ICT services for the university. The head of this institution may be called "director of the IT service center", "head of the computing center" or similar. The person managing the ICT unit of a university is in our context called "director IT".

number of universities	hierarchical relationship between CIO and director IT			sum
	equals*	subordinate*	one person*	
type of CIO				
CIO panel	2		6	8
individual CIO	7	7	6	20
sum	9	7	12	28

Table 2: Hierarchical relationship and type of CIO

* Additional definitions of terms:

equals CIO and director IT are on the same level

subordinate the director IT is subordinate to the CIO

one person CIO and director IT are one person.

Individual CIO vs. CIO panel

We asked what percentage of a full time equivalent (FTE) is spent for CIO tasks. There are noteworthy differences

CIO	number of universities	average time (FTE) for CIO tasks	average time (FTE) for CIO tasks of the participants
CIO panel	8	0.26	0.13
individual CIO	20	1.03	0.53
statistical test *		25.5	16.5
sum / average	28	0.81	0.41

Table 3: Labor Intensity for CIO tasks

The interviewed CIOs who are members of a CIO panel only spend 13% of a full time equivalent for CIO-tasks. The sum of FTE for all members of a CIO panel also is about ¼ FTE. Individual CIOs spend more the 50% of a FTE for CIO tasks. The value of 1.03 FTE means that on average more than one person is working on CIO tasks.

* A word about statistics

As there were only 28 participants in this survey, we had to be very careful with statistics. We applied for all tests the Wilcoxon-Mann-Whitney rank-sum test (U-test), which does not require a minimum number of participants or a Gaussian distribution of the entity.

The test shows for example in the table above that there is a significant difference between the percentages of FTE for an individual CIO compared to a CIO panel.

We applied this test successfully to all reported differences in this paper (with an error rate below 5%) but prefer for simplicity to present the absolute values. More statistical results are provided in the study itself [ZKI14].

Reporting

To whom does the CIO report? The person or the board to whom reports are addressed is often responsible for decisions about IT topics.

For further differentiation we used an additional approach to classify CIO's role referring to the role within the university:

research CIO is a part of the research staff of the university
 director IT CIO is the IT director of the central IT service unit
 staff position CIO is attached to the executive committee (German: Stabsstelle).

Most CIOs report to a board of directors i.e. executive committee.

CIO's organizational role	report addressed to				sum
	no report	vice president	president / rector	executive committee	
Research	2	1	3	5	11
director IT			1	12	13
staff position		1	2	1	4
sum	2	2	6	18	28

Table 4: Addressee of CIO's reports in relation to CIO's organizational role

Universities vs. Universities of Applied Sciences

There are only few differences between CIOs at research oriented universities and CIOs at universities of applied sciences. The universities had established a CIO on an average 6.86 years ago, universities of applied sciences only 3.67 years ago. On average, universities of applied sciences started about three years later to implement CIO structures.

Research oriented universities more often (82%) defined CIOs tasks in written form, but only 17% of the universities of applied sciences did so.

Other Criteria

Comparing “big” and “small” universities, i.e. dividing the participating universities in half (14 with more and 14 with less students), there are only few differences. “Big” universities bear larger costs and on the other hand have more absolute third party funds. Whether a CIO is a full time CIO or a part time CIO does not correlate with the size of the university. There is no evidence that only a “big” university can afford a CIO.

There is even no evidence that a professorship or a PhD is useful for a CIO. There is no evidence that the gender of a CIO is of any effect.

Further there is no evidence that a CIO should be part of the executive committee or should even attend the meetings of the executive committee. The DFG stressed the importance of a steady exchange of information between the CIO and the executive committee. This essential factor was also emphasized by participants in the survey but not evaluated statistically.

Effectiveness of CIO’s Work

It is very hard to find any measure for the effectiveness of a CIO’s work. Many of the participants in this survey were skeptical and did not suggest useful indicators.

Looking for possible indicators within the data of this survey we found that universities with a CIO structure in place that allowed for a better visibility of the IT personal across the institutions also had on average a 9% higher ratio of third party funds. There is an ongoing discussion among the authors whether this might be an indicator. An alternative explanation is that these institutions may have developed a high skill in focusing on the right decisions – and therefore have both: a different CIO structure and more research funds.

We also tried to analyze whether there is a correlation between the authority to decide and a resulting effectiveness:

CIO and director of IT center	Number of universities	FTE of CIO for CIO’s tasks	Sum of all FTE for CIO’s tasks	CIO’s authority to decide about IT domains
one person	12	0.27	0.46	0.00
hierarchical equal or subordinate	16	0.53	1.08	2.50
Sum	28			

Table 5: CIO’s authority to decide

ZKI and DFG claimed to delegate the decision making authority directly to the CIO. Wherever the director IT holds the role of the CIO, the university never granted the CIO the authority to decide about IT domains. That means the executive committee is responsible for decisions of all IT domains. The other CIOs have the authority to decide on average for half of the IT domains defined by Weill and Ross [Wei04].

Decision making authority and hierarchy

The next table compares universities that gave decision making authority to the CIO at different levels. "None" means that the CIO has nothing to decide and primary is a consultant for the executive committee.

Responsibility for IT-domains	Number of universities	Hierarchy: director IT is subordinate to CIO	CIO with operational tasks
None	18	6%	67%
1-5	10	60%	10%
Sum	28		

Table 6: Number of it domains a CIO is responsible for, correlated to institutional hierarchy

Conclusion

The most striking result of the present survey is that nearly half (see Table 1) of all German research oriented universities implemented an official CIO structure, but they rarely implemented the recommendations of DFG, ZKI and others. The percentage of CIO structures within the universities of applied science is much lower.

One of us (Markus von der Heyde) who gave up the position of director IT to work as a freelancer is now working on a continuative study on CIOs at German universities.

There is a growing discussion within ZKI: Today most CIOs do not feel represented by ZKI – when ZKI was founded in 1994 there were no CIOs at German universities. The question is whether and how to include CIOs or other CxOs with IT strategic interest into the ZKI.

ZKI will continue discussing the "CIO topic" in summer 2015.

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Moving a Decentralized Public University to the Cloud

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Keywords

Cloud, Azure, Transition, Data center, Organization development, Legal

1. SUMMARY

A university is often tradition-bound and a much decentralized organization. General introduction of common cloud services and prevent shadow IT can be hard. At the same time staff and students demands a powerful IT-resource center for research and education. To meet the organizations requirements in a cost-efficient, legal way and deliver value to the University's main business the IT Office not only have the ambition to switch from on-premises IT system to ASP/SaaS, but to migrate our existing data centers to Microsoft's cloud service Azure. This paper and the oral presentation will explain Different aspects we must consider before, during and after the decommissioning of local data center.

2. BACKGROUND

For the last years, cloud services and servers have become normality both for companies and for private users. For public sector the reality is a bit more challenging. Most countries within EU tightens the regulations regarding cloud services, especially if they contain personal information and the service provider is located outside EU. Procurement of cloud service could therefore take quite some time, if possible at all. However, legal issues usually doesn't affect the business's expectations and demands of using services they feel are necessary for their work. Besides usage of cloud services there are also requirements that the IT Office can provide cost-efficient resources on-demand that can scale up or down depending of the current need and of course the availability of the service should be close to 100%.

Meeting the demands with limited budget cause new way of thinking. Can it be possible to make all services and servers available in the cloud? What do we need to consider with a vision saying all services should be ASP/SaaS or, when such service is not available, shall be running in a cloud data center?

Economically the calculation looks interesting. Umea University has 300 servers for test and development, normally running 24/7/365. Cloud servers are slightly cheaper and by running those on a need basis, office hours, the savings can be as much as 75%. Other incitements for cloud data centers are better SLA and reliability and easy scalability for the 500 production servers.

Moving to only cloud services and cloud data centers is a major impact to the local technicians and their traditional way of working. Changing culture takes time and requires a strong leadership, but it's necessary since it's too expensive and time consuming trying to keep pace with huge cloud data center vendors. The local technicians has to face a new role, more brokers of cloud services than hosts.

3. THE MOVE

The plan to realize the move to Azure is divided into four steps.

1. Move the entire test and development infrastructure to the cloud
 - a. Create a complete production-like test environment
 - b. Feed information from test source systems, verify all integration workflows with our integration platform BizTalk as well as all (most) target systems
2. Establish a third data center in the cloud, as illustrated in Figure 1.

- a. When we see that the test environment is up and running and we have gained experience working with cloud we create a third data center
- b. One primary and two secondary data centers with the same replication data
3. Decommissioning the secondary on-premises data center within 2-3 year
4. Investigate and move the primary data center to the cloud
 - a. Possible in combination with local data center provider for critical systems

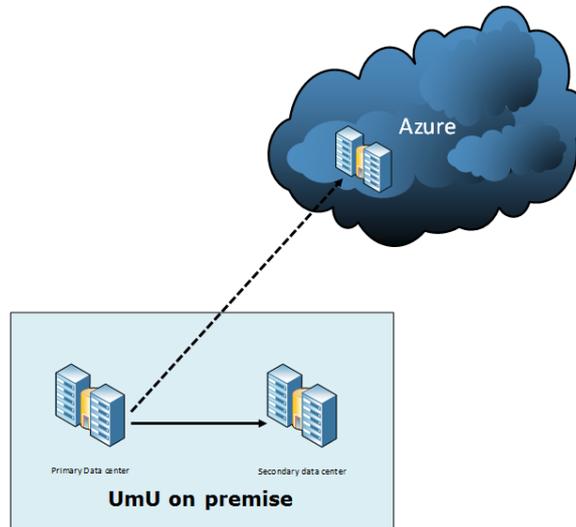


Figure 1 Migration of on-prem data center to the cloud

4. THINGS TO CONSIDER IN THE CLOUD

Cloud data centers requires thorough planning and a safety first approach. The list of things to consider is long and will be explained during the oral presentation. Some key aspects include exit strategy, support from Microsoft, integration between systems and risk management.

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6. AUTHORS' BIOGRAPHIES



M. Wallmark graduated Umeå University, Sweden in 2005 with Master's degree in informatics with additional studies in business economics. He joined the IT Office at Umeå University in 2009 as IT Coordinator. His main responsibility is technical maintenance management within the areas Identity management, Learning Management, Content Management and Collaboration Environments. Between 2006 and 2009, he was Quality coordinator/auditor and implemented a quality management system certified for ISO 9001:2000 and 9001:2008.



S. Berglund is CIO for Umea University since 2009. He has a degree in Computer Science and Business, University of Umea, 1978. After university studies, employed as System Analyst and Designer for business information systems. Returned to Umea University for doctoral studies and teaching in Informatics with special focus in System Design and System Development. He has been a Project Manager for several national projects. He has been Head of the Ladok

Division at the University of Umea, a large unit specialized in system development and maintenance.

Building Service Platforms using OpenStack and CEPH: A University Cloud at Humboldt University

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Keywords

OpenStack, CEPH, Cloud Platforms, IaaS, PaaS, XaaS

1. ABSTRACT

For providing Infrastructure as a Service to the institutes, OpenStack was selected as a platform at the Computer and Media Service of Humboldt University. CEPH was chosen as the storage backend within this platform. The paper describes the project and first results. An overview to OpenStack is given and the results of initial CEPH performance tests are shown. The technical setup is depicted. Moving from traditional data center management to IaaS involves organizational changes as well as changes to service and business models. The first findings of this process are discussed and an outlook is provided.

2. Introduction

The Computer and Media Service at Humboldt University (HU) Berlin is the central IT service provider and data center for the HU. Within the institutes and other organizational units, de-centralized IT staff is responsible for the local IT; hence some services are provided in a wholesale and retail market model.

With around 120 services, the central resource capacity is utilized to a high degree and new services are requested at even increasing rates, while the IT budget remains static. For example, new tasks in the area of research data arise for data centers, requiring a high level of technical expertise and special domain knowledge. Currently, research data tools and related managing infrastructure are often developed in the context of fixed-term projects. Within these constraints, ensuring sustainability of software and information is difficult to manage. With around 430 professors from diverse scientific disciplines at HU, there is no apparent scalable solution to support these new tasks centrally. Besides other reasons, like organizational development and renewing the current technical infrastructure, it was decided to alleviate the burdens of operating the infrastructure for the institutes by building an Infrastructure as a Service (IaaS) environment. It is planned to extend this scenario towards Platform as a Service (PaaS) models successively to increase the amount of self service offerings.

After an evaluation of open source systems, OpenStack was chosen in January 2014, followed by workshops and staff training to build the first bigger testing environment. For cloud storage interfaces and scalability aspects, CEPH storage was decided to be integrated in the IaaS scenario. To support bootstrapping and knowledge building, a company with experience in OpenStack was closely involved. For dogfooding reasons, some new data center services currently in development will be based on the new IaaS architecture. It is planned to apply the same service patterns to more and more services in the next years, using "Anything as a Service" (XaaS) as a basic paradigm, also for organizational development.

To discuss the proper service models for the operation and extension of this cloud as well as establishing the user community, workshops have been held with HU institutes and two different funding models were identified.

3. The OpenStack Platform

OpenStack defines itself as "... a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter ..." (OpenStack: The Open Source Cloud Operating System) and many functionalities are similar to Amazon's AWS platform, even down to the level of APIs.

It consists of several modules or projects, addressing different aspects of the infrastructure, like virtual machine management, identity management, block storage, object storage, network abstraction, automation, bare metal deployment, user front end or specialized services for the management of databases, hadoop or redis as well as utilization metering or network function virtualization. (OpenStack Project Teams)

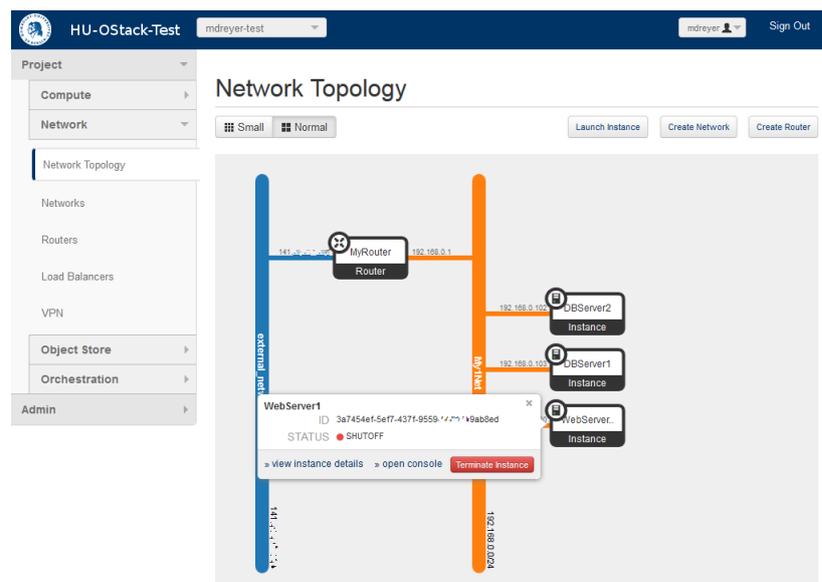


Figure 1. OpenStack dashboard user interface showing a tenant's network and resources

New projects are reviewed by the technical committee and evaluated for maturity which is expressed by the three statuses "Incubation", "Graduation to Integrated" or "First Integrated Release". (Openstack/governance)

Currently it has around two releases each year with the version name starting letters in alphabetic order and the name derived from a city or county near to the corresponding OpenStack design summit. Since its inception in 2010 by NASA and Rackspace, OpenStack has developed at impressive rates. The latest Juno release from November 2014 was built by around 3,000 developers affiliated to more than 200 organizations. Compared to the Havana release end of 2013 it tripled the amount of developers involved within one year (Bitergia's blog). The project is hosted by the OpenStack Foundation established end of 2012.

4. Hardware and Configuration

For the servers, standard hardware was used and we started with a minimal setup, yet providing sufficient initial performance:

The compute nodes are 4 x 16 Cores, each 128GB RAM, the controller nodes are 2 x 12 Cores, each 64GB RAM, for the CEPH server nodes 10 x 12 Cores, each 64G RAM with 5 TB net (16 TB gross) hard disk, 200GB SSD for CEPH journal and 3 CEPH monitor servers are used.

In order to simplify the installation of operating systems and software and to avoid problems, for instance with network latencies, the servers are currently operated in just one location. In a later

development stage, the setup will be deployed in two major locations at Berlin Mitte and Adlershof with a distance of over 25 kilometers (over 15.5 miles) between them.

The servers are connected redundantly to two Brocade switches (ICX7750-48) over 10G copper connectors (10GBase-T), which provide the necessary bandwidth for network communication. The preferred operating system is Ubuntu Server 14.04 LTS. Each CEPH server has two redundant connections to a hard disk array (Infortrend EonStor DS ESDS-S16F-G2840/R with 16 Hitachi SATA hard disks) over fiber channel. The staging area is much smaller: 2 compute nodes, 2 controller nodes, and 3 CEPH nodes including CEPH monitors.

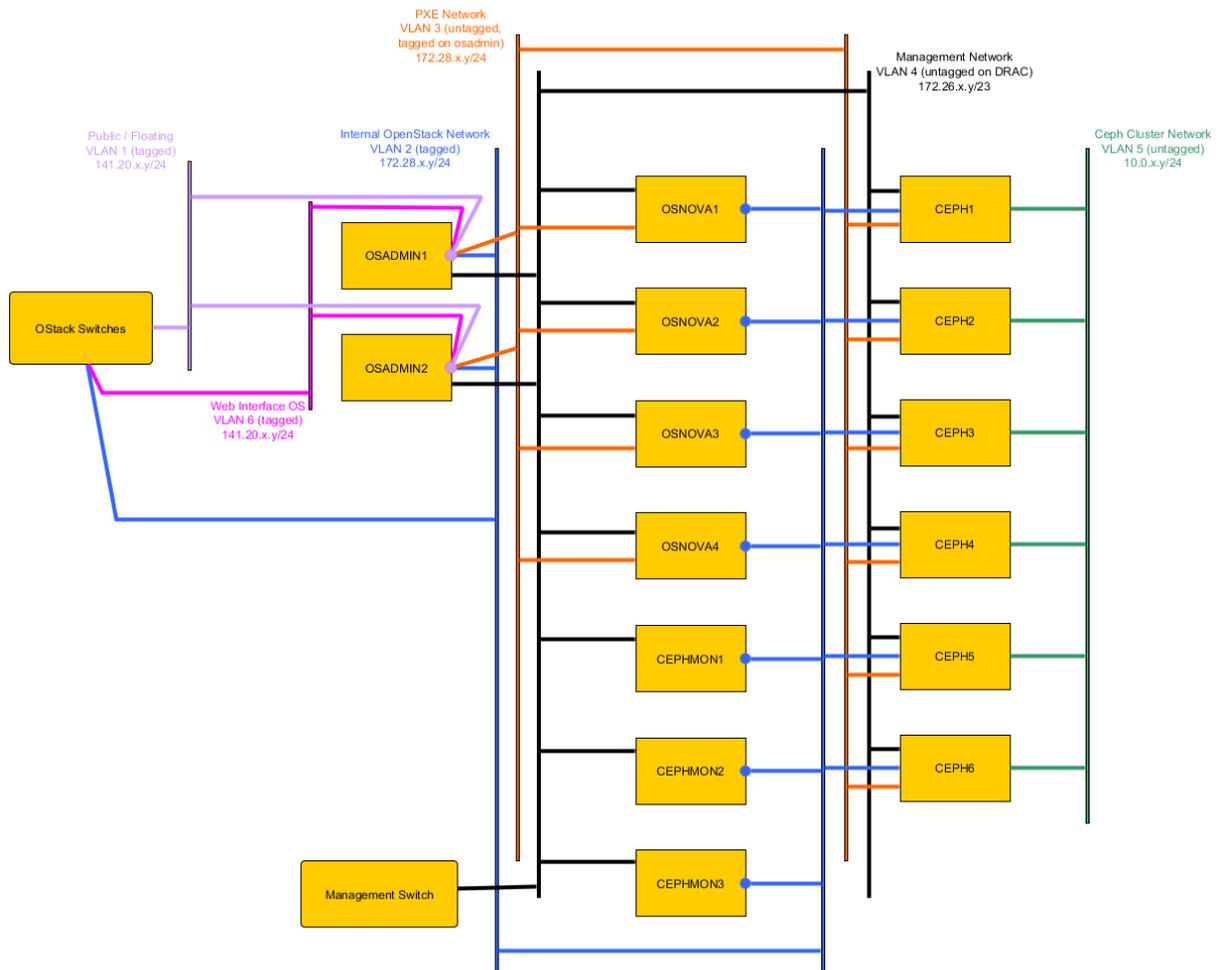


Figure 2. OpenStack physical testbed topology at HU

The OpenStack and CEPH roll-out was done with Ansible configuration management scripts initially provided by the involved company. The OpenStack platform was installed using all modules from the Icehouse release, but not all of them are enabled in the production environment. The compute nodes (Nova) using libvirt (KVM/QEMU) and the network management (Neutron) using VxLAN (SDN) and the Open vSwitch (OvS).

5. CEPH Storage

CEPH is a software defined storage solution that uses commodity hardware to scale horizontally. It is deployed as a volume storage backend to be used for e.g. object storage within OpenStack. Reliance and fault tolerance is achieved by storing multiple copies of objects on disks attached to different servers. Data placement is determined algorithmically instead of using a central map. This distributes

the load of locating objects over all clients, avoiding a central server (or cluster) which could be overloaded by numerous connections. The overall performance can be increased by adding additional object servers.

6. CEPH Performance

Performance tests were performed with VMs in OpenStack. Each VM had access to a 100 GB Cinder volume, which in turn corresponds to a RADOS block device in the CEPH cluster. Default settings are used; the volumes consist of 25600 4 MB objects and the data is striped over the physical drives in the CEPH cluster. The utility fio and direct access to the virtual disk device was used for benchmarks. The impact of multiple I/O streams was determined by runs with 1, 2, 4 and 8 identical VMs and identical I/O profiles.

Write performance was tested with sequential writes using 1 MB block size. In a single stream 295 MB/s are transferred, it profits from the performance of the SSD that store the write journals. The performance has almost reached saturation with 4 concurrent transfers a 514 MB/s (aggregated) and increases slightly to 537 MB/s with 8 transfers. Almost no difference is found for sequential writes with 1 MB and 32 KB block sizes. This can be attributed to the SSD journals and the data striping over all physical disks.

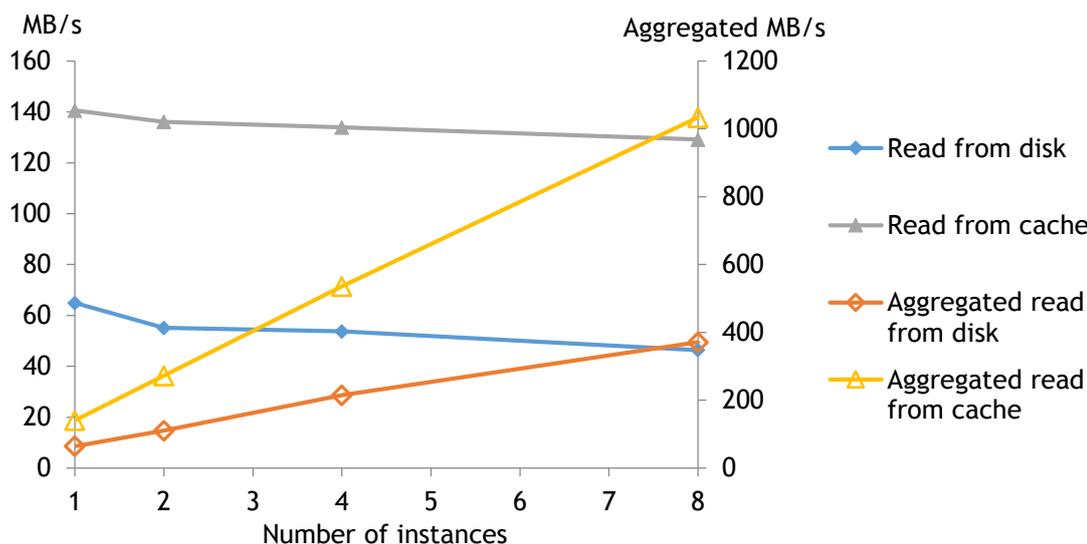


Figure 3. Read performance for sequential reads depending on number of instances.

Measurement of read performance turned out to be more difficult. Initially the results were not reproducible, due to caching effects. The objects are stored on the OSDs as files in an XFS file system and are cached in the RAM of the CEPH server after reading the object. Following reads on the object (which correspond to 4 MB chunks of the block device in the present case) access the RAM cache and no disk read occurs. The solution was to either drop the caches on all CEPH servers or reading the block devices to force the data into the cache before performing a benchmark run. In a single stream of sequential reads (32K blocks) 66 MB/s are transferred upon reading from disk and 144 MB/s with cached data. In both cases multiple streams lead to an almost linear increase. With 8 streams we find aggregated bandwidths of 380 MB/s (disk read) and 1058 MB/s (cached). The scale up suggests that saturation is not reached with 8 streams.

7. Conclusion and Outlook

Moving from traditional data center management to IaaS involves organizational changes, also effecting e.g. administrations techniques, networking and storage technologies as well as service and business models. Therefore the implementation of OpenStack can't be treated just as any other service to be newly introduced, which usually can be installed by applying existing knowledge and deploying services on top of the existing physical infrastructure one by one. As OpenStack means also a shift to software abstraction layers, many prior necessary tasks get obsolete - like for single service provisioning - and new ones arise - like the automating of deployment. For the HU Computer and Media Service, having separate groups for storage, networking, virtualization or databases, the implementation of IaaS can just be handled by incorporating the existing distributed knowledge of each group and developing the necessary knowledge and skills in each group simultaneously. Where managing techniques are changing, also new knowledge and new skills have to be built and incorporated into daily processes. Involving an external company for workshops, training and support helped to deal with the complexity of OpenStack and general acceptance.

After trying to deploy an OpenStack in OpenStack environment for staging purposes, another practical finding is, that a dedicated hardware environment is necessary as a staging area, because e.g. the network dependencies coming from the neutron component. It has to be close to the production setting in terms of hardware components.

After migrating to the Juno version of OpenStack, the cloud will be opened gradually to more and more users. It is expected, that the real usage examples will strongly influence the service attributes.

There are many new technologies to be understood and deployed in the context of OpenStack and IaaS. This is demanding much time and effort to master. Besides the technological challenges, OpenStack enables for very flexible service design. The huge developer community and the increasing number of projects for more services are promising, as long as the community model and community gardening are keeping pace with this growth.

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9. AUTHORS' BIOGRAPHIES



Malte Dreyer is the technical director of the Computer and Media Service of Humboldt University since 12/2012. He was the director of the department of research and development at Max Planck Society, Max Planck Digital Library for six years before. In this role he developed research and publication data infrastructure for the Max Planck Society's institutes, as well as many research tools. His interests now are in the field of scalable information management architectures and infrastructures in the intersection of organizational perspectives on ICT from data centers and information management organizations. He has a degree in computer engineering.



Jens Döbler has a PhD in Chemistry and worked for 6 years as a postdoc on theoretical chemistry. For the last 7 years he worked in the IT department of the HU-Berlin, focusing on storage and backup.



Daniel Rohde is the head of the department of System Software and Communications in the Computer and Media Service of Humboldt University. He has a degree in computer science and is working in the IT service center since 12 years with the major focuses on web server and web applications.

Field trial on the impact of enabling easy mobility on recognition of external studies (EMREX)

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Keywords

Learning mobility, student information systems, digital result exchange, European policy experimentations, recognition

1. BACKGROUND

According to a study performed by the Erasmus Student Network 2012 (ESN) involving 25 student unions, the biggest obstacle for student mobility, after financial support, is the lack of recognition. Another study, the PRIME2010 (ESN), reports that 19% of the HEIs said that the students fail to provide the necessary documentation. Currently the recognition of previous studies from another country requires a substantial amount of paper work from the student and also from the universities. Since no integrated IT-system for handling the process exists, most of this is manual work. One outcome of this labour intensive process is that in many cases the students do not get recognition for previous studies to the extent they are entitled to. Only 73% of students within the Erasmus programme received full recognition for their studies abroad. Partial recognition for certain parts of the studies was the case for 24% of the students and 3% did not gain any credits at all. Astonishing 21.6% of the students were asked to repeat parts of their courses upon return, and 3.6% had to repeat all their studies. It can be argued that the figures for free-movers are even worse.

This paper aims to present the objective for the EMREX project, the outcome (policy experimentation as well as the development and implementation of a technical solution), and the benefits.

2. THE OBJECTIVE

The EMREX project addresses the EU 2020 target that 20% of higher education students should be mobile during their studies. It also addresses similar national policy goals of the countries participating in the project. Furthermore the project is initiated because of fiscally strained national public resources that require more effective and efficient education systems and services supporting them. Academic recognition in higher education is seen as a challenge in learner mobility and also as a potential area for the improvement of a more efficient education system in general.

The EMREX field trial aims at testing new ways to make the administration of student mobility easier and thus promoting higher attainment level to student mobility in higher education and also encouraging more effective recognition of prior learning and avoiding overlapping studies. In the first phase the trial will be set up between Finland, Norway, Sweden, Denmark and Italy.

3. THE OUTCOME

The field trial will comprise the following activities:

- Developing the EMREX platform and connecting the national contact points in a network
- Implementing the EMREX platform at the selected universities
- Piloting EMREX by a selected groups of students
- Gathering data from the field trial via interviews, surveys, and university registries
- Evaluating the results of the field trial
- Promoting a wide-scale implementation of EMREX

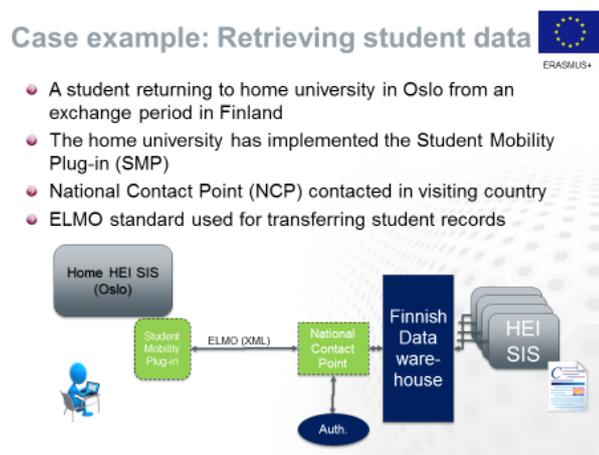


Figure 1: The Emrex concept with example

The tangible outcome of EMREX is a federated solution that supports the exchange of student data on achievements. The solution will be highly scalable and can thus easily be implemented in the whole European community. All institutions of higher education would be able to use the information from countries offering the functionality. The existence of this functionality would create an imperative to an institution to offer its own information to be visible also in the Europe-wide information exchange and hence enhance the recognition of external studies. Experiences from national solutions for exchanging student records and from other industries have proven that going from labour intense manual work to an automated e-tool both lowers the costs and increases the usage. This strongly suggests that EMREX will prove effective.

4. BENEFITS AND OPPORTUNITIES

The biggest benefit coming out of this policy project will be the increased availability, quality and reliability of information about student records of achievement information. This will make student mobility processes easier and faster and more transparent for students. Students will also benefit from the recognition of previous academic studies and degrees because of increased eligibility, when applying for studies in higher education. The universities will benefit from a reduction of manual work. The trial also supports the collection of measurable data on the rate of recognition that can then be analysed and used for improving the national policies on student mobility and rules for recognition of previous studies. The data will increase quality of the learning mobility statistics.

One of the goals and benefits of the trial is the peer learning of the authorities involved. The measure to support this particular goal will be making the results of the development process openly available through open source code. The up-scaling of the EMREX-platform will be provided by applying a decentralised management model: the higher education institutions in the European Community will be responsible for the operation and funding of their own part of the solution. The EMREX-platform will thus not be dependent on being coordinated by a central body or organisation nor on centralised funding either, which will secure its sustainability.

To date, a variety of initiatives have been launched with a view to simplifying the transparency and recognition of skills and qualifications across Europe. These include: The European Qualifications Framework, credit systems - ECTS and ECVET, and some quality assurance arrangements in higher education. The EMREX-platform completes the tools already in action by providing an integrated IT-system for handling the process of administration of student mobility. The solution will thus ensure quality, reliability and increased availability of the student achievement information.

Furthermore, the solution will ensure the quality of the achievement data exchanged between the European higher education institutions. As the credentials will be sent from one National Contact Point to another, the use of false diplomas within the HE-sector is expected to decrease. EU2020 identifies efficient recognition of credits gained abroad through effective quality assurance as one of the key policy issues for EU member states. Creating the EMREX working framework supports this goal. Also the "Strategic Framework for European Cooperation in Education and Training" (ET2020)

sets out expansion of mobility as one of the strategic objectives for the framework and addresses the need of progress in the implementation of lifelong learning strategies as well as the development of national qualifications frameworks linked to the European Qualifications Framework and more flexible learning pathways. The EMREX-tool contributes to this objective as well.

5. BIOGRAPHIES



Mats Lindstedt has a Master of Science in Business Strategy and International Marketing and a Licentiate in Applied Mathematics from the Helsinki University of Technology. He has over 15 years of experience from the ICT industry including program management and R&D development. Since 2012 he work for CSC Ltd in Finland and with developing support for student services. Previously he was the project manager for Tiptop, developing web based support for university students' personal study plans. Currently he is the project manager for the EMREX project.



Anders Bøgebjerg Hansen holds a master's degree in political science from the University of Copenhagen. He has worked with different student information systems at two universities and has 15 years of experience coordinating systems development on the customer side within higher education in Denmark. He is a special adviser at the IT Department of the Ministry of Higher Education and Science (UFM-IT) where he works with contract and project management with relation to the student information system STADS and the application system DANS. These systems are used at all 8 universities and several institutions of architecture and art in Denmark. Anders Bøgebjerg Hansen has been the project manager of many large EU tenders and has for several years been involved in Nordic forums in the area of student information systems.



Simone Ravaioli holds a Bachelor and Masters Degree in Management Information System from Loyola University Chicago. After a corporate experience in New York and Milano, he joins CINECA's group, the leading consortium of Italian Universities dedicated to developing software for HE. He currently holds the position of International Business Development and Country Manager Turkey. Simone is founding member of RS3G - an international group of HE implementers focusing on data exchange standards. He also represents RS3G in the European Standardization Committee (CEN). In 2010 he is appointed Chair of the first EAIE Task Force called DSDP - Digital Student Data Portability. Specialties: European Higher Education Area, Bologna Process, Standards in Higher Education, Internationalization of Higher Education, Software Development Processes, Public Speaking



Geir Vangen has more than 20 years experience in developing nationwide systems within higher education in Norway. At USIT, the University of Oslo University Center for Information Technology, he works as development manager for the student information system FS. Geir Vangen is also responsible for architecture and methods for the section within USIT that develops systems for student information (FS), research information (CRISTin), national admission (SO) and data warehouse. He participates in national and international standardization work, and has been a member of the groups developing the MLO and ELM-standards. He is a member of the steering committee of RS3G. He has been member of national committees appointed by the Ministry of Education and Research, and has lead projects on behalf of the Ministry. Geir Vangen graduated from University of Oslo, Institute of Informatics in 1989.



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The practicalities of transforming Abertay University's stand-alone systems into fully integrated and flexible systems

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Keywords

Information Systems, Stakeholder, Integration, fully-integrated, ERP

1. Summary

This paper will discuss the critical decisions, challenges and issues associated with transforming the University's Corporate Information Systems (CIS) from stand-alone systems into a suite of agile, fully integrated and flexible systems.

The paper covers our practical experience with the pre-procurement phase of the transformation project, including stakeholder engagement and challenges and issues encountered with developing specifications and balancing business requirements with functional requirements. This practical experience is reflected upon, from a standpoint of not disengaging critical stakeholders -that is producing a final specification that is acceptable to all stakeholders.

2. Introduction

In today's economic climate many institutions are reviewing their existing administrative systems to keep costs down and maintain their agility to thrive through business change. Abertay University requires significant investment in its corporate information systems, in order to meet the increasing demands and expectations of senior managers for effective business operations and services to students and staff.

- i. A number of shortcomings with our current systems have been identified, regarding data and particularly the lack of formal and consistent process of controlling the quality of the University data. These shortcomings were also outlined within a major programme of work that was undertaken recently on baselining the student journey (BSJ), which recommended "a major review of Corporate Information Systems (CIS)", as a solution for addressing the systems, processes and people issues stemming from the project.
- ii. Numerous stand-alone systems are being maintained to meet the University's administrative business needs. Considerable effort is spent to keep these systems synchronised. Additionally, the numerous "silos" of data and lack of integration across administrative systems inhibit the University's ability to provide timely and accurate management reporting at the enterprise level.
- iii. Furthermore, the underlying technology for many of the University's administrative systems is out-dated. Some of these systems are ten to seventeen years old. Aging systems are often difficult to modify as the on-going business needs of the users change over time. This also exposes the University to the risks of technical obsolescence and increased difficulty in retaining staff with appropriate knowledge of those systems.

The key objective of the Corporate Information Systems (CIS) Transformation Projects is to deploy a suite of agile, fully integrated and flexible business applications to meet the University's administrative business needs. The integrated flexible solution will provide enriched functionalities for business units, streamline the University's administrative business processes, eliminate

redundant data entry, improve data quality, reduce costs, and improve the efficiency and effectiveness of its business operations and services to students, staff and external stakeholders.

3. Literature review

The literature review for this paper was informed by the factors that are critical to the successful implementation of CIS transformation projects and, in particular, an Enterprise Resource Planning (ERP) project. The approach to identifying these critical success factors differs in the papers reviewed. Some researchers took a narrowly focused, but comprehensive approach (Nah et al., 2003), whilst the approach of some researchers was solely based on models of change (Boonstra, 2005; Melbye, 2011).

The outcomes of the research studies reviewed also differ in terms of the number of critical success factors identified for an ERP implementation. Botta-Genoulaz et al. (2005), on the basis of a case study, see a strong and committed leadership as the only necessary factor for a successful ERP implementation. Nah et al. (2003), in their analysis of a survey of Chief Information Officers (CIOs) from Fortune 1000 companies on the perceptions of the CIOs of the critical success factors in ERP implementation, found the five most critical factors identified by the CIOs were top management support, project champion, ERP teamwork and composition, project management, and change management programme and culture.

In a majority of the papers reviewed (Boonstra, 2005; Melbye, 2011; Nah et al., 2003; Botta-Genoulaz et al., 2005; Sarker and Lee, 2003; Ehie and Madsen, 2005; Motwani et al., 2005; Bingi et al., 1999), the success of ERP implementation is seen to be dependent on the strong, sustained commitment of top management. An in-depth review of all these papers suggest that there is convergence between the outcomes of all the research papers, as the critical success factors other than the strong and sustained commitment of top management flow from this singularly important factor. Therefore, it is not surprising that the number of critical success factors identified for an ERP implementation differ in the literature reviewed.

An outcome from the review of the literature is the importance of treating an ERP implementation as a change initiative, in order to realise the benefits of the ERP project for the organisation (Ehie and Madsen, 2005; Boonstra, 2005; Melbye, 2011). Melbye (2011) went further to argue that, for a successful implementation of ERP projects, the focus must not be too narrow and should be on all the important considerations of communications, training/workshops and process change. This view is further reinforced by Ehie and Madsen (2005) who said *“Organisations that realise full benefits of a technology are those that make necessary changes in their organisational structure, strategies and processes.”* The models of change approach to identifying the critical success factors for an ERP implementation suggests that people, processes and systems should be treated in a harmonious manner and the successful implementation of such a change requires:

- Effective communication of the change
- Commitment to change
- Change to the culture of people

As part of meeting the above-stated requirements, the authors have undertaken extensive stakeholder analysis. In doing so, the authors have used similar approaches to those in Jepsen and Eskerod (2008), McElroy and Mills (2003), and Graham and Gabriel (1996). The approaches used by the authors include:

- Identification of key stakeholders
- Characterisation of the stakeholders in relation to their needed contributions, their expectations as regards the rewards for their contributions, and their power as regards the project.
- Decision about the strategy used to influence each stakeholder and resolve proactively any conflicts.

The significantly new aspect of the stakeholder analysis undertaken in the research work reported in this paper is that concerning the practicalities of the proactive resolution of conflicts, as this is seen as an important part of effectively communicating the change and gaining the commitment of the stakeholders.

In the course of this specific literature review, only one relevant paper was found on the subject of success factors of an ERP implementation (Fowler and Gilfillan, 2003). It is not surprising that Fowler and Gilfillan (2003) commented "The deployment of ERP in universities is a relatively new phenomenon." and this might account for the dearth of information in this area of information systems implementation within universities.

In conclusion, the literature review has identified a gap in what constitutes the critical success factors for ERP implementation in universities and this paper should provide value to those charged with managing the implementation of ERP projects in universities and in the wider organisational context.

4. Progress to date and challenges

A 'business case and investment appraisal' proposal for an integrated system was submitted to a sub-committee of the University Court in December 2014. The proposal was approved in principle, to proceed to the next stage, subject to: the identification of 'core' systems to be included in the single integrated system; and the development and inclusion of options for the integration of systems.

A CIS Requirements Analysis project has commenced to aid the capturing of detailed requirements for our information systems and produce a detailed cost-benefit analysis for the relevant sub-committee of Abertay University Court at its May 2015 meeting.

Concerns have been raised about the tight timeline for completing the CIS Requirements Analysis project. In addition, there is concern that the various LEAN business process re-engineering and other business process activities that are needed to drive and influence our CIS requirements analysis might not be fully established before the commencement of the CIS implementation.

5. Next steps

The next steps are:

- Conduct workshops to gather corporate information systems requirements from stakeholders.
- Produce specifications of business, functional and technical requirements.
- Conduct options appraisal and detailed cost-benefit analysis.
- Align the output of the recent LEAN business process re-engineering to the CIS requirements.

The practicalities associated with some of these next steps will be reflected upon in this paper.

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AUTH Mobile - a university cross-platform mobile app

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Keywords

Development, hybrid app, HTML5, cross-platform

1. SUMMARY

The AUTH Mobile app puts Aristotle University of Thessaloniki in the palm of your hand. The project is part of a broader university-wide initiative in order to provide modern and high quality services to the community and to improve the mobile experience of students, faculty staff, as well as visitors. The project began in 2012 and is currently available as a “mobile app” for the major operating systems Android (Google Play), iOS (Apple iTunes) and also as a “web app” accessible through an ordinary desktop or smartphone web browser (<https://www.auth.gr/mobile>).

2. DEVELOPING THE AUTH MOBILE APPLICATION

With the currently increasing number of mobile platforms, developing mobile applications has become very difficult for Universities, as they need to develop the same applications for each target platform. Developing *native* [6] mobile applications imposes several constraints, such as the use of different development environments and technologies for each mobile platform, leading inevitably to a waste of development effort and rise of maintenance costs. The AUTH Mobile is a *hybrid* [6] app that has been developed entirely by Aristotle University using open-source development platforms aiming to combine the advantages of web and native apps in a single medium.

The application is primarily built using PhoneGap [4], Titanium [1], GWT (Google Web Toolkit) [2], HTML5 and JQuery [3] and provides information that ranges from public info to personalized services for logged-in users with SSO university accounts. The AUTH Mobile Android version is built using PhoneGap, the cross-platform development environment. The iOS version is built using Titanium (based on a common JavaScript source code pool) due to Apple’s reluctance to accept the initial version considering it as a simple web clippings content aggregator. Personalized services are implemented using Google’s GWT framework, while authorization is implemented using Shibboleth [5] a widely deployed federated open source identity solution.

2.1. Functionality

When it comes to information available publicly, visitors can search for faculty and staff contact info, view announcements, maps (**Figure 1**), building locations/photos and other important University services and Department-specific data.

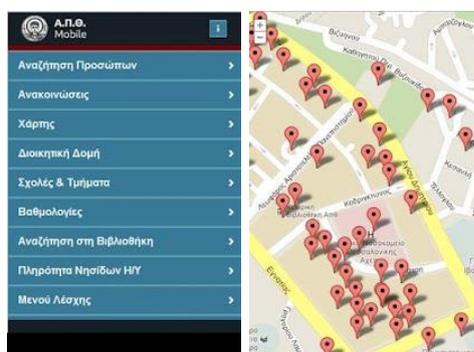


Figure 1. Intro and map page of the AUTH Mobile app

The most recent version of the application also delivers personalized information for students and faculty members. Logged-in students have access to their courses, syllabus and grades, while faculty members can view information about their classes, registered students and also mass-mail entire classes or individual students, without revealing sensitive student mail addresses.

2.2. Deploying the mobile app

Currently the mobile application is available on Google Play (6.5K current installs and a total 13.5 downloads by Feb, 5 2015) and on iTunes app store (7.9K current installs) as shown on **Figure 2**.



Figure 2. Android current installs by device and iOS unit report by Feb 10, 2015

3. FUTURE WORK

Further development is already under way, along the axes of developing a custom personalized app for AUTH community members. It will employ authorization of devices by means of OAuth, personal calendar for students and faculty and live notifications of course schedule changes.

4. CONCLUSIONS

The implementation of smart-phone applications that can deliver instant access to University data is extremely important. In order to keep improving the mobile experience of users, Aristotle University developed the AUTH Mobile as a hybrid app for the major mobile platforms. Its popularity among students proves all development efforts were worthwhile.

The implementation of hybrid apps seems to be a promising way to build generic in nature University apps, supported by open source tools.

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6. AUTHORS' BIOGRAPHIES



Spyros Xanthopoulos holds a Master's degree in Information Systems Science from the University of Macedonia and an Engineer's degree in Computer Software Engineering from University of Patras. He works as a programmer at Aristotle University of Thessaloniki and he also has extensive work experience in the software industry.

EUNIS 2015: ID POINT – USER IDENTIFICATION

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Keywords

ID Point, authentication, identification, service model

1. ABSTRACT

ID Point is service model that meets Finland's strict law requirements regarding user information management as well enables the use of services that would require strong authentication without any or just minor changes of the service itself. Updated information from ID Point-service model that was presented in Eunis 2014.

2. INTRODUCING

The University of Helsinki is an academic community of 40,000 students and staff members. It operates at four campuses in Helsinki and at 15 other locations. For users the IT Centre provides common IT services like helpdesk, local IT support, IT specialists and IT infrastructure (network connections, user accounts, PC's, servers, data bases, etc.).

The ID Point is a service model that enables the use of services that would require authentication without any or just minor changes of the service itself.

3. STARTING POINT

The Helpdesk of IT Centre provides wide range of IT support by email or phone for all users and it is open each weekday from 8 to 17. Helpdesk does not provide opportunity for personal visit. The main limitation for the helpdesk service earlier was that users couldn't be identified adequately before delivering the service.

The user account management system of the university had been developed during a long time period of over two decades. It is composed of multiple systems and therefore it is rather complex to use without expertise and good IT skills. Therefore it was not possible to share the user account management workload outside IT Centre even on remote sites.

During the past several years, we had already made changes on technology and services that decreased user visits at local service points i.e. just few visitors per day. For this reason we have now closed local service points at most campuses. At the same time we gained more calls to helpdesk where user needed be identified before delivering the service. Users preferred to call to helpdesk instead of walking to the nearest local service point while they still existed.

The IT strategy of the university is aiming at developing efficient, equal and centralized IT services for all users. University's research stations are located in 15 different places all over Finland. None of these places have local service. Therefore changes were required in services, service delivery model and staff reallocation to support the strategy. The ratio between local IT services and centralized IT services had changed from 90:10 to 60:40.

Finland has one of the strictest laws regarding user identification management in Europe. The ID Point was created to meet both law requirements as well to aid Helpdesk's identification problem. You could say that user's behaviour shaped our way to provide service from Helpdesk, ID Point was the tool to make this possible.

4. WHY ID POINT?

There is several ways to solve identification problem, so why ID Point? I will go through few examples that could compete with ID Point and show the benefit`

4.1. Vetuma

In Finland there is widely used and electronic authentication system for public sector called VETUMA. With this system users can be authenticated to a service using strong authentication methods e.g. Finnish bank credentials or a police-issued electronic ID card. From the legal point of view VETUMA authentication is as reliable as identification in person from documents.

For most user authentication cases this is a suitable choice, but it has some limitations. For example any foreign employee or students do not have VETUMA possibility. Also bank credentials can be co-owned (i.e. married couples) and there for they cannot be used as VETUMA authentication. The latest downside on this widely used authentication system is that each authentication will create a small cost for university.

4.2. Electronic identification card

Electronic authentication cards are reasonable secure way to authenticate user. There are several variations of this service model, but each has common the starting costs. To have electronic authentication cards in usage, you need both electronic cards as well readers. Also you should be able to maintain and possible to block some card's usage i.e. card been lost or pure misuse of it. This requires personnel to maintain the electronic authentication system at the server as well user end. On research stations where is no local IT support this can become an issue. Also the cost of replace the lost or broken electronic cards. In our case this never was a real option due the start and maintenance costs it will create.

4.3. ID Point

The ID Point we simply used already existing staff and environment. Each main campus has campus libraries where we could provide ID Point identification service. On research stations we found one or two trusted person who's been trained to do identification users when it is needed. We didn't need to invest on any sites since all had already network connections as well computers with they could connect on ID Point system.

Since ID Point system on its simplicity is surprisingly secure we can provide service from Helpdesk that requires strong authentication. Even if user loses his identification code the chance it being miss used is extreme low, course the code does not hold any information whose code it is. There for Helpdesk does always check both code as well the name and see if they match what system provides.

5. ID POINT SERVICE

ID Point service consists of three components: ID Point service desk, ID Point system and Service provider. More detail can be found ID Point service model in Eunis 2014 presentation. The setup of Helsinki University's ID Point service model is described in fig 1.

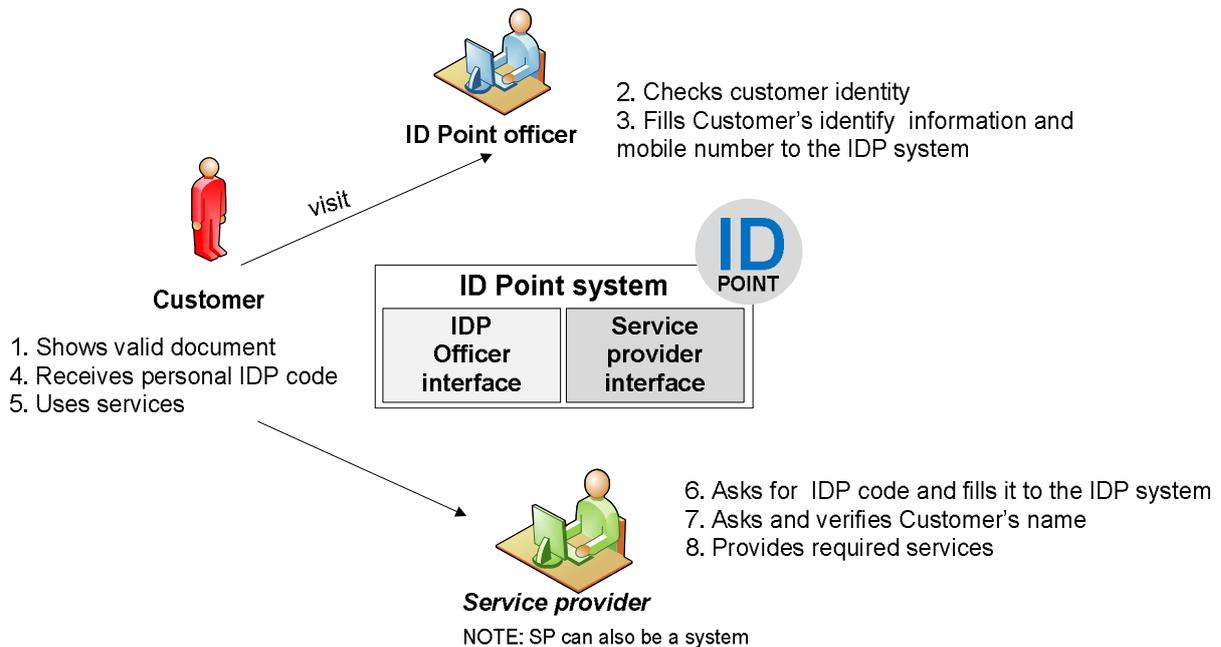


Fig. 1. The ID Point service setup in the University of Helsinki.

The ID Point service desk takes care of user identification. The ID Point officer checks user's identity from a valid document and feeds the required information to the ID Point system. Collected information is firstnames, surname, date of birth, social security number (for those who have one), document type and the author. Only optional information is user's personal mobile phone number.

ID Point system offers separated interfaces for ID Point officers and service providers. ID Point officer can only feed new information to the system but cannot search, read or modified after saving it. Service provider can only feed ID Point authentication codes and read information that system provides with the code.

The ID Point system generates the ID Point authentication code when required information has been filled and delivers it by default to the customer's given mobile number as a SMS-message. However ID Point authentication code can also be printed out to a paper by the ID Point officer if mobile number has not been given. ID Point authentication code on text message or on paper do not hold any information of person who's been identified. ID Point system is only place where user's identification information are combined to ID Point authentication code.

Service provider can use ID Point service model in the services that require customers to be identified. Service can be personal service like IT Helpdesk or it can be a system. Service provider checks customer to give ID Point authentication code and feeds that code to the ID Point system. For a valid ID Point authentication code the system displays user's information stored in the system.

From the customer's point of view the ID Point service is easy to use (fig. 2). Identify yourself to an ID Point officer with a valid document and then receive a personal ID Point authentication code. After that user can use any service which accept ID Point authentication codes.

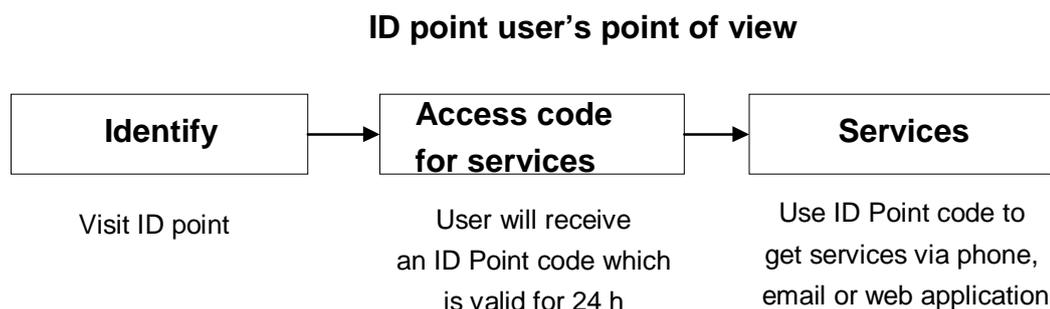


Fig. 2. ID Point user's point of view

There are few limitations to the process from the information security point of view. The ID Point system itself is strongly protected with special technical setup. The ID Point authentication code itself is useless without knowledge whose code it is. Also the ID Point authentication code is valid only for 24 hours and in the current setup it can be used only once.

There is mandatory training for the ID Point officer and for the service provider before they can use the ID Point system. We also had an opportunity to gain expert level training from the Finnish custom officer regarding how to recognize impostor (person who uses other persons real identification papers as their own) and the identification papers authenticity.

Even ID Point was created to aid Helpdesk related user account services, it is not tied on it. ID Point service model is enabling service that can be used to provide any service i.e. by phone that requires authentication.

6. ID POINT HISTORY

The project which side product ID Point was started January 2013. The original plan to launch Helpdesks face to face service though videoconference system was abandoned during the pilot due users preferring to call with ID Point authentication code directly to helpdesk instead of using videoconference system. While videoconference system were still setting up, it came clear that we required identification transfer system. This was the start of ID Point.

The pilot phase started on June 2013 and less than few weeks of starting 2nd campus library contacted us and asked if they could have ID Point service desk. The Project which side product ID Point was ended in August 2013 and ID Point started to live the life of its own. Within a month from pilot's ending, we had ID Point service desks all our campuses in Helsinki. Less than half year, it was expanded in few of our distance locations also.

At the end of 2013 we had only eight ID Point service desks. Five of them were located in campus libraries at four main campuses and three on research stations. In 2014 we trained more ID Point officers including also research stations. By the end of 2014 we had already 15 ID Point service desks all over in Finland in university's research stations and main campuses. At the beginning of 2015 we have already trained three more ID Point service desks. The growth of the service desk usage amount as well usage described in fig 3. Years 2015 numbers are up till April 19th.

Year	ID Point service desks	Total	Average per week	Median per week
2013	5	33	3	2
2014	15	734	14,4	13
2015	18	225	15,9	16

Fig. 3. ID Point growth

From the start we decided to contribute properly education of ID Point officers. Each new officer was trained of the usage ID Point officer portal as well how to identification user proper. ID Point usage have grown dramatically within a year.

Even ID Point authentication code is valid 24 hours, most users tend to user code within first 30 minutes. More significant is that last year about 25% of the authentication usages has been done between five to fifteen minutes and it's been increasing this year. Only first year 16% has been used before five minutes, but after that it has been dropping below 10%. Instead of authentication time usage from fifteen minutes to thirty minutes has been increasing around 15%. Described in fig 4.

Year	Below 5 min	5 to 15 min	15 min to 30 min	Below 1 hour	Below 6 hours	Above 6 hours
2013	16 %	25 %	0 %	6 %	9 %	3 %
2014	7 %	26 %	15 %	8 %	12 %	4 %
2015	8 %	39 %	12 %	7 %	10 %	3 %

Fig 4. Time in when user consumes ID Point authentication code

7. CONCLUSIONS

ID Point initially was a side product of another project. ID Point concept is simple and easy to use and that's why we had more willing partners all over in University. With ID Point service model, we can bring user account services even in remote locations and provide the service even if researchers are out of the field. At the user end, we have received large number amount positive feedback as well our service provide partners been often forwarding to us the positive feedback that they have received regarding ID Point service.

The reason why ID Point service model was so well accepted among users as well our service partners that it didn't try to do anything fancy and it was easy to use for all. The simplicity of the system actually created an option that ID Point service models can be benefit also for other services. The ID Point itself does not provide a service it just provides a possibility to use a service that would require identification.

Based on the experience in all areas in ID Point service, we have started to conversations with other non IT services that could be used via ID Point authentication. We can see several services that could actually benefit of having ID Point providing access to it.

Our plan is to expand ID Point service model to all our research stations and remote sites that have either our personnel or students. Also we have encouraged our departments to have their own ID Point service desks for their personnel, course all new location provides users better chances to find closest ID Point service close to them.

8. REFERENCES

Special thanks for DR. M. Kivilompolo who's idea ID Point was formed and guided though the creation of first paper as well DR. M. Lattu who created the basics for ID Point to be able to form, grow up and develop to a full service.

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9. AUTHORS' BIOGRAPHIES



Maria Kalske has been managing IT support teams since 2004. Currently, she is an IT Local Support Team Manager and leading few projects Leader at the IT Center of the University of Helsinki. Maria has been holding this position over five years now. Prior to that, she worked for several private companies in Finland and has gathered experience in the fields of IT support and infrastructure maintenance.

Academic e-learning experience in the enhancement of open access audiovisual and media education

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Keywords

media education, audiovisual education, film education, e-learning, Moodle, life-long learning, MOOC

1. Abstract

The paper presents how the academic e-learning experience and didactic methods of the Centre for Open and Multimedia Education (COME UW), University of Warsaw, enhance the open access to audiovisual and media education at various levels of education. The project is implemented within the Audiovisual and Media Education Programme (PEAM). It is funded by the Polish Film Institute (PISF). The aim of the project is to create a proposal of a comprehensive and open programme for the audiovisual (media) education.

2. Background

The abilities to research, evaluate and process information and to use the media in a safe and creative manner are basic skills of a member of an information society. The development of a knowledge-based society is one of the objectives of the European Union and national strategies. Hence, reinforcing interactive education (which refers to media education, e-learning and life-long learning) has been an important goal for the Polish education (reported in: *Social Capital Development Strategy, Poland 2030*).

Research proves that a lack of motivation, directly related to a lack of knowledge and skills is one of the main barriers to accessing new technologies. There is even more recognition as to what opportunities and threats are connected with the use of new technologies, but the knowledge on how to acquire and develop these essential skills is quite poor (Lipszyc J., et. al., 2011). Publishing the *Digital Future* (Dąbrowska A. et. al., 2014) - a catalogue of media and information literacy competences, by the Modern Poland Foundation (<https://nowoczesnapolska.org.pl/>), was a step forward. The creative use of the media was mentioned among the crucial competences. The catalogue was approved by the Polish National Commission for UNESCO as a significant input into the *Information For All* international program.

The report on the state of the media and information literacy among Poles was the basis to the launch of the Digital Future programme the aim of which was to implement the concept of the *convergence of competence*. As a result, a set of media educational materials has been prepared for all educational levels including: pre-school, primary and secondary school as well as for other educational institutions, such as community centres and libraries. The materials contain a proposal of topics and ready-made lesson plans and scenarios, including the suggestions for task types and interaction patterns to be used (questions, exercises, team work, references, time needed) as well as organizational matters to be taken into consideration. They are available on the web at <http://edukacjamedialna.edu.pl/>. They are of great didactic and methodological value, meet the needs and expectations of the age group and include achievement tests in each lesson. However, they do not contain, any kind of multimedia resources (Figure 1).

edukacja medialna

LEKCJE WSPÓŁPRACA KOMPETENCJE TURNIEJ WESPRZYJ NAS O NAS KONTAKT

Projekt prowadzi: FUNDACJA Nowoczesni Polscy

Scenariusze zajęć, ćwiczenia, materiały

SZUKAJ

Kreatywne korzystanie z mediów
Pokaż co potrafisz! Poznaj cyfrowe narzędzia i dowiedz się jak atrakcyjnie prezentować swoją twórczość w sieci. zobacz →

KORZYSTANIE Z INFORMACJI
RELACJE W ŚRODOWISKU MEDIALNYM
JĘZYK MEDIÓW
KREATYWNE KORZYSTANIE Z MEDIÓW
ETYKA I WARTOŚCI
BEZPIECZEŃSTWO
PRAWO
EKONOMICZNE ASPEKTY DZIAŁANIA MEDIÓW
MOBILNE BEZPIECZEŃSTWO

CO NOWEGO?
ZADANIE DO WYKONANIA NA II ETAPIE WTEM
Ogłaszamy temat projektu medialnego do wykonania przez uczestników i uczestniczki podczas zawodów drugiego stopnia II edycji Wielkiego Turnieju Edukacji Medialnej.

LEKCJE:

WYCH. PRZEDSZKOLNE
10 GODZIN

SZKOŁA PODSTAWOWA 1-3
20 GODZIN

SZKOŁA PODSTAWOWA 4-6
5 LUB 33 GODZIN

GIMNAZJUM
8 LUB 60 GODZIN

SZKOŁA PONADGIMNAZJALNA
7 LUB 47 GODZIN

EDUKACJA FILMOWA
8 GODZIN

NASZE LEKCJE TO:

WIEDZA W PIGUŁCE
ZADANIA
SCENARIUSZE
SŁOWNICZEK

Zobacz, jak przeprowadzili je inni.

Figure 1. The website <http://edukacjamedialna.edu.pl/> with the scenarios for lessons on media education for pre-school, primary and secondary schools.

At the same time, the Polish Film Institute (PISF) identified several gaps in both formal education on audiovisual, media and film recourses, as well as in the creative use of the media and interactive education (understood as a skill of using multimedia in creating the content and in supporting teaching and learning in various areas of education) (Litorowicz A., Majewski P., 2011).

Its first move was the School Film Library (Filmoteka Szkolna) project. The project provided the secondary school learners with a set of fifty-five Polish classic movies (feature films, documentaries, cartoons) supplemented with the topics to be discussed on their basis. Additional materials on film education, useful for teachers of various subjects such as literature, history or social studies, can be accessed on the project website www.filmotekaszkolna.pl (Figure 2).

As a complementary initiative to the School Film Library (Filmoteka Szkolna) project, an Audiovisual and Media Education Programme (PEAM - first stage) project was launched in 2012, with the University of Warsaw (represented by the Center for Open and Multimedia Education (COME UW)) as the PISF partner.

The screenshot displays the homepage of the School Film Library (Filmoteka Szkolna). At the top, it identifies itself as a program of the Polish Film Institute and includes social media links for Facebook and YouTube. The main navigation bar contains links to the home page, program details, film education, lessons, login, and registration, along with a search bar. On the left sidebar, there is a newsletter sign-up form, project listings (including 'Akcja!', 'Akademia', and 'Kinoterapia'), a calendar for February 2015, and social media engagement buttons. The central content area features two large icons representing film education and lessons, and a video player showing a classroom activity. The right sidebar includes a 'watch' section, a 'we recommend' section with a cartoon illustration, and a promotional banner for the Polish Film Academy with the text 'ZROBILIŚMY DLA CIEBIE MIEJSCE!'.

Figure 2. The website of the School Film Library (Filmoteka Szkolna) project www.filmotekaszkolna.pl

3. The Audiovisual and Media Education Programme (PEAM) project

PEAM is a complementary initiative to the School Film Library (Filmoteka Szkolna) project. Within PEAM we are searching for the best formula for film and media education in Poland, particularly important for the ability to critically analyse the media in a period of rapid transformations in public life. Although there are plenty of well-functioning grass-roots initiatives that exist in Poland, no solutions have yet been implemented to treat the phenomenon systemically.

Thus, the purpose and rationale behind the PEAM Programme is to combine resources available in Poland with analytical traditions as well as the up-to-date multimedia with e-learning technologies (meeting the criteria for Open Educational Resources). The introduction of the PEAM Programme acknowledges the status of the media participant as a creative agent in the process of interactive education.

The aim of the first stage of the project was to create a proposal of a comprehensive and open programme for the audiovisual (media) education and the programme for the use of the media and audiovisual resources at all levels of education.

3.1. The university approach to open education on the media and film

COME UW proposed an innovative approach to the media and film education moving the didactic process to the Virtual Learning Environment (VLE) and with the engagement of the audiovisual means, basing on the fact that digital world is a "natural" environment for the young generation (Tapscott, 1997, 2008), which is at the same time the target group of the programme.

The choice of e-learning as a form of education was made after a comprehensive analysis of its advantages and limitations. The fact that e-learning stays in line with the European Union's policy on the development of the information society, which significantly contributes to the strengthening of the knowledge-based society was also taken into account. It also meets the objective on the improvement and development of different forms of education.

The digital world imposes gaining new competences on its users. Currently, the ability of constructive analysis (including logical linking "pieces of information") is much more desirable than the static mastery of knowledge and its reproduction. The use of e-learning platform gives you more opportunities to reflect on the content (text files, tasks, tests, discussion forums), which in turn fosters the maturation of analytical thinking. Simultaneously, the psychology of individual differences clearly points to the fact that what makes people (even of the same age) different from each other is not only the level of intelligence but the amount of time they need to acquire information. Therefore, the PEAM project's goal is to make the educational program meet the needs of an individual student. E-learning provides the opportunity for self-study and self-testing of knowledge and grants the flexibility of time within the learning process (also through the easy access to materials via mobile devices such as smartphones). What is more, it reduces the social exclusion (e.g. people with physical disabilities can easily access the course via the Internet). Moreover, the materials embedded on the platform can supplement other forms of teaching (e.g. workshops).

3.3 Academic methodology

Therefore, in the first stage of the implementation of the PEAM project, e-learning was considered to be one of the forms of learning based on the application of new technologies. Benefiting from the didactic and methodological e-learning experience gained at the university, COME UW offered to introduce an open source educational Moodle platform to the teaching and learning process, recognizing it as the most appropriate tool for media/film/audiovisual education. The platform allows for rich combination of materials (audio, video, text files) that might be embedded there, which is not feasible within the traditional coursebooks. In the case of film education, the emphasis is put on video files.

Moreover, the platform flexibility meets the expectations of both teachers and students (time-flexible mode of teaching/learning, access possible through mobile devices). A course can be organised both with the teacher involvement, engaging participants in the activities in the forums and in the open tasks to be completed and it can serve as an on-line self-study course with the highly developed self-check part and individual access to the course materials. Easy access to information changes the role of the teacher, whose main duty is not only to deliver knowledge but to be the mentor as well, who assists learners in the process of acquiring knowledge/competence, inter alia, by identifying gaps and giving feedback on the student's progress.

3.4. The pilot e-course

Taking into account the above mentioned advantages, a pilot on-line course entitled: *Film as a story - how to read a film* (in Polish) was created within the first stage of the PEAM project. The content was prepared by experienced academic teachers - specialists in film education in the Department of Film and Visual Culture at the Faculty of Polish Studies of the University of Warsaw.

The main value of the course is that it uses movie extracts to illustrate and explain the meaning of the phenomena that are present in the film making process, e.g. the importance of light and sound in creating film atmosphere, the significance of the metaphor, the impact of scenery on the perception of the film reality (Figure 3), etc.

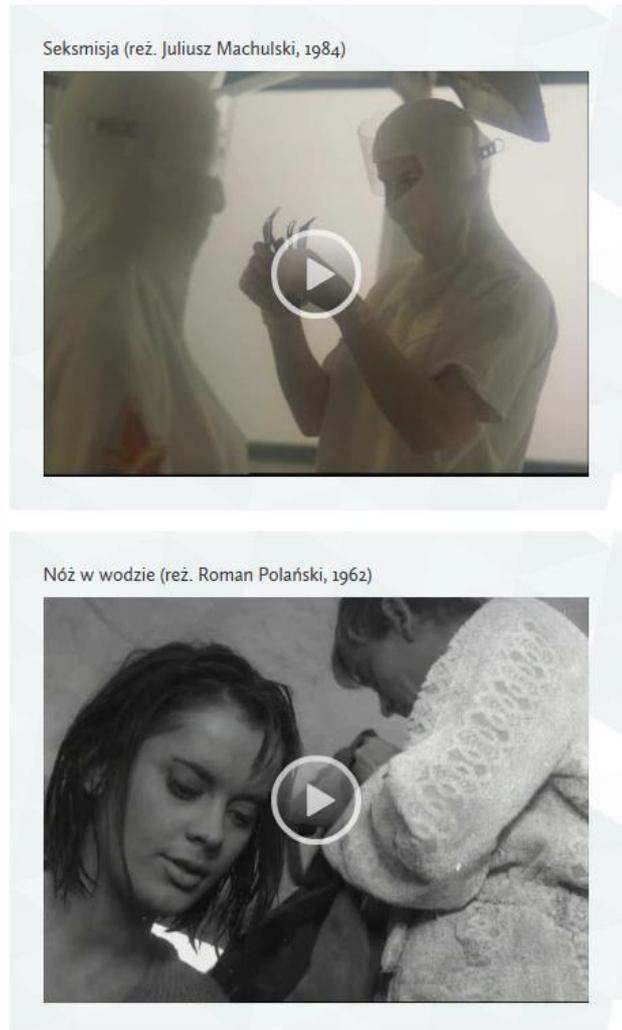


Figure 3. Examples of the movie extracts used for the needs of the pilot e-course: *Film as a story - how to read a film*.

The e-course is divided into modules focusing on the chosen aspects of the film such as film forms or film narration. They contain smaller sub-modules with the explanations of the film-making theoretical background and video lectures. For better understanding of the content and its memorization, the infographics have been introduced (Figure 4).



Figure 4. An infographic with the linked descriptions of the components of the film scenery.

The course provides typical multiplechoice tests (Figure 5.) as well as specially tailored interactive questions based on the films extracts (Figure 6.).

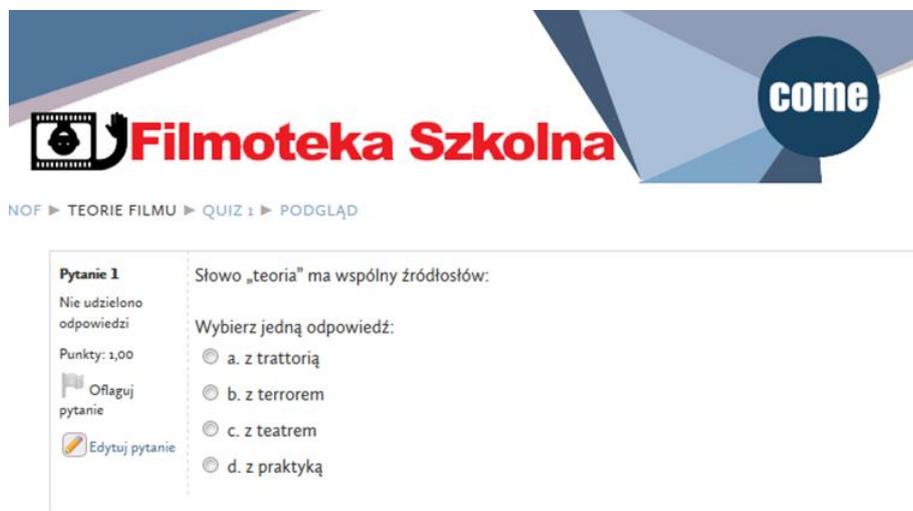


Figure 5: The example of a self-check test.

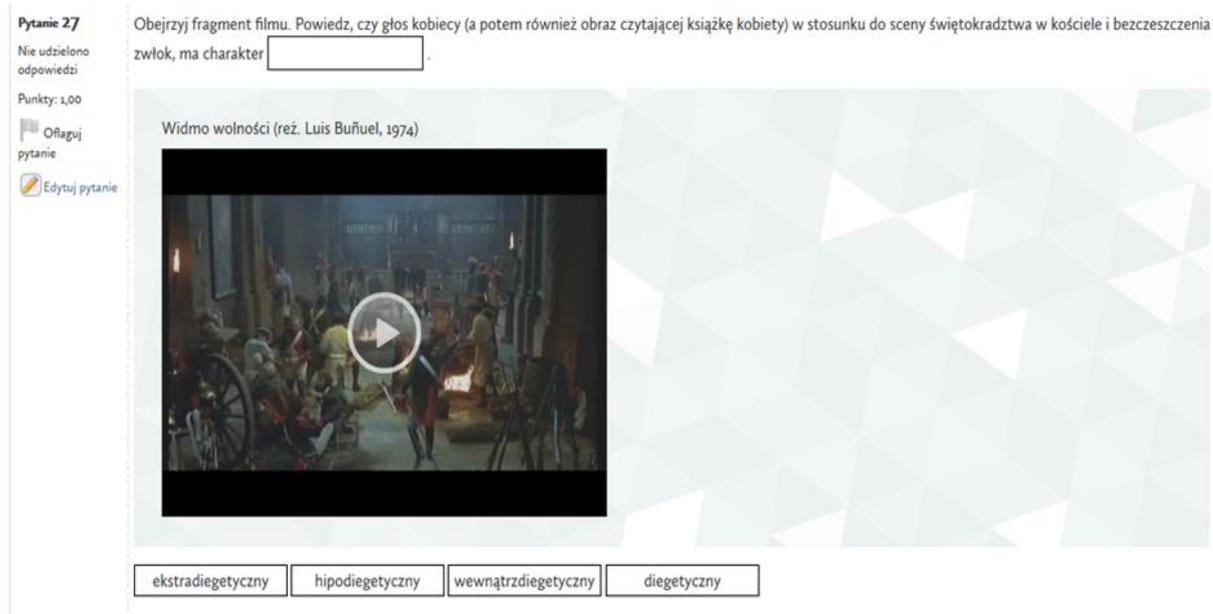


Figure 6. The example of an interactive test question within the *Film as story - how to read a film e-course*.

The course is enriched with descriptions of the skills gained after its completion, wikis, self-check tests after each module, the final test, as well as optional open assignments and a workshop task to be led under the supervision of a teacher (Figure 7). These materials can be easily combined and they are complementary to the traditional face-to-face teaching.

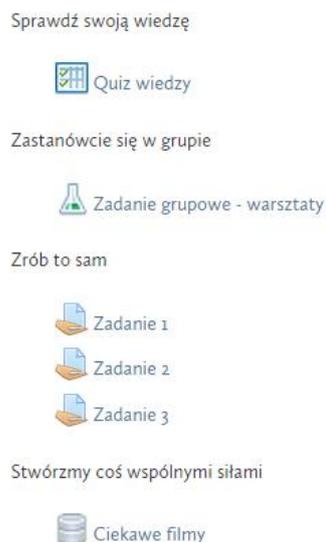


Figure 7. The e-course contains self-check quizzes, group workshops or individual assignments to be evaluated by the supervisor.

The course was reviewed by the students of the Faculty of Polish Studies of UW and got an overall positive feedback. The interesting remark was made on the film extracts. In the opinion of some students, it should include more contemporary movies.

4. Follow-on initiatives

The e-course was positively evaluated by PISF media educators and two other courses were requested to be created on the platform within the second stage of the PEAM project. They are: *The basics of journalism* for young people interested in creating their own journalistic video materials as well as for the teachers and *The methodology of film education* dedicated for pedagogy students, teachers and film educators. On those bases other e-courses are to be prepared.

Within a project, an international conference: *Film and Media Education in Poland and the world - systemic solutions and case studies* is planned.

5. Conclusion

The additional value of moving the learning process into the virtual environment lies in the flexibility resulting from asynchronous mode and access to the course via the mobile devices (also for disabled persons), an implementation of the platform-based evaluation process (feedback forms, surveys), as well as the analysis of the logging-in status. This allows for the supervision of traffic within the course, which might be of significant importance for the project/course feedback and monitoring. On this basis, evaluation of the materials can be made in order to complement or improve them. In terms of massive open education, the courses can be easily transformed to MOOCs on media/film education, if such need for further development arises. The follow-on initiatives within the PEAM project prove the academic didactic experience might be successfully implemented at other levels of education.

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Dorota Sidor, MA, works at the Centre for Open and Multimedia Education, University of Warsaw. She specializes in e-learning methodology. Since 2007 she coordinates a university-wide educational project IBIZA (Interdisciplinary Database of Academic e-Courses). She has taken part in numerous e-learning projects, e.g. Higher Educational Institutions As Integrators for Lfe-Long Learning, Warsaw School of Data Analysis, Audiovisual and Media Education Programme, Ministry of Regional Development e-courses on projects' evaluation, Conducting Research, Preparing the Methodology, Programs and Didactic Materials for Distance Education. Currently she is working on her PhD thesis regarding communication skills of e-learning users. She is a member of Editorial Board of the EduAction open access online journal.

E-course development projects - working with teachers

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Keywords: e-course, e-learning, support

1. Introduction

Information and communication technologies are already starting to have a transformative effect on higher education. New and innovative technologies have become a driver for major changes in people's professional and personal lives. They have changed the way we work, interact, learn and access knowledge. E-learning has moved into the mainstream of educational design and can provide ways to enhance the quality of the learning experience. In the process of implementation of e-learning in higher education it is very important to give support to teachers engaged in e-learning activities, motivate them and challenge them to think in a new way. When thinking of using ICT and e-learning technologies in their teaching, teachers are often unsure which technology to use, how to use it and sometimes they are unable to find time for it in their busy schedules.

Therefore, it is important to provide appropriate, high quality and sustainable support to teachers.

2. How to provide support to teachers

All users should have accessible, sustainable and reachable support in order to feel safe and secure in their work. But support requires a variety of resources - technical infrastructure, training course/curriculum development and support/help.

At the same time we have to be aware that each teacher is different and need different kind of support as well. According to Zemsky and Massy's innovation curve, there are five groups of users. The first group are innovators and adopters. They are pioneers and leaders and bring new ideas but the number of individuals falling into that group is rather small. Support is generally needed by those users who constitute early and late majority and make about 60% of the academic community. The former are open to new ideas and the latter are followers. They are not familiar with ICT and e-learning technologies enough to be fully independent and are often reluctant to use them due to the fear of not fitting in. But when they became aware of reliable and quality support, they are willing to try and explore it/be innovative. Some users require guidance only at the beginning, but afterwards gain enough self-confidence; others need assistance for a longer period of time and feel much safer knowing that there is a place where they can always turn for help. The last group of users are the diehards and they will always resist change, no matter what.

3. The The E-learning Centre at SRCE

The E-Learning Centre at the University Computing Centre SRCE, University of Zagreb, has been providing support to teachers in the academic community for seven years. The E-Learning Centre was established as the focal point for systematic take-up and support in e-learning across the University of Zagreb when the University started the systematic implementation of e-learning in 2007. Some of the Centre's activities are teacher and student support in using e-learning technologies, cooperation with and support to local e-learning teams and groups, establishment and maintenance of the University's e-learning network, promotion of e-learning and (inter)national e-learning projects. One of the first activities the Centre took on was to establish and ensure a generally accessible e-learning platform. The platform was set in motion by the end of 2007 and it has been constantly upgraded and developed according to the users' needs. Creating a positive environment, raising awareness of e-learning within the academic community and providing the necessary support are long term tasks of

the E-Learning Centre. Today, the E-Learning Centre at SRCE provides support to teachers and students at the University of Zagreb, but to other universities and educational institutions in Croatia as well. Apart from the e-learning technologies and tools that the Centre provides to users, Centre also focuses on user support, communication and cooperation with institutions and their local e-learning teams, promotion and dissemination of information about e-learning.

Majority of users who require support are teachers and the Centre is a place where they can come to talk and discuss topics on e-learning. We gladly listen to their ideas and needs and enjoy cooperating with them. We offer training courses (covering a wide range of topics, from new technology to pedagogical trainings), technical support and e-course preparation and maintenance support, manuals, instructions and animations about various tools we provide, consultations and helpdesk. Users feel comfortable knowing that they can contact helpdesk (via phone or e-mail) and quickly get answers and solutions to their questions and problems. Positive attitude and friendly atmosphere also help achieve communication.

4. E-course development projects

While listening and trying to understand teachers' needs, it has quickly become apparent that what is important is working with them and not for them. Also, it was evident that the support should be individualised and tailored to their needs. That is why in 2012 the E-learning Centre started "E-course development projects" service which enables support designed according to teachers' individual needs. The service also enables more specific training and guidance. Invitations for project participation are announced periodically, usually twice a year.

This service includes the design and implementation of e-courses at the University of Zagreb and extends the standard support teachers can get at the E-learning Centre. The extended support provides help during the development of new e-courses or maintenance and further development of existing ones. It provides support and training in the usage of e-learning technologies, application of instructional design in e-course development, development of new and particular modules in e-courses, production of technically demanding e-learning materials and production of animations, videos and simulations.

For each project, the E-Learning Centre team and the teacher sign an agreement that clearly defines the timetable, workload and obligations on both sides. Projects usually last between 3 and 4 months. At the end of each project, teacher carries out a student survey on the implementation of new technologies into teaching and learning process. The feedback shows students' reactions to new ways of learning which both the Centre and the teachers find very important.

So far the students' feedback has been positive, but it has also shown that students think new activities and the new way of learning demands a lot of their time and effort. Students find moving into virtual environment and providing the learning materials and information about the course online, something quite normal, and they are open for possibility to participate in discussion forums, to submit seminars and homework online. They have very positive attitude towards animations which enable them to better understand parts of the course and they usually play them more than once. They are open to new technologies and ways of learning only if they see a benefit in them for themselves. It is important as well that they are easy to use and do not require additional time to complete such tasks. For example, they didn't find mind maps useful enough for further use except when required by the course.

At the beginning, only teachers with existing e-courses applied for the development of animations and simulations, or some additional module programming. After some time, more teachers started to apply for the e-course development project as they have heard about it from their colleagues or witnessed their work.

After the last invitation for project participation in January 2015 the Centre received 13 applications, 10 of which were projects with completely new e-courses. Our idea is to present the experience gathered in supporting teachers while implementing new technologies into the educational process, especially focusing on the e-course development projects during which we worked closely with teachers.

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In 2011 she received the Rector's award for successful and motivated work on the development and systematic implementation of e-learning at the University of Zagreb.

In 2013 she was elected the EDEN Executive Committee member and in 2014 she received EDEN Fellow Award.

In 2014 finished a Master's Programme in Digital Education at the University of Edinburgh, UK.

Tona Radobolja works as an IT specialist at the E-Learning Centre at SRCE and she is in charge of the e-course development projects.

Her field of duty is tutoring and instructional design of e-courses. Among other activities, she created several workshops on how to use Moodle, Mahara and Adobe Connect that E-learning Centre provides for teachers. She holds several certificates for e-learning content design, Moodle Course Creator Certificate and MaharaBites for Teachers.

MOOCs and pedagogy: where are we heading?

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e-learning, pedagogy, MOOC, SPOC, blended learning, VLE, LMS, learning analytics

1. ABSTRACT

MOOCs are often considered as a technology and many realize, today, that they do not follow the well know Gartner hype cycle. In the US they have almost completely disappeared from the Gartner curve although they are still very high in Europe. But MOOCs are not a technology: they are a new means to acquire knowledge, using pedagogy, made available through technology, mainly the ones available through LMS and other social and collaborative tools. Thus they evolve not only through the available technologies but also much slower, at a human pace, through the slow movement of a changing pedagogy.

Up to now the technology of each LMS has constrained the teacher to its underlying pedagogy. The new generation of LMS, introduced with the MOOCs, is using the latest advances of the technology: cloud and cooperative services instead of a bunch of services constrained in a single platform. This will allow to completely rethinking the LMS models as bouquets of services assembled by pedagogical designers. Various bouquets, fitting various approaches to pedagogy, may be made available according to the wishes of the users either teacher or students. MOOCs have shown that the underlying technology permits to consider the generalization of flipped learning for large numbers of students. This will completely change the approach towards the new generation of the virtual environments in the universities towards a more user-centric approach. Instead of the institution the entry point will be the student him/herself.

The new technologies, beneath the MOOCs, permit to acquire huge amounts of data about student's activity. It induces a move towards their analysis and building alerts to inform in real time both the students and their tutors of possible difficulties. This will completely transform the methods to follow the students and probably also to deliver the grades.

Some people have said that MOOCs are the end of the university. They are wrong: they are a chance to better fulfill its responsibilities. MOOCs are the match, which is igniting the light towards a better learning.

2. INTRODUCTION

At the last Educause conference, in October 2014, the word MOOC had completely disappeared. Instead most presenters spoke of Online Courses (OC). In the US a number of people express their disillusion but agree, at the same time, about a changing education paradigm (Mazou, 2014; Morris, 2014); some assert that the MOOC technology is disappearing from the Garner hype cycle before reaching the plateau of productivity and Tapson (2013) speak of a "very slow tsunami". At the same time the number of available MOOCs continues to grow rapidly (Shah, 2014) and a recent report of EUA (Gaebel, Kupriyanova, Morais & Colucci, 2014) confirms that a number of European Universities believe in the future of MOOCs for two main reasons: enhancing their international reputation and contributing to a change in the pedagogy. The yearly report from the Open University in UK (Sharples, Adams, Ferguson, Gaved, McAndrew, Rienties, Weller & Whiteloc, 2014) confirms this last view and explores an impressive number of advances in modern pedagogy linked to technology.

Sebastian Thrun is able to raise \$ 35 Million for Udacity (Forbes, 2014) and Koller (2015) from Coursera, in an interview at the Wharton School declares that, in two years from now, she will be able to compete with most colleges to offer a better and cheaper education and has no fear that her private partners will leave her company.

All these declarations by people, experts in the field of ICT for teaching and learning, are rather confusing and may either lead to pessimistic or optimistic views about the future of MOOCs in Higher Education.

In this paper we will express our views and explain why MOOCs will continue in various forms and how they are transforming the pedagogy landscape.

3. MOOCS AND PEDAGOGY

Let us first comment the pedagogic aspects of MOOCS. The word MOOC, Massive Open Online Course, expresses many ideas together: the two most important ones, which have rocked the world of education, are Massive and Open. Online courses, by themselves, are nothing new and are being used in many universities, on a limited scale, since a long time: the Open University in UK was an ancestor. In fact one may go back to the 19th century (Watkins, 1991)!

Massive courses imply that the personal relationship, which, to some extents, exists in conventional teaching, must be replaced by another pedagogical approach. This led to the introduction of flipped learning. The flipped learning approach also is not new. It was called differently such as "student centered", "learning by project", and has been used by many teachers. The Teluq, the Distance University at Université du Quebec in Canada (<http://www.teluq.ca>), was certainly one of the first pioneers in this approach. However one must admit that flipped learning remained a niche approach until the raise of the MOOCs.

What is really new is the Open approach, which means that anybody is entitled to register in a course, without any control about his/her prerequisites of the basic knowledge needed to successfully participate. Another innovation is that the notion of graduation and of a coherent curriculum vanishes, replaced by certificates. Students follow the MOOCs of their choice, for their own reasons without the obligation to build a coherent portfolio as in a conventional study. This Open approach is the most delicate aspect of MOOCs: how to teach to massive numbers of students whose background is very diverse? In countries, where Higher Education is freely open to all students who have successfully achieved High School, universities are aware of this problem and have been trying since many years to solve this difficulty without success. This is certainly one of the reasons why the failure rate is so high for MOOCs (Hollands & Thirtali 2014).

However most teachers will agree that MOOCs are moving the Higher Education landscape. First of all, the flipped pedagogy is entering the university, starting from the amphitheater where more and more teachers oblige the students to play a more active role, introducing sequences where students must work and discuss together (see for instance Rudolph, Joyce, Lahmine & Boissé 2012) up to a full reorganization of the curriculum where the course is now divided in two parts: fundamentals are learned through online courses, applications and problem solving in face-to-face sequences. When MOOCs are employed in this context they are no more massive neither open since the registered students possess the prerequisites to participate in the course. This is why they are called SPOCs (Small Private Online Courses), private meaning that they are reserved for a selected small audience. They use the same environment as MOOCs for the online part of the course. EPFL, in Europe, was one of the first universities to adopt this approach to pedagogy: students work by themselves, in groups or alone, part of the week. Quite often they meet in the library or elsewhere to watch the videos and learn together. The MIT, for instance, is far ahead: they are in the process of reshaping their catalog of courses, cutting the courses into shorter modules, of the order of six weeks (the standard length of a MOOC or SPOC) so that each course will be able to use a blended approach, part on line, part face-to-face. They have not decided to introduce a blended learning everywhere but the desire is to facilitate this approach whenever appropriate (UNR Paris-IdF 2014).

MOOCs are not a technology. They are a new means to acquire knowledge, using pedagogy, made available through technology. This pedagogy can be applied either in the conventional institutions or at a massive scale like COURSERA or EdX and their European sisters MiriadaX, FutureLearn, FUN, Iversity... MOOC have made the Senates and High Executives sensible to this new approach but the motivations vary from promotion of the institution to recruiting students and transformation of education (Epelboin 2014; Gaebel, Kupriyanova, Morais & Colucci, 2014; Pomerol, Epelboin & Thoury 2014; Pomerol, Epelboin & Thoury, 2015).

MOOCs and their avatars such as SPOCs have certainly moved the traditional approach to teaching out of balance. It means that the pedagogy is shifting towards a user centric approach. This has been

made possible by the introduction of a number of new technologies and especially the social ones. Students use them in their private life and start to use them in their daily work.

For the pioneers, who, since the beginning of this century, have been working in this direction but had difficulties, to convince their fellow professors and to extend their experience to the whole community, this has raised immense hopes.

4. MOOCS AND TECHNOLOGY

MOOCs environments can be described have a bundle of technologies. Very few are new: most of them already existed in the first generation of Learning Management Systems (LMS); a few are new or seldom existed in most platforms, such as peer assessment. Some, such as the forums, were rather unsuccessful. Around 2005, I remember a WebCT users conference, in Barcelona, where many of us complained that our forums were empty, except in the places where distance learning existed. What has made the forums successful, nowadays, in MOOCs, is the distance between the participants and the desire to share a community. The MOOCs platforms are still in their infancy. When compared to the conventional LMS, their possibilities are very limited and the number of available tools very short. Some universities continue to use their own LMS and the main advantage, nowadays, of the MOOCs platform is their capacity to support large numbers of concurrent users.

LMS are digital means used ... for learning and teaching, which implies that they are at the service of pedagogy. There is not a single method for teaching or learning, pedagogies are diverse. LMS try to meet, as well as possible, this expectation. Since different expectations coexist there are different means to meet the different visions of their designers. For instance, Moodle is organized around a pedagogical vision on how to learn, giving little choice to the teacher in the way to proceed. Sakai is much more neutral, does not give much hints to the teacher of how to organize his course and highlights the collaborative aspects. In practice it is always possible to get out of the vision of the designers but this can be difficult. An expert, who has his own ideas of e learning, may feel constrained with Moodle environment. On the other hand a beginner will find it difficult to build his/her pedagogy in Sakai for lack of guidance.

From the educational point of view the ideal platform does not exist. All LMS offer a different vision of teaching and learning. What the user would need is to be able to choose his/her favorite approach available from the various services of the different LMS. He should be able to compose his/her bouquet of services, choosing tools available in different LMS. The expert will compose his/her own bouquet; the non-expert will make his/her choice among bouquets already prepared by the experts, i.e. by the pedagogical designers of his/her institution. He would later enrich his/her course adding new tools and approaches. We are very far from this idealistic view! All services are confined inside their platforms and the standardization is not enough advanced to allow to plug some services of a given platform into another one.

The present MOOCs platforms are today very constrained and too "x" and not enough c "oriented (for the differences between x-MOOC and c-MOOC, see for instance Hollands & Tirthali (2014) or Pomerol, Epelboin & Thoury C. (2015)).

The appearance of a new generation of LMS, required to fit the needs for massive courses in MOOCs, is shivering the LMS world. The first generation LMS are coming to their end unless their core functions are completely rebuild on new concepts and technologies, being used in the MOOCs platforms. MOOCs platforms will merge, in a near future, with a new generation of LMS using the same technologies: a cloud approach and the collaboration between independent services, each of them running separately. MiriadaX (2015), for instance, is starting to move in this direction (BuiltWith 2015). The services will communicate through standardized interfaces in the spirit of LTI (IMS Global 2015).

It will thus be possible to build the bouquets and assemble services to fit various pedagogies. Pedagogical designers will also become services designers.

5. A USER-CENTRIC E-LEARNING APPROACH

One of the main impacts of MOOCs, in universities, has been to create a dynamics towards a blended learning approach; which, up to now, remained in a niche. MOOCs being based on a flipped pedagogy have shown that the underlying technology permits to consider the generalization of this pedagogy

for large numbers of students. This is the most important conclusion: MOOCs have demonstrated that technology can be of great help in a more user centric approach of pedagogy.

A few years ago, we suggested (Epelboin & Lévêque, 2010) the following vision for the future of the digital university (Figure 1).

As a member of the university community anybody, student and staff, has access to a number of services through the portal (light green ellipse), which is the entry point in the digital university. The user's profile is decided and managed by the university authorities. Thus the user has limited possibilities only to organize his/her space and choose his/her services.

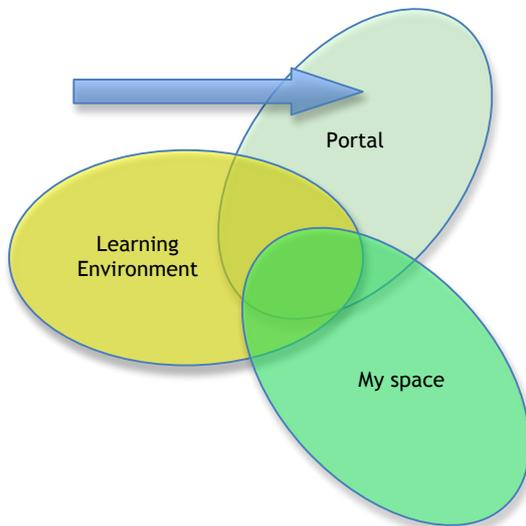


Figure 1: the digital university as seen in 2010

The user can manage his/her relationship with the other members of the community in the “My space” ellipse (intense green) only. In this ellipse the person may establish links with other, share documents... This is the social part of the university where anybody is free to establish his/her communities.

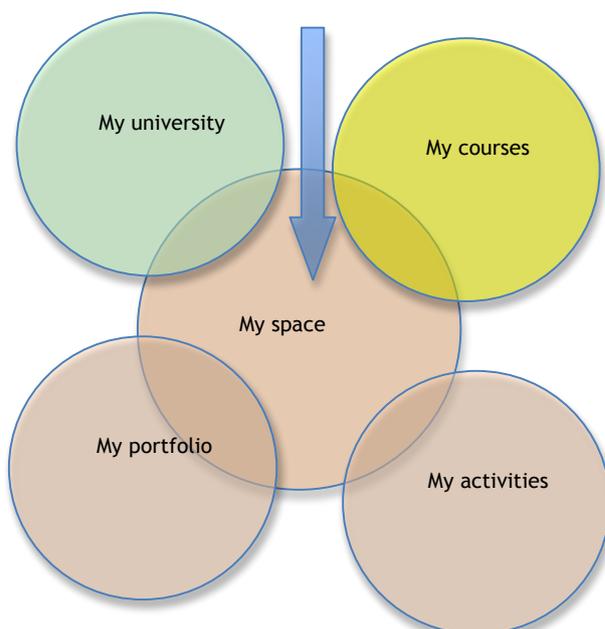
The yellow ellipse (Learning environment) represents the LMS environment, where the teachers assemble their students and organize the exchanges and the roles.

The ellipses cross each other because a number of services are common to the three spaces, such as mail, EDM (Electronic Documents Management)... but with a different view. For instance, in the LMS, exchanges are limited to the students and teachers registered in the

course, in EDM the documents seen in the LMS are not the same than the ones seen in the institutional ellipse “Portal”.

MOOCs, the flipped learning approach and social web tools have made this image completely obsolete. The introduction of massive courses, where the face-to-face interaction cannot exist anymore, lead to the idea of flipped learning. Flipped learning itself put the student in the center and was made possible with the introduction of social web tools. The digital university, although it continues to preserve the face-to-face interaction, is now in the obligation of reorganizing itself, putting the user in the center, according to the scheme of Figure 2.

The entry point is now the student space, where he/she organizes his/her network of relations, manages the visibility of his/her documents and decides how to share them. He/she has access to diverse spaces: “My courses” for learning, “My university” for his/her schooling and other matters relative to his/her study. Other services are not drawn on this figure, such as the library environment and many other services.



The student builds his/her portfolio and, under some controls from the teachers, may also let potential employers access to his/her production.

“My activities” is an example of other available services, available but not mandatory, such as sport and cultural activities provided on or outside the campus.

The number of satellite circles is not limited. What must be understood is that a number of

Figure 2: The digital university as seen in 2015

opportunities are offered to the student. Some are automatically opened, such as “My courses”, other such as “My activities” are spaces where the student can shop.

The entry point, as indicated by the blue arrow, has moved from the institutional portal towards the student personal space and reflects the user-centric approach. This is very important and must be reflected in the design of the user’s interface.

6. DRIVING STUDENTS TO SUCCESS

It is not possible to finish this review of how MOOCs are transforming teaching and learning without mentioning personal data and learning analytics.

Universities are accumulating more and more information about the activity of their students. Their amount and meaning depends on the sophistication of existing services (are these services able to register information of interest?) and their urbanization. A number of services, today, do not contain much information of interest because they are old and were not thought for this purpose. MOOCs have given the impulse towards the analysis of any kind of interaction with any service such as library, social activities, LMS of course, students information systems... all parts of the so-called learning analytics. It has become a subject of research by itself (Sharples, McAndrew, Weller, Ferguson, Fitzgerald, Hirst & Gaved, 2013). Some universities start to build interfaces to analyze their huge amount of data and make them available to the students and to the teachers. Alerts can be automatically sent when these data reveal an uncommon comportment, for instance if a student does never retrieve the documents of his courses or does not go to the library. Data analysis and automatic alerts will become a key factor to increase the success of the students, especially in the first year when they arrive in the university and must adapt to a new working environment. More than the pedagogy induced by a blended learning approach itself, giving to the students and their tutors, pertinent alarms may become tomorrow the key to increase the student’s success, especially in their first year of study.

There is certainly a great interest in building early alerts to take the right action when a student may “loose ground” but this raises many questions.

First of all, to whom belong the original data? The right answer is the person him/herself and he/she should have access to all of them. Their circulation should be limited, inside the university, to a group of people, very well defined. A teacher is entitled to retrieve the information about student’s behavior in his course but not all the courses. Trained tutors should be the sole persons to have access to the whole data about their students, under strict regulations. This raises numerous questions, both ethical and judicial, and this important problem should be solved at a European level.

A second question is the pertinence of the indicators. For instance, what does reveal accessing the documents about the fact that the students read them or not? Ten years ago, one of my courses was on the web, converted into HTML. A number of students came to the lectures with a pile of paper, being the printed version of the course, including the contents of the hyperlinks, and the students nicely explained to me that they preferred the printed version. One of them had done the job of downloading all the files and had made copies available to all his fellows! Thus the web server indicator about access to the documents lost its meaning.

MOOCs have started a move towards the analysis of all the data left by the students in our systems and this will completely transform the methods to follow the students and probably also to deliver the grades. This is a subject by itself for another paper.

7. CONCLUSION

MOOCs are not a technology: they are a means to acquire knowledge. They are build, using a bundle of evolving technologies. This why it is difficult to locate MOOCs on the Gartner hype curve. They are shacking the conventional pedagogy putting out of balance the old methods of teaching and learning. But pedagogy is a slow process, thus MOOCs, SPOCs and their avatars are moving slowly our universities. It is a very slow wave, slowly flooding our landscape. Students as well as teachers will have to adapt to new ways of learning and teaching. It is now recognized that blended learning is becoming the most efficient way of learning and MOOCs will participate in this change. Universities need trained staff to support this change, the ones who have been battling since the beginning of

this century to promote e learning. It is not an easy move and it is not the end of the classic universities. MOOCs are becoming the new Open Educational Resources (OER) and will be used as them. As Koller says (2015) a good MOOC is better than a poor face-to-face course but nothing is replacing a good human interaction.

This will require a new generation of environments: LMS, social and collaborative tools student-centered. Building an adapted teaching environment for each student and course will require a new generation of professionals, at the same time software engineers, course designers and teacher. Building a course will no more be the individual adventure of a professor, alone in front of his/her class but teamwork. This is a complete redesign of the actual job.

The balance between face-to-face and distance learning will vary depending on the subject, on the policy of the universities and students demands. For those unable to attend the university, in less-developed countries and any place, where there is a need to increase massively the number of attendees with a limited budget, MOOCs will provide a part of the possible solutions (Epelboin 2015).

Some people have said that MOOCs are the end of the university. They are wrong: they are a chance to better fulfill its responsibilities. MOOCs are the match, which is igniting the light towards a better learning.

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Accommodating MOOCs into HEI: is blended-learning the solution?

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MOOCs, Blended Learning, eLearning costs, eLearning strategy, MOOC sustainability.

1. Summary

MOOCs are without discussion one of the key changers in education, and in particular in higher education. They affect both on-Campus universities and on-line. Advisory boards in Universities face the need to accommodate a new player in the learning process arena. The MOOC tsunami affects Universities, forcing them to offer MOOCs assuming costs. On the other side, MOOC platform managers need to convince Universities that creating and offering MOOCs is a must, generating revenues at the same time.

This article tries to solve the dilemma: Universities need MOOCs - which means assuming the costs of creating them -, or at least that's the impression. MOOC providers need Universities to create them but cannot offer clear revenues in return. In the perfect world, MOOC creation would be free for universities, and could be offered through MOOC platforms to increase visibility. MOOC providers would look for their own sources of financing to get revenues - and generate benefits-.

We will focus on the University point of view. Universities need to bear costs to create MOOCs. The paper will quantify these costs, and analyse how they can be assumed. Our work hypothesis is that the MOOC model can be sustainable if we create MOOCs not for MOOCs themselves but as a way to improve on-Campus teaching. That means the MOOC will not be generated from scratch, but based on a previously SPOC course. If we do so, traditional teaching can partially accommodate the costs of creation.

After the cost analysis is done, we will verify if the model fits into university strategy. The case exposed in the article will be based in a real subject offered to on-Campus students, which has also been offered as MOOC. The subject has been taught both as SPOC model and as MOOC course. We will try to show lessons learned from the experience.

2. MOOC Costs

In order to compute costs, we have accounted the different profiles involved in MOOC creation. The profiles we have in our working schema are:

- Instructor: who is a teacher of the University
- Teaching assistant: normally a student enrolled in Doctorate programmes or granted-students.
- Staff: who deal with the platform-related issues and link to the platform provides. In our case analysis, it's the Coursera platform.
- Other technical support: for instance, audio-visual managers, producers and post-producers.

In addition we compute the amortization of technical equipment. We don't assign costs for renting facilities, when they belong to the University (which is true for most cases). With this in mind, our experience shows that direct costs of creating a MOOC range 35k€-75k€ for an 8-week MOOC depending highly on audio-visual complexity.

As a remarkable point, MOOC requires an initial effort (almost 70% of cost) to create and around 30% - even less - to run further sessions.

3. Comparing costs: classical teaching vs MOOC model

Is the MOOC cost expensive? From an economical perspective, it depends on the basis of comparison. With this idea in mind, we have tried to evaluate the costs of teaching a University subject. In order to have comparable magnitudes, we have assumed the proportional part of a 12-week subject (so, computing $\frac{2}{3}$ of the costs to compare with an 8-week MOOC).

Universities have factors to compute teacher dedication when computing costs. Our university splits costs into two main blocs: preparation and teaching. While the second one is straightforward (depends on the number of teaching hours), preparation costs are based on the ratio defined in this university teaching model. This ratio depends on factors such as group size, complexity and typology of the subject. For the general case - and in fact, for the subjects of MOOCs we are analysing - it's around 1.5. Costs are highly dependent on teaching staff (in our model, as unique factor).

Our analytics show that it's easier to prepare a classical course than a MOOC - and that means lower cost- . On the other hand, it's more expensive to teach, as more instructor hours are required, and also more expensive to repeat. For simplicity -and coherence with the MOOC model -, we have not considered costs such as space allocation or teaching equipment for the classical model. If the MOOC creation could be computed beginning 35k€, teaching an 8-week subject, with around 400 students, distributed into 4 groups with lecture and problem solving / practice sessions has a cost in the range [12k€-27k€] depending heavily on teacher profile.

However, the most important point is that - according to our model - running the course for a second time requires same university - economic - effort. In other words, although it can be easier for a teacher to run a subject for second time, there is no bonus for it. So, costs remain the same independently of the number of iterations of the subject. Compared to the MOOC approach that's a key difference, as successive courses are cheaper to teach.

4. A word on strategy

The above considerations were taken into account by the managing team in the university. In fact and prior to them, the University decided to enter the MOOC world by offering three MOOC courses from scratch and just offered public. The idea was to gain knowledge and decide where to put effort strategically and answer one simple question: MOOCs yes, or not?

In our opinion, it's critical to analyse the question and to be able to justify the answer. In our case, two main reasons appear as motivators for 'yes'. The visibility and internationalization opportunity MOOC platforms provide and - even more important - the potential impact on the learning process this kind of technologies can provide.

As cons to the decision, there were the costs of creating MOOCs. In a moment when university budgets are -let's say- 'under pressure', costs need to be even more justified.

5. Thinking blended

After analysing the above data, the University tried to assign priority to courses offered on Campus. That means, offering the instructors the possibility to prepare the courses as a MOOC testbench - in fact, SPOCs - which will be first offered inside the University. Doing it this way, we can accommodate much of the creation cost of the MOOC inside the preparation costs of the on Campus subject.

The experience we analysed in deep considered changing the teaching model. The subject had an initial workload of 3 hours per week (2 lecture, 1 problem solving). This model was changed to 1 hour lecture plus one hour problem solving, in addition to MOOC materials to follow explanations. While this model can be used to reduce costs (finally, there is a reduction in teaching hours from 3 to 2 per week), instructors agreed to offer same total amount of hours, but splitting groups to provide better support. As we see, we can decide whether to reduce costs or to increase quality - not only by providing MOOC materials but also by creating smaller groups.

There was an effort to compute how students value the MOOC change. The survey carried out showed these points as the most important to students (rating 1-5, being 5 the higher value):

1. Ability to review explanations (mean 4.6, with 74.9% rating 5)
2. Be able to watch videos anytime and on different platforms (mean 4.6, 74% rating 5)
3. Be able to get immediate responses to quizzes (4.6, 75.8% rating 5)

The survey provides also interesting data for non-valuable items for students. Forums were poorly rated (3.2 with 24.2% 3 or under) and - more shocking - the possibility of having smaller groups was also not really valued (3.4 with 19.4% 3 or less). In our opinion, this result has to be contextualized, and re-evaluated when specifically-designed small-group activities are defined and implemented. Anyhow, if the University could make the effort, students clearly prefer the MOOC version (81%) with almost same percentage rating 4 or higher the experience.

If we measure quality based on student results there is a slight increase in success ratios. We think this data is not statistically relevant yet (it has been analysed for only one semester), but we see a clear increase in people engaging and following the subject.

At the same time, we decided to take the cost analysis one step further. If doing so, we see that the costs of creating a MOOC could be absorbed in the long-term when using the blended approach, if we decide to reduce number of on-Campus hours. In our case, we have decided to keep the number and increase teaching quality, but flipping the classroom could provide also a way to absorb the costs of MOOC creation.

6. Conclusions

Managers of higher education institutions, and in particular Universities, have to face what to do with MOOCs. They have costs - that's undoubtable- and a cost-benefit analysis has to be performed. We tried to simplify the model in order to analyse which costs were direct costs, and how they could be absorbed in an on-Campus environment.

Strategic considerations should be made prior to playing the MOOC game. In our case, we decided to offer MOOCs, shifting from an initial 'standalone MOOC' to a 'MOOC from SPOC' model where MOOCs are created based on on-Campus teaching. MOOC platforms provide worldwide visibility and at the same time force a renewal in the way of teaching which can have high impact in the quality of teaching, concepts we would not like to give up.

The analysis of the points above should also provide guidelines for higher education institution managers, who will need to explain the bottom line of MOOCs projects. Having a clear vision of costs and benefits can also help to take management measures to fit costs. In our opinion, the blended learning approach is a way to keep costs controlled, increasing quality at the same time and providing the benefits of being part of a MOOC platform.

As a final word, and with independence of the numbers we offer, Universities - and in particular public institutions - should return value for society and - no doubt - MOOCs can play a role. In addition, there is also the opportunity cost, and in particular for institutions deciding not to enrol. Putting together strategy and numbers should allow managers to evaluate the proper impact of MOOCs in their institutions, and that means answer the first - and not so simple - questions: MOOCs: yes or not? And if so, why and how?

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Teaching with Twitter: reflections on practices, opportunities and problems

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1. ABSTRACT

In recent times there has been an increasing wave of interest in the use of Social Media for Teaching and Learning in Higher Education. In particular, the micro-blogging platform Twitter has been experimentally used in various Universities world-wide. There are relevant publications reporting on experimentations with Twitter for reaching diverse learning goals, including better engagement, informal learning or collaboration among students. Existing research papers on the use of Twitter however focus exclusively on the positive aspects of experimentations, on what went well in the use of Twitter. In our University we run a small project on the use of Twitter with goals that are similar to those of others: fostering participation and better learning processes. In this paper we report on our project and the strategies and best practices we adopted for using Twitter for teaching. We also reflect that in our experimentation however we encountered a number of practical problems connected for example with use of technology, with the class settings and with spam. In the conclusion we offer some recommendations for Teaching and Learning with Twitter based on our personal experience.

2 INTRODUCTION

In contemporary hyper-connected society, learning and teaching takes place not only in physical contexts (classrooms) but also in virtual contexts. There are university supported Virtual Learning Environments (VLE) (e.g. Blackboard), as well as variety of unsupported Social Media Platforms (SMPs) that students can use as a Personal Learning Environments (PLE). SMPs are applications that enable the users to create and share content in cooperative forms (e.g. blogs, Twitter). SMPs can also be used as 'Back Channels' within Lectures where students can use their personal devices (e.g. Mobile phones) to maintain a real-time online conversation alongside the main lecture. SMPs are media that largely change traditional assumptions about the audience (Jenkins, 2006). In the traditional media model (e.g. newspaper, television) there is a separation between production and consumption of information (e.g. newspaper editors and journalists produce the content and the public just consumes it). In SMPs assumptions are made instead on the existence of a proactive audience which also produce the media content, in a situation in which communication is a many-to-many rather than a one-to-many process (Bruns, 2008).

The process of Teaching and Learning (T&L) as supported by information technologies is clearly not new area of inquiry. For example, the concept of E-learning - defined as the use of "Information and Communication Technologies" in education - has been around for some years now (Andrews and Haythornwhite, 2007). Traditionally however we understand E-learning as something taking place within specific and custom based platforms, developed and supported for example by Universities or companies. SMPs however offer a different starting point: these are already widely in use by people for their daily communication. In other words, they are not custom based platforms, created for the sole purpose of learning, they are instead one of the ways in which people communicate and learn in our digital age. Many of our daily activities are being influenced by the wide diffusion of SMPs of

which Facebook, Twitter, Blogs or Online Gaming are the most relevant examples. In SMPs, users are both the consumer and producer of the content.

In our University we conducted a small research project (from January to September 2014) on the use of SMPs for teaching and learning, in particular using Twitter. Our project was based on multiple intents, including:

- Generate interest in the students and staff around the use of Twitter for T&L;
- Increase the skills in the use of Twitter for T&L among the members of the research team;
- Conduct a literature review on the use of Twitter for T&L;
- Test a number of best practices (including additional apps) transferable across diverse modules;
- Integrate these best practices with existing learning technologies (in particular the University VLE);
- Conduct an evaluation with the students about the overall project.

There are many reasons connected with the choice of Twitter for this project. Firstly, Twitter is an easy to use platform. It is a microblogging platform that allows to communicate using short text messages of 140 characters. It is quite direct, very synthetic and has a short learning curve. It is also the second most used Social Network platform after Facebook (Venturebeat, 2012). Secondly, the interest in using Twitter for T&L in Higher Education goes back few years now and we have initial accounts of this being done in 2008. The effectiveness of Twitter for T&L therefore is quite established among the academic community. However we are still in the process of discovering its potential for T&L purposes.

In this paper we will report on some of the results of this project and in particular on the literature review and on the best practices. Toward the conclusion of the paper we also discuss some of the practical problems we encountered during the conduction of our project. We then conclude the paper offering recommendations based on both our literature review and our practical experience for conducting T&L with Twitter.

3 LITERATURE REVIEW

The project team conducted a literature review on the use of Twitter for teaching and learning during the period January-March 2014. For sampling the material we used an approach different from those of existing literature reviews on the same subject (e.g. Gao et al, 2012; Tiernan, 2013). Rather than selecting articles on the basis of the scientific rigor we used a "very permissive" snow ball sampling strategy, collecting both papers of high scientific quality as well as publications that were quite descriptive and less rigorous (including MA Thesis, conference papers). This was done with the specific intent to capture a wider understanding of the practice of using Twitter in class, as we observed that often more descriptive and less rigorous publications were far richer of details about the actual use of Twitter than more rigorous publications. For collecting the material we used mainly scholar.google.com an online service offered by google, which allows to search and retrieve scientific publications leveraging the potentialities offered by the google search engine. Using this approach we collected 39 papers broadly related with the subject of Twitter (and microblogging) for T&L in Higher Education.

3.1 Literature review and learning theories

The connection between the use of technology (at a general level) and Twitter more specifically with learning theories is an aspect that emerged during the review. Not all the publications reviewed have strong connection with learning theories and some remain quite vague on this aspect (e.g. Lowe and Heaton, 2012; Sullivan, 2012; Cronin, 2011). One of the publications revised argue (as a recommendation for future research) for the need to bringing more scholarship into this area (Tess, 2013). This is a position that we strongly second, as indeed learning theories should provide the framework within which Twitter can be used to achieve learning goals.

In the sample, we were able to trace explicit connection with learning theories in 11 papers (Holotescu and Grossek, 2010; Grossek and Holotescu, 2010; Ebner et al. 2009; Junco et al 2013; Junco et al 2011; Tess, 2013; Evans 2014; Leaver 2012; Blessing et al 2012; Elavsky et al 2011; Kassens-Noor, 2012). Even before conducting the review we expected that possible connections with theory could be directly linked with some forms of flexibility and direct student participation in the learning process, in line with the Social Media rhetoric of participation:

The Internet Communications degree, of which Web Communications 101 is part, is driven by the idea of ‘knowledge networking’, which emphasises that learning and teaching increasingly happen in networked environments, often utilising networked approaches, but here networks do not refer to specific online tools but rather a broader sense of connectivity which is typified by, but not limited to, online communication. (Leaver, 2012, p. 98)

What expressed in the previous quotation is an idea that owes much to the perspective of Social Media Literacy developed by Rheingold (2010). The consideration that it is possible to channel and better support learning processes with social media by focusing on certain “literacies”: attention, networking collaboration, participation and critical consumption. In this light, it is noteworthy to observe that in a minor number of publications we traced explicit links between the use of Twitter and an emerging learning theory called “connectivism”, which according to the promoters place itself after traditional learning approaches (i.e. behaviourism, cognitivism and constructivism):

Prior to the development of social media, the dominant learning theories were behaviourism, cognitivism and constructivism. [...]. Connectivism (Siemens, 2005), by contrast, is based on the premise that knowledge exists in the world rather than in the mind of an individual. The theory was developed in an attempt to take account of the impact of the information revolution and the shift in importance from what an individual knows to what an individual knows how to find out through the connections they have created. (Evans, 2014, p. 905)

The theory of Connectivism emphasizes certain aspects of learning collaboration and leveraging new media for learning, but in ways that according to Siemens (2005) go beyond Social constructivism and other more individualistic approaches. The connections between the use of Twitter for T&L and the Connectivism approach as well as with the Social Media Literacy perspective are clear (Rheingold, 2010). This is for example Rheingold:

Using the technologies and techniques of attention and participation allows people to work together collaboratively in ways that were too difficult or expensive to attempt before the advent of social media. Though collaboration has a slightly different definition from cooperation and collective action, in general doing things together gives us more power than doing things alone. (Rheingold, 2010, p. 19)

Learning is a social and collective process (as for the constructivism perspectives) which can however - and this is the key connection between Social Media and Connectivism - be better augmented using new and emerging technologies. Furthermore, these technologies allow to access knowledge that exists in the world, outside the “mind” of the learner. We have therefore a better collaboration and cooperation in the learning process which can take advantage of knowledge that exists over the internet and other forms of online media: Knowledge therefore that exists in the world and not only in the mind of the learner.

During the analysis we traced connection with other learning theories. Some authors made explicit connections with constructivism approaches (e.g. Holotescu and Grossek, 2010; Tess, 2013). The followings is an example:

Consequently, in a society where most of the people suffer from lack of time, the authors encourage the use of microblogs in educational activities, because a microblog-based learning has as immediate consequences an unprecedented flexibility in comparison to classical education, a real participation, an interactive collaboration [...] Moreover, the capacity of transforming the traditional learning structure (the students’ learning performances improve) by using multimedia objects observes constructivist theory and pedagogical principles. (Grossek and Holotescu, 2010, p. 2155).

The excerpt presented above is directly connected with social learning processes and collaborative learning theories. There are relevant connections between the Communities of practices approach and the idea of using Twitter for, for example, supporting the creation of communities among students or enhance a better interaction between students and the instructors (Tess, 2013).

In the review of literature we were able to find also one paper that has an explicit connection with Cognitivism:

Cognitive and developmental literature consistently reports facilitative effects of reminders on long-term memory tasks[...]. We believe that using technology to highlight and remind students of important knowledge after the class and in a humorous manner is consistent with past memory research and will provide an advantage for recall of those concepts in subsequent assessment. (Blessing et al 2012, p. 269)

This connection is made however only in relation to a specific practice: using Twitter to remind concept and therefore reinforce the cognitive learning process. In such case the direct intervention and the use of Twitter is not connected with the creation of a social and collaborative learning process but it is directed toward the single learner. Interestingly - but not surprisingly - no explicit mention is made to behaviourism in relation to the use of Twitter or micro-blogging for T&L.

3.2 Literature review and learning practices

The rhetoric surrounding SMPs clearly is one of collaboration and collective production of content. Literature findings show for instance that the use of Twitter can in some instances generate a better sense of community among students:

The use of a microblogging tool in a course to foster informal and process-oriented learning led to interesting results. At the end of the course it was shown that microblogging is indeed a new form of communication. (Ebner et al. 2010, p. 98)

Observations therefore support the idea that Twitter can indeed support a process of community generation in a way that goes beyond traditional class dynamics.

The use of Twitter for T&L can also support new forms of communications among students and between students and instructors. These are often observed in experimentations with Twitter. Some lecturers explicitly used Twitter as a direct communication channel, fostering in some cases a two way communication between lecturers and students:

We improved contact between students and faculty (principle 1) by providing an avenue for contact congruent with their digital lifestyles. (Junco et al, 2011, p. 128)

In the perspective of Social Learning and Communities of Practices (Wenger, 1998) in particular, the instructor acts more as a facilitator compared to other learning theories in which for example there is a complete dependence of learners from instructor (i.e. behaviourism). Clearly social media and Twitter in particular can offer opportunities to foster this facilitator role by creating reciprocal forms of communication.

A key aspect is the issue of inclusion/exclusion. It is important to consider that not every student has a Twitter account or might be interested in using it. Therefore, exclusion for the students not interested or not possessing an account should be limited where possible:

Use of the Twitter feed is not mandatory, nor is it graded. This is important for students to realize, particularly those that are unable or see no value in using this particular technology. Do not make the mistake of unintentionally shaming students by privileging this technology (and those who are using it) over students who do/cannot; (Tyma, 2011, p. 178)

This is a relevant observation that needs to be transformed also in some practical solution. For example in our project we provided the course hashtag (e.g. #SO1054A, the code for a module called Virtual Environments, Crime and Cyberspace) Twitter feed in the University VLE, in this way students could access the Twitter content for the module without the need of a Twitter account and by visiting a learning environment with which they are familiar and that they frequently use.

A key aspect for the success of using Twitter is not to leave the experimentation to excessive emergent processes. While it would be possible to offer the use of Twitter in a very loose way,

successfully embedding this social media in teaching and learning practices require a structured approach. Lin et al (2013, p. 44) called the "structure" a scaffolding:

Instructors should focus on the main objectives of incorporating Twitter in class and introduce these functions as appropriate. With proper scaffolding, students should struggle less with the tools and will be able to better interact with peers.

The scaffolding or structure should be accompanied with a clear presentation of the goals and objectives of the use of Twitter, and the best practice suggested here is to use some time at the beginning of the course to make a proper introduction to the goals and objectives:

An interesting series of reflections observed in the literature are connected with the role of the instructors (i.e. lecturers) and how the use of Twitter changes their role and what are the expectations connected with their role. A clear suggestion offered in a number of papers is that instructors need to know well the new medium and display confidence in using it for T&L, with planned activities and production of digital content:

In order to have success in the classroom with Twitter, you will want to become knowledgeable about Twitter and its functionality. (Tyma, 2011, p. 177)

In order for the use of microblogs in didactical approaches to actually reach the previously mentioned results, a closely planned development of digital contents is necessary (the description of educational objectives, the orientation of education according to certain concrete landmarks, the construction of efficient learning situations, the planning of adequate evaluation tools). (Grossek and Holotescu, 2010, p. 2155)

There needs to be therefore a substantial preparation phase connected with the use of Twitter in class, and nothing can be left to improvisation. Instructors need to master Twitter and plan carefully the activities and the technological settings for the use of Twitter. Furthermore, an interesting research by Johnson (2010) also investigated the connection between the use of Twitter for teaching and the student's perception of the instructor credibility finding that the explicit connection between instructors and Twitter content shows a higher perceived credibility of the instructors in the eyes of students. Mastering Twitter and providing relevant content therefore could increase the perceived credibility of the instructors for students.

4. USE OF TWITTER IN CLASS

In line with the consideration that the use of SMPs needs to be underpinned by a pedagogic model, we offer now a short discussion of our perspective. Our project was underpinned by the pedagogic perspective of Communities of Practice (CoP) (Wenger, 1998). The key assumption of the approach is that learning is a social process in which people engage with one another via practical activities. Learning is a social process taking place in communities of people that build a shared repertoire of practices. Practice is doing something in the world one is immersed in. It involves the mobilisation of existing elements that are both explicitly available, but also tacit. According to Wenger (2007), people in communities "develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems—in short a shared practice. This takes time and sustained interaction". The notion of CoP well connects with SMPs: learning is a collective process of people that bring with themselves their own skills, experiences and abilities via the mediation of the platform. SMPs can foster a collaborative process of creation - students contribute to knowledge creation via Social Media - via sustained interaction in a situation which there is also a significant reduction of the distance between producer and consumer of information, between instructor and students. Students are entrusted to produce - at least part - of the information they consume.

We conducted an active use of Twitter during semester 2 of Academic Year 2013/2014 in 3 different modules and with diverse levels of intensity. The key module where Twitter has been used for the whole semester is SO1054A (4th year criminology module Virtual Environments, Crime and Cyberspace). We will account here mainly for the activities carried out in this module. The activities carried out in SO1054A using Twitter can be divided according to the main traditional teaching activities:

- Activities conducted in Lectures;
- Activities conducted in Tutorials.

In particular during tutorial activities we proactively embedded the perspective of CoP in the use of Twitter, hence explicitly linking the SMP with our pedagogic perspective. Before describing the actual practice, few words will be used to describe the preparatory tasks carried out by the team, again in particular for the module SO1054A.

5.1 Preparation

There has been a preparation phase for the project which was conducted in the weeks prior the start of the teaching. The team also took advantage of existing knowledge of its members and was able to arrive at the start of teaching with a clear plan for action. Preparatory activities included:

- The lecturer set-up of a specific Twitter account, to be used for teaching purposes only and therefore separate from the personal account.
- The creation of module hashtag, specifically #SO1054A, through which all the content of module would feed on Twitter.
- An exploration of the opportunity to integrate Twitter within the University VLE.
- A plan for the activities of the project throughout the semester, for both lectures and tutorials.

Additionally a key preparatory aspect to which we paid particular attention has been the integration between the existing University VLE and Twitter. There are several reasons for this. It is relevant that all the students are treated equally and when introducing an “external” technology like Twitter, it is not reasonable that students should be forced to have a Twitter account or use Twitter. Therefore, the integration between Twitter and the VLE is essential. With this integration for the module SO1054A students were able to access the hashtag (#so1054a) from the VLE without feeling compelled to have a Twitter account. Furthermore, during the semester lecturers embedded a number of relevant hashtags in the VLE (e.g. #malware or #cybercrime) hence allowing students to access a wider selection of materials.

5.2 Lectures

Twitter has been used throughout the semester during lectures in the form of a Twitter wall in class. The set-up consisted of an adjunct projector, a laptop with Twitter projected directly on the class wall (see Figure 1). The idea was to allow for more direct interaction between the instructor and students during the delivery of lectures, with students producing content that would feed into the lecturing process. On this, an important aspect to consider is that the classroom had a sufficient large white wall space to project the Twitter wall directly in front of the class (or the space for an additional screen). This wall space is essential for the task. As we will observe later the rooms in which the other 2 modules took place were not favorable for running a live twitter wall. In other Twitter experiments as studied in the literature review, the ideal set-up would also consider a Teaching Assistant managing the Twitter feed, in order to keep the back-channel alive during the lecture.

In the first lecture of the semester the students were briefly introduced (15 minutes) to the idea of experimenting with Twitter. They were briefed about the expected learning goals of the project, about the good practices of using Twitter during the module and about key basic concepts of Twitter. During the introduction it was made clear that the use of Twitter was not mandatory and that the lecturer would offer opportunities to benefit from the content for those who do not have a Twitter account (via the VLE). In class Twitter was used with the intention to offer an additional opportunity for students to interact with the lecturer and for activities such as posting new contents or asking questions. An observation that can be made is that since the Twitter wall is visible by everyone in the class, this hinders participation (i.e. in the same way as for asking questions normally). This issue was raised during the evaluation with the students. Furthermore, since

students use their personal accounts, a problem that was raised during evaluation was that not all the students feel positive about mixing University and personal content on Twitter.

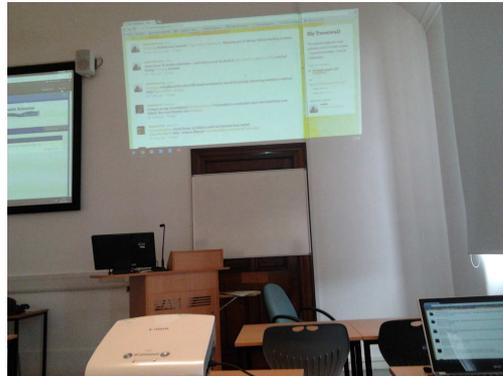


Figure 1. Set up for teaching with Twitter in class, module SO1054A

However, during the experimentation in class with the Twitter wall the following Twitter “apps” were also tested with the intent to find transferable solutions that could be used across diverse modules:

- **Tweetwally:** this a free app that creates a Twitter wall ready for projection. It allows to project tweets connected in particular with specific hashtags (i.e. #SO1054A) and tweets will appear in linear order on the wall. The app also offers the opportunity to have a unique URL (e.g. <http://so1054a.tweetwally.com/>) which facilitates retrieving of the information or embedding the wall in the VLE.
- **Bufferapp** (<https://bufferapp.com/>): allows to buffer a number of Tweets that are posted (with the designated hashtag) at set time/date. The free trial version of Buffer allows to buffer up to 8 Tweets per day, a number sufficient for the purposes of the experimentation. Buffer was used to produce content on the lecture wall, while the lecturer was teaching. This required advance preparation of a number of tweets connected with the lecture. The Tweets buffered would normally offer content related to: 1) further readings; 2) specific definition of concepts and source (i.e. publication); 3) websites with relevant information.

Advantages and problems encountered: in most experimentation with Twitter (as analysed in literature) the Twitter wall in class is managed by a Teaching Assistant (TA) that works together with the lecturer. The role of the TA is to keep the interaction live n the wall during the lecture. Since this was not possible for various reasons, for the conduction of our project, Buffer was used as a sort of “replacement” of the TA tasks. While this was a reasonable solution, in the feedback moments the students remarked that the buffered Tweets were appearing in a “robot a-like” fashion with marginal engagement. A further problem encountered in using Buffer was the need to synchronize the Tweets with the lecture content. During preparation phase of the buffered Tweets the lecturer tried to estimate the time required to reach a certain point of the lecture and planned the Tweet accordingly. This strategy worked on some occasions but in others was limited. Generally, however, testing with this app was relevant and the team is currently using it in the prosecution of its activities with Twitter for T&L.

- **GroupTweet:** a third application used during the project was grouptweet (<http://grouptweet.com/>). This app allows to create group discussions in anonymized way, using a hashtag (e.g. #ve_cybercrime). Essentially, the key aspect why this app was tested is that it allows the appearance of Tweets in an anonymized form on the class wall. The team idea was that this could facilitate the interaction of the class with the Twitter wall, while minimizing problems with the students exposing themselves to the whole class.

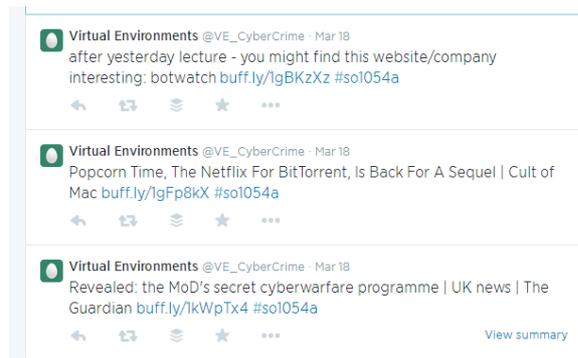


Figure 2. tweets appearing anonymously with grouptweet on the class wall

5.3 Tutorials

A key aspect that emerged from the literature review is to “embed activities with Twitter” directly into lecturing activities. While lectures (especially for the module SO1054A) were kept in the traditional format (with just the addition of the Twitter wall), experimentation for bringing Twitter directly within the class activities has been done in tutorials. This seems a reasonable choice as tutorials are meant to foster activities that include group learning, discussion and confrontation. This is also in line with the CoP perspective: our pedagogic approach to teaching with SMPs. The format of the tutorial for SO1054A has been planned as follows:

1. At the beginning of the tutorial, the lecturer would recall the key concepts/aspects of the lecture (length: approx. 10 minutes).
2. A short video connected with the lecture content (pre-selected by the instructor from various outlets) would then be presented offering further insights into the subject of the lecture (for example a video about malware software, or about manipulation of reputation online) (length: approx. 10-15 minutes)
3. Before the video presentation, the students were provided with a sheet containing group-work tasks, to be conducted in the second part of the tutorial. These tasks would include discussing a number of questions but also conduct a number of activities with Twitter (20 minutes)
4. The final part of the tutorial was a final collective discussion about the results of the group-work and findings made with Twitter (10-15 minutes)

The step number 3 is where Twitter has been directly embedded in teaching activities using the CoP perspective. Following are two examples of group work tasks to conduct with Twitter during tutorials:

Twitter tasks	twitter
<ul style="list-style-type: none"> • Search for the #malware hashtag • Do you see any pattern in the tweets using this hashtag? • What types of malware are being discussed in the displayed list of tweet #malware hashtag • Retweet one of the tweets using the #malware hashtag for the #so1054a and add a comment 	<ul style="list-style-type: none"> • Look for these bots on twitter: @Yoda_Bot @RedScareBot @LogicalBOT @MarmiteBot • What can you tell about the followers/following ratio? • Would you follow a bot on twitter if this provides interesting content?

Figure 3. Examples of tasks to be conducted with Twitter during the tutorials

There are two key pedagogic aspects underlying this approach:

1. Allow the students to do group-work activities with social media. Students would use Twitter in group work - as a small CoP - to discover relevant aspects connected with the lecture content and learning from each other, with the instructor acting as facilitator of the process. This learning would include not only finding relevant material for the module, but also learn together how to use Twitter. Students were also encouraged to post content for the module using the course hashtag, in this way sharing their findings and thinking with the class. This was a process for fostering social learning among peer students.
2. Offer insights on the use of social media for obtaining up-to-date information. This is perhaps the key aspects for embedding Twitter in the lecturing. SO1054A is a module on "cybercrime" (broadly defined). This is a subject who is in constant evolution and professionals need to find way to remain updated about the evolution of cybercrime. Twitter (as well as other SMPs) can offer a relevant channel - a sort of access to a World-Wide CoP of experts - for achieving this goal as information travels in real time over Twitter and it is possible to follow both selected hashtags (e.g. #malware, #piracy) or users (e.g. @schneierblog one of the most renowned security expert or @kasperskylab a world leading research lab on malware and security).

Generally the use of Twitter directly within tutorials has been evaluated positively by the students during feedback moments. Students used Twitter for discovering additional knowledge and tweeted content for the class using the module hashtag, hence fostering a social learning process. During the evaluation students also offered positive feedback on the fact that working with Twitter during tutorials offered the a broad array of new material for their study and courseworks. From the lecturers point of view, there is the feeling that the use of Twitter has helped the students understanding the relevance of social media for continuous learning and especially professional purposes.

5.4 Problematic issues

During the conduction of the project several practical problems arose. It is relevant to reflect on these problems in particular in the light of the consideration that current literature rarely touches on practical issues and problems. The following are two of the key problems encountered during the project:

1. **The Classroom:** as anticipated we have tested with a Twitter wall in 3 modules. Testing in more classes/rooms revealed that not all the rooms are suitable for a live Twitter projection. One of the modules took place in one of the main lecture theatres and the team projected a Twitter wall alongside the lecture on an additional screen. However the room physical layout is made in a way that the wall is visible only in the first rows. A solution to this problem would require additional planning before using Twitter and the selection of an appropriate room.



Figure 4. Room physical layout impacts the experience.

2. **Spam:** during the experimentation in the core module for the project (SO1054A) some issues emerged with spam. While spam never reached a high level and remained limited to few isolated cases, it is important consider some of the problems connected with it. In particular two different forms of spam emerged. The first form is the spam of the class Twitter wall. While this was not widespread there have been few occasions in which students used the wall to send spam messages (e.g. jokes visible to the whole class) that disrupted the flow of the lecture. This raised disturbance for both the lecturer and the students who were following the lecture (comments about this were reported in the evaluation). A second form of spam was the spamming of the class hashtag. This has potential for being more disruptive, as it could "pollute" the module hashtag resulting in diminished positive learning experience. In this case the lecturer ignored the spam, which disappeared after few days.

6. CONCLUSION

This paper presented some of the practices we used for the conduction of a teaching project using Twitter for T&L at a University. The first half of this paper has been devoted to a presentation of the results of a literature review. Key outcomes from the literature review produced by the project are:

1. **Learning Theories:** the need to pay particular attention on the connection between learning theories and the use of technology - including Social Media - in class. This is an aspect which is apparently often overlooked in practice but which is relevant to achieve pedagogic goals by using SMPs for T&L. In our project we linked our tutorial activities with Twitter with the perspective of Communities of Practice.
2. **Exclusion/inclusion.** Twitter is often seen as a tool that can better foster engagement and participation and that can offer alternative channels for communications. This is in line with the rhetoric surrounding the social web: anyone can participate. However, while there are advantages offered by the technologies for a large inclusion, it is important to consider risks of exclusion when developing a project. Lecturers need to plan activities that will facilitate inclusion such as, in our case, bringing the Twitter feed in the VLE.
3. **Structured approach.** Leaving an experimentation and practical use of Twitter in class to emergent processes might undermine outcomes. A relevant suggestion identified in the literature is the use of a "scaffolding" with proper introduction about the tool and the expected goals as well as the embedding of activities within the learning process. This gives students a roadmap and justifies the use technologies for teaching and learning and supports the work conducted with students. In our project we embedded Twitter directly into tutorials with structured activities and discussed the project with the students in lecture one of the semester.

At a general level the key goal of the project was starting to raise interest around the use of Twitter in our University and also offer to participating staff the opportunity to increase their skills and confidence in using SMPs for their T&L activities. Seen differently, this was a process for building a Communities of Practice among staff members. The staff enjoyed an opportunity to work together as community on practical activities and learning from each other by doing these activities. The pedagogic model of the CoP hence does not just apply to students but to the whole University (students & staff). These goals were reached as the use of Twitter is currently continuing also after the end of the project. Staff members involved in the project are currently conducting training activities for other staff members at the University. Project members have also produced simple guides for supporting the introduction to other staff to the use of Twitter, for example a short guide on how to embed a Twitter feed in the University VLE.

A final conclusion of this project has been the formulation of a number of recommendations, and in particular:

Recommendation 1 - Training: There should be training activities planned at a University level for teaching staff since delivering T&L with the use of additional SMPs is a complex process that requires

appropriate training for lecturers who need to prepare not only themselves but also a number of planned activities in order to embed SMPs appropriately in the teaching and learning flow. As discussed above the appropriate perspective for this process would be the one of CoP, where staff should work together on practical issues and learning from each other.

Recommendation 2 - Social Media Policy: Staff needs to be trained about the Social Media Policy and should contribute to changes to the policy. Indeed recent research shows that there is a rather increased use of Social Media for communication with students, also replacing more “traditional” communications (e.g. email), however not everything can be communicated with Social Media (e.g. issues surrounding exams) and staff should be aware of what is allowed and not allowed by Social Media Policy at University. The Social Media Policy should also reflect inputs from staff and their teaching practice with SMPs.

Recommendation 3 - Planning: as detailed in this paper, a key aspect for using SMPs for T&L is planning (e.g. rooms, software). Planning therefore should be embedded in any attempt to use Social Media for teaching and the University should support this. Running a project requires material, equipment and an appropriate room. There should be a centralized planning approach offering full support to teaching staff.

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BENCHEIT - Benchmarking Higher Education IT

An Update on the Work of the EUNIS Bencheit Task Force

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Keywords

benchmarking, BencHEIT, CIO, IT management, costs

1. Summary

Several higher education institutes have systematically collected their IT organization's financial and volume data since 2010 and share them with each other. Data from year 2014 is expected to involve around fifty organizations.

EUNIS Bencheit task force gathers the data and generates an analysis. CIO of an institute can evaluate his/her organization's IT expenditure, technical volumes and IT personnel data against their peers' numbers.

Data is collected in three dimensions

1. Organizational level: centralized IT, other centralized units, distributed units e.g. faculties and research centers. This way participating organization can see how (de)centralized their IT is in comparison to others.
2. Account level: financial data is divided in hardware, software, staff, facilities, outsourcing and other costs.
3. Services: all costs and also some of the volume data is collected within different IT services e.g. infrastructure, workstations, business applications.

The aim of this exercise is to give CIOs tools to start more detailed discussions how to improve the performance of institute's IT services. Analysis also gives some perspective to common development within the higher education IT.

This yearly benchmarking survey has been so far free of charge, the only expense being the work effort involved in collecting data. Data is freely shared among participants and only among them.

In our presentation we will explain the process and some examples how to use these results from analysis. We will also present some examples of indicators from BM2014 survey analysis. We will also show historical development of a few indicators during last five years of benchmarking process.

Bencheit is one of the EUNIS official task forces. This presentation aims to be both a short summary of what the Bencheit aims and benefits are, but also to give a short glimpse of what new results have been obtained during the latest benchmarking round during January-April 2015.

There will also separately be a dedicated Bencheit preconference seminar during Tuesday 9th of June 2015 in Dundee, which is especially intended for those organizations that have already participated in the benchmarking process.

2. AUTHORS' BIOGRAPHIES



Teemu Seesto has M.Sc. in economics from Turku School of Economics. He has been a teacher of information systems science for twenty years. Seesto was the CIO of Turku School of Economics during 2006-2010. He is currently the IT general secretary of FUCIO, the Network of Finnish universities' CIOs. Teemu is a member of the Bencheit steering group.



Yvonne Kivi is an IT planning officer at the University of Helsinki and the project manager of Bencheit. She holds a B.Sc degree from Arcada university of applied sciences. Yvonne is the key contact person to most of the institutions that participate in the Bencheit work.



Ilkka Siissalo is the CIO of University of Helsinki, EUNIS Vice President and chairman of the Bencheit steering group. Ilkka holds an M.Sc degree in biochemical sciences as well as a bachelor level degree in marketing. Ilkka has acted as the IT leader in various research related institutions both within the private sector and academia for over 25 years.

EUNIS 2015: A national business intelligence service for UK Education and Research

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Keywords

business intelligence, benchmarking, performance management, analytics, decision making, shared services

1. Summary

“Business intelligence simplifies information discovery and analysis, making it possible for decision-makers at all levels of an organisation to more easily access, understand, analyze, collaborate, and act on information, anytime and anywhere” Source: Microsoft 2008

This session describes a national initiative to develop new business intelligence (BI) shared services for UK education and research. The production service will replace an existing service in use at 163 higher education providers, by over 4.5K staff in November 2015. In addition we are developing a research and development (R&D) function as an exploratory project phase running until late 2016. Jisc has a mission to make the UK the most digitally advanced education and research nation in the world. The higher education statistics agency (HESA) collects mandatory data from all publicly funded UK higher education providers. The higher education strategic planners association (HESPA) represents the Heads of University planning. Building on prior work of the collaborating organisations and utilising modern technologies, the new services aim to take BI to a wider range of staff than is currently possible. *During the session we will showcase the overall service design and give examples of BI maturity capability, responding to comments, questions and inviting delegates to follow and contribute to the work.*

2. Need

The benefits of good business intelligence to support evidenced-based decision making are well known and a summary provided below, yet there has been little join up to help education providers exploit it. HESA and Jisc have joined forces with HESPA to develop tools, services and advice that will enable a wide range of staff in making sound business decisions, promoting UK education sector maturity and capability in business intelligence.

3. Barriers and benefits

Barriers to successful business intelligence implementation include:

- Technical - data cleanliness, definitions, ownership and currency
- Non-technical - data literacy, interpretation, strategy and the usual cultural issues faced when using technology to underpin change.

Whether an organisation has little to no business intelligence provision or has a mature coordinated service, these new HESA and Jisc services and tools will help address these and bring many benefits:

- Greater leadership and business acumen by enabling senior and middle managers to make sound evidence-based decisions at strategic and operational level
- Saves money through reduced need for commercial benchmarking
- Saves staff time through easier and faster data compilation and analysis

- Greater efficiency and effectiveness through innovative use of data to support process improvement
- Value for money through enabling a wider range of staff to use these services regardless of their expertise in data analysis and with a much wider set of data
- Demonstrating to government and other stakeholders a commitment to understanding and improving efficiency
- Enhances business intelligence skills and consolidates best practice through delivering training and cascading expertise.

4. Services and timescales

The initiative is developing the following during November 2014 - November 2016;

- A service populated with quality assured data, dashboards and visualisations based on the business questions planners and their customers need answers to, using Tableau software (beta release July 2015, production release November 2015)
- A national 'Analytics Lab', an R&D function where business questions requiring access to wider data sets can be explored. We will facilitate collaborative efforts to acquire data and undertake analyses. Successful outputs will migrate to the frontline service (exploratory project)
- Building on the OCU higher education BI maturity model we will offer national and international benchmarking through linkages to the European wide EUNIS BI Taskforce and North American Higher Education Data Warehouse Forum surveys
- Relevant advice, guidance and training
- Professional services cost benchmarking
- Links to other Jisc analytics initiatives for example the national learning analytics services

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6. AUTHORS' BIOGRAPHIES

Myles Danson, Senior co-design manager and BI initiative project manager



Myles has been working in Higher Education (HE) for eighteen years. The last eight years have been at Jisc, firstly as a Programme manager overseeing a diverse portfolio across the entire programme lifecycle with over 60 institutional projects. Most recently he became a Co-design manager at Jisc, essentially designing new services for Jisc members. He works with a wide range of individuals, professional associations and organisations representing key HE staff with the aim of bringing the benefits of technology to bear in the enterprise area (essentially running the university as a business). In 2010 he worked with colleagues to develop the Jisc Business Intelligence (BI) Infokit, an online resource offering practical advice and guidance for those wishing to undertake BI in a higher educational setting. Later he contracted and oversaw eleven institutionally based projects as they used the resource, developing their own in house BI capability. He is currently co-project managing this initiative with Nicola Phelps and sees this as the next big step toward helping a wide range of people to accruing the benefits BI can bring and impacting positively on their daily working practices. He likes to apply the three U's to his work, striving to ensure that outputs are Useful, Usable and Used. He has a background in e-Learning and an MSc in Information Management. The first ten years of his career were at Loughborough University exploring e-Learning and e-Assessment systems and developing and supporting new services.

Jonathan Waller, Director of information and analysis and BI initiative Senior responsible owner

Jonathan's role at the Higher Education Statistics Agency (HESA) includes responsibility for all of the Agency's information output activities, covering the full range of information products and services. His 22 years' experience of working within the HE sector began at the Higher Education Funding Council for England (HEFCE) working in the area of research funding. Subsequently joining HESA, he has held a number of roles and been involved in a wide range of different activities and initiatives over the years. He contributed to the formation of the 'Heidi' online management information service which was launched in 2007. The appointment to his current position in late 2007 gave him overall responsibility for the content, delivery and user support of the Heidi service, as well as the strategic development of HESA's information products and services. Starting working life as a data analyst has given Jonathan a keen sense of the value and potential of data in helping organisations to make well-informed decisions in complex and changing environments. His role in the HESA-Jisc Business Intelligence project is as the Senior Responsible Officer at HESA - working closely with Jisc colleagues to ensure that the project delivers on its potential to significantly improve business intelligence capability and impact for the benefit of user organisations.

Using Logstash and Elasticsearch analytics capabilities as a BI tool

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Keywords

BI, IoT, ElasticSearch, Analytics

1. SUMMARY

During the summer of 2014 the Aristotle University of Thessaloniki utilized the Elasticsearch/Logstash/Kibana (ELK) stack for log parsing and monitoring purposes. Not long after a handful of useful services & dashboards were developed and used as source of truth for central reporting needs. Logs input recipes and filters were applied on several data sources and enabled us to gain insight into useful analytics that are further used in order to obtain and support acute and justified business decisions by our administration.

2. BACKGROUND

One such example is the periodical need to update licensing contracts with software vendors, which include (in the case of Aristotle University of Thessaloniki) a handful of software stacks required for educational and research operations of our academic community (such as MATLAB, ANSYS, ArgGIS and more). The defacto logging mechanism of the floating licensing schemes used in such implementations [1] is poor in itself and does not allow for careful retro-investigations of how many licenses from the pool were actually used during the licensing period and for how long. In the past, custom developed scripts would parse the logs accumulated over time, figure out such metrics and dump a series of aggregated results to a central database for further reporting.

3. OUR SOLUTION

Using simple filtering schemes and Logstash we are now able to obtain not only such accumulated results but make more advanced analytics queries into our data, such as which departments actually use the licenses from our pools more heavily, to what end and extent, and which specific features of the licenses are more than others needed by our community (i.e. which ANSYS sub-product was more often used and which was not used even if it was included and paid for in the initial contract). This accumulated information and insight will lead over time to better and more justified decisions by our administration when examining the proposed renewal contracts by the software vendors.

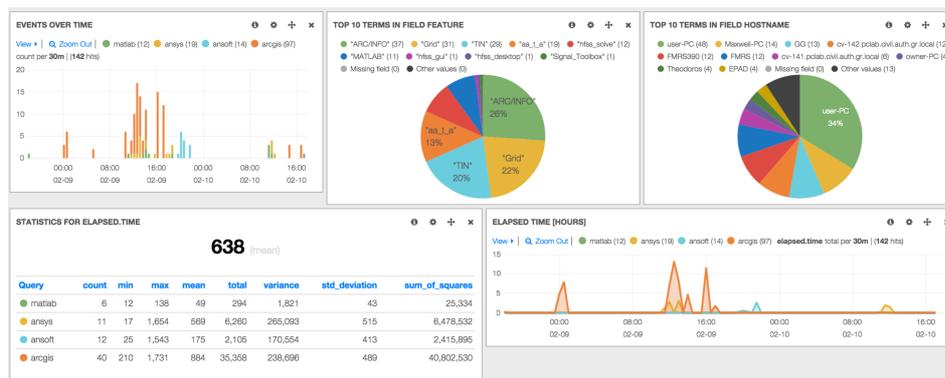


Figure 1 Licensing Service Real time analytics dashboard

Furthermore, this information is given to us in a near real-time environment (Figure 1), something that allows us to fine-grain reserve sub-pools of the licensing in the case of repeated patterns (i.e. weekly academic classes and so on), and our helpdesk to have a rapid insight whenever a licensing problem occurs and is reported.

Several other aspects of the ELK stack implementation in other IT operations have been used and proven useful so far. Examples are accounting records and break in attempts. On the latter aspect for example we now monitor via carefully crafted dashboards the successful and unsuccessful user logins (Figure 2) and using custom API calls towards Elasticsearch we can identify suspicious events in no time (i.e. simultaneous user logins from different countries/regions).

On the accounting level we have a solid view of the incoming and completed compute jobs that are directed to the compute clusters within our premises and administration. Not only can we monitor the number of jobs that are being executed over time but also record other useful metrics, such as CPU efficiency (per job), CPU utilization (overall), waiting times and even exit codes, that further assist our helpdesk services identify quickly when something has gone wrong. Our team has gone one step further and currently integrates IoT devices into the ELK stack thus enabling deeper and more fine grained resolution monitoring in Data Center environments. Thus at the moment the impact of huge parallel jobs (i.e. jobs utilizing over more than 100 CPU slots) on environmental metrics (temperature and humidity) and the UPS output load are monitored in real-time (Figure 3) something that allows us to figuratively assess the cost impact of such jobs overall.



Figure 2 World mapping of ssh activity towards AUTH terminal services

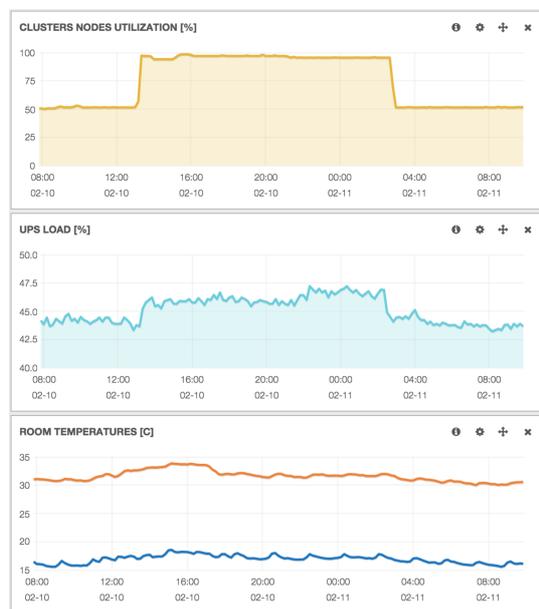


Figure 3 Actual impact of large MPI (parallel) job on power consumption. We note an up to 4C rise in front- and rear rack temperatures. Costs can be accurately estimated from UPS output metrics and AC Units power consumption.

4. CONCLUSION

Our future plans include the integration of logs obtained from Campus-wide distributed access points and radius services in order to detect fraud movement in the campus and integration of further IoT devices over the campus that will allow us to design and provide “smart” university services to our academia and our administration to obtain a better insight on the actual needs through such deep analytics services.

5. AUTHORS’ BIOGRAPHIES

Mr. Paschalis Korosoglou is the technical coordinator of the Scientific Computing Office at the Aristotle University of Thessaloniki. He holds an MSc in Computational science and has participated in major national and European projects. Currently, he is leading the activities of the Scientific Computing Office with regard to Grid, Cloud, Big Data and HPC activities.

Information Systems for Next Generation Universities

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Keywords

Enterprise Architecture, Portal, Cloud, SaaS, Big Data, Mobile, BYOD, SOA, ESB

1. ABSTRACT

This paper presents a next-generation architectural pattern for university information systems, consisting of a unified user experience, shared services in the Cloud, and analytical insights from Big Data.

Information technology has bridged the gaps of time and distance and created an interconnected world where knowledge creation and sharing are multi-directional. This enables collaborative learning and research opportunities that are in stark contrast to the traditional unidirectional approach, where knowledge is obtained at specific places and times. There are also new challenges such as managing social media interactions and the voluminous data generated.

For a university to have effective and competitive information system architectures, three characteristics that are very important: a Unified Experience, Shared Services and Analytical Insights.

In this paper, we present technology solutions and implementation strategies for these three aspects of IT architecture for HE. Firstly, how an Enterprise Portal such as SharePoint or Liferay provides a unified front-end and becomes the chief aggregator of services for students, faculty, alumni and prospective employers. Secondly, we present how shared services such as admissions, student services, research, finance and administration can be hosted as a Service Oriented Architecture in the Cloud to reduce costs, enable vast, on-demand capacity and enhance business agility. Thirdly, we describe the unprecedented challenges & opportunities of Big Data for universities, the new frontiers of text analytics and data-driven science they need to cross, and the new data management capabilities they need to evolve, such as Early Content Analysis, Multi-pass Processing, Visualisation and Predictive Analytics.

However, implementing and managing effective solutions is not trivial. As a pre-requisite, institutions need to map out their needs, assets and other information systems and maintain a roadmap towards a long-term vision. We conclude by presenting a broadly applicable framework that institutions can use to jump-start an Enterprise Architecture Programme that is appropriate for their needs and provides self-sustaining and optimised advancement towards their long-term vision.

2. TRENDS IN EDUCATION

The impact of Collaborative and Social Computing on academic learning and research has resulted in a fast-evolving education landscape. Universities are developing a broader engagement with students across entire student journey, which makes personalization and usability more important than ever. Aggregated and specialized services and views are required for student retention, prospective employers, alumni, researchers, etc. In recent times, there has also been a significant increase in funding pressures, which increases the need for efficiency and accountability for learning outcomes. That also results in the need for standardized workflows, cost-effective shared services and transparency in information sharing.

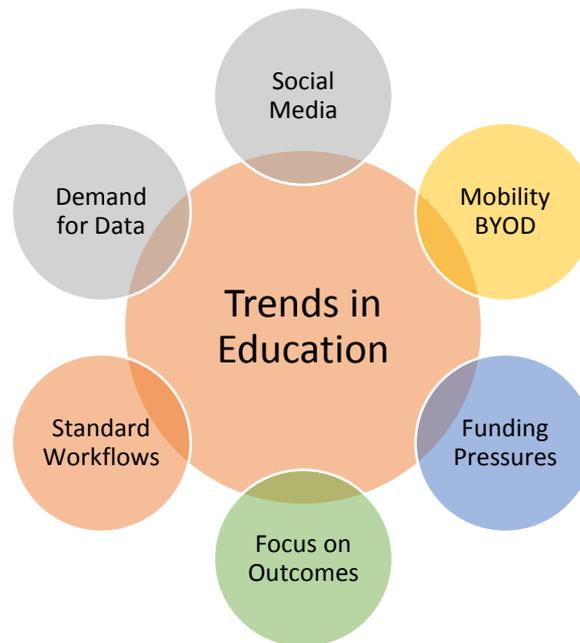


Figure 1

2.1. Broader Student Engagement

Universities often face many problems and high costs because the entire student journey, from applicant to alumni, is not well integrated. For example, the information of an individual may be accepted and stored multiple times, and may have inconsistencies. Further, if the user experience in these interactions is not engaging, opportunities to capture and analyze the data are lost and there will be an increase in abandoned applications, dropouts and poor academic outcomes. There are four key aspects of student engagement that need to be integrated and managed:

- Recruitment - improve all interactions for conversion of enquiries to actual registration
- Retention - track engagement and performance to retain and improve learning outcomes
- Employment - assistance with getting employment, which is an important success criteria
- Re-engagement - how to engage alumni for helping students, attending events, donations, etc.

Due to this, universities increased their focus on a smooth and unified student experience, where the students can access all their information from a single source in a secure manner, and through multiple channels like portals and mobile devices. Ideally, this information is highly personalized according to the circumstances and context of the student, and does not require the student to have anything except the necessary proof of identity. The information presented includes courses, messages, scores, schedules, connections, etc. The students are able to collaborate online through this interface, and data is integrated from various sources such as Student Record System, Timetabling, Library and Finance.

2.2. Intelligent Administration

These days, universities face an onslaught of information from various sources. Due to this, university administrations need to do much more than just 'keeping the lights on'. They need to be much more responsive and use that information to mitigate various types of risks and make continuous improvements in their operations. For example, a student may use his phone to locate a seminar room, download course material onto his phone during the seminar, post some inappropriate content on his university blog, inadvertently upload a virus onto the network, and leave an hour later. Somehow, the university is supposed to respond to this effectively and fast! Some of the key areas of challenge and opportunity are:

- Social Media - unstructured information like blogs needs to be monitored and mined

- Mobility and BYOD - Bring Your Own Device empowers users but also poses security risks
- Workflows - learning and research management workflows are being standardized
- Agility and Efficiency - funding and competitive pressures demand higher performance levels

3. INFORMATION SYSTEM ARCHITECTURES FOR NEXT GENERATION UNIVERSITIES

For a university to have effective and competitive information system architectures, three characteristics that are very important:

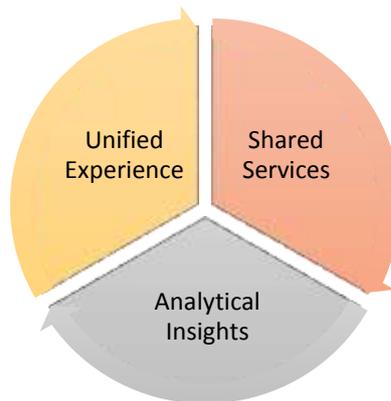


Figure 2

3.1. Unified Experience - Enterprise Portals

In order to provide a smooth and seamless user experience, a unified front-end is required for the shared services. This includes a consistent way to organize and manage users, groups, sites, pages, content, privileges, etc.

Enterprise Portals such as SharePoint and Liferay are a natural fit for this need. An Enterprise Portal becomes the chief aggregator of services and provides a rich online channel for students, faculty, alumni and prospective employers. The portal itself can also be hosted in the Cloud, with a *multi-tenancy* architecture for greater cost savings and easier management, offering common portal infrastructure services for managing content, users and personalization, within or even across institutions.



Figure 3

3.2. Shared Services - Cloud Deployments

Higher Education Institutions are increasingly using the Cloud as an alternative to on-premise data centers. Cloud services are easier and are more affordable to implement and change. They also offer an unprecedented level of standardization and reuse through configuration and composition for the specific needs each institution, instead of re-development or customization. SOA initiatives have facilitated this move to shared services in the Cloud. Enterprise Portals can be a façade over the Cloud services.

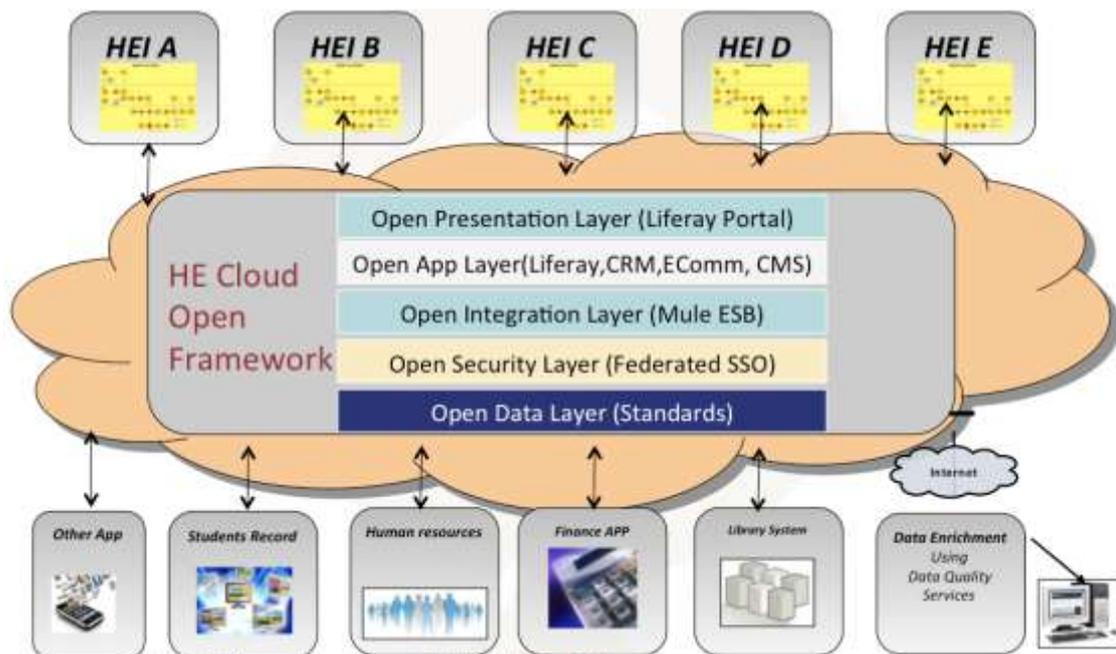


Figure 4

Cloud architectures provide dynamically scalable and often virtualized resources as a service over the Internet. Higher Education Institutions can use such shared services for providing student services, research, finance, administration and other business functions through secure integration of their data and any legacy systems/services in the Cloud environment.

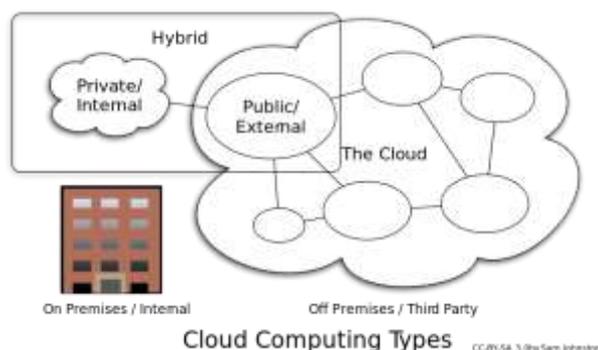


Figure 5

Having the services hosted in the Cloud optimizes resource usage across large resource pools, making computing resources more affordable and enabling vast, on-demand capacity. The underlying Service Oriented Architectures provide Software as a Service (SaaS), and the Cloud deployment provides the Infrastructure as a Service (IaaS). This greatly simplifies implementation and change of the shared business services.

3.3. Analytical Insights - Big Data Analytics

Collaborative and Social Computing are creating increasing amounts of structured and unstructured content. Educational institutions need to correlate large amounts of content created by students, applicants, faculty, researchers, etc. This Big Data presents unprecedented challenges & opportunities - it opens up new frontiers in text-analytics and data-driven science. For example, students at risk of dropping out can be identified by analytics that evaluate a combination of factors such as grades, attendance and participation. Typical insights universities can get from Big Data Analytics include.

- Student success such as enrollment and graduation rates
- Faculty performance, research performance and overall financial performance
- Predictive analytics - “at risk” students and programs

Data governance is also coming of age in 2013-2015, including policies for capture, processing, retention & archival. Handling big data is changing from a specialized need to a common information management strategy. We can take lessons from data processing models such as electronic discovery in order to handle Big Data. The Electronic Discovery Reference Model (EDRM) depicted is one such model that organizes the data lifecycle.



Source: edrm.net

Figure 6

From such traditional models, and newer strategies to manage Big Data, we can utilize many techniques that apply well to handling large amounts of academic data, including social media information. Some of these techniques are:

- Multi-pass approaches can help segment and qualify data for selective handling
- Early Content Analysis techniques for reducing input data sets from institutional systems
- Visualization is key to fast, interactive analysis
- Parallel & pipelined I/O are required to keep up with the processing power
- Predictive coding & analytics can better leverage computing power for data from student social interactions
- Combination of manual & automated review of multi-pass processing may yield best results

4. GETTING REAL RESULTS

4.1. Understand Your Needs

Collaborative work patterns, shared services and large amounts of data offer tremendous opportunities as well as challenges. The educational and research institutions that will fare well will be those that have taken timely and incremental steps to upgrade their IT and operating models by adopting Service Oriented Architectures (SOA), open standards and Cloud-based platforms. A pre-requisite or first step is to have a clear understanding of their current state and a vision of their long-term target state. There may be many ways to achieve this, but a consistent, manageable and measurable approach is critical to success. Such an approach will typically fall under the umbrella of Enterprise Architecture (EA) initiatives. The easiest way to jump-start an Enterprise Architecture program is to perform an 'EA Assessment', customized for Higher Education.

4.2. Leverage Technology Enablers

Technology enablers such as Cloud Architectures, Enterprise Portals and Big Data Analytics provide the necessary toolset for achieving the 'next generation' vision for university information systems. There are numerous products and services in the market, and universities have their own legacies. In this complex environment, the key is to map all the elements to a simple architectural pattern, such as the one presented.

4.3. Have a Roadmap

It is not enough to have a vision and a technology strategy and toolset. Realization of the vision depends upon successful execution. Adoption and use of technology enablers requires careful planning and agile execution. Even the best laid plans need to react to change, so the planning and execution should be viewed as a roadmap where detours and course-correction may be necessary to overcome obstacles, but certain milestones must be achieved and the destination must always be kept in mind.

Practically, this translates into continuously maintaining an organizational roadmap, typically in the form of short-term, mid-term and long-term objectives, with associated plans. The objectives and plans should be periodically aligned. This can be done as part of an Enterprise Architecture program. However, good judgment is critical to ensure *just-enough* planning and making sure that the analysis and planning is distributed across execution cycles in order to maintain agility in the execution.

5. CONCLUSIONS

Trends such as Collaborative and Social Computing are changing the education landscape. Students, faculty and researchers need and expect a unified experience, seamlessly integrating all the information systems behind the scenes and responding to changes in a fast, effective and economical manner.

Technology offers solutions for these needs - a unified experience in the form of an enterprise portal, agile business capabilities in the form of shared Cloud services and the ability to correlate and analyze copious amounts of information in the form of Big Data technologies. However, implementing and managing effective solutions is not trivial. As a pre-requisite, institutions need to map out their needs, assets and other information systems and maintain a roadmap towards a long-term vision.

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7. AUTHORS' BIOGRAPHIES

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Sukrit has 20 years of IT experience in delivering products, solutions and consulting services in Education, Healthcare, Government, Manufacturing, and Telecommunications. His work experience spans enterprise architecture, systems integration, portals, data center operations and strategic planning.

Rajesh Sinha - Founder and CEO of Fulcrum Worldwide



Rajesh Sinha is the founder and CEO of Fulcrum Worldwide. Under his aegis Fulcrum diversified its industry-specific offerings and expanded its operations to include the UK, APAC and South America. The cloud product he envisioned for the Higher Education sector won several awards for supporting next generation collaborative learning.

Rajesh is on the board of advisors for consortiums in US and Europe. From advising CEOs, CTOs and CXOs on the trends such as Big Data and Mobile strategies to mentoring students of HE institutions in entrepreneurship, he reaches out to the entire ecosystem of present and future thought leaders. He's frequently invited as a keynote speaker and presenter at global events such as Liferay Symposiums, EUNIS, NASSCOM sessions, and SOA symposiums.

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Being a thought-leader in UK's Higher Education (HE) sector, Pawan has been helping universities revolutionizing applicant, student, staff and alumni experience across the UK. From implementing unified experience to transitioning to complex, high-risk, new business processes, he has been helping universities to optimize their IT infrastructure and investment.

Rich Internet Applications In Higher Education Admissions Systems

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Keywords

HEI admissions software, candidate management, rich internet applications, AJAX

1. ABSTRACT

The need to quickly adapt to policy changes in HEI's requires an agile information system with quick turnarounds and the ability to custom tailor the application process to a single institution without affecting the others. With this in mind Central Applications Office in Croatia has adopted a single page application approach based on JavaScript framework and AJAX.

2. BACKGROUND

Every HEI is different and has its own set of rules and requirements. Traditional monolithic website architecture offers little room for customizing the individual needs of different institutions. To answer the needs of Croatian educational institutions, a more flexible approach was required. This led us to designing a new system which would isolate different institutions into separate web based applications in order to minimize turnaround time. In Croatia there are 129 HEIs and 775 undergraduate study programs. Every year there are around 40 000 candidates applying and they make 190 to 200 thousand submissions to individual study programs. The applicants can make their submissions from January until June.

3. SYSTEM ARCHITECTURE

Croatian HEI admissions system (NISpVU) started out as a classic monolithic web system based on a custom CMS that wanted to encompass every possible requirement presented by the HEI-s. For our new applications system we chose a distributed server and database architecture. The comparison of the architecture of both new and old systems is shown in Image 1.

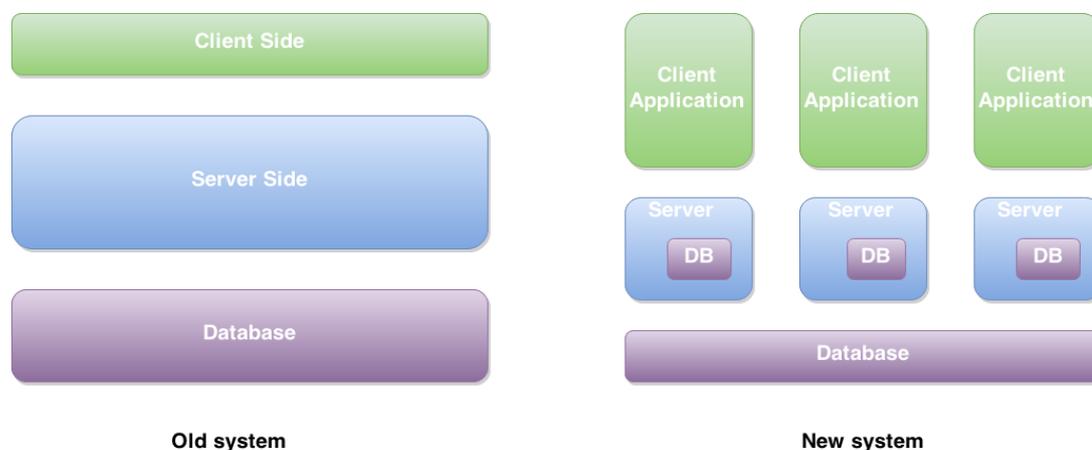


Image 1. Comparison of the old NISpVU and new NISpVU2 system architecture

The new system also employs a client heavy approach in which most of the work is offloaded to the client's machine. This in turn offloads our server side and allows for a more responsive system. The new system is implemented in DHTMLX JavaScript framework on the client side which gives us the ability to make desktop-like interfaces that are easier to use and feel more natural and "native".

On the server side the database is divided into two parts. All the information which is identical to all HEI's is kept in the shared portion of the database while all the information pertaining to the application to study programs is located in the isolated database shard tied to the server application of the institution in question. These are shown as small purple squares in Image 1. We use PostgreSQL as the DBMS due to its ANSI compliance and open-source nature. Compared to the much more widespread MySQL, PostgreSQL allows us to have instantiated views which are important for our decentralized system architecture.

The server side architecture is implemented in PHP and data communication between applications is made through JSON messages via a standardized API. This allows us to completely isolate and compartmentalize each individual application. That way changes made on behalf of a single institution due to a change in policy or enrollment conditions do not affect the system as a whole. We chose JSON over XML due to it being over 50 times faster in processing time while utilizing half the processor cycles as XML.

We have found that although this new architecture creates code overhead in certain areas, the overall system is easier to manage due to the fact that each HEI is viewed as a completely separate entity. At the same time by having a low-level shared database for common information we can synchronize individual shards after each enrollment cycle and have a complete picture of the enrollment process for statistics purposes.

This new architecture allows us to quickly adapt to the demands of HEI's with minimal changes to the overall system architecture which is very important to us due to the small size of our organization.

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Mirko Stanić has a Master's Degree in Information and communication technology from University of Zagreb (2010). He has worked in Central Applications Office since 2011 as the lead software developer on the Croatian Higher Education Admissions system (NISpVU2). His work is divided between working as a developer in software projects and working as a consultant on specialist projects.



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Igor Drvodelić is an Assistant Director and Head of Central Applications Office at Agency for Science and Higher Education. He is a member of the Committee for Monitoring the Implementation of State matura and applications for study programs. He is currently involved in the implementation projects for new national information system Higher Education Admissions system (NISpVU2). Has a Master's degree from University of Zagreb.

An open-source Document Management Solution for the University of Thessaloniki

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Keywords

Document management, processes, workflows, administrative roles, group collaboration, auditing

1. SUMMARY

The Aristotle University of Thessaloniki daily handles a large number of internal and external documents in paper format. Our goal was to replace the paper-format documents with a modern Document Management System (DMS) that would support the day-to-day tasks and improve efficiency of procedures within the University. To this purpose, we have evaluated a number of open source and commercial solutions and finally decided to adopt Alfresco community edition, an open source version of a commercially available system. This paper contains a brief description of the solutions that were evaluated, the challenges of developing the custom model and procedures for deploying Alfresco for a large organization and finally the benefits of a Document Management System in production.

2. BACKGROUND

Universities are organizations that are handling large amounts of documents (mainly in paper format). The volume of the documents handled by the Correspondence Tracking System (Πρωτόκολλο) of the Aristotle University Thessaloniki, in 2014 alone, was about 50K. Document management systems (DMS) are typically deployed to handle document centric workflows, as well as collaboration scenarios. But the costs for commercial solutions are heavy, with licenses calculated based on users accessing the system and yearly imposed. These costs soon become unsustainable, especially for large organizations, such as universities with hundreds of employees and thousands of students.

3. ADOPTING AN OPEN SOURCE DMS SOLUTION

3.1. Researching software solutions

We have started our research on available open-source document and knowledge management solutions two years ago, looking for products that would meet our current requirements and would scale sufficiently for future needs, both in terms of numbers of users, as well as functionality.

We reviewed a number of solutions, both local to Greece and internationally available, as well as customized software for large organization *protocol handling* systems: Scriptum, resCom, Alfresco, OpenKM, SharePoint, Nuxeo.

The selection decision of the Alfresco Community Edition was based on the criteria of product features, community size, cost and scalability for future use. Alfresco has a free and open source Community Edition, enhanced by a very strong commercial presence and a very active developer ecosystem.

3.2. Customizing the Document Management solution

The Alfresco platform allows for custom modeling of the document attributes, organizational tagging, group and person directory syncing from external systems and a multitude of authentication methods. We took up the task of developing a custom solution utilizing these features, in order to

serve the needs of our administrative services. Additionally, a series of common real-world procedures, such as Incoming/Outgoing documents, were modeled using workflows and implemented using the Business Process Model And Notation (BPMN) specification.

The basic functionality of the deployed Document Management System is:

- Document collaboration - uploading and versioning
- Searching - indexing of documents based on keywords and metadata
- Notifications - document sharing
- Reviewing - document approval
- Task assignment - ad-hoc or document-associated and completion tracking.

The main workflows developed are:

- University council meeting notes approval and proposal voting
- Notifications pushed to user groups, according to Organizational Unit and Role
- Document approval or rejection, addition of custom metadata and classification for incoming and outgoing streams.

The system is being deployed as a web service (docs.auth.gr) and file service (through the WebDAV protocol). It plays the role of a central repository for all documents in the organization. It is available via SSO authentication to all members of the academic community (faculty, staff, administration and researchers).

3.3. Future extensions

Plans for future development in the Document Management System of the Aristotle University of Thessaloniki include the following:

- **Signed docs** - development of custom workflows that would allow users to automatically digitally sign documents within the system by utilizing their personal digital certificates, and
- **Interoperability with external IT systems** - integration with existing IT systems within the university, for Payroll and Human Resource services, as well as external government systems, in order to automate and simplify common processes.

4. CONCLUSION

Even though our DMS system has only recently been deployed, its usefulness for streamlining administrative procedures is gaining recognition fast. Since its introduction, it has led to significant improvements in reducing costs and making the day-to-day document-related operations more efficient.

5. AUTHORS' BIOGRAPHIES



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Surveying CRISs and IRs across Europe

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Keywords

Current Research Information Systems, Institutional Repositories, Interoperability, Research Information Management

1. Summary

Current Research Information Systems (CRISs) and Institutional Repositories (IRs) are two main components of the Research Information Management (RIM) realm.

The rising strategic importance of RIM for higher education and research institutions relates to the need of fostering research and innovation, providing faster and broader technology transfer to industry and society, a critical factor for global competitiveness, and the subsequently increasing competition among institutions to augment and communicate excellence in research.

Knowing how institutions through European countries are using their CRISs and IRs for RIM was the main goal of a survey jointly carried out by EUNIS, the European University Information Systems Organization, and euroCRIS, the European Organization for International Research Information. This initiative followed a first survey performed in Portugal in the context of the development of a new support system for the management of Science Information carried out by the National Foundation for Science and Technology (FCT).

This contribution aims to present the preliminary results of this European-wide survey for CRISs, IRs, and their interoperability, both with each other and with other internal and external information systems.

2. CRIS and IR's Survey

One of the assets euroCRIS offers to the higher education and research community as part of its mission is the Directory of Research Information Systems or DRIS, <http://eurocris.org/DRISListAll.php?order=cfTitle>. This directory provides a list of running CRIS systems - mainly institutional, but also regional, national and vendor ones - together with a comprehensive description of their features, which includes the associated IR when available and the level of interoperability between both platforms. The DRIS has gradually added new entries in recent years, but the total number of records is still very low at the time of writing when compared to repository directories like OpenDOAR which feature thousands of platforms. This is due both to the need to provide comprehensive information about the platform features (which makes filling in the template a time-consuming task) and the specific nature of the CRIS community, that is traditionally less open to sharing information than the repository one (see "7 things you should know about CRISs, IRs and their interoperability" (P. De Castro, 2014) to find more about why this is so). These constraints, added to the fact that until very recently the DRIS would only feature CERIF-compliant CRISs (CERIF: Common European Research Information Format) have so far limited the coverage and subsequent impact of the euroCRIS DRIS.

As a way to get a comprehensive picture of the availability of fully-operational CRIS and IR systems in Europe today, EUNIS and euroCRIS decided to survey a broad range of higher education and

research institutions, between March and May 2015, preparing and distributing a questionnaire to its members in more than 30 countries. More than 300 institutions are potentially covered.

The survey was divided in two main parts, following the structure of the previous PT-CRIS survey (Pinto et al., 2014). The first part of the survey aimed to collect a picture of the present CRIS implementation level at universities and research centers. A rather comprehensive set of questions was prepared. However as only the most advanced CRIS gather the conditions that enable the answer to all questions, a smaller subset of key questions were marked as mandatory. The second part of the survey targeted institutional repositories and again only a subset of the questions prepared are required to be answered, others may be left blank if not applicable.

Both CRISs and IRs have the main goal of collecting information about research activities carried out in an institution hence both systems share some similarities. Some higher education and research institutions are using CRISs, some have IRs and some have both systems, often linked to each other. Besides this, new developments allow extending IRs to include CRIS functionalities (Bollini & Mornati, 2013), and thus in the context of the survey, it was important to clarify the adopted definition of these systems. For the context of the survey we adopted the following definition for a CRIS: a CRIS is an informational system, built in-house or purchased from a vendor, dedicated to collecting, analyzing, reporting, providing access and disseminating research and development (R&D) information. For an institutional repository the definition adopted was: an IR is a digital collection of research outputs (mainly publications and datasets) aiming to collect, to preserve and to disseminate the intellectual production of a higher education or research institution.

For both CRISs and IRs the survey aimed to collect information about the respective identification, main functionalities and contents, interoperability i.e. links to internal as well as to external systems, e.g. library management system, financial management system, human resources management system, among others, compliance with protocols, standards and vocabularies, and management issues.

As at the institutional level research management is normally distributed across different units, libraries, IT and research project units being the most common, the survey was prepared to be filled by different people within each organization.

Results from the survey are shared only in the aggregate and when fully processed will be accessible from the EUNIS Research and Analysis Initiative - ERAI section of EUNIS website, <http://www.eunis.org/era/>.

The CRIS and IR landscape is a very swiftly evolving one (Pablo de Castro, Shearer, & Summann, 2014) under pressing research reporting requirements from funders and governments in many countries. The results of this survey will as a result need to be periodically updated, which is an argument for having them hosted at the euroCRIS DRIS Directory.

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Lígia Maria Ribeiro received her degree in Applied Mathematics in 1977 at the Faculty of Sciences of the University of Porto and holds a PhD in Engineering Science from the University of Minho.

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She was President of EUNIS between 2004 and 2006, after being vice-president for two years. She is presently member of the EUNIS Board of Directors. She was also member of the Technical Committee of TERENA between 2008 and 2011. Since 2014 she is a member of the Task Group Best Practice/DRIS of euroCRIS.

She is author or co-author of more than 70 publications and was responsible of 11 financed projects. She was also responsible for several University of Porto projects, specifically the information system, SIGARRA, the institutional repository, the grid project and the e-learning cafés project. In relation with the information system SIGARRA she received two awards, the Descartes 1998 award and the EUNIS Elite award in 2000, and in the e-learning field she received the Jens Dørup E-Learning award in 2013.

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Pablo de Castro works as Open Access Project Officer for rolling out the OpenAIRE2020 Gold Open Access Pilot at LIBER, the Association of European Research Libraries based in The Hague. He is an expert in Open Access and research information workflows and management systems, an area he has recently developed at GrandIR Ltd in Edinburgh, building upon the work previously carried out for the UK RepositoryNet+ Project at EDINA National Data Centre (2012-13). MSc in Physics from Universidad Complutense de

Madrid (UCM), he has a background as Institutional Repository manager for the Spanish National Research Council (CSIC, 2007-2009) and Open Access advocate for Carlos III University in Madrid (UC3M, 2009-2011). Besides being an ORCID Ambassador, Pablo is also serving on the euroCRIS Board as leader of the CRIS/IR Interoperability Task Group.

Is a Current Research Information System (CRIS) a critical corporate system for HEIs? A Case Study from the University of St Andrews

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Keywords

CRIS, Information Management, REF, Enterprise Architecture, Open Access, Research Data Management

1. Abstract

With over half of all UK Universities using a commercial Current Research Information System (CRIS) to manage and promote institutional research activity and output, this paper examines the drivers behind this rapid adoption and how the CRIS has raised awareness within central units (Registry, HR, Finance) of how they 'fit into the bigger picture' of research within the University. It also looks at how the CRIS has adapted to the rapidly changing funder policies around open access to research outputs and data.

2. A brief history of CRIS in the UK

The Universities of St Andrews and Aberdeen were the first to implement the Pure¹ commercial CRIS in 2009. The main driver then was the recent RAE2008 exercise which had required the preparation, validation and submission of research performance data (outputs, students, project funding, staff) from the previous 6 years. St Andrews and Aberdeen were by no means unique in finding this process resource-intensive, for both administrative staff and researchers. Issues included the fact that the data required was often siloed in HR, student and finance systems. The key feature of Pure, or similar CRIS systems, such as Converis² (Thomson Reuters) or Elements³ (Symplectic) is that it pulls together research-related information from all areas of the Institution, providing appropriate access to users, including researchers who can manage their publication, activities and impact and highlight any errors in centrally held student or project data, as well as for research managers throughout the Institution.

In the REF2014 assessment exercise the process of data preparation and submission was vastly improved, with all areas of the submission managed through Pure.

According to a report (Russell, 2012⁴) 51 Universities had adopted a CERIF⁵-based CRIS by the end of 2011. More recently a survey by James Toon, University of Edinburgh in Summer 2014 found that all but 7 of the top institutions ranked by RAE2008 research income had a CRIS.

¹ Pure, Elsevier, <http://www.elsevier.com/online-tools/research-intelligence/products-and-services/pure>

² Converis, Thomson Reuters, <http://thomsonreuters.com/converis/>

³ Elements, Symplectic <http://symplectic.co.uk/products/elements/>

⁴ Rosemary, R. (2012). *Adoption of CERIF in UK Higher Education Institutes. A Landscape Study*. UKOLN, University of Bath.

⁵ CERIF (Common European Research Information Format) is an internationally recognized standard for research information exchange. It is maintained by www.eurocris.org

3. The St Andrews experience : how corporate is a CRIS?

Pure is managed by the Research Policy Office at the University of St Andrews, but is used widely in the Library and within Schools. The information exposed via the CRIS has widespread ownership across corporate functions : Registry, Finance and Human Resources, leading to an increased awareness within the central units of how they 'fit into the bigger picture' of research within the University.

Researchers, by and large, engage well with the system and many Schools, groups and individuals reuse the data in Pure on their own or in collaborative websites⁶. There is recognition that the CRIS saves time for the researchers as they can enter/collect their research outputs and activities together in one place for reuse elsewhere. This was reinforced by the overwhelmingly negative response from researchers across many institutions to the introduction of Researchfish in 2014 to collect outputs from Research Council funded grants. Researchfish does not allow bulk upload of outputs institutional CRIS, thus obliging researchers to re-enter substantial amounts of data. The Research Councils are working with the systems suppliers and Universities to build in bulk upload for future collections.

The CRIS also drives the public-facing research portal⁷, a key means for the University to advertise its research activity and outputs, attracting staff and students alike.

Pure is classified as a critical corporate system, subject to the same resilience and business continuity measures as the Finance, HR and Student Record Systems.

Away from the primary uses of the CRIS to manage and make accessible research information, the implementation is a prime example of the application of basic information management principles :

1. Enter data once.
2. Make data accessible on demand (according to security role).
3. Make use of standards. (Pure is CERIF compliant)

4. Reacting to policy changes

Over the last few years, the funder policy landscape has changed rapidly particularly in the area of open access to research outputs, both publications, and more recently, research data. Whilst there are substantial procedural and, in some cases, organizational changes required to support these changes at the institutional level, the modifications required to Pure have been reasonably straightforward. These include adding additional workflow and metadata to support the HEFCE Open Access policy and providing both data catalogue and data repository functionality to support funder data management policies. Integration with standards such as ORCID and Datacite are also provided.

The use of a familiar interface also helps ensure engagement with the new procedures and policies from the researcher community.

5. Conclusion

In answer to the question posed in the paper's title, the CRIS has undoubtedly become one of the key corporate systems at St Andrews, and likewise at many other, particularly research-intensive, universities. The adoption of CRIS has also raised awareness amongst other stakeholders across the research sector - funders, publishers, third party information suppliers - of the importance of standards for building efficient and effective information exchange procedures. As these standards-based exchange procedures become implemented, Universities and other stakeholders will benefit from better quality and more comprehensive data to support decision-making at all levels - from government downwards.

⁶ <http://phyesta.supa.ac.uk/staff/prof-andrew-cameron>

⁷ <http://risweb.st-andrews.ac.uk/portal/>

6. AUTHORS' BIOGRAPHIES

Anna is Head of Research Data and Information Services, moving to the Library from ITS in 2013. She has previously held posts as Programme Manager, Data Architect and Enterprise Architect and was also co-opted to serve as Senior Research Policy Advisor in 2011.

Her current role consolidates her skills and expertise in research information management and policy development. She is a tireless advocate of the basic management information principles of entering data once and using open standards to improve data quality whilst minimizing data collection burden across the research sector.

Anna is Executive for strategy on the euroCRIS Board, a member of the Snowball Metrics Steering Committee and chairs the Pure UK Strategy Group and the CASRAI-UK Data Management Planning Working Group.

SIGMA CRIS: SCIENTIFIC OUTPUTS, INTEGRATION AND INTEROPERABILITY

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Abstract

Society increasingly demands quickly, easily and a homogeneous access to the information. Access to Internet, mobile devices, social networks as Facebook or ResearchGate, which create links between people to share data reaching anywhere in the world within seconds or the increase commitment for the cloud, where access from any device and place allowing the access to the own documents, videos, photos, music, etc. keeping the own customized environment or applications to share documents as Google Drive or Dropbox, which allows to agile data access are examples of agility in the flow of information and is something that nowadays is needed and is no longer questioned.

This paradigm transferred in the scope of research, knowing that universities, their affiliated research centers and researchers have the aim on spending time doing research, getting funds for their research or teaching and the moment to feel the need to transfer or enter the results into an information system that do not report short-term progress or improvement in their day to day of research never arrives. Faced with this situation takes more relevance offer systems that provide the flexibility and immediacy of access to scientific publications generated. In this regard already exists commercial databases as Web Of Science, PubMed, Dialnet, Scopus, Google Scholar, etc. that provides it.

On the other hand, SIGMA Gestión Universitaria, which is a not-for-profit consortium established in 1996 by a group of 8 top level Spanish Public Universities to provide technological solutions to their needs for managing academic, learning, research and organization processes aligning its SIGMA CRIS Solution with the ERA requirements.

SIGMA and their universities have made great efforts to promote competitiveness, mobility, create synergies and improve the research quality in-house, regionally, nationally and internationally. This has allowed great progress in all areas, researcher's mobility, creating synergies with shared resource centers between different institutions and improving the research visibility generated.

In line of what has been said, SIGMA is making a major effort to focus its research solution in the current demands of the research community. These efforts have focused on three main areas of development: improving the usability of the solution that the researcher uses to update their scientific production, automatic interoperability with commercial scientific databases and the image adaptation to standards quality that currently defines the market for web applications.

Keywords: Sigma, CRIS, scientific production, interoperability.

1 SIGMA GESTIÓN UNIVERSITARIA CONSORTIUM

SIGMA Gestión Universitaria [1] is a nonprofit consortium established in 1996 by a group of 8 top level Spanish Public Universities to provide technological solutions to their needs for managing academics, learning, research and organization processes. SIGMA represents 20% of the students in the Spanish university system. The consortium's objective has evolved towards the continuous technological modernization of university management through the development of IT solutions aimed at automating the administrative processes and, as a result, guaranteeing their effectiveness.

Technology and innovation are the backbone of the services and solutions provided, based on a highly open source development and deployment platform for J2EE certified application servers compliant on a multi-tier and high performance proven open architecture. Internationalization is also one of SIGMA's top priorities. For years, SIGMA has established relationships with other European university consortiums. Lately, SIGMA has open new strategic areas of interest such as SaaS, BI, eLearning and Mobile. SIGMA focuses the development and support of two main suites of solutions:

1.1 SIGMA Student Information System

The European Higher Education Area (EHEA) was created to construct the Europe of Knowledge and place it at the international forefront, in order to benefit mobility and employment opportunities, and also to unify higher education studies in the EU. Since then, one of the main priorities of SIGMA [1] has been the adaptation of its products and services to the requirements of the EHEA, thus assisting the universities in the group as they go through this important transformation process.

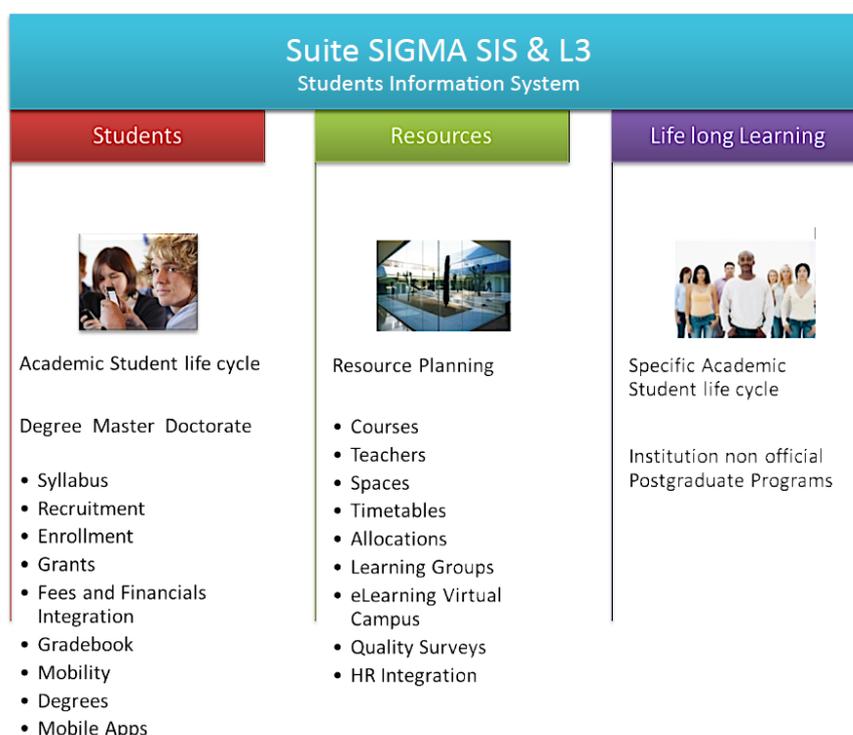


Fig. 1. Suite SIGMA Students Information System

1.2 SIGMA Current Research Information System

The European Research Area (ERA) [2] was created to facilitate the mobility of researchers, attract the best world researchers and coordinate the national and regional programs. Since then, SIGMA [1] has incorporated in its products - adaptations and new functionalities to support the scientific activity as well as its promotion, and has aligned its SIGMA CRIS Research Project with the ERA requirements.

Sigma is also aware of the new research trends (mobile devices, EuroCRIS Common European Research Information Format – CERIF [3] initiative, unique author identifier studies (i.eiraLIS [4]), altmetrics [5], ...) through continuous studies and the experience provided by the joint collaboration with the universities that compose the consortium.

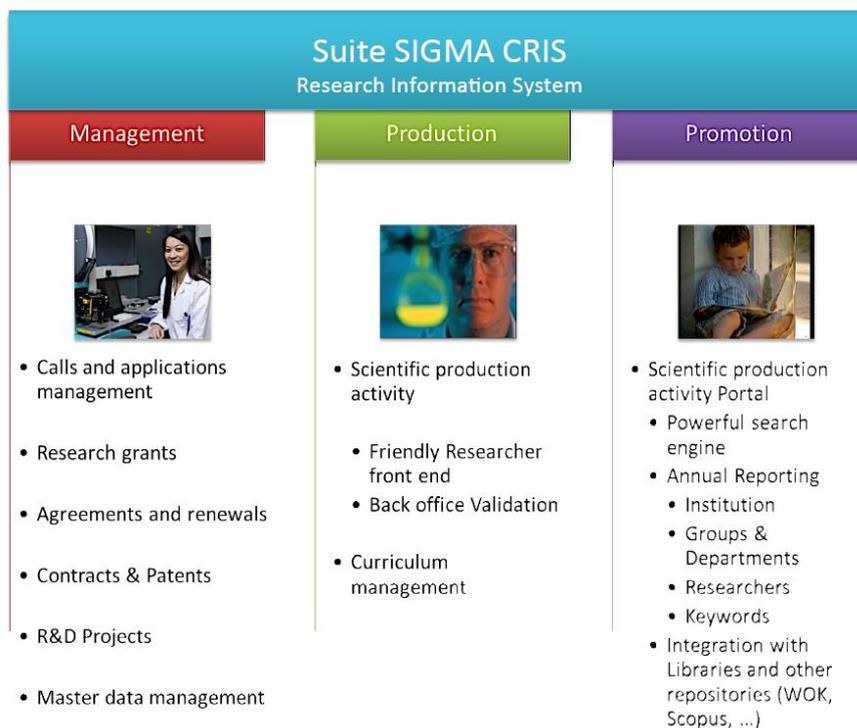


Fig. 2. Suite SIGMA Current Research Information System

2 SCIENTIFIC OUTPUTS, INTEGRATION AND INTEROPERABILITY

Promotion and dissemination among research community and society are as important as research. Any researcher wants their work to be recognized and make it known, so publication of a scientific output increases the opportunities of being cited and thus its impact.

The universities have made great efforts to promote competitiveness, mobility, create synergies and improve the research quality in-house, regionally, nationally and internationally during the past few years. This has allowed great progress in all areas, researcher's mobility, creating synergies with shared resource centers between different institutions and improving the research visibility generated, but there is still a long way to go.

How scientific outputs are promoted and disseminated?

- **Institutional Web Sites:** Universities and research centers have they own portals and CRIS systems. SIGMA provides CRIS to Spanish Universities.
- **Research Results Transfer Offices (OTRI):** There is an OTRI in almost all the universities and national public research centers, as well as in the university-business foundations and in many technological centers. The OTRI has played a major role as part of the efforts made by the Spanish universities to bring their activities into line with society's needs.
- **Databases of indexed journals:** WoS, Scopus, Dialnet, PubMed are examples of database of indexed journals, where all contributions (articles, editorials, letters, reviews, discussions, etc...)

that may publish on journals are collected. Those databases may be general in scope or cover a specific academic discipline and a significant number of them are still proprietary, available by licensing agreement from vendors.

- **Open Access Repositories:** the open access movement was formalized in the Budapest Declaration, in February 2002, which established that the results of scientific work should be free access, free of charge and without most copyright and licensing restrictions. Recolecta (www.recolecta.net), Recercat (www.recercat.cat), Raco (www.raco.cat) or TDR (www.tdx.cat) are examples of research open access repositories.

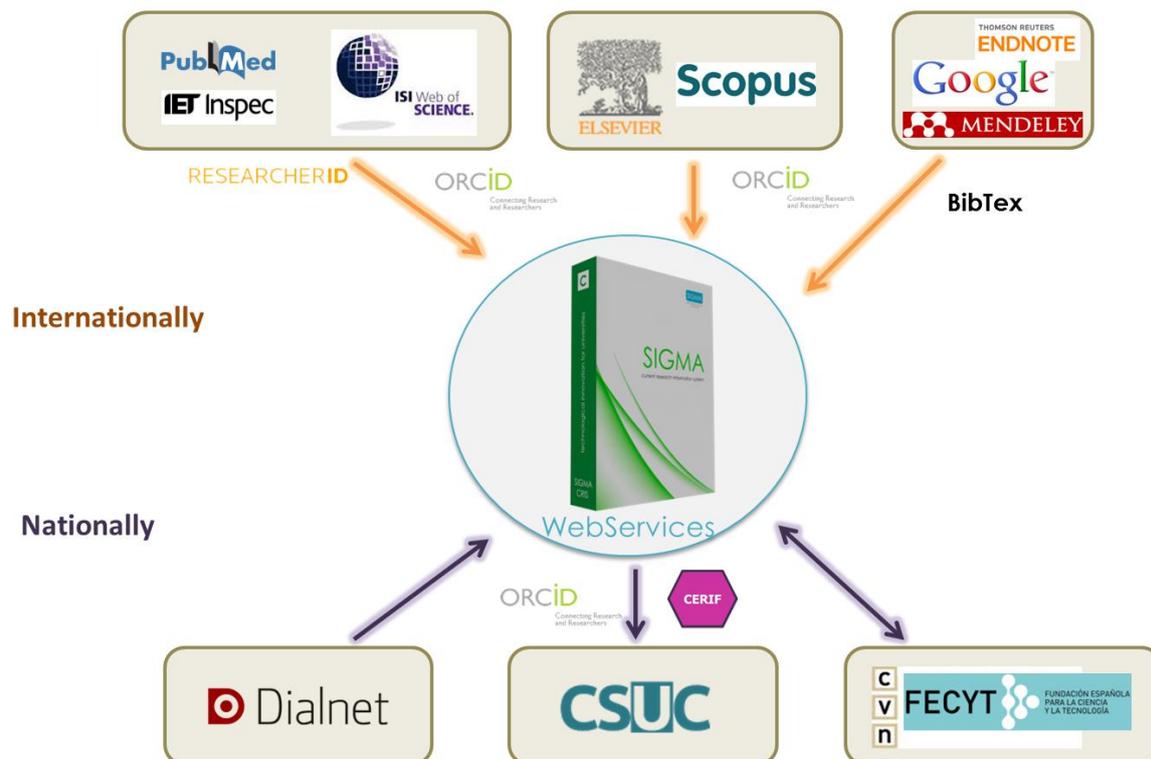
The main advantages for researchers and institutions for the promotion and dissemination of scientific outputs are:

- Acquire global visibility.
- Raises the prestige of the authors and institutions.
- Encourages contact between researchers working on the same research scope from any part of the world.
- Facilitate the transference of these results to the companies.
- Promote the participation of the university community in R&D projects.

In this scenario, SIGMA decided to invest actively and improving its product of research management specifically in the module of scientific production. It was decided to give a strong impetus to the solution of scientific production in the sections: usability, interoperability and image. In the area of usability has been done a thorough review of the tool used by researchers to introduce, completing and reviewing scientific production. Specifically improvements were:

- Show initially only required fields and hide the optional fields under "Additional Information".
- Reordering fields to give more importance to the text fields than the codes.
- Add autocompletions for title fields.
- Facilitate the massive influx of publications.

About interoperability we can comment that the adaptations have been made using webservice that allow you to connect to international repositories such as WoS, Scopus and Dialnet.



One of the first steps to solve is the author name disambiguation. A right researcher identification is important in order to improve the scientific discovery processes, make the collaboration easier among the research community and guarantee a right interaction among the existing research information systems, such as bibliographic database, this is the challenge of ORCID. SIGMA CRIS manage ORCID which links research activities of the same author indexed to different information systems, and this is adopted as standard researcher identifier among all universities of the consortium (Haak, 2013)⁵ which will allow the aggregate query to the research which is produced at these universities and recollected from different systems. Since the launch of ORCID, there was a very strong campaign to encourage the creation of this identifier, placing Spain within the top five countries in the ranking use.

In order to unify data from IR and CRIS, DOI (Digital Object Identifier) is the alternative to locate and identifier scientific outputs (articles, chapters, etc...) as ORCID identifier is for researchers. Both identifiers are managed on SIGMA CRIS. Having analyzed several alternatives for standard exchanging data from CRIS Universities to the central repository, XML-CERIF is the alternative adopted by the consortium. This interoperability will be reach by calling Web Services using OAI-PMH protocol.

Finally, about the improvements in image, it has been redesigned the Scientific Production Portal giving it a more modern view and according to the profile view of a researcher and his entire scientific production, in addition to consulting catalog online of the university.

In this process of improvement, has been tapped to include an expert guide that allows society and the media in particular, to consult a list of expert researchers in several fields.

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The CIO's role in the establishment and development of a Community of Universities and Establishments (ComUE).

Case study: Challenges and prospects for the ComUE *Sorbonne Universités*

Harry Claisse (UTC) / Rafael Gutierrez (UPMC) / Frédéric BIGRAT (Sorbonne Universités)

The foundation for scientific cooperation (FCS) "[Sorbonne Universités](#)" was founded in June 2010. It federates [eleven](#) higher education institutions and leading research centers covering a broad spectrum of disciplines including sciences & technology, medicine, engineering, social sciences, business administration and arts. This complementarity allows the foundation to create a multidisciplinary university with a common project that combines a specialist training offer and leading research programs that meets today's educational paradigm shift. Their common aim: "Do more together".

While asserting their autonomy and their disciplinary specificities, the different members of Sorbonne Universités have chosen to unite their strengths around a common scientific, intellectual, cultural and social project ; rethinking the university.

In June 2014 a monthly meeting of initially five, and now seven CIO's was created. The aim is to ensure that the importance of information systems is not neglected in the various projects of the ComUE.

Today IT Departments are confronted with identical problems and with identical challenges. It is thus a natural reflex to collaborate and exchange between peers. This tendency is already reflected by dynamism of several national organizations:

- CSIER : The Higher Education and Research IT System Dept. Committee
- University & Research Network Days (JRES)
- Regional Digital Universities (UNR).

So what can be the added value of CIO collaboration within the ComUE? What are the synergies and what curbs collaboration at this level? And from the ComUE's point of view, what is the link between top level political support (Ministry, University President ...), the reality of project management and the ubiquitous aspects of heterogeneous information systems?

It is attempting to answer these questions that Sorbonne Universities CIO's have identified numerous opportunities. This case study will introduce these different aspects in the hope that they can be useful to others and transposed to similar environments.

Beyond the case study, the purpose of our speakers is to exchange with their European peers, who like them, experience the global digital revolution.

The areas of work that will be presented are:

- How to provide a role of expertise to our Governance by trying to anticipate the evolution of the institutions IT system (Moreover through the identification and implementation of technical prerequisites),
- Progressively share the respective digital service catalogs and services (mutualize services and networks...)
- Standardize technologies employed and working methods,
- Establish a network expertise.



Stuart McLELLAN

After working for 9 years in the private sector as a systems and network engineer Stuart McLellan integrated the IT Service Dept. of La Rochelle University as head of systems and network. He was equally involved in high performance computing and scientific computing. After 10 years at La Rochelle he joined the prestigious Ecole Normale Supérieure de Cachan as assistant CIO, Head of HPC and Information Systems Security Manager (ISSM). In 2011 he was nominated CIO at the ENS-C. In January 2015 he joined the National Natural History Museum of Paris as CIO where he undertakes the modernization and the evolution of the Museum's Information Systems.

Already a member of EUNIS as CIO at the ENS-C, Stuart McLellan has participated in the BencHEIT and BI Taskforces.

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EUNIS 2015: The new manager - a gardening type!

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Keywords

Agile, management, culture, successful teams

1. Summary

A hundred years ago, Frederick Winslow Taylor wrote his book, *The Principles of Scientific Management*, and set the agenda for management for the next century. Command and control became predominant. Workers were exchangeable objects in machinery, and if something broke you fixed it by switching the broken part. You became a successful manager by knowing the business skills best of all.

Nowadays, we are not managing simple production-environments where all employees do the same tasks. We are handling complex, competence-based organizations, where we need many different skills to meet the goals of the organization. It is a gigantic eco-system where many kinds of knowledge are needed to complete the work. As a manager, you can no longer optimize single parts in order to solve issues; that will only create bottlenecks and waste. You need to focus on the whole.

The agile methods that are beginning to conquer the IT area need environments that encourage responsibility and ownership, learning, innovation and an ability to respond to change. This requires a leadership that does not focus on measuring, giving orders and controlling, but paves the way, builds trust and sets the frameworks. What challenges do these gardeners of management face when they lead an agile business within a non-agile organization? What challenges will you face when you try to implement agile practices and change the culture of the organization that you are leading?

2. The new manager - a gardening type!

The Swedish Council for Higher Education is a government agency with responsibilities spanning widely across the educational sector. The department for Application Management and Operations within the council manages various administrative IT systems used by the Swedish universities and university colleges. The department has gone through an agile transformation during the last 5 years. Completing an agile transformation normally takes a long time, mainly because you are not only trying to implement a new methodology, new processes and roles. You are also trying to change the culture of the organization, all people's ways of thinking, their actions and values, including your own.

There can be many reasons for adopting agile methods. Most organizations want to achieve better quality in the product and higher customer value. But you may also strive for better sustainability in the product, adaptability and more innovation within your organization. These outcomes are like fruit on an agile tree. If you want to be able to pick the fruit, you need to develop an environment in which the tree will grow and flourish. This environment contains the values we want the teams to have, as well as the organization as a whole: ownership, collaboration, learning, visibility and discipline. It is very unlikely that you can create this environment by being a manager of the old school. The command and control will unable every attempt to make the teams take responsibility for their own work. Measurements will stop or slow down collaboration and learning and instead create an individualistic and competitive workplace where it is tempting to take shortcuts. Solving issues by exchanging "broken parts" will spread a fear of failing. That in turn will make people want

to hide mistakes as long as possible, and problems within a project might be visible to the management very late. Fear makes people want to play safe and will not encourage innovation.

Your tools as a manager to grow the envisioned environment, no longer includes being the most skilled in the organization, or command and control. You need to own the vision and own the system, meaning that you take responsibility for the direction of your organization and the ecosystem that you are managing. You create and maintain the environment, your garden. You define the end of your garden, you ensure that no plants take over at the expense of others; you see to that everything stays within its limits. You empower your teams and the individuals in them by letting them take the decisions that they can take on their own. Make sure the teams get what they need to do their job. That can be with tools, decisions or resources of different kinds. Be an example. Facilitate improvement and innovation, by letting the teams fail safely and early on. Invest in learning. See to that the whole organization do retrospectives, inspect and adapt, and continuously take small steps forward. Use scrum boards that enhance the visibility. That builds trust through feed-back, thereby creating opportunities for change and innovation and better solutions for our end-users. Visibility also exposes problems earlier and enables better decision making.

What kind of manager can do this? There are plenty of different models for making personality profiles, often used for describing different communication or management styles. These models usually divide humanity into four corners, four colors or four types, like the DISC model, DISA, RAT or IPU. They usually contain one type that is dominant, fast moving and competitive. One that is analytic and cautious and structured one that is social and team focused, and one that is creative, communicative and inspiring. The traditional successful manager has high scores on the dominant and analytic side but he or she might not be so strong on people skills. In an agile culture, where management is set out to create empowered, successful agile teams that take responsibility for their own work and their own processes, there will be more focus on the people skills, and the ability to communicate the vision and point out the direction for the organization. There will still be a demand for the traditional skills in the dominant and analytic field, for the responsibility of owning the system and defining the framework, but I suspect that the most successful management groups will need to cover all communication styles in order to enable a sustainable agile transformation and the growth of the successful agile teams.

In order to achieve a sustainable agile transformation you need to change the values and behavior of all people. Processes, roles and responsibilities change, and the way of doing things will be different. Not only for your team members, will it also apply to all kinds of managers, from project managers, application managers and managers on a very high level. Now, there is nothing harder to do than cultural change. To do this you will need people skills and a communication ability, to make them want to change themselves. You must take care of the eco-system in your garden. It may seem like a hard task to adapt a gardening approach on the whole leadership of an organization, and at UHR we have only just started. But there is a big reward. Sometimes you get to sit in your garden and see how beautiful it is.

EUNIS 2015: Procurement of Cloud Services

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...

Keywords

Cloud, procurement, Azure, Amazon, Box

Introduction

This paper discusses the challenges with procurement of cloud services for institutions.

The use of cloud services has expanded rapidly within institutions, often without control from central IT. Why has this trend started and how should central IT manage it? Procurement is one way to control the use of cloud services, but there are other ways for faculty and students to start using cloud by themselves. In this paper, my focus is on procurement and describes three explicit examples of procurement of cloud services at Umea university with different approaches. Why did we choose these different ways of procurement and what have we learned from them.

Why has cloud services become so popular at institutions

Cloud based services are easy to acquire and sometimes free of charge. Of course, they are attractive to student and staffers. No need to go to IT technicians and ask for permission. If there is a cost, a credit card will do the job.

Cloud services supports innovation, which is crucial for research. It is easy to fix access to services. Often, the acquiring process is simple and work can start within minutes. Sometimes, even money to pay for the service is not needed. IAAS cloud services allow establishment of computer resources fast and flexible. There is a short way from hypothesis to computed results.

Depending on type of cloud service (i.e. SaaS, PaaS, IaaS), different strategies must be used and if not carefully chosen, a burden of bureaucracy can overwhelm the procurer.

Real cloud service procurement examples and how they were managed

In this paper, I will discuss three different examples:

1. Procurement through a national body (Box)
2. Procurement together with three other universities (Microsoft Azure)
3. No procurement - services free of charge (Microsoft O365 and GoogleApps)

The reasons for choosing each of the approaches are described together with a follow-up of how things actually became.

Lessons learned

What have we learned from these approaches and what are my recommendations. When should institutions collaborate and how can it be done. Obstacles to look for are discussed.



The author is CIO for Umeå university since 2009. He has a degree in Computer Science and Business, University of Umeå, 1978. After university studies, employed as System Analyst and Designer for business information systems. Returned to Umeå university for doctoral studies and teaching in Informatics with special focus in System Design and System Development. He has been a Project Manager for several national projects. He has been Head of the Ladok Division at the University of Umea, a large unit specialized in system development and maintenance. He has been a board member of EUNIS and worked as an expert for the European Commission. Current EUNIS publications includes:

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LEARNING TO LINK-IN

Teaching undergraduate sport students how to professionally network via social media using a Pebblepad platform

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Keywords

Transitions into employment, Professional social networks, Self-promotion, Employability, Self-awareness

Abstract

Increasingly, professional social networks are being used to connect, collaborate, make valuable contacts, source 'experts' and for recruitment purposes. The majority (92%) of employers use social media to recruit, and 1 in 6 employees state that their current post is as a consequence of social media. 'LinkedIn' is the most popular social media network used by recruiters and it's reported that more than a third of job seekers use this platform to enable them to find work.

Pedagogy

Universities are expected to produce employable graduates who can adapt and manage their future careers. However, debate exists about whether employability skills can be developed in the classroom. In a highly competitive job market self-promotion and self-assertion are considered key skills, if prospective employees are to come to the attention of recruiters. Therefore, given these advances in recruitment practice it could be argued that curriculum time should be devoted to ensuring that students have the capacity through reflection to evidence the knowledge, skills and experiences that they have developed during their studies.

Technology

Pebblepad is an e-portfolio tool which allows students to collate and reflect upon achievements, as well as to set themselves objectives and actions for personal development. Students are able to import or use Pebblepad technology to create assets, including web-folios/pages, within their portfolio.

Innovation

This paper details how tools within Pebblepad have been utilised to give students guided practice in professional networking to foster employment prospects. Assessment issues, including reasonable adjustment for those with learning disabilities, are considered as well as student testimonials recounting their experience of participating in this form of learning.

Usefulness and benefits of the innovation

Student feedback has been positive with evident appreciation of the opportunity to articulate what they have to offer to a prospective employer in this format. Students recognise the value of receiving guidance and feedback, regarding what information is appropriate to include in a professional outward-facing web-based platform.

Introduction - Technological context

More than a third of the world's population now use the internet, and social media is used regularly by 91% of online adults - almost a quarter of adult online time is spent engaging with social media (Internetworldstats.com, 2012). Student populations are considered keen consumers of social networking technology (Barkhuus & Tashiro, 2010) and consequently, these platforms are now being used as learning spaces (Skeels & Grudin, 2009; Ettinger & Kijl, 2009). It is recognised that engagement with technology within courses may improve learning (Davis, O'Brien & McLean, 2008) and that using social network platforms as adjuncts to learning can increase student connectedness (Hung & Yuen, 2009). However, their use as learning tools still causes some debate (Selwyn, 2009) with any utilitarian value coming from increasing staff and student engagement and opportunities for informal learning and peer support (Junco, Heiberger & Loken, 2010). Some students have expressed the view that social media is an enclave for their private not their classroom lives (Madge, Meeks, Wellens & Hooley, 2009), and this can explain their reluctance to participate with these media for learning.

Pedagogy - Employability Context

It is widely acknowledged that universities have a responsibility for producing employable graduates (Knight & Yorke, 2003; Schomburg & Teichler, 2006) who have the ability to adapt and manage their future careers (Bridgestock, 2009). However, there is some debate about whether these employability skills can be developed in the classroom (Cranmer, 2006). Whilst some note that teaching and assessing employability skills does not impact on performance in the labour market (Mason, Williams & Cramer, 2009); others state that assessments that allow students to test the development of graduate attributes provide an opportunity for formal and informal feedback thus, enhance skill development (Treleaven & Voola, 2008).

Increasingly, professional social networks are being used to connect, collaborate, make valuable contacts (Chen, Geyer, Dugan, Muller & Guy, 2009), source 'experts' and for recruitment purposes (Backstrom, Huttenlocher, Kleinberg & Lan, 2006; Cohen & Clemens, 2005; Skeels & Grudin, 2009). The Jobvite Social Recruiting Survey for 2012 notes that 92% of employers use social media to recruit, and 1 in 6 employees state that their current post is as a consequence of social media. LinkedIn is the most popular social media network used by recruiters and 38% of job seekers use this platform to enable them to find work (Jobvite, 2012). LinkedIn describes itself as 'an online network of experienced professionals' with a membership of more than 225 million (7.9 million adult users in the UK).

Mayrhofer, Steyrer, Meyer, Strunk, Schiffinger & Iellatchitch (2005) note that in a highly competitive job market self-promotion and self-assertion are key, if recruiters are to identify prospective employees. Indeed, Knight and Yorke (2003) state that self-awareness and self-promotion are important career management skills. Therefore teaching students to use these social network platforms for professional purposes and to enable their profile to come to the attention of employers, would seem timely. Many university programmes that prepare students to enter the traditional professions (medicine, dentistry, law, nursing, teaching) insert guidance on using social networks responsibly within their programmes of delivery. It is recognised that the existence of, and engagement with, social media can make it difficult to separate personal and professional lives (McCartney, 2012) and manage aspects related to privacy (Boyd & Ellison, 2007). Printed text on social media platforms leave a lasting footprint for the author which can negatively impact on the graduated student's future employment prospects (Schurgen O'Keefe & Clarke-Pearson, 2011).

Therefore, the premise of this intervention is that when students use a social network platform to showcase their skills, experiences, areas of knowledge and attributes to prospective employers it is important that they are provided with feedback as to the relevance of materials included, their communication skills within this medium, and their ability to self-promote in a professional context.

Intervention - Innovation

Sport students at Abertay University participate in a placement experience at each stage of study, supported by weekly tutorials. They are required within these sessions to reflect on practice and update and develop personal portfolios (PDPs) that appraise strengths, summarise skills and

experiences, identify opportunities, and areas for development linked to objective setting. These activities are encapsulated within a module titled 'Contexts in Sport' and in recent years Pebblepad has been utilised as tool with the second year sport students to enable them to conduct and record this ongoing self-reflection. A new unit of assessment was developed for the 2012/13 academic session which required the students to prepare and submit a webfolio, in the style of a Linked-In profile, to a Pebblepad gateway for grading and feedback.

The students were given the following brief for the assessment which was to be submitted at the end of the first semester:-

Title = submit in Pebblepad a Webfolio asset that is maximally 1000 words long but acts as a 'Linked-in'-style professional connections platform that showcases your skills, strengths and experiences to prospective future employers

To pass this coursework, the student is expected to:

Choose a template which balances the need to be professional with the ability to catch a prospective employer's attention.

Provide a summary of skills, experiences, and personal achievements/assets that would act as a 'showcase' of what you can offer prospective employers in the sport and exercise industry.

Articulate these skills, experiences, and achievements/assets in a manner which demonstrates an ability to balance detail with conciseness.

Demonstrate an ability to be self-reflective.

Assessment Guidelines

Student's ability to be personally reflective and self-evaluative

Flow and organisation of material

Balance of conciseness and detail in information provided

Presentation of material for a professional audience

Grammar, spelling and punctuation

Staff from the university's Technology-Enhanced Learning Support team worked alongside the module team in initial tutorials to introduce the students to the software and its capabilities. Weekly tasks required the students to undertake self-evaluation of placement experiences, as well as reflect on feedback from other units of assessment/classroom activities that they were engaging with. The students were then encouraged to update their Pebblepad accounts with this ongoing appraisal of their skill/knowledge acquisition and personal development. Pebblepad also allows the students to maintain a current Curriculum Vitae (CV) and within tutorial classes students were given opportunities to populate this with in-curricula as well as extra-curricula data.

Students were advised to browse the 'Linked-in' website to have oversight of how professionals network and the type of information that is presented in this forum. They were also encouraged to consider what information they would extract from their CV to specifically present within the webfolio. As part of the students' assessment preparations, a member of the university's Career Service team delivered a well-received session on 'Netiquette'. Students were further invited to submit early drafts of the webfolio ('share their asset') to the module team for formative feedback.

Outcomes - usefulness and benefits of the innovation

One hundred and forty-three students registered to take the module in 2012/13 and their profile of grades for this unit of assessment is illustrated in Figure 1.

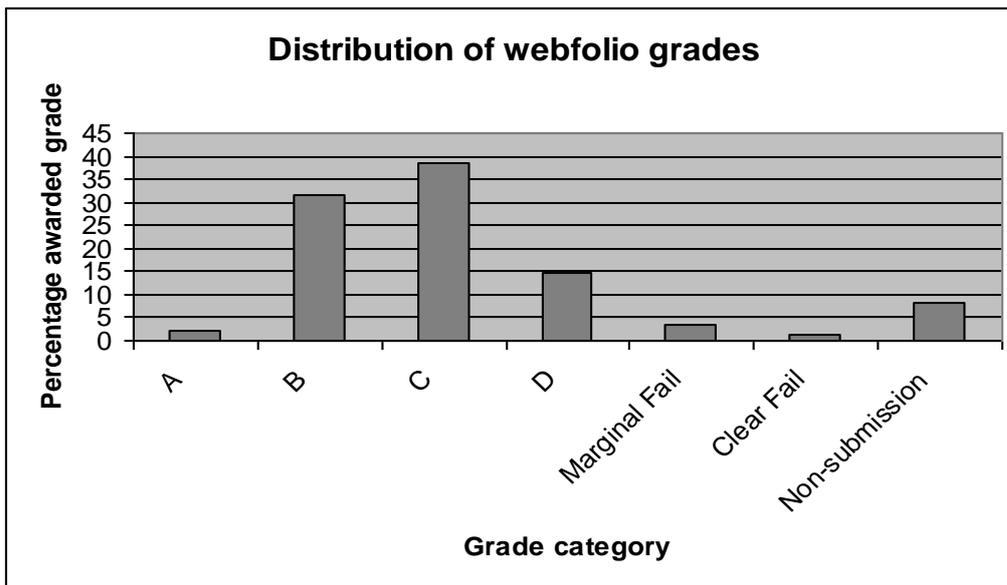


Figure 1 Spread of grades for the webfolio

Generic and individual feedback was provided for the students. The generic feedback explained the grade distribution:-

A grades - well-written, well-presented, fluent and concise pieces which excluded personal information but made it clear what the student was studying, stage of study, achievements and accolades as well as qualifications. The front page contained a good amount of relevant information that would stimulate the reader to want to go beyond the first page. These webfolios also indicated what experiences the student had had (including placement) and included the tasks you were required to do but then also linked this to skills gained. There was a nice summary of strengths also linked to evidence (weaknesses were not included), and a brief sentence on future aspirations. The student had also considered where they were utilising theory learned in practice, and there were some nice reflections on learning/development. There was limited listing of information, allowing the reader to appraise the students skills in terms of constructing a short piece of prose. A positive attitude emerged from the work.

B grades - generally well-written but there may have been some limited sentence construction/grammatical errors. Experiences, accolades and achievements were evident - the balance of information was still toward learning and gaining skills, though there wasn't always the fullness of details. Placement was referred to, as well as tasks undertaken, and it was evident what you were studying. Again there was limited listing of information.

C grades - generally well-written but there may have been some sentence construction/grammatical errors. Experiences, accolades and achievements were generally evident - most provided details of work experiences/placement, though there wasn't always the fullness of information. Sometimes playing sport predominated over the detail provided regarding studying sport. There was some listing of information and written sections were generally shorter meaning the reader had less of a chance to appraise skills in this area. The sections may not always have flowed from one to the other and there was some limited repetition of information.

D grades - these contained the right type of information eg. experiences, qualifications, accolades but there was limited reference to study experiences or skill development. There were often issues with the layout of the webfolio either regarding fluency between sections, or repetition of information, or in terms of general written English. Often personal information predominated over what a future prospective employer would expect to see showcased in this forum.

Fail grades - *these were generally too brief, too personal in style and information, and made insufficient reference to experiences from the domain of sport and exercise eg. had omitted to mention placement, or to consider skill/strength development'.*

It was evident from the profile of grades that the assessment was suitably discriminatory and able to differentiate student performance- however, the module team were disappointed that there were fewer students getting grades at the top end of the range, particularly when there had been opportunity for formative feedback in the weekly tutorial classes. It was of note that, despite preparatory tutorial tasks being set for the students to optimise the capacity for feedback, few students availed themselves of this opportunity. Therefore, this is something that staff will try to promote more heavily in subsequent academic sessions.

Student feedback, in respect of the unit of assessment, was very positive. Students appreciated the opportunity to articulate what they had to offer to a prospective employer in this format. They also appreciated being guided, via the feedback, as to what information was appropriate to include in a professional outward-facing web-based platform and how best to present this.

Student comments included:-

'it hadn't occurred to me that what I perceived as an innocent photo of me having fun might be interpreted differently by an employer'

'I found this a really interesting exercise to do, as I hadn't ever thought about the need to promote myself to future employers via the web'

'I liked being able to choose how I organised the information but it was difficult to know if I was including the right type of information for an employer'.

Initially, the assessment brief had requested that the students submit a two page webfolio. However, module staff, when working in-class with the students, recognised that this was a somewhat restrictive format and instead the brief was revised to give the students a limit of 1000 words. This gave students the freedom to organise the material in a manner which they felt best allowed a prospective employer to easily access key information. Reflecting on the final student feedback led to a job brief for a community sports coach being used in the subsequent academic session to help give the students focus on what they presented within the webfolio.

An issue that caused concerted deliberation for the module team related to how to assess the sometimes poorer presentation of material eg. mis-spelt words, poor sentence construction, if the student had a declared learning disability. This concern emerged when the team were providing formative feedback and allowed discussions to take place with the Student Disability Advisory Service (SDAS). There was the potential for tension in respect of reasonable adjustment given the assessment guidelines clearly stating that grammar, spelling, punctuation, fluency and presentation were integral skills that would be graded. Consequently, all of the students who had declared their learning disability and were enrolled on the module were provided with additional proof-reading support by SDAS. SDAS were also able to use this as an opportunity to signpost web-based tools that students could access as learning support for subsequent assessments, as well as promoting resources that could further enhance (if required) the student's written and visual presentation skills.

Conclusion

In an increasingly competitive job market it is important that graduates leave university with a skill set that they can professionally articulate on online platforms (Mayrhofer et al, 2005; Knight and Yorke, 2003). Fleming, Martin, Hughes & Zinn (2009) note that developing entrepreneurial skills in order to be able to market themselves, in addition to developing a sense of 'professional ethics', are considered relevant competencies for graduates from sport programmes.

With the global reach and the variety of audiences accessing the worldwide web, as well as the growth in social media for networking and for recruiting (Chen et al, 2009; Backstrom et al, 2006; Cohen & Clemens, 2005; Skeels & Grudin, 2009; Jobvite, 2012) it is increasingly relevant that

students are taught to communicate professionally via this medium (McCartney, 2012). It is currently too early to evaluate if engagement with this type of assessment and specifically the guidance and graded feedback, has had an impact on this cohort's employability. Appraising communication skill development has proved to be a valued tool for this student population and one that the subject team will continue to engage with.

Whilst debate still exists about the value of social networking tools for learning purposes (Madge et al, 2009) as well as the worth of teaching employability skills in a classroom context (Cranmer, 2006; Mason et al, 2009), there is scope to consider the impact of this type of guided simulation using web-based technology to advance self-presentation.

Graduate employment statistics, as derived from Destination of Leavers from Higher Education survey data, now form part of Unistats' Key Information Sets (KIS). Students report this as being a valuable tool in aiding them to make an informed decision about their chosen programme of study and their preferred location (HEFCE, 2013). Institutions, particularly those that are publically-funded are also expected to reflect on the effectiveness of their operations, particularly in a 'market-driven environment' (Universities UK, 2013). This can include consideration of programmes of study and the perceived value of their contribution to the economy. Therefore, the impact conferred by heightening student employability could extend beyond the graduate.

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Biographies



Andrea Cameron is the Head of School of Social and Health Sciences at Abertay University. Prior to this, she was the Director of Academic Programmes for the School, leading on issues of Teaching and Learning, Quality Assurance and Quality Enhancement. This role was subsequent to Andrea being the BSc (Hons) Sport and Exercise programme leader. Andrea is a Senior Fellow of the Higher Education Academy. She is module tutor for the first year 'Contexts in Sport' module, co-ordinating the first year sport student placements. She presents and publishes work in relation to Personal Development Planning and employability initiatives, including 'Clients in the Classroom'. Andrea is a sport scientist and a registered nurse teacher, continuing to produce patient publications for a Diabetes charity. Her interests in heightening skills, competency and employability in graduates derive from her clinical nurse teaching experiences.



Carol Maxwell leads Abertay's Technology Enhanced Learning Support team. The team help staff maximise the impact of their teaching through the use of learning technology. Prior to this she developed training programmes for a paper making company when converting to a new ERP system. She has also worked in the Banking Sector where she managed their back office systems. Carol is a member of the Chartered Institute of Personnel and Development and has a PGDip in Blended and Online Education. Her interest in student employability stems from her background in HR and the affordances of learning technology including social media.



Dr James Cobby is an early career researcher and lecturer within the Division of Sport and Exercise Sciences at Abertay University (Dundee). In 2009, James was awarded a first class honours degree in Sports Science from Edge Hill University. James then gained a distinction award in Sports Physiology (MSc) at Liverpool John Moores University (LJMU) in 2010. He then stayed at LJMU (2011-2013) completing his PhD entitled 'The Effects of Life-long Training on the Ability of Aged Skeletal Muscle to Adapt to Exercise: Insight into Age-related Loss of Muscle Mass and Function' under the expert supervision of Dr Graeme Close, Dr James Morton and Dr Jatin Burniston. James hopes to continue exploring how the elderly adapt to both acute and long term exercise and nutrition interventions at Abertay University. James is a member of the Physiological Society and the Society for Free Radical Research-Europe.

Serious EdGames©: Digital innovative serious educational gaming for mobile technology

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Serious Educational Games, mobile learning, educational technology, e-Learning

1. ABSTRACT

Serious EdGames is an innovation which sought to meet the need for enjoyable learning experience in education and training for built environment professionals. It incorporates innovation in e-learning methodologies and learning materials designed for mobile devices such as iPad, Surface Tablets, Galaxy Note Smartphones etc. It also meets the needs for a flexible solution where a large number of learners could do their training anytime, anywhere.

Serious EdGames (SEdG) improves best practice in education and training for built environment professionals. It attests the SEdG concept. The essence of SEdG is to enrich and enhance learning experience for built environment professionals, producing learning materials that work on devices that many learners are well familiar with.

2. INNOVATION

Recent developments and studies (e.g., Chee, Mehrotra et al., 2014; Cowley, Fantato et al., 2014; Eck, 2010) on serious games have shown its potential as a learning tool. A significant result of our Serious EdGames (SEdG) innovation is the major improvement in best practice that few educational establishments achieved - SEdG makes a breakthrough in this education technological space where the most modern technology is used to support the technology-savvy learners and learning professionals. In its use of prevalent mobile technology, this innovation significantly increases learning amongst the younger professionals. It delivers 'boring' subject matters in an engaging way. The engaging gaming format, the exploitation of already-familiar technology encourages learners to learn. Being an online game, it has similar *learning by doing* attribute where each learner could "outlive and demonstrate his individual values, thoughts, and opinions, and be sure that others thoroughly study and acknowledge his character." (Friedl, 2003, p. 31)

This innovation was funded for 7 months by the University of East London. This short time-scale presented enormous challenges in coordination with critical stakeholders and resources. To maximize success, we planned a tight schedule of intense collaboration based on the Dynamic Systems Development Method. Barrow and Mayhew (2000) set out several characteristics and reasons why this method in rapid application development was useful in such an innovation, including its emphasis on consensus and democracy.

The designer and the developer first discussed in detail the rapid design methodology for SEdG for built environment learners and professionals, and the required resources for implementation and outline plan. Having forwarded our resource requirements to relevant suppliers, we devoted our time to piloting SEdG applications which we then showcased to senior users and funding committee. This is a critical challenge because SEdG was a very new concept to support active learning; the funding committee gave us full support and encouragement and so we overcame these challenges.

Figure 1 Serious EdGame integrated into MOODLE



We suggested an outline plan to funding committee which they agreed upon. According to Kotter (2012, p. 126), achieving short-term wins from the beginning increased stakeholders confidence and interaction. This increased return on investment and innovation success. Our outline plan included milestones such as feasibility study, pilot applications and launch. Feasibility study included resource gathering, stakeholders and workflow. Pilot applications involved stakeholders who evaluated early versions of the SEdG against active learning principles and specific learning outcomes of each game. We then progressed on the games, gaining further feedback from stakeholders.

We showcased pilot SEdG applications to built environment learners, professionals and academics to elicit their feedback on serious game designs and implementations that were most engaging for learners. With this, we overcame potential knowledge and experience gap of learners. To prepare

for the launch, we published the game, and submitted full closure report to the funding committee. Having delivered what we set out to do, the funding committee agreed to the closure a month ahead of schedule, a testament to the innovation having satisfied all e-learning objectives.

The SEdG *Survey* and *Goals* are designed for learners to explore a plot of land, with the intention of deciding on the alignment of a trunk road. While key sites (e.g. factories, public venues, parks, Special Protection Areas etc.) are shown, learners are asked to survey the site by controlling the *Character* to walk around the site, in order to find out a number of areas on the site where there are particular concerns, e.g. Special Protection Areas. Learners find the style of these SEdG much richer and free flow than traditional structured simulation games, and much less intensive than third-person shooting games.

Figure 2 'Survey' Serious EdGame

The screenshot displays a Moodle course page for the 'Survey and Goals' game. At the top, there is a navigation menu with links for Home, Applicants, Students, Staff, Research, Alumni, Academic Schools, and Contact Us. Below this is the UEL (University of East London) logo and a user profile for David Wong (Logout). A breadcrumb trail indicates the user's location: My home / My courses / ACE / CE / 1213 / CEM014 1213 B / Games for Learning / Survey and Goals game - explore a city to build a ...

The main content area is titled 'Survey and Goals game - explore a city to build a trunk road'. It features a 3D isometric map of a city with various landmarks labeled: 'Public Venue', 'Village', and 'Phone'. The map shows a character walking through the city, with various buildings, trees, and a duck. There are also several red arrows indicating movement directions.

Below the map, there is a link to play the game in full window, the last modified date (Thursday, 20 June 2013, 10:33 PM), a link to Moodle Docs for this page, and the server name (App 3).

The footer contains contact information: Enquiries: 0208 223 2468 Email: servicedesk@uel.ac.uk, Moodle Website: http://www.uel.ac.uk/moodle/, and Copyright © University of East London. It also features several accreditation logos: QAA (UK Quality Assured), Living Wage, Positive About Disability, Customer Excellence, Investors in People, and disabledGo.

Learners control the *Character* by using the cursor keys on their keyboard, or touching on the on-screen arrow keys if using a mobile device. If learners wish, they can click on the designated link to play in the game in its own window which can give them a better playing and learning experience.

In Figure 3, learners explore the site and go to locations that they can find out more information. If they come to the Special Protection Areas region, a pop-up box appears to give them an explanation. If they choose to they can then proceed to this next "stage" of the game.

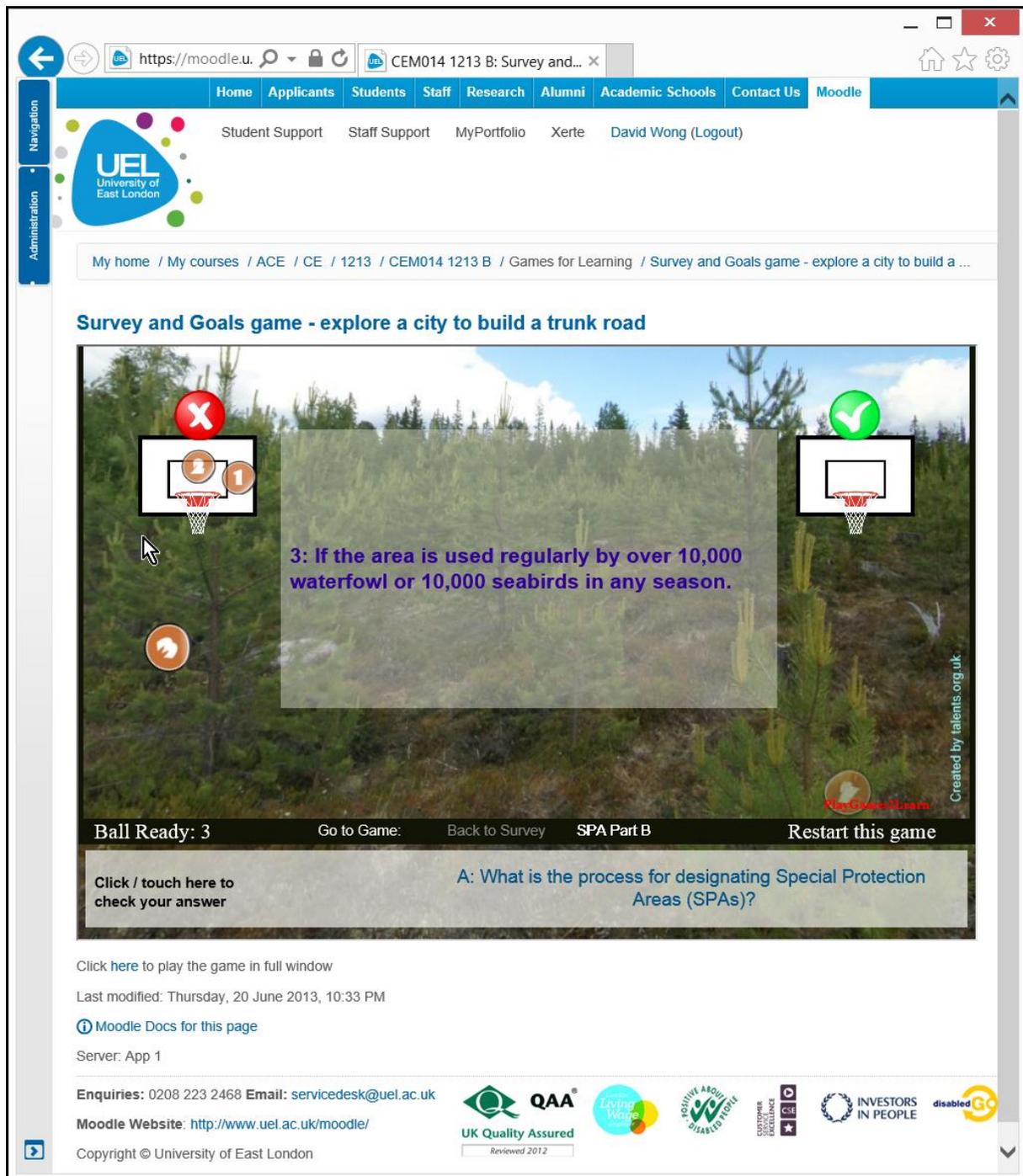
Figure 3 Navigating the Character to learn about Special Protection Areas, a pop-up explanation is shown

The screenshot shows a Moodle course page for 'CEM014 1213 B: Survey and Goals game - explore a city to build a trunk road'. The page features a navigation menu at the top with links for Home, Applicants, Students, Staff, Research, Alumni, Academic Schools, and Contact Us. Below the menu is the UEL (University of East London) logo and a user profile for David Wong (Logout). A breadcrumb trail indicates the current page location: My home / My courses / ACE / CE / 1213 / CEM014 1213 B / Games for Learning / Survey and Goals game - explore a city to build a ...

The main content area displays the game interface. The game title is 'Survey and Goals game - explore a city to build a trunk road'. The game area is a 3D isometric map of a city with various buildings and trees. A central pop-up box titled 'Special Protection Areas' provides a definition: 'Special Protection Areas - areas which have identified as being of international importance for the breeding, feeding, wintering or the migration of rare and vulnerable species of birds found within European Union countries. They are European designated sites, classified under the Bird Directive'. The map includes labels for 'Laboratories', 'Factories', and 'Suburb'. Navigation arrows are visible on the map.

Below the game interface, there is a link to play the game in full window, the last modified date (Thursday, 20 June 2013, 10:33 PM), a link to Moodle Docs for this page, and the server name (App 1). The footer contains contact information: Enquiries: 0208 223 2468 Email: servicedesk@uel.ac.uk, Moodle Website: http://www.uel.ac.uk/moodle/, and Copyright © University of East London. The footer also includes several accreditation logos: QAA (UK Quality Assured), Living Wage, Positive About Disabled People, Customer Excellence, Investors in People, and disabledGO.

Figure 4 Next stage of the game - the "Goals" Serious EdGame is where learners are presented a series of questions for them to respond



As shown in Figure 4, learners consider one statement at a time and can take as long as they want to “score” each ball. The statement is presented prominently to help focus learner’s attention.

3. PEDAGOGY

This section elicits the pedagogic approach that underpins the design of the SEdG. There are different learning styles. Learners may learn better in different approaches to suit their learning styles. Some learners are *visual learners*, that is, they learn through visualization. They learn better

with pictures and diagrams. They prefer to record in visual form so that they can see them in order to absorb the materials. SEdG benefits most for this learning style.

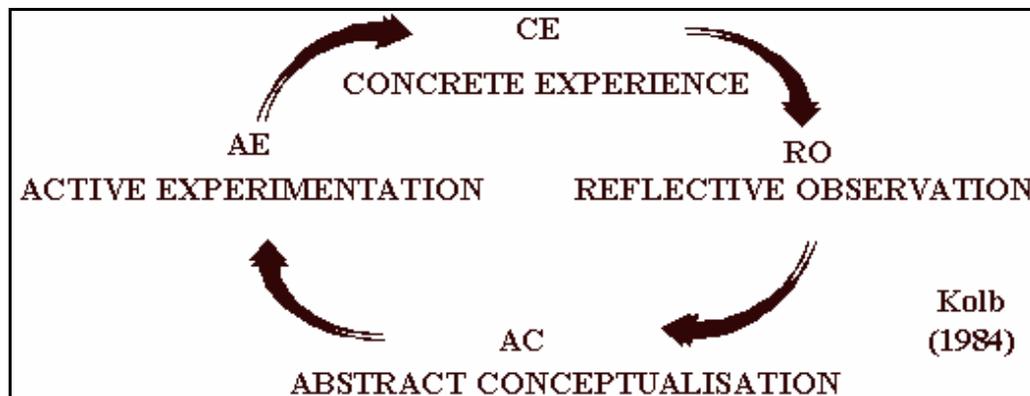
Another group of learners may learn better through listening. They are *auditory learners*. They absorb better when the materials are read aloud. The learners of this learning style interpret information in speech through listening to tone, pitch, speed and some other nuances. Written notes are less effective to their learning unless they are in audio form. SEdG is designed to be readable from a screen reader. This would unquestionably benefit auditory learners as most browsers support auditory provision for accessibility.

However, for *tactile learners*, a long lecture may not give much help to them as compared to doing hands-on activities. They learn more effectively by doing than thinking. SEdG works best suits this type of learning style as the learners will engage in interactive activities.

Kolb (1984) explained the learning cycle by his four learning styles: accommodators, divergers, convergers and assimilators. Figure 5 shows the Kolb's learning cycle. Accommodators (Concrete experienter/Active experimenter) are active experimenter; they are doers rather than thinkers. They learn more effectively by doing, hence SEdG is the best way to learn for this category of learners. *Divergers* (Concrete experienter/Reflective observer) start from the details and work up to the bigger picture. They like to work with others, and learn well from constructive feedbacks. SEdG can benefit them if the design of the learning materials contains great details; SEdG has feedbacks which fall into this category. Such feedback would contribute to the constructive feedbacks which benefit the divergers. *Convergers* (Abstract conceptualization/Active experimenter) are thinkers who ask questions and try to solve problems. They like to understand how things work. Assimilators (Abstract conceptualizer/Reflective observer) prefer thinking than acting. They like lectures with demonstrations, they appreciate the knowledge of experts. They learn best through conversation with a logical and thoughtful approach. The engagement with SEdG suits this learning style because the interactivensness creates a dialogue with the experts in a logical and thoughtful way.

Figure 5 Kolb Learning Cycle

Source: http://reviewing.co.uk/research/learning_cycles.htm



Fundamental to the pedagogical approach that underpins the design of SEdG is an awareness of the learners' readiness to learn. This must mean a readiness to change: acquiring new skills, attitudes and knowledge will affect learners' perception of themselves. This is consistent with a constructivist view of learning, the learner building new ideas into concepts based on their prior understanding (Light, Cox et al., 2009, pp. 22-23). The learners' readiness to change in learning with SEdG gives the learners the best opportunity to succeed.

The SEdG concept promotes activity-based learning so that learners can be fully engaged with the materials. This concept not only promotes learning at learners' preferred time and pace, it also promotes "multiple attempts" in assessment activities, in particular, the learners are less likely to feel embarrassed as they would in a class environment.

SEdG is a highly original concept: it promotes an exploratory approach to learning: learners apply their own prior knowledge and experience to make their own decision on structuring their learning experience. SEdG is an exciting implementation of the theory of active learning.

4. TECHNOLOGY

SEdG game design typifies online games where the technology is as important as the look and feel. Friedl (2003, pp. 36-37) reminds us that online games is an art form in the way the designer conveys the message to players. Such a message includes the graphical and interactive content, as well as culture and worldview. In the *Survey* and *Goals* games, it is important to provide a world that has some similarity to the physical world, an environment that bears some resemblance to what professionals find in their physical work environment. Instead of a closed-up view for the learners, the game maintains an overall view, with some degrees of *panning*, so that learners have a strong sense of where they are and want to go to explore further.

The use of the *Character* adds fun, but also a sense of purpose. It puts learners in control of the game, in the same way they are responsible for their own learning. It reminds learners games such as *Pac Man* they might have played when young, making a smooth transition to playing *Survey* and *Goals*. This way of creating online presence is further explored by Tamborini & Skalski (2006, pp. 226-227) who says virtual social actors create their online presence, and self-presence can be invoked by an object that represents an individual player. Li et al's (2012) study on avatar further reinforces online presence in self-identification.

Friedl (2003) further says playing games is an exercise of deconstruction of information that players receive, enabling them to focus on what is important. As learners explore in the *Survey* game, they will soon reduce attention to the significance of some of the games artefacts (e.g. houses) which are not important for learning. Learners will walk to areas indicated by e.g. the *ducks*, because these are where learners find further information that leads to next stage of the game. They get further information they need for the survey. Having deconstructed the environmental information, learners have the relevant information to progress with their learning.

Due to rapid development constraint, SEdG is created using *Construct 2* (<https://www.scirra.com>). It provides a development environment to program sequences, interactions and conditions between objects, and between the character and objects. To publish games, it generates a collection of files to support playing on desktop computer and mobile devices. These files conform to HTML5 and web app standards. Affirming such best practices gains widest reach in smartphones running iOS and Android operating systems. SEdG applications are integrated into MOODLE virtual learning system. They allow the best resources of both organization of materials, assessment of understanding of the materials in MOODLE. Engaging, exploratory, self-paced activity-based learning is made possible by SEdG.

We overcame the challenge of IT resource by identifying alternative web hosting where we could add and update SEdG and related files in real time. We also overcame challenge of MOODLE integration by implementing document embedding and interoperability methods. This was critical so that learners would not see pop-up error or security messages when they activated the games.

We overcame the challenge of lack of devices for testing by acquiring several smartphones of different operating systems and versions (e.g. iOS on iPhone, Android on Samsung, Windows Mobile on HTC) and larger screen size devices (e.g. iPad2, Google Nexus 7). With this, we improved on our SEdG rapid design and implementation routine, thereby turning the challenge into our competitive advantage.

5. USEFULNESS AND BENEFITS OF THE INNOVATION

5.1. Evidence of Benefits and Achievement of Learning Outcomes

The learning outcomes of SEdG are to know planning law, including the system of development plans, planning applications, and acquiring consent for development, to identify the powers in land acquisition, compulsory acquisition and compensation, to comprehend the legal enforcement of development control and special planning controls, Nationally Significant Infrastructure Projects consent (NSIP) and environmental impacts of the development. In our survey on achievement of

learning outcomes, 47% of learners responded positively to enjoying the learning using SEdG better than the traditional methods of learning, while 21% didn't agree. Some comments included "people can learn more easily by loading examples via games", "it's more interactive way of learning, more fun and more relaxing", and "we would spend more time to learn a subject in the game than reading a book". Undoubtedly, SEdG contributes to the increase in retention of learners.

More learners (29%) agreed that they focused better when using SEdG as in contrast to reading printed books, compared to 24%. Regarding retaining what they learn, 29% said SEdG achieved this, against 21%. Asked how likely they would use SEdG for learning, 27% said no compared to 24%. Some suggestions were made, for example, less graphics, sound and animation; the use of immediate response or checkpoints when they have done an assessment action; and "the layout of questions could be a little more attractive with more figures, charts and different design."

The survey reflected no significant barrier these learners faced with the use of such an approach and this particular interactive medium. The majority was able to acquire their online presence with the aid of the character and proceeded with the learning activity. Over 92% of the learners progress to the final year of study towards their professional qualification.

SEdG has been used as a motivational trigger as the features of SEdG such as sensory stimulation, storylines related to fantasy, can raise learners' curiosity and interest. SEdG keeps the instructions short and clear with step-by-step disclosures, enhancing the learning experience of the learners. Learners could learn much more and apply what they learn with relevant applications to real-life situations. Learners acquire new learning skills which will improve their employability.

5.2. Developer's Achievement

A distinctive achievement is the implementation of SEdG concept to meet the need of built environment professional education and training. It is measurable in its implementation of e-learning principles: learners spent much shorter time compared to instructor-led or text instruction methods, to get involved in the learning and assessment due to its games setting. It is not a surprise that learners maintain a much longer time in the work because of the enjoyable nature of learning by playing, they involve at a much deeper level of critical engagement with the material, and relate the work more easily to real-life situations.

Another achievement of measurable outcome is the innovation demanded that the game design methodology maximizes re-use and re-purposing. In practical terms, a SEdG application can be easily modified to produce alternative versions of the games for different purposes, e.g. different sets of scenarios and questions. SEdG can also be transferred to design different learning materials.

SEdG creates a new world of learning for built environment professionals where they can learn their training materials of any size anywhere they find themselves in. For example, instead of waiting for attending lectures on a topic in a future session, learners can learn ahead of the scheduled lectures, keeping the interests of the fast learners. They can learn the materials and attempt the corresponding assessment whenever and wherever convenient to them. In this way, all learning styles are actively supported.

5.3. Support for learners with Special Needs

The success of technology integration is also an achievement of measurable outcomes. This involves specific standards (HTML5, responsive web design and document embedding and interoperability) to integrate with MOODLE and together present learning materials on learners' smartphones, laptops and desktop computers. Integration of several components give learners a rich, engaging and enjoyable learning experience, and also enable supporting features from each component: material categorization in MOODLE game interaction in SEdG, and finger navigation on smartphone. These can all be adapted to support for learners with special needs.

6. TRANSFERABILITY

SEdG concept is transferable since its focus is creation of enjoyable learning materials for built environment professionals, rather than proprietary or closed methods that are implemented for specific platform or set of users.

This innovation is highly transferable. SEdG applications are produced in HTML5 formats, the files could be placed on any computer and servers, and the code will run in any web browser. The SEdG can be transferred to any web pages that support document embedding; this is done on user's computer, independent of web server software. The SEdG code can also be transferred to any learning system that support learning tools interoperability methods including MOODLE. New versions of the *Goals* games can be easily created with a new set of text files, without the use of Construct 2. Construct 2 license is affordable with educational site license and students options.

This innovation is highly flexible. Many free, open source or low cost game creation programs are available that could produce files meeting HTML5 formats. This aspect is independent of the document embedding and learning tools interoperability methods that integrate third-party applications into MOODLE. In fact, any web-based learning systems would work apart from MOODLE. Together, they seamlessly deliver SEdG to smartphones or computers, proving that SEdG is highly transferable.

7. CONCLUSION

SEdG is an innovation which benefits built environment professionals undergoing training because the SEdG implementation provides a much more enjoyable and engaging environment where they could learn much more and apply what they learn with relevant applications to real-life situations.

Our evidence proves that SEdG improves learner learning, retention, the learners' success in progression to the next level of study. SEdG benefits learning designers and instructors by incorporating active learning methods. They can improve their own knowledge of teaching and learning styles. The gap between "play learning" (as would in kindergarten and primary schools) and professional learning championed by this innovation is very much reduced. This paves the way for education professionals to carry out further research on active learning through SEdG that maximizes learning goals.

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Networked Virtual School - beyond OER and MOOC

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"The invention of the automobile and the airplane did not come from a detailed study of how their predecessors, such as horse-drawn carriages, worked or did not work. yet, this is the model for contemporary educational research. the standard paradigms for education research take the existing classroom or extracurricular culture as the primary object of study, but the real question, one might say, is whether we can invent the - educational automobile ". Seymour Papert.

ABSTRACT

In the article there are presented basic assumptions and pedagogical results of IT School Program run from November 2012 by Warsaw School of Computer Science. Starting from a group of distinguished academic computer science lecturers and scientists from 15 best Polish universities who developed and implemented the idea of Polish Open Computer Science Online Academia - Open Educational Resource (OER) for Polish computer science university students, then launching (non virtual) MOOC "Informatics Plus" program for secondary school students in which took part over 20000 secondary schools' students from 5 Polish Voivodships, finally basing on experience gained in previous two projects Networked Virtual (IT) School Program (supported by personalized IT learning system - PITLS) for secondary school students and teachers from over 500 schools in Poland was designed and implemented.

The author explains the aims of the Program, its pedagogical key layouts such as usefulness, partnership, networked learning environment, diversified and high professional level of materials, Interactivity mechanisms, personalization, built-in incentive mechanisms (individual and team), and automation of selected elements of the educational process and system data analysis. The virtual educational tools and techniques used within the Program are listed. Great emphasis is put to presenting the pedagogical and statistical results of the project based on author's own surveys done within three years on population of students and teachers taking part in IT School Program and big data analysis generated by PITLS. Finally the main future directions of IT School Program development are shortly discussed.

In conclusions author will among others try to answer the question what is the reason of the phenomena that over 60 000 students registered in the Program within 2,5 years since its starting and till now have performed altogether almost 400 000 online courses confirmed by IT School Program course certificates.

The openness of the program places it among OER initiatives, massive number of participants involved and number of courses performed resembles MOOCs, but primarily it has a kind of networked virtual organization (NVO) structure, thus it is called Networked Virtual School (NVS), which seems to have characteristics going beyond what is described today as OER or MOOC.

1. INTRODUCTION - ICT AND CHANGING EDUCATIONAL PARADIGMS

Nigel Willetts in his article "Computers in classrooms" (Willetts, N. *Computers in classrooms*, 2012) linked information technology to the technology of building roads: "when you come face to face with a rolling road technology you must decide to take the operator role or become part of the road!" ICT has become undoubtedly a kind of rolling machine serving the construction and development of modern societies. Education is also taking part in this process and ICT is playing the role of a machine enhancing children's development while learning, when used properly. Therefore, using ICT in education especially of children and youth, one must take caution and prudence that they will become aware technology operators knowing how to make best of it and how to avoid the risks and threats that they can bring.

ICT is the powerful tool that changes business, industry, communication, healthcare and many others including education, so many scientists indicate the necessity to define new objectives of modern education of children and youth and to change the paradigms of education, which is the result of disruptive technological change. Anthony Duisburg, in the article "Online learning - the future of education"(Doesburg, A. (2012). *Online Learning – the Future of Education?*) described the process of changing educational purposes as a transition from literacy and numeracy (three "R") to learning critical thinking, communication, collaboration and creativity (four C). There are attempts of a new interpretation of Bloom's taxonomy of educational objectives in the era of digitalization of the learning process (Churches, A. *Blooms Digital taxonomy*, 2009).

Everybody agrees that ICT plays a very important role in changing traditional educational systems from proving performance oriented classrooms into personalized (networked) learning environments oriented on improving learning as described in table 1 by Chris Watkins (Watkins, C. (2010). *Learning, Performance and Improvement*).

Table 1
Proving Performance vs. ImProving Learning

Traditional Classroom (Proving - Performance Orientation)	Personalized Learning Environment (Improving - Learning Orientation)
Teacher-centered	Learner-centered
Learners follow instructions	Learners actively participate in learning
Goal is correct answer	Goal is for deeper understanding
Whole class lesson with learners working alone	Learning happens individually, in pairs, in threes and in groups
Teacher gives time to answer questions	Message is on improvement with a focus on effort
Learners focus on tests and grades	Performance linked to effort and progress

Source:<http://www.personalizelearning.com/search?updated-min=2014-01-01T00:00:00-08:00&updated-max=2015-01-01T00:00:00-08:00&max-results=24>.

Also other authors appreciate the important role of ICT in changing of educational landscape. Barbara Bray and Kathleen McClaskey (Bray B., McClaskey K. (2015). *Make learning personal*) developing the idea of personalized learning which according to them "is a controversial term that means different things to different people depending on where and how it is referenced. Some educators believe it is the alternative to "one size fits all" instruction where others promote programs or tools that personalize learning for you and others emphasize that learning starts with the learner", also stress that "technology is moving the idea of "personalized" forward everywhere we look".

The very important factor which can accelerate changing the educational systems into personalized ones apart technology itself, is young peoples' attitude to new technologies. Tamar Lewin headlined her article in the New York Times (Lewin, T. (2010). *If your kids are awake are probably online*) - after discussing the results of the report - Generation M2: Media in the Lives of 8 - to 18-Year-Olds (A Kaiser Foundation Family Study. 2010): "If your kids are awake they are probably online". When we look at the results of the report it looks as new media consume most of children's free time. Sometimes they balance on the borders of addiction as the research shows. In the past children used blackboard chalk for playing hopscotch, nowadays they use computers for plenty of different activities, not only for playing one game, among them for learning.

Many reports concerning the importance of the new media in the lives of children and young people when they are online, show significant role they play in shaping perceptions of all aspects of the world around them, also on education. Results presented in table 2 show the frequency of chosen activities done in internet by IT School students, giving an idea of time they take in their life but also of their priorities in using internet.

Table 2
How you spend your time on the Internet - specify the frequency

Activity	Very often		Often		Not very often		Never	
	2013 %	2014 %	2013 %	2014 %	2013 %	2014 %	2013 %	2014 %
I browse social networking Sites	51,46	48,44	29,61	32,87	11,29	11,42	7,04	7,27
Checking e-mails	38,71	23,88	42,11	32,22	18,20	39,45	0,36	3,46
Talking with friends	51,70	31,83	31,19	33,91	14,32	28,03	1,70	6,23
I play games	17,60	29,41	20,63	21,45	42,48	35,99	17,48	13,15
Look at online stores, Auctions	11,29	13,49	37,38	32,18	42,96	42,21	6,43	12,11
I learn using educational recourses in the net	8,37	28,72	25,36	47,06	50,73	21,45	13,35	2,77
Using the resources of the portal IT School	4,25	11,07	22,45	34,26	47,94	43,25	22,69	11,42
I'm looking for entertainment content, music	52,91	51,90	36,41	38,75	6,92	8,30	1,09	1,04
Browse news	24,15	32,53	41,63	42,21	27,18	21,45	4,37	3,81

Source: IT School survey, Warsaw School of Computer Science, 2013, 2014. Number of respondents who answered this question: 824, 289.

The indexes of over 80 % very often and often for all students are assigned to: looking on social networking sites (81,07%), checking e-mails (80,82%), talking with friends (82,89%), and looking for entertainment content, music (89,32%). In two consecutive surveys there are two distinctive trends one is raise of percentage of students who very often play games (by 11,8%) and of students who very often and often use educational recourses in Internet while learning (42,9%)! Internet becomes whether we want it or not every day educational children's educational assistant as much or even more important in some ways then teacher. The above values correspond to Cisco Report (*Cisco Connected World Technology Report, 2011*) results of more general nature according to which for 78

% of students the primary way of getting information and news are laptop, computer, smart phone and tablet, 81 % of students consider the internet as important or almost as important to their life as water, food, air, and shelter and most important technology in daily life for 83% of students are laptop, computer, smart phone and tablet.

ICT technology because of its flexibility, mobility, capacity, versatility of possible usage, networking nature and most of all because of very positive students' attitude to them seems to be a long awaited holy grail for personalized education, understood as unlimited source enabling to improve learning process enormously.

2. GENESIS OF IT SCHOOL PROGRAM

The way to IT School Program was probably similar to those experienced by many other universities in the world. "For us OER have to be part of the Universities' social mission. Universities are not isolated islands, or, at least, they shouldn't be. They are part of a big framework and this framework is the one that has to benefit from using OER. Universities have to commit themselves to provide support to the society, and the best way to achieve this is by making the access to a good education easier for everybody" (Martinez, S. (2014). *OCW (OpenCourseWare) and MOOC (Open Course Where?)*). Similarly IT School Program activities are part of the strategy and mission of Warsaw School of Computer Science that relate to the dissemination of ICT knowledge and competences beyond the traditional academic community using modern ICT technologies, often described as outreach.

The very initial idea of the Program was born when over ten years ago Warsaw School of Computer Science (WCS) launched Polish Open Computer Science Online Academia (POCSOA) (www.pwi.edu.pl), with the support of 15 best Polish Universities. In result over 30 excellent Computer Science video lectures were produced for open public, mostly addressed to computer science students and academic lecturers. Watched by thousands of viewers it was (and still is) a form internet open TV, having very limited possibilities of interaction (viewers can evaluate lectures, giving the opinion on their quality).

Some time (2009) before MOOCs were shown by American consortia, Informatics Plus project supported by EU funds was launched and run for four years by Warsaw School of Computer Science, serving over 20 000 students and teachers from 300 Polish secondary schools. The program results among others were the preparation and realization of full 150 - 20 hrs courses and 100 - 1,5 hrs lectures authorized by 100 distinguished academic professors from top 10 Polish universities. This program we can call first Massive Open Course type, not online, the biggest of such in Poland. It used internet only incidentally via Frontera Platform, being mostly a face to face program. Also over hundred of written (electronic) materials were produced and video recordings as well, among them a Homo Informaticus, a set of essays written by academic lecturers for secondary schools' students and teachers. But from the point of view of IT School Program the most important was research made among the secondary school teachers before starting the Informatics Plus program, trying to find out what are the most missing areas (subjects) to be covered by the program, not represented sufficiently in the nationwide computer science curricula. To identify areas of computer science, which are represented in the curriculum insufficiently, in the opinion of the teachers they were asked: 'What subjects and areas represented in the framework of national curriculum would you like to provide students more broadly, especially in the context of extracurricular forms of education? ". The teachers' for and against were: algorithmic and programming: -155 YES, NO - 69, databases: YES - 132, NO - 92, multimedia, graphics, web technologies: YES - 170, NO - 54, Computer Networks: YES - 138, NO - 86, trends in the development of computer science and its applications: Yes - 70 No - 154. As indicated the results of survey, each (except the last one) has been the subject considered by the vast majority of teachers not sufficiently represented in the curriculum, which pointed to the need to broaden their (teachers and students) knowledge in the field of these areas. The most needed support expected by teachers were found in the areas: "Multimedia, Graphics, Internet technologies", followed by "Algorithms and programming" (*Final report, Informatics Plus Project*, 2012). Especially the second one caused many doubts, how students can learn informatics properly not having sufficient recourses to learn fundamental concepts of computer science.

3. IT School Program aims, organization and main assumptions

Basing on experience gained in previous projects, IT School Program was launched in November 2012, as neither OER nor MOOC or blended learning, it went beyond these three ideas trying to construct Networked Virtual School which is in a different context similar to "Networked Common School" introduced by Leonard J. Walks "(Walks , L. J. (2004). *The Concept of a 'Networked Common School*".

The main objective of the Program was and still is to increase the level of ICT competences (e-skills) of all secondary schools' students registered in the program. Other aims are: popularize basic knowledge of computer technology to those who are not interested in ICT, encourage and prepare young people to study in the field of Information Technologies and thus facilitate the study of the core courses in Universities, give the teachers tools for individualized learning with ICT talented students. The Program is addressed also to these (secondary and non secondary school users) who want to improve their labor market "attractiveness" by obtaining WSCS accreditation of ICT skills or simply for self studies.

From the organizational point of view IT School resembles "the regional network of secondary schools which may also be defined in a larger sense as a networked School of schools or common networked school, a virtual counterpart of a multi-campus state university. The regional network as a virtual organization has its own organizational identity but also provides a larger organizational context for local school 'branch campuses' with identities of their own" (Walks , L. J. (2004). *The Concept of a 'Networked Common School*). The IT School organizational structure is a very flat one consisting of teachers (called coordinators of the program) and their students representing the secondary schools registered in the Program. Warsaw School's of Computer Science role is integrating one, mostly from content and technical point of view. But surely IT School has its own organizational identity visualized in IT School brand mark and represented by huge students and teachers community.

Leaving aside discussions on contemporary educational theories connected with IT technologies such as constructionism, connectivism, cognitive apprenticeship, learning in collaboration, learning in partnership and learning in a situation (Attwell, G., Hughes, J., (2010). *Pedagogic Approaches to Using Technology for Learning*, Pedagogika web 2.0) , in this paper I will concentrate on presenting pragmatic approach to the learning taking as the basis of IT School educational concept such ideas as usefulness, partnership, networked learning environment, diversified and high professional level of materials (content), built into the system interactivity mechanisms, personalization of education, built-in incentive mechanisms (individual and team), and automatization of selected elements of the educational process, management and system analysis (big data).

The usefulness of the program was assured on the very initial stage by a survey asking the teachers among other questions, what they and their students need most to support computer science teaching/learning (*Final report, Informatics Plus Project, 2012*), having in mind that IT School Program was not to replace but to support weak points of national computer science curriculum. Prepared in close cooperation with teachers and students no wonder that two surveys gave results as below. The question addressed to teachers in surveys from 2013 and 2014 was whether the content offered by the IT School portal is useful for students?

Table 3
Is content offered to the students by IT School Program useful?

Answer	Number of answers		%	
	2013	2014	2013	2014
Definitely yes	81	61	59.12	72,62
Yes	55	23	40.15	27,38
Rather not	1	-	0.73	-
Definitely not	-	-	-	-

Source: IT School survey, Warsaw School of Computer Science, 2013, number of respondents who answered this question: 2013 - 137, 2014 - 84.

The results obtained were obvious and confirmed very well performed consultancy stage, in the first part of the project. Participation of teachers and students in establishing the areas and materials gave excellent starting point for further activities.

To confirm ex post usefulness of the program in a survey from 2015 the teachers were asked about the frequency of using IT School resources during classroom lessons:

Table 4
How often do you use educational resources of IT School Program in classes with your students?

Answer	%	Number of answers
More than 3-4 times per month	26,61	33
About 3-4 times per month	17,74	22
About 1-2 times per month	34,68	43
Less than once a month	20,97	26

Source: IT School survey, Warsaw School of Computer Science, 2015. The number of respondents who answered this question: 124.

The above results show that over 50% of teachers use the resources almost on every computer science lesson each month, giving a clear evidence that IT School Program is very useful for teachers and students. The usefulness of the program is also expressed by massive participation in the program and its different activities, by the students and teachers (table 5). IT School Program is not obligatory, so usefulness is one of the main reasons that makes the program so popular in the secondary schools students and teachers community.

Table 5
IT School - chosen statistics

IT School data	2012/2013	2013/2014	2014/2015	2012-2015
Number of registered Schools	385	73	66	524
Number of registered users	24173	20190	21153	65516
Number of registered Coordinators	672	386	275	1333
Number of courses performed	66902	193498	159940	420340
Number of tests performed	138164	408582	232989	779735
Number of competitions participants	538	2600	3419	6557
Number of page views*	3 030 565	7 049 921	7 978 799	18 058 709
Number of unique users*	115 302	160 757	291 422	550 533

Source: IT School data, Warsaw School of Computer Science and Google analytics data*, as on 21.04.2015.

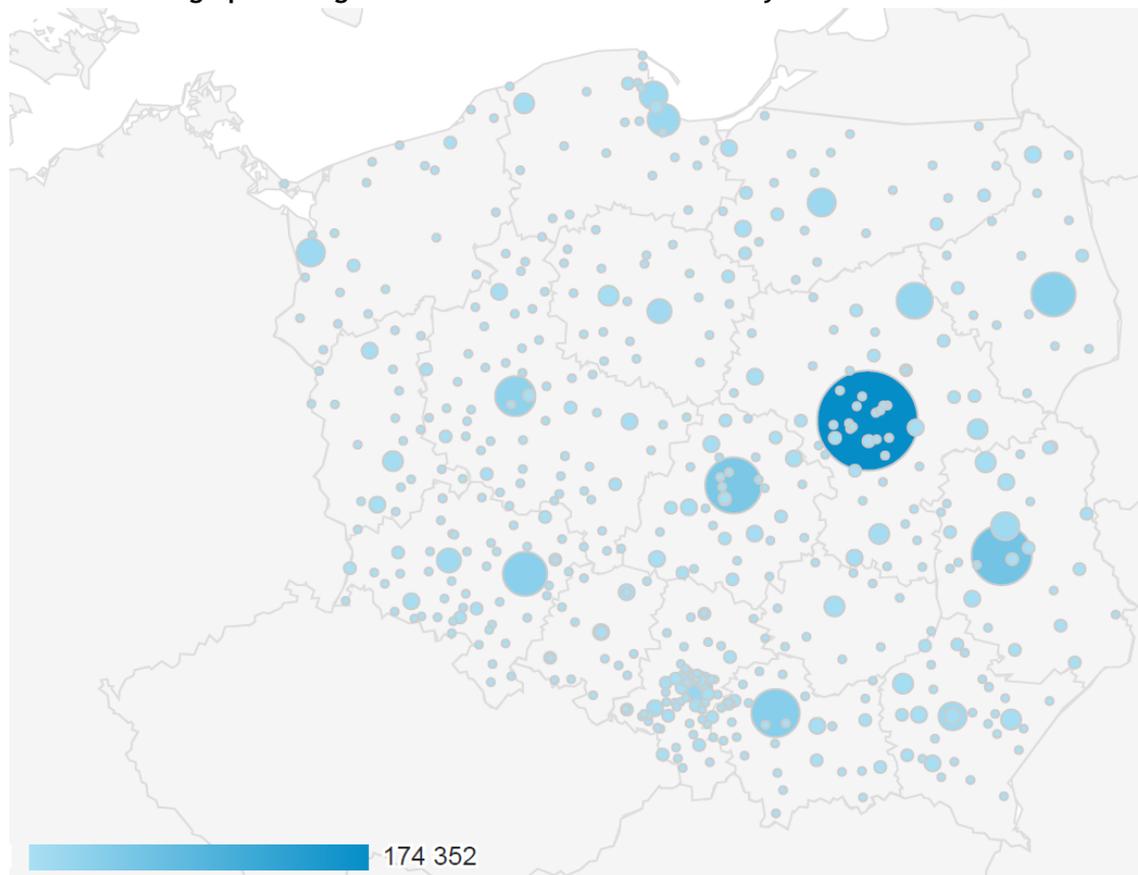
Usefulness of the program may be described in quantitative data as above, but also in quality terms such as increase of ICT competences, preparation for labor market or for further studies which will be shown while presenting pedagogical results of the program.

Partnership is next important principle of the Program. It's the community of secondary school computer science teachers and students that took part in the preparatory (research) part of the program, then in preparing and consulting the didactic materials together with academic lecturers and scientists, and finally in implementing the Program and evaluating it. Partnership was and still is realized on different levels university-university, secondary school - secondary school and secondary school - university. The idea of partnership is also applied to students who are surveyed often on different aspects becoming in that way also active partners in improving the Program results, which is especially important for personalization of learning. The forums for students (facebook) and teachers (LinkedIn) are open to express opinions on IT School Program activities and development.

It would be difficult to talk about personalized learning not having data on every student progress accessed in close partnership with teachers and students via online and face to face discussions, surveys performed after each school year and information gathered by PITLS.

Networked learning environment was natural for the Program which is being implemented in over 500 secondary school all over Poland. For the purpose of the Program a dedicated web platform was projected and implemented by WSCS, with functionalities supporting achieving the aims of the program. It among others enables forming interschool groups working together on different projects and delivering lectures from distant localizations like USA or Japan

Picture 1
Geographical logins to IT School PITLS in Poland by sessions numbers.



Source: Google analytics data 22.10.2012 - 30.04.2015.

The users of IT School Program logged in from 619 localizations in Poland and 3 444 in the world. Diversified and high professional level of materials was and still is one of the most important principle of the Program. Quality of the content is the thing that makes the Program so well accepted both by students and teachers. The results presenting level of students and teachers acceptance of chosen Program content is shown in table 6.

Table 6
Which of the Program resources are most useful for students ?

IT School chosen content	Teachers		Students	
	Number of answers	%	Number of answers	%
Video lectures	97	71.32	221	29,39
E-scripts	98	72.06	229	30,45
Presentations	107	78.68	292	38,83
Tests	85	62.50	352	46,81
Scientific distance groups	31	22.79	65	8,64
All are useful	2	1.47	223	29,65

Source: IT School survey, Warsaw School of Computer Science, 2013. Number of respondents who answered this question: students - 752, teachers - 136.

5 out of 6 chosen resources are useful for 30 % or more of students. Almost 30 % have the opinion that all materials are useful to them. Teachers evaluation on quality and usefulness of the content are approximately twice higher than students ones'. It explains why the program is so widely used by teachers for learning purposes As it was mentioned earlier for developing the Program such pedagogical forms and tools are used as courses, lectures (traditional and online), competitions, games, visits to IT firms, online academic scientific groups for secondary school students run by academics, participation in professional IT courses and many others. In cooperation with some universities open computer science lectures conducted in Polish academic centers take place. Lecture topics include the most interesting subjects concerning the theory and applications of computer science and information technology. Lectures are an opportunity to meet with academics at the premises of universities and get acquainted with the unique atmosphere of this traditional academic form of knowledge transfer. Online computer science lectures given by the best Polish academic teachers, among others from Warsaw University, Jagiellonian University, University of Wroclaw, Warsaw University of Technology, Military University of Technology and many other renowned Polish universities. E-learning computer science courses for secondary school students, allow to acquire the knowledge and ICT skills and to obtain IT School certificates. The important tool are also nationwide knowledge and skills competitions such as using computer graphics to make posters, algorithmic contest, Grand IT test and many others.

High marks given by teachers to chosen recourses (table 6) bring immediately the question in what way the teachers use the materials. The answer are presented in the next table 7.

Table 7
In what way do you use IT School Program resources with your students?

Answer	%	Number of answers
I use IT School materials in computer science classes	70,97%	88
I recomend studying IT School materials as homework	52,42%	65
I use IT School materials in additional classes (e.g. special interest groups)	40,32%	50
I recommend studying IT School resources to most talented students to broaden their standard curriculum knowledge	72,58%	90

Source: IT School survey, Warsaw School of Computer Science, 2015. The number of respondents (teachers) who answered this question: 124.

As shown IT School Program is used in different ways, what is especially satisfying is the use of

the program in additional classes and for work with most talented students, which are one of the important aims of the program.

Interactivity and automating mechanisms such as immediate information about the test results or number and kind of activities done by the student available to them in real time are built in the information system. Also the teachers have at their disposal a special panel which enables them monitoring their students activities and progress in learning. Automatization of selected elements of the educational process, management and system analysis are developed to monitor students performance and to help teachers to personalize students learning. There are special sub programs enabling collecting and processing big data in real time and on that basis formulating further proceedings.

Personalization of learning is at the moment expressed in possibility of choosing by student any courses to be performed to make a specialized set of skills and knowledge ie. in computer networks, in computer graphics or in databases. Also the online contests are the form of involving students according to their personal interests like computer graphics, algorithms, databases, programming etc. Each student can plan his/her own activities in the program for school year, and after registering to the system to monitor progress he/she has done (by getting points for each activity). Each student's activity is also assigned to his/her school enabling each month and school year to rank all registered schools by their students' activities.

Built-in incentive mechanisms (individual and team), they are mechanisms which make the students more interested in Program's activities like competitions or public voting on best in their opinions works. Also the final competition for the title of most active schools of the Program nationwide and regional (Voivodships) rankings release a lot of students' engagement. The students are especially engaged in "Magic of Christmas" (December) and the Best IT School of the Year. The number of competitions' participants raises every year (see table 5). In the table the numbers concerning students' participation in Best IT School competition (ranking) are not shown, because it's all IT almost 70 000 School population is involved.

4. PEDAGOGICAL EFFECTS OF IT SCHOOL PROGRAM

The most important question to evaluate the results of the program is to what extent the contribution in IT School Program raised the ICT competences of students?" It was asked to teachers and students.

Table 8

To what extent the contribution in IT School Program improved the IT competences of students in the opinion of teachers and students?

	Teachers		Students	
	Number of answers	%	Number of answers	%
To a very large extent	17	20,24	34	11,76
To a large extent	51	60,71	84	29,07
Moderate	16	19,05	119	41,18
To a very small extant	0	0	25	8,65
Not at all	0	0	27	9,34

Source: IT School Survey 2014, Number of respondents (teachers) who answered this question: teachers - 84, students - 289.

81 % of teachers and 41 % of students think that participation in IT School Program raised students ICT competences to a very high or high extant. The teachers' opinion is much better about students' progress in raising IT competences than student themselves see their progress. One of the measures on which such opinions are formulated apart from surveys are test results, performed by students after each course.

Table 9
Average students' test results generated by PITLS

Test results according to attempt	2012/2013	2013/2014	2014/2015
Average result of the tests during first attempt	72,5	78,1	82,8
Average results of the tests	64,7	58,9	77,6
Average results of the tests during successful attempt	89,3	93,5	94,7

Source: IT School PITLS, 2015 as on 21st of April. Scale: 1-100, Successful result > 70.

Test results and answers (table 8 and 9) show that participation in the program brings conviction about raising students' ICT competences shared both by students and teachers, confirmed by test results generated by PITLS. As it was signaled earlier an important issue is teachers role in learning process. The teachers are called IT School Program coordinators to stress their supportive and advisory role in learning. To learn how they support students in learning they were asked in what ways they monitor students' work while using IT School Platform.

Table 10
What is the way you monitor students' work while using the IT School platform?

Answer	%	Number of answers
I use the teacher's panel monitoring the activity of students registered in IT School Program	59,68%	74
I verify students knowledge using test results available on the platform	41,13%	51
I include the educational content from IT School materials to exams, tests and tasks checking students' progress	45,97%	57
I motivate students for additional activities in the program, like taking part in competitions, taking individual additional courses from outside the standard class syllabus.	67,74%	84
I take the student activity in IT School program into consideration in final computer science class assessment	54,03%	67

Source: IT School Survey 2015. Number of respondents (teachers) who answered this question: 124.

The range of ways used by teachers to monitor students' work and progress is far wider than those listed in table 10. All of them stress coordinating and supporting role of teachers in learning rather than traditional teacher centered position as content deliverer and supervisor.

In next question of the last IT school teachers' survey I wanted to learn to what extent including IT School Program resources to teaching resulted in improving students involvement in studying the IT subject

Table 11

Please assess to what extent having IT School Program included to teaching computer science has improved the students involvement in studying the subject; as well as their interest in IT:

Answer	%	Number of answers
To a very large extent	8,06	10
To a large extent	41,94	52
Moderately	39,52	49
To small extent	6,45	8
I do not see connection	4,03	5

Source: IT School Survey 2015. Number of respondents (teachers) who answered this question: 124

For half of the teachers' surveyed including IT School program in obligatory curriculum is a decisive motivator to increase the students' involvement in learning and interest in IT. Only 4% of teachers can see no influence of IT School Program on learning IT improvement.

Teachers were also asked to assess the results from table 11 in deeper details by indicating the impact of IT School Program on particular effects of education in different thematic and "life" connected areas.

Table 12

Please assess in percentage how big is the impact of your students' participation in IT School on particular effects of education:

Answer	% and number of answers		
	Largely	Moderately	Poorly
Growth of basic computer skills, including: searching, analyzing, processing information	42,24% (49)	42,24% (49)	2,59% (3)
Growth of poorly represented in general paths of education skills, such as: computer graphics, multimedia, Internet technologies, computer networks, databases	53,45% (62)	32,76% (38)	3,45% (4)
Growth of awareness on IT use in everyday life and work (except for studying)	37,93% (44)	43,10% (50)	4,31% (5)
Growth of proficiency in using ICT for studying	37,93% (44)	44,83% (52)	5,17% (6)
Better understanding of the role of security and proficiency in use of ICT; as well as improved competences in these areas	37,07% (43)	42,24% (49)	7,76% (9)

Source: IT School Survey 2015. Number of respondents (teachers) who answered this question: 124

In teachers' opinion the important growth (from 37 to over 50%) can be observed in all categories. The above results confirm that massive participation in the Program is the effect of its holistic approach putting the learner in the centre of the system.

5. CONCLUSIONS

IT School evolved from OER through MOOC fazes reaching the new quality of Networked Virtual School which is innovative combination of both previous, with special stress put on partnership in different aspects among academic and secondary levels educational organizations, making it academic outreach program for secondary schools students and teachers. As a Program designed to accompany regular school curriculum "It avoids some restrictions of a fixed curriculum, by freeing educators to think outside of the old curricular box to experiment with learning designs more in keeping with new patterns of rational action emerging in the network era. On the other hand it does not reject, but offers a means for enlivening, curricular learning, as students bring relevant real-world experience into curricular situations and take curriculum-based knowledge back out into real world problem settings for application" (Martinez, S. (2014). *OCW (OpenCourseWare) and MOOC (Open Course Where?)* . The networked virtual school is a model not of replacing but supporting ICT education in secondary schools. It is an open, massive online educational virtual organization serving precisely identified and constantly evaluated users' needs, established in close cooperation with them. Usefulness, understood as customizing the level, quality and organization of IT School to students and teachers expectations is the answer to the question why in 2 and a half years it become the biggest such program in Poland. Still there are a lot of new concepts and ideas to be introduced in future especially in the personalization of tutoring and further automatization the big data analysis gathered by the system to the benefit of the users.

Most of the teachers agree with the statements shown in table 13, which make the essence of personalized learning paradigms such as new learning culture, open learning environment, deeper learning and partnership in learning (Bray B., McClaskey K. (2015). *Make learning personal*).

Table 13

Below you can find few statements concerning the IT School Program - please tick those you agree with:

Answer	% and number of answers		
	I agree	Hard to say	I disagree
Participation in IT School Program develops students' responsibility for their own education	69,83% (81)	28,45% (33)	1,72% (2)
The possibility to choose the courses encourages students consciousness on their own predispositions and interests	87,93% (102)	12,07% (14)	0,00% (0)
The educational resources available at the platform are useful for working with IT talented students	88,79% (103)	11,21% (13)	0,00% (0)
The platform delivers educational resources supporting the individualization of education	81,90% (95)	17,24% (20)	0,86% (1)
It is possible to notice the growth of interest in technical studies among the students using IT School Program	42,24% (49)	54,31% (63)	3,45% (4)

Source: IT School Survey 2015. Number of respondents (teachers) who answered this question: 124

Finally it's worth learning what benefits of participating in IT School Program can students see. The answers show that some personalized learning values as possibility of improvement of students' own IT skills and knowledge and access to content customized to their needs and level of knowledge are crucial in perception of the Program.

Table 14
What benefits can you see from using IT School Platform :

Answer	%	Number
Possibility of IMPROVEMENT my own IT skills and knowledge	70,93	205
Possibility of using the knowledge and skills acquired in future work or while studying in university	31,49	91
Access to content customized to my needs and level of knowledge	29,07	84
Possibility of personal learning at home, after school	37,72	109

Source: IT School survey, Warsaw School of Computer Science, 2014. Number of respondents who answered this question: 289.

Warsaw School of Computer Science is not listed amongst the best polish computer science universities/faculties, but all of us have deep understanding that outreach in the form of partnership with secondary schools community can bring benefits to both sides. That's why we put special attention to making the IT School better in that way improving our own skills and knowledge. There are many papers presenting benefits coming from OER and MOOC ideas, which surely they have, but none of them is a result of such a close cooperation between all actors of educational scene as Networked Virtual School, where learner is in the centre, with all system elements supporting him in his knowledge and skills improvement.

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The road to institutional information security management and the creation of the UCISA Information Security Management Toolkit

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Information security is a growing institutional challenge; if not managed correctly enterprise strategic objectives are at risk. How can you convey the importance of this, and instigate a program to build an information security management system? How do you ensure that policies are appropriate, well maintained, and implemented effectively?

Information security is defined as the preservation of confidentiality, integrity and availability of information. Preservation of all three characteristics is crucially important, and requires engagement throughout the institution. Information is wide-reaching and includes: student personal data, intellectual property, exam preparation and results, benefactor details, and financial information.

An information security management system (ISMS) includes all the policies, procedures, plans, processes, practices, roles, responsibilities, resources, and structures that are used to protect and preserve information and ensure it is available. It includes the elements that organisations use to manage and control their information security risks. In this age of increasing numbers of threats and attacks on institutions' IT systems, information security is still often seen as being an IT problem; instead this is one part of a bigger institution-wide challenge.

UCISA has published an Information Security Management Toolkit www.ucisa.ac.uk/ismt. A team of five universities and colleagues from Jisc Technologies have, with guidance from the lead author Bridget Kenyon from UCL, created a resource for use by information security/governance professionals wishing to put in place an information security management system (ISMS) in their organisation. The Toolkit also addresses how to convey the importance of information security to the organisation.

The Toolkit outlines an approach to successfully implement an ISMS based on ISO/IEC 27001:2013 (Information technology – Security techniques – Information security management systems – Requirements). It is intended as a practical resource, providing an overview of the key aspects of a successful ISMS and guidance on how to implement them. It also includes case studies, as well as templates and example resources which organisations can tailor to suit their needs.

This conference session will draw on the experience of the contributors to UCISA's Information Security Management Toolkit to highlight practical steps towards implementing an ISMS, starting with defining the policy and getting senior management buy in, through to building the business case, implementing the policies and evaluating performance.

After an initial survey to identify the maturity of information security management systems implementation in the audience, the session will break to identify the issues participants are facing and highlight solutions. Session participants will: recognise that information security is the responsibility of everyone; understand the steps required to build an information security management system and learn from institutions that have implemented aspects of an ISMS.

UCISA, the Universities and Colleges Information Systems Association, is a membership organisation representing those responsible for delivering information management systems and technology services in universities, colleges and other institutions. UCISA membership is institutional and has almost 100% coverage within the higher education sector in the UK. UCISA also has over 110 corporate members.

UCISA publications, case studies and event materials (presentations, streamed content and other post-event resources) are freely available to colleagues across the UK and internationally at www.ucisa.ac.uk

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Information Security Risk Management in Higher Education Institutions: From Processes to Operationalization

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Information security, Risk management, ISO/IEC 27001, Higher education data center

1. ABSTRACT

Information security has successfully gained high levels of management attention in European higher education institutions (HEIs) over the past decade, but is the data stored in HEI data centers, IT departments, or faculty server rooms really more secure as a consequence? In this article, we first review how information security policies and risk management processes were typically introduced in HEIs as an important first step, but then argue that many HEIs still need to complement these “people and processes” steps with efforts to make efficient use of them on the “technology” layer.

HEI servers that can be accessed from the public Internet have a long history of being lucrative targets for attacks by all kinds of miscreants because, e.g., the network bandwidth available at many HEIs can be misused for sending Spam emails or participating in high-volume denial-of-service attacks. More targeted attacks are performed, e.g., to spy on intellectual property related to research projects and HEI collaborations with industry partners. And in times of *doxing*, i.e., the black-hat hacker sport of making an organization’s internal documents and emails public, as in the 2014 Sony case, the demand for protecting certain data even against more determined attackers become obvious. Until about 10 years ago, most system administrators and service operators were sufficiently familiar with the information security implications of the hardware and software in their area of responsibility. But meanwhile, services such as private cloud hosting environments, groupware collaboration tools, and web-based learning management systems have grown to a complexity that practically cannot be mastered by individuals anymore. More often than not, complex software services are operated in production use without scrutiny regarding their security settings or thorough consideration of additional security measures that should be placed upstream.

To cope with this increase in complexity in a structured manner, security management processes, e.g., based on the international ISO/IEC 27001 standard, have been introduced, along with the assignment of responsibilities to roles such as HEI Chief Information Security Officers (CISOs), the preparation of policies, e.g., regarding data classification and secure disposal of media, and check lists for handling security incidents and data breaches efficiently. According to the textbooks and for very valid practical reasons, risk management drives each of these activities.

However, information security risk management is a process that requires a lot of information as input, and even more expertise. It can therefore quickly turn into a useless placebo paper tiger when it is not applied properly in practice. But when given only a high-level process description, many system administrators and service managers do not know how to do risk management in a meaningful way, i.e., with reasonable efforts and immediate benefits from the results. We therefore present our strategy for *operationalizing information security risk management* in a HEI data center with a focus on both HEI-internal IT services as well as HEI cooperation, e.g., in research projects, with the long-term goal of compiling the feedback we receive into a HEI best practice guide on information security risk management.

2. INFORMATION SECURITY: TOOLS OF THE TRADE

In order to understand the strengths and weaknesses of information security risk management in HEIs as of today, it is important to know how information security has developed as a discipline and what HEIs have done to jump on the bandwagon. Just like many other areas of information and communication technology, information technology started as an almost purely technical field of action. This era, which we summarize shortly in Section 2.1, has brought many great methods and tools, most of which are as important as ever, but having a system administrator's head trapped in this mindset can cause more harm than benefit today. Good practices for IT service management, as they became popular with frameworks like ITIL® and standards, such as ISO/IEC 20000-1, provide the big picture for offering and operating IT services in a customer-oriented manner and include information security management as one of their pillars or cross-sectional processes. Because security management is most often seen as part of IT service management, we discuss the resulting implications in Section 2.2. Higher education was not the first sector to routinely have formal information security management introduced in an organization-wide manner, but meanwhile most HEIs of any size have an information security management system, consisting, e.g., of processes, policies, and role assignments set up and running. This constitutes our initial situation and is presented as an overview in Section 2.3.

2.1. The era of security technology without management as we know it today

Until about the mid-1990ies, information security was a riddle wrapped up in an enigma for most IT service users and the management; with a few exceptions, such as password-protected access to services and data, it went mostly unnoticed by everyone except the system administrators who had to fiddle about the inner workings of these services. Technical terminology that was heavily influenced by military wording, such as *attacks* and *demilitarized zones*, and technology associated with the military realm, such as *encryption*, added to the mystery. It stems from these times that a considerable portion of the technical IT staff still considers themselves alone as able and appropriate authority for anything related to information security and tries to maintain the somewhat paradox state of not being bound to outside directives while “voluntarily” taking on only a very limited personal responsibility in the case of information security catastrophes.

Following this golden era of little interest in and even less control of what the IT staff did IT-security-wise, management interest in information security started to rise under the guise of compliance: Organizations started to not only have to justify their steadily increasing IT expenses in more detail, but new laws which made very clear that information security shall not work without top-level management commitment.

2.2. Security management as a part of IT Service Management

Information security is not the only discipline that suffered from the growing complexity of IT infrastructures over the years in practice. Fulfilling user requests, fixing technical incidents and faults, and keeping track of inter-service dependencies are just a few examples of tasks that can easily be done on a small scale, but they need structured and often tool-supported workflows when growing in scale. Given the dozens of IT services provided by most HEI data centers, which often require hundreds servers and networking components that need to be maintained, constrained by a tight budget, especially for staffing, it comes at no surprise that increased efficiency through better policies, processes, workflows, and procedures is a charming option. Good practice documentations, such as the versions 2 and 3 of the IT Infrastructure Library (ITIL®), have started to attract a significant number of HEIs, and meanwhile the majority of HEI data centers uses them as guidance even if higher process maturity levels can take quite a long time to achieve. The basic merit of these good practice approaches is the description of individual processes, such as capacity management for planning resources ahead of time or release management including rollback option in case a software upgrade goes wrong; but their overvalue lies in the elaboration of the interdependencies between the individual processes, tasks, and people assigned to them. As will be discussed later in Section 3, security management is often designed as cross-cutting process with interfaces to almost any IT service management process, which ensures that information security is not only considered during the preparation of technical changes to the infrastructure, but also becomes an integral part of contracts made within the domain of service level management and configuration management.

Several IT service management processes can be turned into quick-wins, such as incident management, whose immediate benefits become obvious when, e.g., a trouble ticket system is set up and turns out to be a real time-saver for handling user requests and incident reports. Other processes, including security management, tend to have a harder start, because, among other factors, a lot of documentation such as various policies and process specifications (e.g., for security incident handling) has to be prepared. Writing those documents is often delegated to experts in the area, which means that people who are not yet fully convinced of the benefits of more formal processes and have a very technical background produce concepts, which run the risk of not striking the balance between being either too technical or too abstract to be useful for a broader audience. This potentially adds to the frustration of the technically oriented experts and seemingly proves that formal security management adds no real value but only wastes time.

What pundits often fail to recognize is, however, the important impact of a structured and extensive documentation of security management activities on the visibility from a top-level management perspective. As we will see in Section 5, the crux that needs to be climbed is assuring the technical staff of the necessity of formal methods and their turning to the staff's advantage at the same time.

2.3. Information security formalisms in higher education institutions

The extensive autonomy of organizational units in HEIs is often seen as a challenge for IT governance and security management is no exception. As shown in Section 3, management commitment to information security is one of the first important building blocks, and therefore many HEIs that, for example, established a chief information officer (CIO) position at the level of a vice president decide to introduce the role of a chief information security officer (CISO) either as a dual role for the CIO or appoint, e.g., the head of the IT department or a security expert in a leading position as CISO with direct reporting to the CIO.

Besides the formal responsibility that comes with the CISO position, it primarily is a boundary role between HEI management, IT service management and operations, the HEI-internal users, and inter-organizational special interest groups as well as public authorities, such as law enforcement. Due to the nature of this position, a CISO needs to set up an internal structure to ensure top-down and bottom-up information flow for all organizational units. One typical solution is to establish a HEI-wide information security working group with one representative, referred to as information security officer (ISO), from each department and central institution, e.g., the administration and the library.

Each represented organizational unit will have certain degrees of freedom to arrange internal sub-structures, which typically are required to assign further required security management roles closer to the staff level. These roles are, for example, related to risk management, asset and equipment management, disciplinary competence, physical and environmental security, access control, system and network security, and interfaces to other IT service management processes. As already this incomplete list makes obvious that a lot of dedicated tasks have to be performed, not yet including awareness programs and getting everyone actively involved in information security, such a HEI-wide working group can only give its attention to selected topics and therefore decision proposals need to be well-prepared by the individual organizational units. The key to both is to address the most important problems first, or, in other words, effective risk management, which is discussed in the next section.

3. INFORMATION SECURITY RISK MANAGEMENT: FRAMEWORKS AND TOOLS

There are numerous standards, frameworks, models and supporting tools available for risk management. Some of them are general-purpose and can be applied to any kind of risks, others addresses specific risks, e.g., financial, operational, strategic, or in particular IT risks. In this section a short-list of different, well-known and also internationally accepted risk management approaches focusing on information security risks will be presented.

Planning an information security management system (ISMS) based on ISO/IEC 27001 mandates a responsible handling of risks targeting the confidentiality, integrity, and availability of information or any other kind of critical assets, i.e., anything that has some value for an organization to accomplish its business objectives. In the context of the ISO27k standard series, ISO/IEC 27005 provides guidelines for information security risk management. Rather than specifying or giving some

recommendation and dictating specific risk management methods, the standard defines a continual risk management process consisting of a sequence of different activities. In the first step the risk management context has to be established, before threats and resulting risks have to be identified, assessed and dealt with. Some software tools support an ISO/IEC 27005 compliant risk management, e.g., the *SecureAware*¹ ISMS tool by Neupart or the open-source ISMS software *verinice*².

Another practically used risk management approach is provided by the German Federal Office for Information Security (BSI) and its standard documents BSI 100-X. The BSI's IT-Grundschutz Methodology also specifies an information security management process based on a more simplified risk management approach, which also starts with a structured analysis of the organization's ICT environment to derive security requirements. In contrast to ISO/IEC 27005, this methodology's best-practice orientation slashes the expended effort for threat and risk identification and their assessment through the definition of specific threat catalogues combined with catalogues describing appropriate security controls. In addition to that, if higher protection levels with relation to the assets' CIA requirements are needed or the ICT environment distinguishes from common operational scenarios, BSI's standard 100-3 provides the definition of a risk management procedure. Based on a threat analysis, which encompasses the IT-Grundschutz related threats, as well as the identification and assessment of additional threats, a suitable risk treatment has to be conducted. For this treatment, different options, e.g., reducing the risk by implementing specific security controls, risk avoidance, risk transfer, and acceptance are effective. Back to IT-Grundschutz methodology and its security process, a second security check has to be done after choosing an adequate risk treatment option to ensure that all remaining risks are acceptable by organization's top management.

Also the US-American National Institute of Standards and Technology (NIST) provides a risk management methodology defined in its special publication documents NIST SP 800-30 and NIST SP 800-39. In this approach, risk assessment is a key component of a holistic, organization-wide risk management process, which usually starts with a risk framing phase, i.e., analogously to ISO/IEC 27005 the establishment of an organization-specific risk management context and an appropriate strategy that addresses how the organization intends to assess and respond to identified risks. The risk assessment includes a risk model, which defines risk factors and their relationship to each other to determine risk levels. Typical risk factors are threats, vulnerabilities of an asset and impact, conditions, and constraints. A threat, its source, and the materializing risk for an asset are usually defined in so-called threat scenarios, which describe the events in more detail and how they contribute to cause harm. Uniquely NIST's risk assessment approach provides risk aggregation, which allows combination of singular low-level risks to more general or higher-level risks. Risk aggregation can also be used to describe relationships among discrete risks and the consequences, e.g., once one discrete risk materializes, another risk becomes more or less likely. NIST also deals with uncertainty to allow for limitations in exactly predicting the likelihood and the impact of a certain threat event. The risk management process itself consists of the identical phases as defined in ISO/IEC 27005.

Since a few years, besides the more generic risk management standards there exist more practicable approaches, methodologies and frameworks. The OCTAVE method - Operationally Critical Threat, Asset and Vulnerability Evaluation - was created to help organizations to perform information security risk assessments. The first version of OCTAVE, released about 15 years ago, focuses primarily on larger enterprises having a multi-layered organizational structure and are able to use vulnerability evaluation tools and interpret their results. OCTAVE as well as OCTAVE-S, an adapted version for use in smaller organizations, consist of three phases. In phase one, the organizational view is defined consisting of assets, threats, organizational vulnerabilities, and security requirements. Phase two provides a more technical view describing key components and their (technical) vulnerabilities. In the third phase the risks, the protection strategy as well as the mitigation plan are developed. In 2007, both versions were replaced by OCTAVE Allegro, which focuses primarily on information assets in the context of how they are used, where they are stored, processed, and transferred as well as exposed to threats, vulnerabilities, and any kind of disruption. The data collection process, which in previous OCTAVE versions was performed in workshops and by an analysis team, was replaced with a simplified worksheet-based method. It focuses on the

¹ <http://www.neupart.com/products.aspx>

² <http://www.verinice.org>

information itself as the asset worth protecting, so the definition of a risk management context is not mandatory anymore. IT systems, storage, and networking equipment as well as cloud infrastructure components used from service providers in outsourcing scenarios are defined as information asset containers. Within areas of concern, the analysis team describes threats in some kind of mostly unstructured way before they are expanded to threat scenarios to enable risk identification and analysis. To simplify the risk analysis, OCTAVE Allegro computes a relative risk score based on a quantitative measure of the threat's impact. For example, if the reputation is most important to a HEI, then to all risks impacting the HEI's reputation will be assigned a higher score. In the final step a mitigation plan has to be developed based on the computed risk score.

Another approach is the RISK IT framework by ISACA. It mandates that IT risks should always be connected to business objectives, i.e., it needs to be integrated with the overall enterprise risk management, for instance based on COSO ERM, to establish and maintain a common risk view to support the making of risk-aware business decisions. The underlying process model consists of three phases: the risk governance, risk evaluation and risk response. Risk governance, equivalent to the business and top-level management perspective, establishes the risk tolerance and risk appetite of an organization. In the risk evaluation step, the business impact of relevant risks amongst the pervasive presence of IT has to be determined using risk scenarios and various risk factors, which can be interpreted as casual factors influencing either the frequency or the business impact of a threat. Risk response requires the selection of so-called key risk indicators, which provide a forward- and backward-looking view on the organization's risk landscape, selecting an appropriate response option and its prioritization based on the associated costs, the option's effectiveness and efficiency.

Another popular risk management method is MEHARI (MEthod for Harmonized Analysis of Risk) by the Club de la Securite de l'Information Francais (CLUSIF), which was designed to align with the risk management approach of ISO/IEC 27005, i.e., its focus is on answering the *how* rather than the *why* question to do risk management. MEHARI starts by considering three types of *need* for each business activity: 1) The need of services, 2) the need of information and data required to complete the service, and 3) the need for regulatory or legal compliance. For risk identification this method differentiates between intrinsic and contextual vulnerabilities, which describe any weaknesses of a security control. Unique to MEHARI's risk management method is a knowledge base to describe risk situations. Through the mapping of implemented security services and its rated effectiveness in relation to the CIA impact of the considered risk, defining risk situations and conducting risk assessment becomes possible. CLUSIF provides Excel-based audit questionnaires to define the relevant business processes, risk management domains, the data classification, vulnerabilities. Risk situations and their impact can be derived from the questionnaires' answers and already implemented security services. Some of the questions are mapped directly to security controls described in ISO/IEC 27002, i.e., how to counteract specific threats.

The last methodology described in this section is MAGERIT. Its risk management consists of two steps, the risk analysis and the risk treatment. The analysis phase splits up into four sub-phases: the identification of primary and secondary assets, the threat identification, the determination of resulting risks, and the implemented safeguards. MAGERIT's primary assets are the processed information and provided services. Typical threats are listed in an categorized elements catalogue. A table-based assessment of the threat's impact and likelihood allows the determination of the resulting risk value. As known through the inclusion of safeguards, the risk's likelihood or its impact can be reduced. MAGERIT takes the effectiveness and maturity level of a safeguard into account, which can be a critical factor for risk assessment and determination of residual impact and risks.

Note that this overview of standards or frameworks could not be exhaustive, but gives an overview of the definition of each risk management process, its phases, and activities that have to be performed as well as of some tools, which support these tasks.

4. THE GAP BETWEEN READING ABOUT RISK MANAGEMENT AND DOING IT

On the one hand, a HEI-specific instance of the overall risk management process has to be designed and implemented, and on the other hand, this HEI-specific process needs to be practiced and prove its worth. We outline both challenges for the typical process phases in this section, and focus on a solution approach for the second challenge in the next sections.

All of the reviewed approaches define risk management as a continuous process, which usually starts with the establishment of the context. Most of the standards differentiate between primary and secondary asset types. On the one hand, higher-level management usually knows the important business processes and has a big picture of which information needs to be protected; for example, in HEIs there is an examination office and the students' personal data, such as addresses and grades, are valuable. On the other hand, the staff level, especially the technicians and system administrators, usually have in-depth knowledge about the secondary assets within their functional responsibility and sometimes also about the relationships between these assets. For example, a software-based examination management system may run on three different servers and make use of a central NAS file server for data storage. Unfortunately, none of the standards gives detailed instructions how the risk-management-relevant assets can be found adequately, i.e., neither too coarse- nor too fine-grained. As a consequence, system administrators can specify the value of hardware and software assets quite easily and make estimates of the costs related to their working time when, for example, a compromised server needs to be re-setup from scratch. But it is practically next to impossible for them to quantify the value of, e.g., one student record stored on their servers or make assumptions about the impact on the HEI reputation when the confidentiality of student records is compromised. Furthermore, all tools mentioned above require the manual definition of assets and their relationships to each other, but currently lack technical functionality to import existing data from other data stores, such as, e.g., a campus management system, an organization-wide ITIL® configuration management system, or other workflow management tools. Thus data inconsistencies are bound to occur in the long run as it is cumbersome to maintain the same data independently in different IT systems.

The next activity in the risk management process is the identification of threats affecting these assets. While ISO/IEC 27005 includes a short and quite superficial threat catalogue, the BSI IT-Grundschutz methodology provides a very comprehensive and detailed, but mostly technical view on the threat landscape. The others favor the description of threat or risk scenarios, but usually do not give some details in form of a template or table to perform this step. One typical problem is the definition of risk categories and which groups of people should consider them in which depth. For example, damage to assets caused by earthquakes, fire, or floods do not need to be dealt with by each system administrator separately when a common room for all servers is used; on the other hand, the service-specific risks may vary greatly between web-based applications, so it may not be wise to treat all web-based applications equally during risk identification.

For risk analysis and risk assessment, the frameworks differentiate between quantitative, qualitative, and semi-qualitative (NIST 800-30) approaches. Usually there are example tables to describe the method by itself, but each organization has to find its own best-fitting approach. The risk assessment has to take existing safeguards into account, but only MAGERIT's approach assesses their effectiveness and maturity. The other approaches pursue an all-or-nothing risk treatment. Quantitative risk assessment is non-trivial, especially when already the value of an asset is hard to quantify, as is the case with many information assets, such as a student record or the HEI president's email account. Also the likelihood of a risk can often only be roughly estimated. A simplified approach is consider how often a risk materialized in the past to make an educated guess about how often it will occur in the next timeframe; this, however, does not take into account changes to the threat landscape - for example, a zero-day exploit may compromise a server that never had any security incidents before.

For the risk treatment phase, the standards ISO/IEC 27001, appendix A and the corresponding code of practice document provide some means to reduce the likelihood of risk materialization or its impact. These standards lack a direct mapping of threats, resulting risks to a list of suitable security controls to act upon these risks as it can be seen in BSI IT-Grundschutz methodology or partly in CLUSIF's MEHARI. Matters are complicated further by the fact that the top management's and technical staff's point of views usually do not match in the risk treatment. While the former often prefer to define policies and processes, the latter want to implement technical countermeasures.

Therefore, a typical state of projects implementing risk management at HEIs is that process specifications inspired by standards and good practice frameworks are written and the processes officially come into operation, but comprehensive implementation cannot be achieved because the involved stakeholders do not comprehend what and how exactly they should contribute and how

they could benefit from the results. Enabling the more technically focused staff to contribute to and benefit from a HEI-wide risk management is the goal of our approach presented in the next section.

5. OPERATIONALIZING THE RISK MANAGEMENT PROCESS

In this section we provide a template-based risk management approach primarily intended for responsible system and service administrators. In our security concept documentation template, which we presented at EUNIS 2013, the administrators have to describe, among many other security-relevant parameters, the risks specific to their services. When filling out this template, often the following questions arose:

- How can I identify all the assets implementing or supporting the described service?
- How can I determine an asset's criticality and value?
- How can specific threats be identified? Are there any catalogues available, maybe specific for, e.g., a Linux-based server, webserver, or a database server which can be used as a starting point?
- What information is required for describing a threat? Is a very fine-grained scenario description necessary or are some keywords sufficient?
- Which metrics or classification scheme can be used to determine the likelihood and impact of risks?
- How can I formulate already implemented safeguards? How do I have to describe the already planned measures that will be implemented to reduce or avoid an identified risk?
- How do I have to document the risk identification and analysis? How often do I have to repeat these activities?

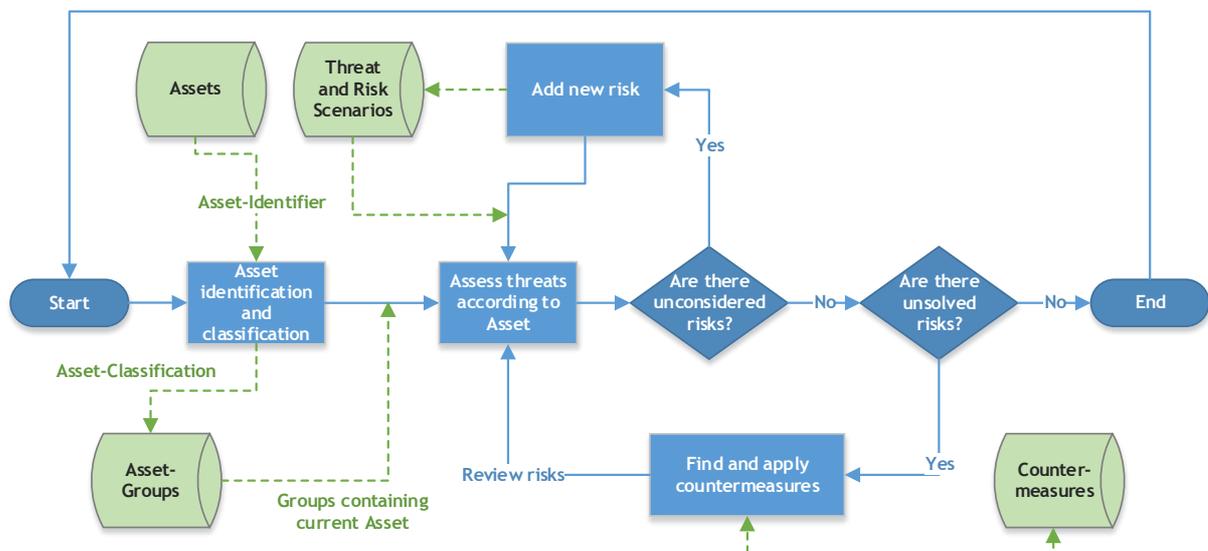


Figure 1: Workflow overview - integrating a new asset

An important aspect that will improve the willingness to contribute to a risk management process is enabling as much flexibility as possible. Thus, the approach provides reusability of most parts of the institution's already existing management infrastructure:

One essential element, most HEI's already implemented, a Configuration Management Database (CMDB), serves as one data source for describing details about secondary assets. Other data sources, providing similar information can also be connected using defined interfaces, e.g., import of csv-files or direct access to databases. Operating such a CMDB is one important step on the way leading to a successful risk management, because it usually contains numerous information required for asset identification and provides all functions to add, change, and remove them.

The following step - denoted as asset classification - can be done separately with references to the particular asset in the CMDB.

Figure 1 shows an exemplary integration of several data sources interdepending on the overall risk management process. The states (shown in blue) describe the several steps to integrate an asset, whereas the green glyphs and the dashed lines describe required data sources, information, and interaction with the user.

The implementation possibly benefits from a decoupled structure of data sources, since it can be done without affecting the existing infrastructure. Therefore, on the other hand, there is a need to associate them with each other, which can be achieved by a unique item identification and references among the data sources. As the overall approach of providing a structured template as guidance for writing security concepts was well received, a similar approach was taken to foster information security risk management on the system administrator level. It covers the aspects described in the following sections.

5.1. Asset identification, grouping, and criticality

System and service administrators focus on technical aspects implementing and supporting the provided services. Thus the business perspective or any associated strategic objectives that have to be achieved are mostly out-of-scope of their risk management activities. Natural risks, such as floods and earthquakes, as well as threats targeting the data center's buildings and specific security areas or rooms usually have a very huge negative impact on all services provided by the HEI. But because of their comprehensive characteristics, such risks have to be taken into account in the risk management procedure by the facility management staff and not by each individual administrator.

The administrator's focus is on technical assets - which generally serve as basis for the HEI's services, so each asset usually belongs to one of the following groups:

- **Communication Infrastructure**, at which, on a more fine-granular level, those assets can be a part of the network connection cabling or network components like routers and switches.
- **Device Infrastructure**, split at least into physical and virtual hosts.
- **Software**: As soon as an administrator deploys a new host, this is probably the most comprehensive asset class to consider. The huge diversity of software makes it practically impossible to register all risks; then again, it is even more important to reduce the risk to a HEI's acceptable level. Thus, the consideration of operating systems (Microsoft Windows, Linux, BSD, ...), service software (e.g., web services, database services, ...), further associated applications like runtime-environments (e.g., JRE, Perl, ...) and self-made software will provide a lot of benefits.
- **The Service context and related Information**. Obviously, important aspects are login credentials as well as user accounts and the data being processed within the service. For instance, PII requires - mostly due to statutory and regulatory requirements - higher protection levels than publicly available or only slightly critical information. Also, essential configuration files can be seen as critical assets, since they are one with the highest relevance for information security.

Grouping of the identified assets simplifies the risk management process by reducing the complexity of asset-threat relations because threat scenarios descriptions can be reused assets with similar specifications; it also is a simple approach to support the provisioning of user-friendly views of the data with additional functionalities like filtering and risk preselection.

To determine the asset's criticality, the administrator has to answer the following, exemplary questions depending on the asset type and confidentiality, integrity, and availability requirements:

- How many users are affected if the service is not available or partly not available due to a hardware defect, software configuration failure, or when taken offline due to a security incident? Typical answers for a HEI's environment and if a service explicitly provided for students will be affected are either less or more than 1.000 users.
- What impact does an accidental or deliberate disclosure of critical information have, e.g., from a legal point of view, for the HEI's reputation, for each user, and so on, broken down

into some simplified related questions like “Does the service or any component process or store PII data, e.g. name, email address, account data, IP addresses? If so then this can be directly mapped to applicable data protection laws and eventuate in a high asset value.

- Can assets be effectively grouped to assign a value to the group rather than to each asset itself, e.g., workstations of HEI employees? But do any differences between such group members exist, based on, e.g., their specific role and duties within an organization? Typical, simplified questions to answer can be, e.g. “Does your role in the organization demands direct or indirect access to PII data?” or “Does your role in the organization imply administrative access to more than 25 server machines, e.g., as an administrator responsible for the virtual server environment?”

5.2. Threat identification and description

Based on the identified assets and asset types, the administrators have to identify and describe threats. Based on threat catalogues provided by ISO/IEC 27005 and BSI IT-Grundschutz threat and risk scenario templates are used containing the following information:

- **Actor:** The trigger or cause of a threat or damage occurring. This can be for instance an external adversary, an employee of a contractor, an insider or even a guest, who uses the service temporarily, or any other event that takes place threatening the e.g., the availability of the whole service or integrity of the processed information.
- **Threat type:** Allow the categorization of threats, e.g., malicious intent, accident or error, failure of hardware or software component used, or external requirements based on statutory or compliance frameworks.
- **Event:** Short description of the threat event itself, also based on a category like disclosure of critical information, service interruption, unauthorized modification of critical information resulting in erroneous results, theft, destruction, ineffective service provisioning, violation of existing policies, rules and regulations at a higher level or inappropriate usage of a service or supporting component.
- **Asset:** The threat’s description should contain information about the affected assets, e.g., the service infrastructure, the information or application.
- **Time:** This element can be used to describe further details about the threat’s duration, the time the threat event occurs, or the time needed to detect security-related events.

The question the HEI’s risk manager has to ask at this point is “How many risk or threat scenarios can be managed?”. One technique of keeping the number of scenarios manageable is to develop a set of more generic scenarios throughout the HEI, but also apply more detailed scenarios in which risk levels are assumed to be significantly higher. The following example describes a high-level risk scenario to describe threats affecting a database’s integrity:

- Actor: internal and external
- Threat type: failure, malicious
- Event: intentional modification failed, data corruption (unauthorized client’s transactions)
- Asset: database used by described service
- Time: duration (unknown), timing (unknown)

5.3. Risk assessment

In the next process step the identified threats have to be analyzed and assessed. The analysis is usually easier to perform when following a qualitative instead of a quantitative approach. For the determination of the risk likelihood, the following questions are relevant and have to be answered by the service administrators:

- How do you categorize the accessibility of your service and how many users typically use the service? The likelihood of a risk materializing is obviously higher, if a huge number of users has access to the provided service. The accessibility should also be taken into account because those services, which have to be provided for users outside the HEI’s internal

communications network, may eventually be compromised by any private, not controllable client machine via the Internet. In both cases the likelihood often has to be assumed high.

- Do any known vulnerabilities exist in the service or one of the underlying components and cannot be fixed for given reasons? Some services require certain software versions. Updating the software can have either incalculable side-effects or interfere, for instance, with the stability of the service or additionally require an update on the client-side and may therefore not be acceptable. If such vulnerabilities exist and, e.g., can be exploited over the Internet even by inexperienced attackers, then the likelihood should be set to a high value.
- Has the service or any underlying component already been part of a security incident that occurred in the past? If so, did you take any additional countermeasures that prevent similar incidents from occurring again? The likelihood that a perpetrator will return if a service has already been part of a security incident may be high because the IP address of the server machine may have been published in an underground community, because a backdoor installed by the first successful compromise may not have been removed completely or the measures taken are not as effective as planned.

On the other hand, service administrators have to determine the impact of an occurring threat event. Based on the already described criticality estimation of the asset concerned, a direct qualitatively mapping to the threat's impact is often possible. A short example:

- Number of affected users: If less than 10 users are affected, then the risk has a low impact. If, however, even more than 1.000 users are affected, then the impact is very high.
- Any legal regulations can be concerned: If yes, then the impact should also be very high.

If for each threat and asset the impact mapping has been performed, this can result in different impact levels. For example, a threat or resulting risk can have a very high impact on the affected users but no regulatory impact (e.g., not concerned = low); then, the highest impact value has to be assigned to this risk.

For risk assessment usually both, the likelihood and impact values have to be combined. An event with a medium likelihood and a very low impact usually does not require further treatment action. But, on the other hand, threat events with a low likelihood but a very high impact should be taken into consideration, because even a single occurring event would affect a huge number of users or the HEI as a whole.

5.4. Risk treatment

After finishing the risk assessment, the risk management approaches discussed before usually provide four treatment options (reduce, avoid, accept, or transfer). From a technicians perspective only two, reducing the risk by appropriate countermeasures and risk avoidance through the removal or replacement of vulnerable components are feasible. Because risk avoidance often requires major changes to the service provisioning itself or also the procurement of new hardware and software, this section concentrates on countermeasures with a view to reduce the risk..

Each countermeasure has to be specified, planned, documented and maybe linked to a request for change from the IT service and change management point of view.

For the specification of a countermeasure, also the usage of a template-based approach is recommended containing the following mandatory and optional information, which enables the instantiation of a specific risk treatment option:

- **Unique ID:** A countermeasure (template) must be clearly recognizable for referencing purposes.
- **Short description** of the countermeasure.
- **Responsible for implementation:** The person responsible that overviews and monitors the implementation of the countermeasure.
- **Completed until:** The implementation should be completed until the defined point of time.
- **Tasks:** Description of each task to implement the countermeasure, maybe linked to a request for change in the context of the change management procedure of the HEI.

- **Implementation requirements:** Usually IDs of other template instances describing countermeasures that have to be completed before or have also to be completed in parallel to or following this implementation.

Through instantiating a specific template to reduce the likelihood or impact of a certain risk the risk's treatment can be described. From a business people perspective the goal is to achieve at least an acceptable remaining risk level. From a service administrator's point of view only the implementation of the suggested countermeasures has to be done. Afterwards the risk analysis has to be repeated until all not acceptable risks are taken into account and appropriate countermeasures have been implemented and documented.

6. BEYOND BORDERS: INTER-ORGANIZATIONAL RISK MANAGEMENT

Nowadays HEI's services are not only provided for their own employees or students, but rather eLearning, high-performance computing, grid and cloud-based services, e.g. sync-and-share file storage services are provided inter-organizationally. Because the security of these services remains as one complying requirement, information security management and especially risk management also have to be performed across HEIs' borders. For instance, if one HEI centrally provides a sync-and-share file service for all or some institutions of the European research community, this is, from a technical security and especially a risk management perspective, comparable to an outsourced service in the private enterprises sector. The service consumer, e.g., also a HEI, therefore remains responsible for information processed by the outsourced service, but can not directly act upon the cloud-service provider's infrastructure, security, and risk management processes.

For example, the identification of assets must take place in a distributed fashion. On the one hand the customer HEI and on the other hand the service provider HEI have to identify the service-related assets. The provider contributes information about the used server hardware, the network components, and the software installed. From the customer's point-of-view, the transferred and on the provider's side stored or otherwise processed information are critical and protection-worth assets. To determine the asset's value, the provider's administrators usually use their own organization-internal scheme as discussed in the previous sections. The customer or even each service user have to determine the information's value using another criticality scheme because only they have the required knowledge about the sensitivity and classification of their data. The identification of threats also varies when compared to intra-organizational risk management. Threat catalogues used by one HEI may differ from those used within the others. Analogously, the procedures to derive the results of the likelihood and the impact estimation of a threat event materializing are often different. For example, if the service customer uses a scheme to qualitatively determine the likelihood of a risk related to the information assets, which consists of four levels (low, medium, high, very high), but the provider uses five likelihood levels (very low, low, medium, high, very high), then a direct mapping of these different schemes is required or a new scheme to be commonly used in the cooperation must be designed.

7. CONCLUSION

Risk management is the key to successful information security management. In turn, risk management can only be successful if a risk management process is not only specified on paper, but also practiced. Unfortunately, standards and good practice frameworks can only provide generic guidance and each HEI must find its own way to put this knowledge into real-world practice. The major problem addressed in this article is how to get the technology-oriented members of the staff level practically involved in HEI-wide risk management, which is often perceived as abstract, bureaucratic, and without practical benefit on the technical level. We presented a checklist-style approach and exemplary questions that helps system administrators with the individual risk management steps asset and criticality identification, threats identification and description, risk assessment, and risk treatment. It complements the security concept documentation template presented at EUNIS 2013. Finally, an outlook to inter-organizational risk management, e.g., as part of HEI cooperation and research projects, was given. The long-term goal of our activities is to compile the feedback we receive into a HEI best practice guide on information security risk management, so any suggestions for improvement are highly welcome.

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The importance of having a disaster recovery planning process

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Keywords

Risk management, disaster recovery plan, emergency mode.

1. Summary

In November 2013 our university had an IT disaster. Everything that was not supposed to happen happened. Our main power supply went down in our main IT operation hall and the result was that our uninterruptable power supply (UPS) and diesel generator broke down. We were in an emergency mode and our security manager called in the disaster group, following the instruction in our disaster recovery plan. In this presentation I will tell the story of a ten year long journey. From how I struggled to anchor the need for disaster planning until we were faced with managing a disaster and how we came through it.

2. ABSTRACT

Risk management has been a top issue for many years, still many organizations have not done their homework. Does your organization have a business continuity plan? In a survey MSB - Swedish Civil Contingencies Agency asked this question to all the 351 Swedish authorities. 65% answered no. Who is responsible for the disaster work at your department? I asked the question to a big IT department, no one raised hand. This was in 2014. In 2002 I asked our CIO and our security operation manager some questions.

are there operation alternatives for key it-systems	no
have you identified all key it-systems	no
is there a list of all services and their order of importance	no
is there an appointed group accountable for coordinating the security work	no
is there an appointed person in charge giving information	no
do you have a disaster recovery plan	no

Figure 1 Some questions to identify the current situation in 2002

According to the answers it was time for some actions. What is not documented does not exist. Identify how the disaster recovery plan relate to the business continuity plan - hopefully there is one. Set up a disaster recovery plan, including checklists. It's easy to make the plan, the challenge is to involve all the relevant roles and make them take responsibility for their tasks. You need to know your role. Who is responsible and what actions to be taken before, during and after an emergency situation. Make a priority list over all the important IT systems. Include all the information owners in the work - they need to realize that maybe their system is not the most important. To your help you can use the priority list you have set up for your service desk, teacher, student, researchers. And the impact it has in the organization, total enterprise, department, multiple users. Document all other subsystems, services and clients and connect to the service level agreements - which I hope you have.

Make scenario exercises with the staff to get them to understand their role and identify what they need to improve - expensive but money well spent.

Every important IT application need to have its own disaster recovery plan which regulates the conditions that apply and the persons to be contacted.

It took me ten years to get everyone involved onboard. We did an extensive workshop in the autumn 2012 and the participants realized that they had some homework to do. In November 2013 we had our first situation ever classified as a disaster.

It turned out that our uninterruptable power supply system had broken down. The only solution was to build a new one. The manufacturer was located in Italy and they needed two months to deliver. We faced two months in emergency mode. We bought and we borrowed small UPS, coordinated people, gave information and followed our plans. As a result, all of our prioritized important services was up and running according to the time frame set in their disaster recovery plans.

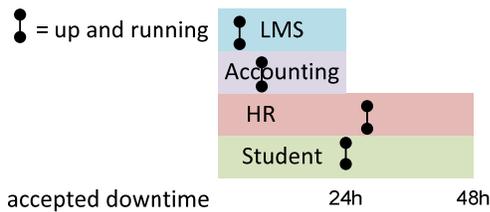


Figure 2 IT systems up and running according to plan

In the end of January we could go back to normal mode. When I compiled the analysis report, I noted that we were prepared and we passed our first disaster ever successfully.

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K. Westerlund. I work as an IT-strategist at Umeå University since 1997. I am a part of the IT-Office and we have a mandate from the University Management to take strategic responsibility for all common IT at the university. Between the years 1994 to 1997 I worked as a project manager and was responsible for the development of an IT system supporting human recourses, named Primula, for higher education in Sweden. At the beginning of the 90s I worked as a development strategist at Umeå University and in the sector. During the years 2006 to 2012 I was a member of the Ladok Board. I have studied informatics, economics and law at Umeå University. The past four years I have put a lot of effort into developing the Enterprise IT Architecture area - doing it my way- at our university. On an annual basis, I give a number of seminars in various fields such as EA, Governance, Management and Information Security.

STORK 2.0 project results: Exploring Pan-European eID interoperability frontiers

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Keywords

STORK, STORK 2.0, Pan-european projects, Mobility, Identity Federation, Cross-border services, Digital Identity, Authentication, Interoperability.

1. Summary

Secure idenTity acrOss boRders linked 2.0 (STORK 2.0) is the continuation of a project co-funded by the European Commission as a part of its Competitiveness and Innovation Programme (CIP) in order to address, in a cross-border scenario, the identity management and citizen information sharing problem. This project, which is currently finishing its execution, has brought together 19 countries and 60 consortium partners mixing public and private sector organizations.

By running four real-life pilots, the project has put some light into the complexity of cross-border interaction among European member states, beyond the simple electronic identity interoperability. One of these pilots, the eAcademia pilot, is focused on the potential usage of cross-border provided university user role and academic records information on university electronic services by foreign students moving from one European university to another.

This article will summarize the main outcomes of the project and will focus on the paths that have been opened after the project, its sustainability and further adoption by new stakeholders.

2. Background

University Jaume I is the leader of the eAcademia pilot in STORK 2.0. This pilot allows students to access services and retrieve their academic information in universities from several member states using their own national credentials. This paper describes the main outcomes of the pilot's running. Results and benefits obtained by all stakeholders are presented; challenges encountered and their future implications are analysed, and special attention is paid to the sustainability of the common interoperability infrastructure after the end of the pilot.

3. Results and outcomes

The main remarkable result of the project, is that an acceptable degree of interoperability among the member states participating in it has been achieved, despite the great complexity behind the definition of the requirements and the number of partners involved. The common interoperability framework put in place by the European Union Member States involved in STORK has allowed universities to successfully and securely provide user academic information to feed services in a cross-border environment that wouldn't be otherwise possible.

Services offered range from distributed eLearning courses, to services related with the introduction to the job market (academic records aggregation and validation systems, job selection platforms filtered by the user's academic records), all of them on a transparent and scalable cross-border environment.

The main technology outcome has been the widening of the previous pan-European federation of electronic identities, with the addition of new functionalities (such as authentication on behalf of another legal/physical person), member states and sources of information (academia providers,

business registers). The aim of the original Identity Federation was to delegate the authentication procedure on the involved party who has control over the validation of the authentication data, which are national authorities which guarantee the authenticity and validity of identity proofs and attributes, and provide a graded scheme of the quality of the authentication. In the new federation, other sources of attributes are added, which required the development of an updated quality assurance assessment system for the validity of each data provided by each source.

Besides this, the automated treatment of user information on many use case scenarios of the services developed has evidenced the need for standardization and harmonization of data sets and data structure specifications at a European level.

The use of electronic identities issued in the country of origin and the electronic transfer of academic records and information generates several benefits for the student moving to another University in a different country. Those benefits depend on the services made available by each academic institution, but they can be summarised as follows: students can apply online for job positions or internships without the need for manual verification of their degrees or academic status; they can access to related courses of several universities without the need of enrolling on each one of them, students can retrieve signed academic records from different sources at a time without the need for validating their identity in person in each one of the sources. For this reason, the following benefits arise: reduction of the administrative burden for students, access to personal data stored in several institutions safely and in real time, provide faster, safer, easier and more flexible access to services and all of STORK previous benefits derived from cross-border authentication.

Access to electronic services using STORK authentication mechanisms and authorisation based on role attributes allow the management staff to avoid some in-person formalities, but also, some additional benefits derive from the use of identity attributes improving the quality of the data managed by the University: administrative processes become easier and more transparent, the use of eIDs and automatically processed user data increases the overall quality-of-service because applications can be processed faster and more efficiently, electronic formalities can be performed without need of a previous in-person registration and credentials delivery procedure, some services can be offered to groups of people based on their role and not on their specific identity, and thanks to the attributes linked to the identity of the user, the data quality is greatly improved.

4. Conclusions and future challenges

The pilot has shown that generalization of eIDs by the European countries will contribute to eliminate formalities in all aspects of university activity, and to build a full electronic and cross-border academic environment that will enable the student to access a broad set of educational and job-related services just by having his own national electronic credential.

The most immediate challenge of the eAcademia pilot, in order to attain sustainability is to promote the adhesion of new attribute providers that would attract a great number of potential users. More users would then attract new service providers, eager to consume the data provided for their own services, which would encourage them to add their data too.

Also, there's still a need for a greater effort on lessening the breach between the common user and the infrastructure: given the heterogeneity of the specific member state infrastructures and actors, and given the high legal requirements established in user information and consent, the experience that should be transparent for the user becomes complex, and this should be the focus of future works.

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Keep Your System Integrations on a Short Leash

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Keywords

System Integration, Enterprise Architecture, Application landscape

1. Summary

New emerging technologies and business requirements with demands for advanced information exchange among IT-systems requires a total control of existing system integrations. When Umeå University was designing a new integration platform, it was essential to create a maintainable comprehensive view of all current and upcoming system integrations. This case study discusses what actions was taken in order to obtain control of the application landscape in an Enterprise Architecture context.

2. Extended Abstract

As the university grows, new and effective services to students and employees requires an advanced information exchange among the IT-systems at the University. Automatic processes are essential for efficiency and is dependent on system integration to several IT-systems. In the eagerness to meet new advanced business requirements, systems integrations tend to grow uncontrollably. Often there are no total picture of the system integrations within the enterprise and no control of what information is flowing through the systems. Has there been a full analysis and planning prior to setting up an integration? Has the owner of the information been notified and accepted the information is used? Or has a quick file transfer been set up to satisfy the urgent needs for information exchange? System integration requires in-depth analysis and planning and a common problem is that most project budgets does not contain enough budget to handle the integrations in a proper way. The complexity and costs of integrations are almost always underestimated which led to lack of analysis, lack of documentation and low quality integrations that will cause major problems in operations. At the end there will be a spaghetti like situation which is uncontrollable. It's a ticking time bomb which will rapidly increase operating costs.

The University have for a few years ago developed an EA framework adapted to the local needs. One part of the project created a holistic overview of the application and the technology landscape for the university. Today there are three maps over the university IT-systems, an Object/System map, a Dependent view and a Technical view. As a result of having the complete map of the application landscape the situation was analysed and a decision was made to develop a new integration platform based on the product Microsoft BizTalk. This new platform was necessary in order to meet new business requirements.

The key of having control of your system integration is to set up a governing framework for integrations which includes to produce the necessary documentation. The implementation of the integrations should be performed by dedicated team (ICC). There are advanced and expensive systems and tools for achieving control of integrations but In this case we have chosen a light weight approach using simple tools such as a SharePoint Wiki and SharePoint lists. We have been inspired by existing models and framework in the domain of system integration.

The following have been important when creating a governance framework for the new integration platform.

Get control of the projects and put integration issues into focus. Find out exactly what the integration needs of the project is i.e. information model, protocols, error handling, frequency, data migration etc. From the provided information an architecture analyses can be made and a detailed migration

plan can be developed. Particularly it is important to discuss the integration architecture in an early stage with agile projects and make them understand the importance to create an architecture and integration plans early in the project.

All information should have an owner. The owner should set rules for how the data, attributes or attribute groups, can be used and distributed.

All data transfers should be approved by the information owner and documented in an information contract. For this purpose a simple SharePoint list together with an approval workflow have been created to contain information contracts with unique numbers e.g. IC001, IC002 etc.

All integrations are documented and identified with a unique number e.g. INT001, INT002 etc. The numbering can be traced down to the specific piece of code. The integration has a described purpose, a described information model and a described set of parameters that is transferred. The integration refers to one or more information contracts. This provides the tractability necessary.

A collection of integrations that interacts together are documented in terms of Integrations Scenarios i.e. a source system is providing data that is distributed to a number of systems using orchestrations in the integration platform. The Integration Scenarios is identified with a unique number INTSC001, INTSC002 etc. All systems used in the Integration Scenarios is described and uniquely identified.

All web services in the architecture is described and listed in simple SharePoint lists. Documentation is generated for the services and the documentation link is provided in the SharePoint list. A complete but simple documentation of services will prevent projects from developing services that are duplicates or very similar from the services in production.

Prior to new projects this governance framework for integration provides the possibility to analyse the current architecture and create a transition plan for the project. What new integrations should be applied? Can existing integrations be reused? What existing web services can be used? What information models are affected? Using the framework the answers for those questions and others will be more reliable and a realistic budget can be estimated for the system integrations. The project will faster achieve its goals and can present a solution that is aligned with the target architecture. The information owners will have a total view of where their information is distributed in the enterprise.

Integrations	Direction of events
INT001 Account activation via ServiceDesk	From ServiceDesk to BizTalk in order to activate account for a person
INT002 Account provisioning in Office 365 for students	From BizTalk to Office365 in order to create new accounts and / or update existing accounts
INT003 Account provisioning in Google Apps for students and employees	From BizTalk to Google Apps in order to create new accounts and / or update existing accounts
INT004 Account managing in Active Directory for students and employees	From BizTalk to Active Directory in order to create new accounts and / or update existing accounts
INT005 Management of mailboxes and email addresses in Exchange for students and employees	From BizTalk to Exchange in order to create new accounts and / or update existing accounts

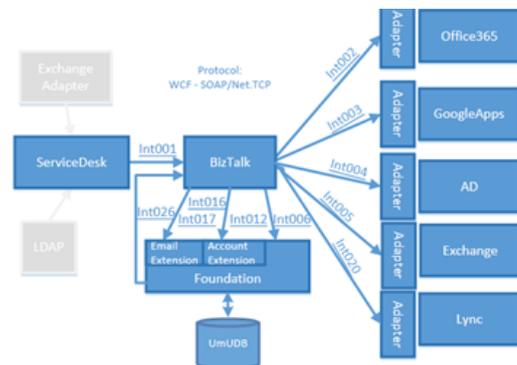


Figure 1 Example of integration documentation: list of integrations and an Integration Scenario

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4. AUTHORS' BIOGRAPHY

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AGILE AND MORE: A SUCCESSFUL REDESIGN OF ICT-INFRASTRUCTURE AND INFORMATION EXCHANGE IN HIGHER EDUCATION IN THE NETHERLANDS.

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Keywords

ict infrastructure, information exchange, higher education, agile, scrum, sprint, success, cooperation, chain process, Studielink, DUO, xml, machine to machine, digital enrolment, generic registers.

Summary

Between 2010 and 2013 the information exchange process between higher educational institutions and DUO, executive agency of the ministry of Education Science and Culture (OCW), has been fully modernised. For this three year project BRON-HO the agile method (scrum) was used. All chain partners were intensely involved. Thanks to this approach all (!) prior set goals have been achieved.

The project in which the ministry of OCW, 55 educational institutes, the Vereniging van Samenwerkende Nederlandse Universiteiten (VSNU)¹, the Vereniging Hogescholen², Studielink³, software suppliers and DUO collaborated closely, led to the successful implementation of new ICT-infrastructure and a new way of data exchange.

The batch exchange was replaced by XML messages and web services. The CRIHO-register at DUO which contained all data generated by higher education institutions, was replaced by a new structure where enrolments and student results from all educational sectors are registered in the register of education participation and the register education results. The enrolment process in higher education is fully digitalised. The information on tuition fees and the amount of funding is supplied directly when the student registers. Hence the administrative burdens for institutions have been significantly reduced.

For an automation project conducted by governmental organisations to be this successful can be accredited to the approach, which was fundamentally different from previous projects. At the end of 2010 all partners met and together they drafted the master plan for this project. Here the deadline of December 2013 was set. Deliberately was chosen not to produce a list of demands. The only thing that mattered was a result in accordance with the law. Immediately the development process began. After every four weeks the results so far would be assessed by all the partners, which included testing. This process was repeated approximately 40 times (40 x 4 weeks). The success of this project is not only the result of the efforts of DUO or the Ministry but also the result of the commitment and effort of all partners involved!

What is DUO?

DUO (Dienst Uitvoering Onderwijs) is the executive agency of the ministry of Education Science and Culture (OCW), which also executes tasks for several other ministries in the Netherlands. The main commissioner is the ministry of OWC, for which DUO executes a large number of education related laws and regulations.

DUO's core business:

Provide student grants and allowances for school expenses, collect tuition fees and college loans and provide loans and payments to naturalising individuals;

Funding of educational institutes;

Organise state and naturalisation examinations, attend for all logistical issues for the central examinations for secondary education, manage the selection, enrolments and placements of lottery courses in the higher education;

Collect and manage educational data in several registers;

Enrich educational data to turn them into information products;

¹ Umbrella organisation of universities in the Netherlands

² Umbrella organisation of universities of applied sciences in the Netherlands

³ Central registration portal for higher education in the Netherlands

Acknowledge diplomas, manage the Diploma Register and represent the National Europass Centre in the Netherlands.

Why the BRON-HO project

BRON-HO is a chain process in which registrations and diplomas of higher education students are recorded in DUO's registers. These registrations and achieved diplomas are the basis for payment of higher educational institutes. This involves a large number of participating partners: ministry of OCW, Studielink, software suppliers and higher educational institutes

The old situation

Higher educational institutes have provided DUO with their data since 1986. This used to be done with batches. However, processing these batches and adjustments in the data was very exhaustive. All data generated by higher education institutions were registered in the register CRIHO, from enrolment to deregistration. A student who wished to apply to a university needed to provide a large number of documents; diplomas, grading lists, certificates etc. This seemed not very efficient as much of the information was already in DUO's possession (in one of the registers), for all educational institutions provide DUO with all the students' study results. Once a year DUO determined the amount of state funding an educational institute would receive for the following year based on the number of students registered and the released diplomas.

The BRON-HO project

The three year project BRON-HO in which the ministry of OCW, 55 educational institutes, the Vereniging van Samenwerkende Nederlandse Universiteiten (VSNU)⁴, the Vereniging Hogescholen⁵, Studielink⁶, software suppliers and DUO collaborated closely, led to the successful implementation of a new way of data exchange.

The batch exchange was replaced by XML messages and web services. The CRIHO-register was replaced by a new structure where all enrolments and all student results of all the educational sectors are registered in the general registers of education participation and education results. The enrolment process in higher education was fully digitalised. The information on the amount of state funding is supplied directly when the student registers. Hence the administrative burdens for institutes have been significantly reduced. .

Governance

Overall management: programme manager OCW

OCW's programme manager was responsible for overall management of the entire system development BRON-HO within the chain. This means that all chain partners were timely informed and managed on what was expected of them. For example the activities that had to be executed, the agreed deadlines and the working agreements. The programme manager took action in case of problems concerning the working agreements and if necessary presented them to the project group. The collaboration was formed as follows:

For the overall management a management platform and a project group was installed. The project group monitored the progress made and decided on the issues which were presented by the work group system development in which the institutions were all represented.

Approach in relation to the chain

An important element of the scrum method in relation to the chain is an in place work group. The composition of this group is crucial for the success of the project. The work group has to represent all chain partners, in this case educational institutes, software suppliers, the ministry of OCW, DUO and other stakeholders.

During the first couple of meetings the work group drafted the product backlog. After the product backlog was set up the work group would be differently structured. The meetings were split up into a morning and an afternoon session. During the morning sessions the developed software from the previous sprint would be accepted based on a demo. Also would be decided what would be developed in the following sprint and the acceptance criteria that would have to be met. Here all stakeholders would be present. The afternoon session would be split up into two parallel sessions:

⁴ Umbrella organisation of universities in the Netherlands

⁵ Umbrella organisation of universities of applied sciences in the Netherlands

⁶ Central registration portal for higher education in the Netherlands

one technical and one functional meeting. In the technical meeting agreements would be made on the technical aspects of the next sprint (based on what was decided on in the morning session). In the functional meeting would be considered what other aspects could be fitted in the following sprint. After a work group meeting the sprint teams of DUO and the software suppliers would start developing the next sprints functionalities that would be accepted based on a demo in the following work group meeting.

By using the above described method it is possible to connect various systems after only a few weeks. It allows one to see how the systems work, whether the right choices were made and whether these choices need adjustments in a very early stage. After every sprint a small functioning piece of software is delivered which leads to a complete functioning system after all sprints have finished.

Testing with educational institutions

Acceptance of the new services within the chain was realised by performing a number of tests by the chain partners. The programme manager drafted a master test plan in which all test were described. For each test a detailed test plan was defined. The tests were performed in stages of which a number was already performed during the development process. For a test to be considered to have passed all the individual tests from each partner had to perform successfully. In the following paragraphs the various tests are described.

Sprint test

After each sprint would be tested to demonstrate whether the new functionality actually works within the chain (in accordance with the defined requirements). The test was divided into two phases. The first phase was focused on the technical effects between DUO and the educational institutes. The institutes had already defined the acceptance criteria (test cases) in advance. These criteria had been completed with test cases specifically designed to test the interface. In the second phase the institutions actually tested all test cases.

Chain test

The objective of the chain test was to demonstrate that the new and/or adjusted connection between software suppliers and DUO function according to the technical requirements throughout the entire chain. Based on the list of demands several scenarios were described for not only the technical but also the functional aspects would be tested throughout the entire chain. These scenarios were drafted by DUO and the institutions under the management of the programme manager.

Field test

The aim of the field test was to show that all processes throughout the entire chain could actually be performed by all chain partners. The field test was based on scenarios and check lists of the tests performed by all partners. The preparations and the coordination of the field test were mainly conducted by DUO.

Scrum / sprints

For the development of applications within the infrastructure of BRON-HO the scrum method has been used. The scrum method is a proven development method which is especially suited to develop software in a fast pace where functionalities aren't developed in a detailed way.

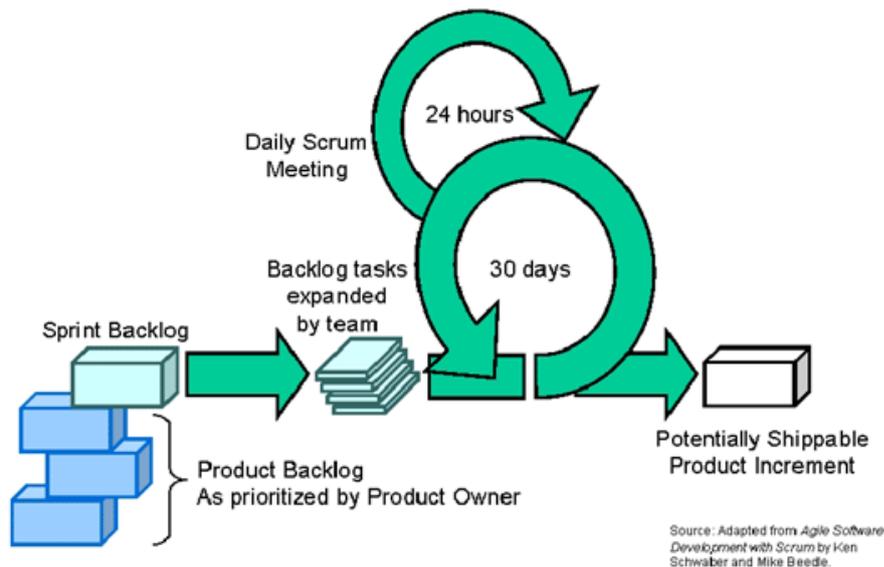


Figure 1: Scrum method

Scrum means working in short iterations, usually of a month. The aim is to deliver completely functional software after each iteration (sprint in terms of scrum). Completely functional means not only coded, but also tested and documented so it could be released right away.

An important element of the scrum method in relation to the chain is an in place work group. The composition of this group is crucial for the success of the project. During the first couple of meetings the work group defines the product backlog. The product backlog is leading for what is to be realised in which sprint. This way the product owner is really in charge of the project. With every new sprint the product owner can decide on the priorities and thus react on market changes.

For a sprint to produce release-ready software doesn't mean each sprint leads to a release. The product owner decides when a release takes place. This could be after each sprint but also after several sprints because only then a complete set of functionalities is available. Even in the latter situation it is important to produce completed software for problems to not be postponed and the productivity to be accurate and realistic.

Results

The results of the BRON-HO project are the following.

The current way of data exchange based on batches is replaced by exchange based on XML-messages. Now activities such as preparing export files and processing import files are no longer necessary. This leads to less manual activities and less chance of failures. A fully functioning machine to machine connection via Studielink with all educational institutions has been realised within BRON-HO. A service is available which allows institutions to automatically deliver data on registrations and results. This data exchange not only no longer requires manual actions but it is also very robust as educational institutions always send a complete set of information concerning a registration or diploma, which assures information to be complete and correct.

The enrolment process of students by institutions is supported by DUO with the following services:

- Provide personal data (24 x 7)
- Provide previous educational data (24 x 7)
- Provide indication of tuition fee
- Provide altered personal data
- Provide altered previous educational data
- Provide altered indication of tuition fee

The services that supply personal and educational data 24/7 have a response time of only a few seconds. These data are requested from Studielink at the moment a student wants to register his enrolment to an educational institute. The data DUO produces in this process are shown to the registering student. This increases convenience for the student as well as decreases incorrectness.

Within seconds after the student's registration DUO provides an indication for the tuition fee. This enables institutions to easily set up a request for payment (or mandate) for the tuition fee and present this to the student. This significantly shortens the run time of the registration process.

Furthermore DUO signals institutions as soon as personal, educational or tuition data alter. Especially signals concerning altered educational data are very efficient, for the institutions no longer need to request the student for a copy of their diploma and subsequently process these changes.

The scope of the project consisted also of a number of business services. In the former situation the relevant business services were partly individually supplied and executed by several departments within DUO and were supported by the systems CRIHO, HORS⁷ and Data Ware House.

In the new situation the business services are to be delivered by DUO in an integral way. Support will take place through various information facility components.

This means that BRON-HO is not really only one new application. It is supplied with data from several generic components. The new structure that replaced the CRIHO register provides data on education participation and education results. Here all facts and figures on participation and achieved results/degrees can be managed for all sectors of education. This new set of applications offers various services to both internal and external partners (such as students, educational institutions and DUO's finance department).

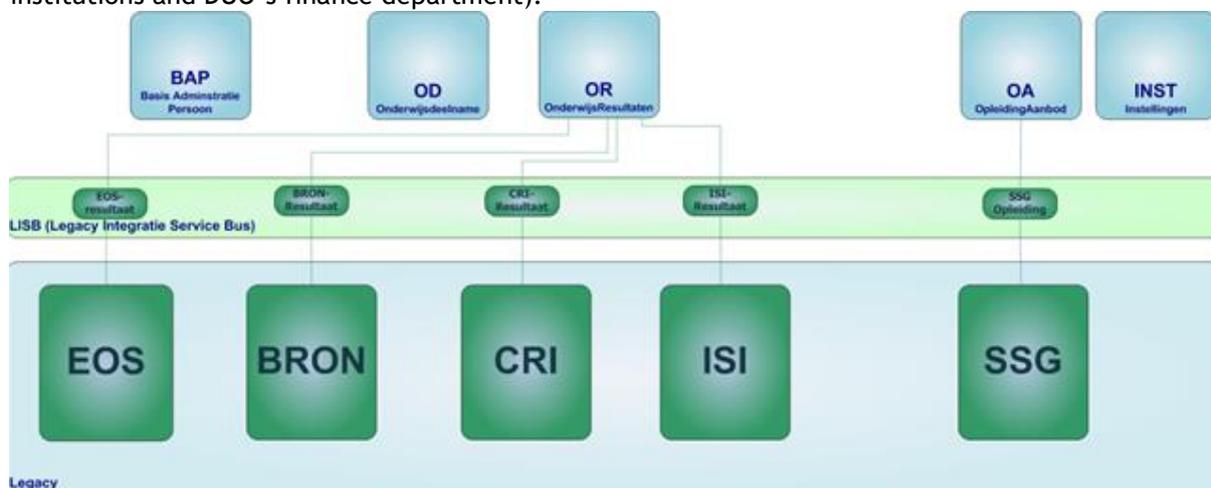


Figure 2: from sector oriented applications to generic registers

The introduction of BRON-HO delivers the following (qualitative) structural benefits:

A more flexible infrastructure which enables time to market and implementation costs due to legal changes to be shorter/lower.

Create opportunities to provide additional services to external parties in the future, e.g. support the registration process.

The business services are provided by DUO in an integral way. Support will take place through various information facility components. The infrastructure within BRON-HO is created conform an event-driven service oriented architecture. This means that the integration between various business services was released based on events.

The applications HOI⁸ and HOST⁹ react to events which occur in the registers BAP¹⁰, OD¹¹ and OR¹².

A more flexible infrastructure which enables time to market and implementation costs due to legal changes to be shorter / cheaper. By realising various business services supported by several

⁷ Application for the calculation of payments per institution

⁸ Hoger Onderwijs Informatiediensten: higher education information services

⁹ Hoger Onderwijs Status Toekenning: higher education status acknowledgement

¹⁰ BasisAdministratie Persoon: basic administration personal data

¹¹ OnderwijsDeelname: education participation

¹² OnderwijsResultaat: education result

applications (*separation of concerns*) and *loosely* coupling them, processing changes within a business service will have less impact compared to the traditional silo application, thus time to market is shorter and costs are lower. The run time of the project was decreased due to the scrum method which led to monthly releases. The scrum method also enables greater interaction with educational institutions. This means larger commitment, better functional synchronisation and optimal prioritising.

Opportunities are created to provide additional services to external parties in the future, e.g. support the registration process. By disconnecting registers from information services it is easier to create new services. The registration process is supported by real time supply of centrally verified and relevant educational and personal data as well as the type of tuition fee relevant for this student.

All objectives were realised within the agreed timeframe and had all partners highly satisfied on the results.

Success factors

After the release of BRON-HO a project evaluation took place. The most important success factors and lessons learned are described below.

The management and project approach played important roles in the success of the project. Both the commissioner (OCW) and DUO showed courage by providing the project much freedom. It was trust that provided the project with the independence it needed. It was based on short lines of management which requires a certain attitude. Also much effort was put in the right focus and priority of the project.

The commitment of all (external) stakeholders (Studielink, educational institutions and software suppliers) was very high. Among other things this was visible through the frequency of the meetings and the number of persons present. A chain project like BRON-HO definitely needs this and requires a certain flexibility, enthusiasm, persuasion, drive and courage from all the stakeholders. This contributed to a good basis which led to priority for the project and increased acceptance.

By frequently showing results and being transparent, through monthly sprints, the stakeholders' - especially the educational institutions - confidence was built.

A project such as BRON-HO requires the entire chain to be extremely well informed. The contribution of the external implementation manager, who frequently visited all involved educational institutions, was substantial.

Internal communication within DUO is not to be underestimated, especially in relation to the attention and priority the project needed.

This large sized project requested a large sense of collaboration and collectiveness both within the chain and the project. Collaboration, both internal and external, worked excellent and has certainly contributed to the success of the project.

At every point in time during the project the objectives and activities were clear to all project partners. The willingness to help each other to realise the objectives was very high.

The phased delivery of BRON-HO has eventually led to a smooth final release. The phasing helped spread the risks and reduce time pressure. This also accounts for the phased connection of institutions to BRON-HO. To be able to divide the project in such phases a well-oiled multidisciplinary team and priority in the various environments is essential.

A project like BRON-HO requires a certain mentality of the project members. Sometimes so called cowboy behaviour can be necessary, however the timing is important. Wanting to learn from previous experiences, awareness of quality and persistence are essential.

BRON-HO was provided with highly qualitative project support, which is very much justified for a project of this size. The project support had a clear additional value for the project in terms of effectiveness and efficiency.

As BRON-HO had a very large number of project members it would almost be too large to manage properly. The independent attitude and professionalism of the members however contributed to pleasant and uncomplicated collaboration.

The implementation phase is one of the most important parts of the project. Due to the large amount of work and the run time needed it is essential to start this process in time and allocate the right people with the right objectives. Focus on the implementation (control and responsibilities) is necessary until the very end of the project.

When a project has to take into account performance requirements which were instructed by external parties it is crucial that these requirements are imbedded from the very beginning of the project.

When generic building blocks are to be used, the performance requirements of these building blocks are to be defined in an early stage.

For an automation project conducted by governmental organisations to be this successful can be accredited to the used approach which was fundamentally different from other projects. At the end of 2010 all partners met and together drafted the master plan for the project. Here the deadline of December 2013 was set. Deliberately was chosen not to produce a list of demands. The only thing that mattered was a result in accordance with the law. Immediately the development process began. After every four weeks the results so far would be assessed by all the partners which included testing. This process was repeated approximately 40 times (40 x 4 weeks). The success of the project does not only belong to DUO or OCW but to the commitment and effort of all partners!

The implementation of the project was split up. The registration process was implemented first and not until one year later the other processes were released. Both releases took place without any complications.

The higher educational institutes are very positive about the results of BRON-HO. The institutions experience less administrative actions and better and quicker available data. The institutions have been more in control of the enrolment, payment and funding processes since the introduction of BRON-HO.

During the tests the implementation manager would keep record of the process in a dashboard using traffic light symbols. This dashboard was distributed to all institutions and was used in the management platform to discuss and speed up progress. Institutions would keep each other focussed on the progress which led to less delays.

Final remark from the project manager:

The approach which was used is eligible for every kind of chain which wishes to connect to a basic register.

DUO currently works on the project *Doorontwikkelen BRON*¹³ in the vocational education field. When this project finishes, BRON will be further developed within the field of secondary education.

¹³ Follow up development of BRON

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Building an IT-ecosystem of services and exploiting agile methods

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Keywords

Agile, Open source, SOA, Student Administration System, Ecosystem, Peppi, Software development

1. ABSTRACT

Metropolia University of Applied Sciences started to renovate Enterprise Architecture on 2010. The renovation process ended up to be a complete ecosystem for Higher Educational Institutions Today we are extending the ecosystem with additional services for students and student administration. To do this, we have started two projects that are implemented by using agile development methods. This paper explains the background of our ecosystem as well as the challenges in building and extending the ecosystem. One of the challenges that we have encountered is combining traditional project methods with agile methods and also doing this simultaneously in two separate projects. We also describe the methods that we have used to build our ecosystem as well as tools to manage and visualize the overall progress of the extension in our case projects.

2. INTRODUCTION

Traditionally, all the IT-systems used in Higher Educational Institutes (HEI's) have been specializing on one small part of business process. The process itself can be very extensive in the means of time or different process phases. For example, student management from applying to graduating could be described as one business process and still there might be several systems that must be used to handle this one process. From the user point of view every system delivers different user experience and, in the worst yet very common case, the user has to insert the same data several times so that these systems get all the necessary information. In the system administrative side there is a lot of headache in maintaining all the user permissions and data integrity.

The reason why it has come to that is mainly historical. IT-systems have been developing rapidly over time and different vendors have seized their territory in fulfilling the needs of a certain business process phase. In addition, technologies being used have been varying between vendors and there has been very little specified application interfaces to be used by others. It's still not the vendors or the IT-development to be blamed. The HEI's have not demanded or specified such things as Service Oriented Architecture (SOA), open interfaces or interoperability. Furthermore, business processes differ between organizations so it has been easier to build a system to support one small part of a process than to develop a system that could fit for the whole process on several organizations.

Also the methodology in developing IT-systems has been changing over time. Even a few years ago it

was almost a rule that IT-projects were implemented with traditional waterfall method where everything is strictly specified beforehand. The problem is that not everything can or should be specified in advance. Nowadays agile project management has become more popular in implementing IT-projects but it has also some drawbacks as explained later on.

In short, we have noticed some problematic issues in current IT-environment that we wish to fix in our new ecosystem. This paper explains how we are expanding our current ecosystem and how we are doing it.

3. ECOSYSTEM BACKGROUND

Renewing all systems in one project can be risky. That one project will be a mammoth. Rather than solving all problems in one project it could be wise to split that mammoth project to smaller pieces. That is exactly what we have done.

Six years ago we realized that it is not possible to go on like before. Many things had to change. We set up a long-term objective to renew all main systems for the end users.

First we had to change the way of thinking and forgetting the old habits. That process included

- Enterprise architectural thinking
- Creating and acquiring IT systems
- Using new technology and de facto standards
- Providing services based on user roles
- Committing executives

We made big decisions and commitments for future. Some of the decisions would carry on for many years to come on and we had to commit our executives for those decisions. Without executive commitment long-term projects simply wouldn't have a chance.

We started the change over 6 years ago and we are still half a way from The Goal. But saying so it is also important to say that we have already achieved many phasial goals along the way. We have already implemented the ERP services and they have been in production over 2 years now. Also we are in the verge of implementing student administration system and services for students to production.

3.1 Enterprise architectural thinking

Enterprise architecture (EA) thinking is getting foothold in organisations. EA is nowadays guiding many future IT projects and giving them objectives for the future. Enterprise architecture is defined by Gartner as follows “ **Enterprise architecture (EA)** is a discipline for proactively and holistically leading enterprise responses to disruptive forces by identifying and analyzing the execution of change toward desired business vision and outcomes. EA delivers value by presenting business and IT leaders with signature-ready recommendations for adjusting policies and projects to achieve target business outcomes that capitalize on relevant business disruptions. EA is used to steer decision making toward the evolution of the future state architecture.” (Gartner, 2015) As Gartner also defines, EA itself doesn't create future software but instead it gives value and objectives for projects that creates the future IT systems. This was something that we had to understand in the beginning. It is important to have EA but probably even more important to have projects that creates concrete values guided by EA.

3.2 Creating and acquiring IT systems

Normal or most common procedure of acquiring IT systems is defined in Systems development life cycle (SDLC) (Radack 2009). The most common phases of acquisitions are:

1. Initiation - The need for system including system requirements
2. Acquisition/development
3. Implementation
4. Maintenance
5. Disposal

The most popular way in acquisition/development phase is to use Waterfall method (Bowes, 2014). SDLC and waterfall method were also very typical choices for us in 2009 and before that. In 2009 we also had to rethink the way of creating and acquiring IT systems. There were some weak spots on SDLC and waterfall. (CMS 2015)

The main character for both is that they assume that everything is known beforehand and nothing changes during the project. For example: 1. customers know everything that they need from the system before development phase and 2. all the technical choices made beforehand are the best ones for this project.

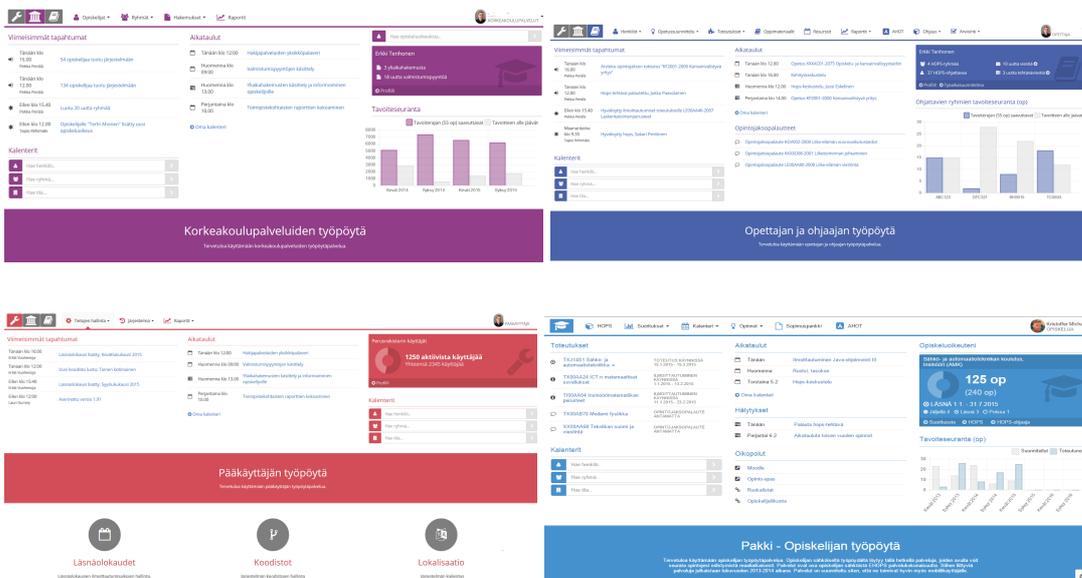
We had to think new ways that could tackle those weak spots. Choice was that we use agile approach for development phase and consortium for acquisition process. Agile methods helped us to make changes during the development phase and consortium gave us more tools for SDLC.

Rather than buying "blackbox" software from the market we wanted to create ecosystem of services that are defined, designed, developed and owned by us. This meant that we could also define the level of dependency to those technologies we chose to use. These choices gave us great advantage concerning the lifecycle phase of maintaining and further development. Referring news article on ComputerWeekly.com support and maintenance costs have increased every year for Global 2000 companies in the US and UK (ComputerWeekly.com, 2014). At the same time many CIOs expect that they will have IT budget cuts in the future (Gartner, 2014).

3.3 Providing services based on user roles

We knew at an early stage that the collection of services we were developing would cover wide range of business processes and some of the services would overlap between processes and user-roles. We decided to bundle needed services from the user-role point of view and build role based dashboards. Of course users may have multiple roles but that is not a problem since all the dashboards are on the same platform and changing a role on the fly is only one click away. There is no need to change between different systems. Also adding of the roles or making even new dashboards, is relatively simple, if necessary.

Basically all the users are using exactly the same services from the technical side. They only need to have some roles that they have access to the services. The user inherits some predefined permissions based on his/her roles and they are not bound to a specific dashboard. The permissions can also be fine tuned user-specifically. Almost all the business logic is built into the service layer which means that we can build role-optimized user interfaces very easily with the same background service. The role based dashboards look very similar (Picture 1) to each other although the actual services that they provide are meant to fulfill very different processes. Some services even appear exactly the same in different dashboards it they are needed by several roles - room reservation service is an example of this kind of service.



Picture 1: Role-based dashboards

Above are some screenshots of different dashboards. The idea is that every dashboard has same look and feel. Navigation and user experience are uniform through the ecosystem and more services can be added easily on the dashboard. Some services are fitted into the front-page like in the example, some services need more space and can be accessed from the top menu. The menu itself changes based on user role and user permissions.

3.4 Committing executives

Building an IT-ecosystem is a long-term decision both financially and operatively. This means that the organization has to be committed to the decisions. One point of view is financial, it may take several years to build an ecosystem piece by piece and also the already existing services will need some upgrades from time to time. In addition it is not usually feasible to adopt every new IT-solution that comes into the market especially if it does not fit into the chosen ecosystem. The executives need to think carefully when it is necessary to make exceptions on the ecosystem.

The other point of view is operational commitment. The organization needs to be committed to give necessary human resources in order to successfully carry out the whole process from setting the requirements to actual implementation. Also new procedures need to be introduced and put into use in the organization and this takes commitment.

4. EXTENDING THE ECOSYSTEM

What we call an ecosystem in this case includes the combination of architecture, platform and services provided to the end-user through role based dashboards. In short, the dashboard is actually just a collection of modular services that a certain user role needs to accomplish his/her tasks. The user can have several roles simultaneously thus having access to multiple dashboards. It is also possible to finetune user access within services themselves.

Student administration services is a project where we completely renew our old student- and accomplishment register including its user interfaces and reporting. The old system is outdated and incompatible with our ecosystem. Furthermore, we need wide range of application interfaces to the register in order to automate and develop new student services. This we cannot provide with our current, closed system.

Student dashboard services is a project that exploits the data and application interfaces created in the student administration services project. The project produce new services for student-roles including for example personal study planning and messaging services. It also combines existing services into the same role based dashboard.

As mentioned above, we have started two more projects in order to cover the missing elements: student administration services and student dashboard services. Student dashboard services -project is based on the requirements that have been defined earlier in nation-wide TIPTOP -project (TIPTOP, 2014). Student administration services on the other hand are being built on processes that were defined during the project. The requirements for both of the projects were made on 2013 and early 2014.

The actual development phase started on summer 2014. Both projects have their own budget, aims and steering group so they are completely separate projects although they implement the same ecosystem. It was mainly coincidental that the projects started almost the same time since the early background of both of the projects were very different and complex.

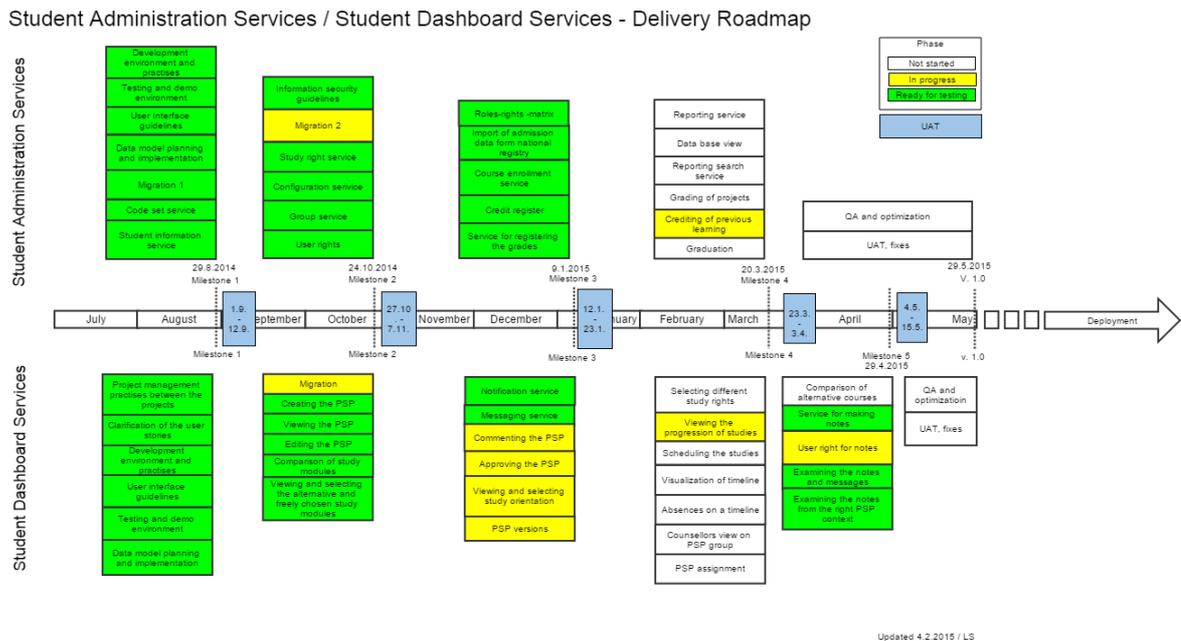
We were in a situation where we had relatively well defined ecosystem with a bunch of already implemented services and now we needed to extend the ecosystem in two separate projects. Shortly after starting the projects we noted that some project outcomes were dependent on each other and even some of the staff were working on both projects. We needed to somehow combine or synchronize these projects.

5. PROJECT METHODS AND OUTCOMES

On the bidding phase we ended up choosing same vendor for both projects. From the day one it became clear that the projects would be easier to manage if we would use the same methods in project management and development. From the vendors point of view it was rather challenging in the very beginning to hammer both projects to the same project model since the requirements were made with completely different way: the student registry services requirements were formulated on a very detailed way with a waterfall style, while the student dashboard services covered basically the user stories.

The vendor chose to use the scrum method in the development phase in both projects. Projects' timeline is divided in four or five milestones (producing a development version submitted to user acceptance testing) all having the own goals that fill the certain amount of the requirements. The actual development has been managed in two-week sprints including the established scrum elements, i.e. the use of product and sprint backlogs, sprint planning sessions, Daily Scrums, sprint review sessions and sprint retrospectives (SCRUM ALLIANCE, 2014). The chosen method has been suitable for our needs thanks to its consistency and transparency. It has also allowed us to follow the development and, on the other hand, clarify the requirements if - and when - needed.

The vendor has been using Atlassian JIRA's Agile features in the project management, and it has fulfilled our needs in managing the project and following the development. However, especially for the stakeholder needs, we have learned that one simple yet evolving picture is an excellent way to stay on the map of the project, and to communicate to stakeholders through the project's lifespan (Picture 2).



Picture 2: Projects' Delivery Roadmap

In addition to described scrum conventions, there have been a traditional project organization in both projects including the separate steering groups, joint project group, and a number of expert groups. Especially the expert groups have been crucially important in clarifying the requirements and testing the versions. Test results have been analyzed thoroughly and are used in shaping up the requirements or polishing the user interfaces and so on.

In the Student administration services project we started from the student administration services (information of students, study rights, accomplishment registry etc.) and administrator services (code set services, logs, localisation etc.), and then proceeded to teacher (user interfaces for approving the enrollments for courses and register the credits) and student services (enrollment for courses).

Student dashboard services project, on the other hand, has been producing features for personal study planning (PSP) for both the students' and study counsellors' dashboards. The PSP tool covers features for both "narrow PSP" and "open-ended PSP" needs. (Ansela & al., 2006). The narrow PSP refers to the target of making a concrete plan 'what to study', 'when to study' and 'how to study'. The open-ended PSP, on the other hand, is more focused on the learning and interacting with the student counsellors and peers. That is why the messaging service has been essentially integrated to the personal study planning service.

As explained above, these two project are producing a certain amount of new services in four different user role dashboards: student, teacher/counsellor, student administration, and administrator. This highlights the benefits of service orientated architecture. We can gradually build a compatible ecosystem using the existing application interfaces and services.

5.1 Traditional versus Agile methods

Agile development methods have been lately very popular in IT-projects. Yet, there has been a lot of debate on how effective those agile methods really are. In our case we are using agile SCRUM for the actual coding part of the projects and more traditional project management for the overall implementation. By overall implementation we mean the specification phase, coding/development, training and actual deployment phase. There have been numerous empirical researches on agile development and the benefits or drawbacks it might bring compared to non-agile development. The results do not seem to be conclusive and it is not always clear to the developers themselves if agile methods are being used or not (Murphy, 2013).

On the basis of our experience the question should not be if we are using agile methods. More important is that we use the right methods. We have found a way to use agile methods with our vendor for the development part of the project and combine it to a more traditional project model which fits better for the more rigidly governed Educational Institute.

5.2 Future challenges of the ecosystem

We have described how we have built and started to extend our IT-ecosystem of services. Yet, we acknowledge that the chosen ecosystem will not last forever and needs to be replaced at some point. Currently used architecture supports renewing of modules and services quite freely but still it has some limitations. There will always be new technologies to replace older and we do not know the actual lifespan of our architecture model. Our ecosystem covers major part of our business processes so it has become crucial part of our organization. When the day comes that we need to replace it we need to think it through carefully. Still, we think that we will be in a better situation compared to building current ecosystem since now we have modules and services that are well documented and implemented with identical technologies. Since we have built our current ecosystem modularly over time we should be able to renew it with new technologies accordingly.

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Responsive, resilient, elastic and message driven system solving scalability problems of course registrations

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Keywords

Course registration, reactive system, Scala, model of cooperating actors, Single Page Application, NoSQL database, USOS, USOS API

1. ABSTRACT

Course registration is one of the most demanding functionalities of student management information systems. In the *University Study-Oriented System* (in short: USOS [7]) which is used in more than 40 Higher Education Institutions (in short: HEIs) in Poland (gathered in MUCI consortium [4]) we cope with it from the very beginning which dates back to 2000. There are various registration scenarios, some of them are more appealing to students and administration giving immediate feedback and being fully automatic, others are more practical and less demanding with respect to computing power. The optimal solution should stay user friendly but also get burden off the university administration, meaning both student's offices and IT departments.

We attacked the problem by a new approach inspired by the *Reactive Manifesto* ([5]) and built a *reactive system*, responsive, resilient, elastic and message driven. The registration is run in micro rounds until all the interested students register to courses which are offered by the university. Micro rounds last app. 5 minutes, so first come first served approach is avoided but anyway feedback is almost immediate. To achieve the respective responsiveness, scalability and resilience, involved technologies were chosen carefully. Backend server runs in asynchronous and distributed computation model of cooperating actors which exchange messages. Data is stored in NoSQL database kept in main memory for most of the time and the frontend is designed as a dynamic single page web application. The scalability of the new solution was tested using infrastructure of the University of Warsaw, the biggest HEI in Poland with more than 50 thousand students.

2. INTRODUCTION

Course registration is one of the most demanding functionalities of student management information systems. In USOS we cope with it from the very beginning (which means 15 years). Registrations based on the first come first served approach are more appealing to students who get immediate response to their registration requests and administration who need not be involved in any hand made decisions, but on the other hand are the most demanding with respect to computing power. If not supported by highly scalable infrastructure and carefully tuned software, may lead to disaster. There is a way of delivering more computing power during rush hours (e.g. by buying it from a cloud provider), but it involves additional cost and extra organizational effort without guarantee that the problem will be completely solved.

We attacked the problem in a different way. Inspired by the *Reactive Manifesto*, we decided to build a reactive system, responsive, resilient, elastic and message driven. First come first served approach is replaced by micro rounds (short time periods lasting app. 5 minutes). The registration starts with the first active micro round. Students deliver their preferences using a dynamic single page web application. During a subsequent short time interval backend server makes registration decisions which are immediately displayed to students. For some users the registration ends, those less lucky continue the game delivering new sets of preferences in the next micro round.

The new approach compliant with the *Reactive Manifesto* demands new architecture and technologies. The system consists of three layers, which are event-driven. The user interface is

implemented using AngularJS as a dynamic single page web application. The application server runs in asynchronous and distributed computation model that allows to scale both vertically and horizontally. The technology used is Scala and Akka. Backend functionalities are delivered to other layers by USOS API ([3]), which is public API to the system and USOS application server. Temporary and permanent data storage layer is focused on the performance of operations while ensuring data safety. This is supported by NoSQL database MongoDB.

University Study-Oriented System is an integrated suite of applications, running on top of a central Oracle database, installed in more than 40 higher education institutions in Poland, altogether offering educational services to almost $\frac{1}{4}$ of the population of students from public sector HEIs.

In this paper we describe the whole project from design through implementation to deployment. In Chapter 3 various approaches to registration implemented in USOS are described. Section 3.4 is devoted to the new registration approach. In Chapter 4 we explain the technological aspects of the solution and in chapter 5 show test results. Conclusions are drawn in the last chapter.

3. REGISTRATION FOR COURSES AND CLASSES IN USOS

3.1. Introduction

In modern higher education institutions flexibility of study programs means in particular that students may freely choose a substantial part of their curricula. The software support is needed to help to make good choices and enable to pass information on what has been selected. This information is later used for student assessment and checking whether a student met requirements of a particular study program.

The important aspect of this process is the huge amount of data which needs to be gathered in the system. Doing by hand all the necessary registration activities would be a substantial burden for every student administration office. The only economically acceptable solution is to let the students do it by themselves.

Course registration is just the first step in the registration procedure. At the next stage students choose particular student groups (classes, labs, lectoria, project teams etc.) which gather at various times and days of the week. This step has a significant impact on a student's weekly schedule and has to be carried out taking his/her preferences into account.

Web based registration is vulnerable to scalability problems. In a medium-size faculty, like Faculty of Mathematics, Informatics and Mechanics of the University of Warsaw, every year about 1500 students register for about 300 courses. In the University of Warsaw in 26 didactic organizational units study more than 50 thousand students, the largest faculties have more than 6000 students. There are approximately 20 thousand courses offered every academic year. These numbers give some impression about the scale of the process.

For the 15 years of the USOS development we designed and implemented a couple of registration procedures. The main two are described in the following sections. In the end the newly designed registration method is described.

3.2. Two-phase registration

In this model students register for courses during the first phase and for classes during the second phase. The procedure does not require students to be available during registration at the same time or at the same place.

During the first phase students choose courses they would like to attend. The decision whether a particular student is accepted for a particular course is made off-line. When the registration module is switched off, the authorities get the lists of students asking for acceptance for particular courses and make decisions. If the lower limit on the number of course participants is not reached, the course is cancelled. If there is no limit on the number of students who can be accepted or the limit is not exceeded, all the students are allowed to take the course. Otherwise students are accepted according to some predefined criteria. Usually these criteria are difficult to implement so it is more reasonable to make the decisions by hand. This may seem cumbersome but in the past all attempts

to implement this process failed due to many exceptions to general rules. It means that students have to wait until the end of the course registration to get the results.

Then the group registration module is switched on. These students who were accepted for the course can now state their preferences concerning various study groups of that course. These preferences can be expressed in a couple of ways, e.g. a student may create some variants of his/her weekly schedule and/or list classes which should be chosen with high/low priority and/or list days and time periods which should be chosen with high/low priority (e.g. low priority given to Friday evenings, high priority given to classes starting after 11 am). After a couple of days the module is switched off and the group registration engine assigns students to classes taking into account their preferences, trying to minimize the number of time conflicts and preserving other requirements. Sophisticated algorithms were implemented for this engine (see e.g. [2]).

During the second stage students are guaranteed that they will be accepted to one of the groups, but not necessarily to the favored one. It may even happen that a student has to drop the course because the group schedule is unacceptable.

There is still another module which may be (optionally) used. This is called stock-exchange, although what is really being exchanged are places in particular classes. A student can submit a place in a particular class for sale and ask for a place in a different class. After a couple of days the stock-exchange engine is switched on and it automatically matches buyers with sellers (even in cycles longer than 2) exchanging students among groups.

Such registration procedure works reasonably well at the faculty level, where students take courses which are in line with their specialization. It is relatively easy for the faculty authorities to make decisions whom to accept and whom to reject. Students know where to complain in case they feel they are not treated fair.

3.3. Direct (combined) registration for courses and classes

Curriculum of a typical study program involves also some courses which are not offered locally by the faculty to its students, but are delivered by some designated faculties to all students of the university. These are for example foreign language courses which are offered by the Center for Foreign Language Teaching, physical education classes which are offered by the Physical Education and Sports Center or general introductory lectures on philosophy which are provided by the Philosophy Faculty.

There are also faculties which prefer fully automatic registrations not involving human decisions.

The model of registration for such courses and such faculties is different and needs separate software support. Students register directly for course groups on a first come first served basis. This means that if only the group limit is not yet reached and a student is entitled for registration, he/she gets registered and this registration gets approved straight away. Students get immediate feedback, but they have to be on-line on the moment registration starts and compete with thousands of other students.

There is a variant of this procedure called token based registration [1]. Every student receives a number of tokens of different kinds and registers to classes paying with these tokens. Each course has its price given in tokens, usually this price corresponds to the number of hours. After reaching class limits registration to this class is suspended. When a student registers, the system charges him/her the appropriate amount of tokens of the proper kind. If more tokens are needed than the student possesses, he/she should be given the possibility to cancel or to approve the operation before the due payment is charged. The student should transfer money using his/her unique account number.

Tokens serve one more purpose. They set a limit for the maximum number of groups a student can choose in one registration round. This limit is used to prevent over-registration. If there was no limit, some students might register to many groups, just to postpone the final decision to the very last moment and unregister right before the registration is switched-off.

3.4. Micro rounds

Direct registrations are more appealing to students and administration giving immediate feedback and being fully automatic, two phase registrations based on preferences are more user-oriented by giving the possibility to match supply and demand and also by being less demanding with respect to computing power.

The optimal solution should stay user friendly but also get burden off the university administration, meaning both student's offices and IT departments.

The new type of registration is run in micro rounds (short time periods lasting app. 5 minutes) until all the interested students register. The registration starts with the first active micro round. Students enter their preferences using a dynamic single page web application. During a subsequent time interval backend server makes registration decisions which are immediately displayed to students. Having access to all requests, the server may optimize distribution of places between students. For some users the registration ends, those less lucky continue the game delivering new preferences in the next active micro round.

Registration may be in one of the following stages (see Figure 1):

1. Waiting – registration has not started yet but details of courses and classes are available to students who can plan in advance their preferable schedules.
2. Active – micro round is active, students may define preferences. The micro round is short but long enough to diminish the pick loads of first come first served approach.
3. Break – interval between two active micro rounds, students' requests are processed, results of registrations are displayed to students and stored in USOS database.
4. Finished – registration is finished

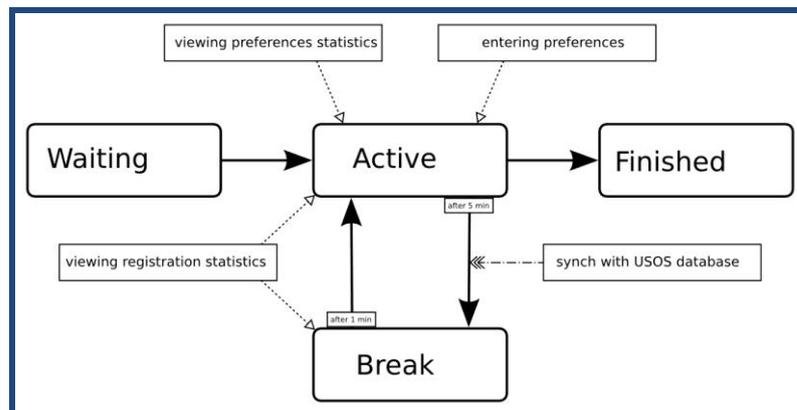


Figure 1 Stages of the registration with micro rounds

This model of registrations not only seems to be an acceptable tradeoff between various requirements but also enables effective implementation. Students' requests can be processed in parallel – preferences from various students are independent and need not be stored immediately in the database. They are kept in memory and synchronized with the central databases during intervals between active micro rounds. During synchronization all the records are transferred to the database in an efficient manner, which helps to increase throughput and to reduce the load of the database. The implementation details are described in Chapter 4.

4. DESIGN AND IMPLEMENTATION

According to the *Reactive Manifesto* "Systems built as *Reactive Systems* are more **flexible**, **loosely-coupled** and **scalable**. This makes them easier to **develop** and amenable to **change**. They are significantly more tolerant of failure and when failure does occur they meet it with elegance rather than disaster. Reactive Systems are highly responsive, giving users effective interactive feedback."

Requirements against the new model of registration comply with the principles of reactive applications – applications which, generally speaking, are event driven. By placing the new registration system in this context we can take advantage of the universal knowledge and experience, as well as patterns and ready solutions developed by the creation of similar systems.

4.1. System architecture

General overview of the system architecture is shown in Figure 2. It comprises the following layers:

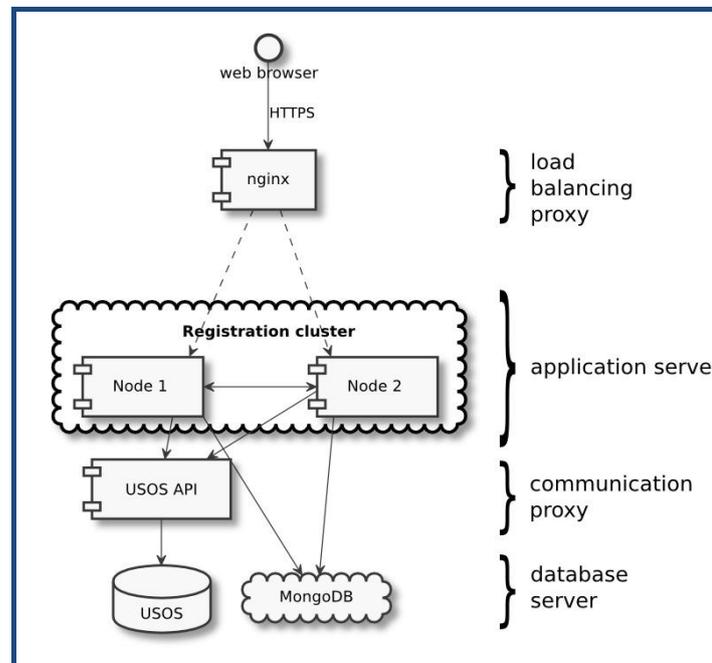


Figure 2 The overview of system architecture

1. User interface

User interface is a separate module of USOSweb, web based application for students and staff. High performance should be guaranteed in the frontend, as well as in the backend. We decided to implement user interface as a single page application. Such applications can reduce the amount of data sent over the network and lower the load on the HTTP server. In this approach, all HTML, JavaScript and CSS is taken during single page load or downloaded dynamically when necessary, usually in response to user actions. Downloaded resources are placed in the browser cache. More details on a single page approach is given in section 4.3.

2. Load balancing proxy

In order to ensure proper performance and scalability we decided that the application server will be distributed. That means that we need a proxy responsible for load balancing. Mechanism used must comply with the following assumptions:

- a. support for Server-Sent Events,
- b. routing of calls from the same client to the same node – so called sticky sessions,
- c. support for secure SSL connection,
- d. support for proxy cache.

From various possible candidates **nginx** has been chosen.

3. Application server

The application server is a distributed **cluster of nodes**, from which everyone can accept any connections from customers. These can be both regular HTTP connections and asynchronous connections to send notifications. The nodes communicate between each other to support

load balancing and to provide resistance to failure. Application server is described in detail in section 4.4.

4. Communication proxy

USOS is a suite of software applications built in a distributed architecture. There is a central Oracle database with many packages, functions, triggers, jobs, etc. USOS API is a standard REST-like interface to data gathered in USOS, publicly available, well documented, with guaranteed backward compatibility. API methods are gathered in modules, e.g. *users*, *courses*, *terms*, *geo*, *mailing*. Each API method is well-documented in XML, so methods and their parameters may be automatically validated. Results of methods are delivered in XML or JSON format. Methods with the administrative key may fetch data from the central Oracle database, the others get access only to a local MySQL database (which is periodically synchronized with the central one). USOS API implements business logic and makes it available to other modules of the software system.

One HTTP request stores all served requests made for one course conducted at the end of each micro round. Thanks to this database is not unduly burden even when many students try to register in a short time.

5. Database server

The application server uses USOS API to retrieve and store data from/to Oracle database (such as the fact that someone is registered to a course). Data associated with the application itself, such as sessions, registration requests, and also provisionally collected data on courses and classes, are stored in a separate database. Because this database will have to serve a large number of read and write requests, which can be processed in parallel (requests of different customers do not require any synchronization), the data store does not have to comply with all the requirements posed by relational databases. NoSQL databases give the opportunity to achieve higher performance at the expense of, among others, deterioration of insulation of transactions, and are more cost efficient than commonly used relational databases.

We considered a couple of NoSQL solutions but finally have chosen MongoDB. Mongo nodes can be reproduced increasing the degree of data replication, and also their safety. Data can also be distributed between nodes, enabling greater degree of parallelization of read and write operations.

The chosen solution allows to achieve two important goals. The first is to take off the load from Oracle with minimal interference with the existing structure present in the database. Data from Oracle database are made available by USOS API in a convenient form that allows to group read and write requests. The second objective is to use the local database MongoDB, so that several common operations performed by the students – registration requests – are processed locally, in an efficient manner. We have achieved this by reducing the required number of queries to the database (especially writes) and assuring high independence between data structures for different students.

This architecture has a decisive impact on the performance and scalability of the system. Chosen components and communication between them ensure high effectiveness and resistance to failures. What's more, some components of the system, e.g. database and load balancing proxy, are interchangeable. If in the future better solutions appear, it should not be difficult to use them instead of the chosen ones.

4.2. Communication between system components

Communication between system components is also thoroughly designed. USOS API connects directly with USOS Oracle database. For this purpose it uses a pool of TCP connections. Thanks to this no time is lost for establishing a new connection when a new request appears for processing. Together with the reduction of superfluous operations, it minimizes database load during registration.

Application server communicates with USOS API via HTTPS. Data are transmitted in JSON format.

Communication between user interface and the application server takes place in two ways:

- a. synchronous – HTTP calls of server methods,
- b. asynchronous – implemented by the SockJS protocol. In case of new web browsers it is implemented via Server-Sent Events which provide a standardized way for the server to send content to the browser without being solicited by the client, and allowing for messages to be passed back and forth while keeping the connection open. In this way a two-way (bi-directional) ongoing conversation can take place between a browser and the server.

4.3. User interface (frontend)

User interface is not just a collection of static pages, but a separate web application. It has been written – according to the latest design pattern in creating interfaces – using SPA (Single Page Application) architecture.

The latest development in technology, e.g. HTML5 and fast runtime environments for JavaScript code, has allowed developers to create large and functional applications running on a client side, not – as before – on a server platform. The concept of one-page application refers to web application that runs in a browser, can immediately respond to a user action without sending to the server a request to render a new page, using the capabilities of current technologies and browsers. A classic example of such application is Gmail. SPA approach has many advantages:

- **Improved productivity** – most of the interaction is handled without the server since a large portion of logic is implemented on the client side. When the page is loaded the client retrieves the data from the server in JSON format which limits the flow of data over the network comparing with the traditional approach. The page consists mainly of static files, which makes caching easier and gives a better effect.
- **Separation of the client side of an application from the server side** – in SPA approach client side is separated from the server side and the two parts can be developed by independent teams of programmers. Their collaboration can be limited to determining API and method of communication. Both parts can be distributed separately provided that they are compatible with each other.
- **Easier testing** – easier testing is a consequence of the previous advantages. Greater modularity of the system promotes testing.
- **Ready API for other clients** – one page applications draw data from the server using API. This API provides access to the data also to other customers, e.g. mobile applications.
- **More fluid user experience** – the user running SPA has the impression as if it was a desktop application. The application immediately responds to user actions. Thanks to this user in almost every minute knows what's going on.

There are also some drawbacks of SPA which can be overcome by a careful design.

We use client-side library AngularJS which is web browser JavaScript framework adopting SPA principles. AngularJS's templating is based on bidirectional data binding. The HTML template is compiled in the browser. It implements the MVVM pattern to separate presentation, data, and logic components. Angular brings traditionally server-side services, such as view-dependent controllers, to client-side web applications. Consequently, much of the burden on the server can be reduced.

Students register in USOSweb on a web page showing available classes on a timetable, as demonstrated in Figure 3.

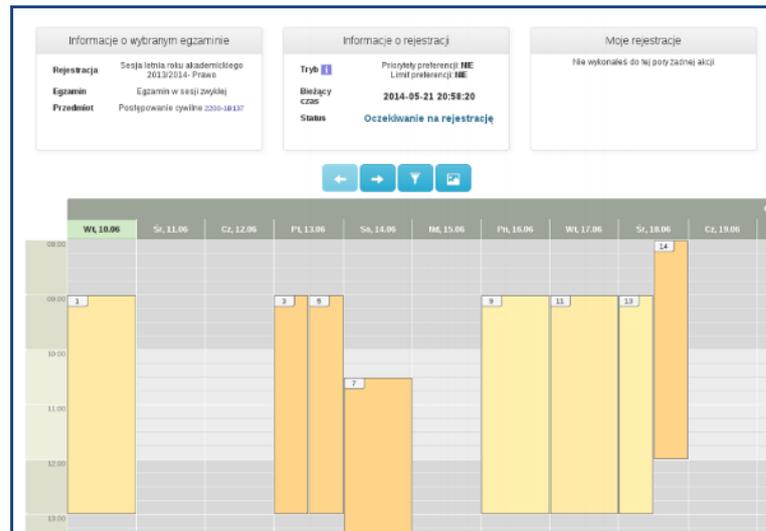


Figure 3 User interface

4.4. Application server (backend)

Internal architecture of backend

Application server is responsible for handling the registration process, in particular:

- providing information on available registrations, courses, and classes,
- collecting registration requests,
- aggregating and delivering to end users statistics on registrations and registration requests,
- processing of requests, calculating the results and storing them in the database.

It is implemented as a stand-alone application serving as a proxy between user interface and USOS API. It is run in Java Virtual Machine. Data between user interface and the application servers and between application server and USOS API is send by HTTP protocol in JSON format.

Internal architecture of the server is based on the **model of cooperating actors**. The central concept is an **actor** – from an abstract point of view it is a single thread, executing its actions sequentially. Programming with the use of actors is an effective way to implement concurrent and distributed systems. By hiding issues such as the physical location of the components of an application (represented by actors), it allows for easy dispersion of these components on multiple machines.

Actors communicate by sending messages using a message queue. Actor can be chosen for execution if its message queue is not empty. In practice actors are implemented using a pool of threads, an actor is chosen for execution by runtime but should give back a thread to the pool before blocking.

Server is mostly written in Scala with some parts written in Java. Scala is a functional/object-oriented programming language with a very strong static type system. Programs written in Scala are very concise and smaller in size than programs written in other general purpose programming languages. We use Akka toolkit which supports the model of actor-based concurrency, in particular the libraries akka-actor and akka-cluster.

System scalability

Server scales according to the number of users – students participating in the registration. Model of actors and Akka make it possible to scale both vertically (for more processors) and horizontally (for more machines) – distribution of the server on multiple physical machines is almost imperceptible in the code of business logic (responsible for handling the registration).

Registration model is very simple. Preferences of a particular student are independent of preferences made by another student. All necessary validation can be made in parallel with validations done for other students.

By a computation node we understand single server process run as a separate instance of JVM. Each process is given its share of resources – number of processors (threads) and RAM. Vertical scaling means an increase of application performance with increasing computational power of a single node.

Requests coming from a particular student are handled by a single actor. User interface in the browser maintains a connection using SockJS protocol. The user can log on to the server from many different computers, browsers, their windows or tabs – each copy of an open interface corresponds to one SockJS connection. The server manages all connections associated with one account by a common instance of an actor. Thus, we consciously limit the impact of the simultaneous actions performed by many users logged into the account of the same student – the most important operations in the context of a single account are synchronized, which contributes to fair distribution of resources between actors, which translates to the performance felt by all users.

Horizontal scaling means an increase of application performance with increasing the number of computational nodes. Thanks to Akka, remote communication between actors is almost as simple as between local actors. Philosophy behind Akka suggests such programming that implies nothing about the time or delivery of messages. Written code should be both asynchronous (also taking into account potentially very long response time), as well as handle lost messages (or replies). With this way of writing applications, decision about distributing actors on many nodes can be taken at a later time, e.g. in a configuration file.

5. TESTS

The preliminary tests were run in a computer lab of the Faculty of Mathematics, Informatics, and Mechanics of the University of Warsaw, on desktop class computers. Each machine hosted one MongoDB and one application server. Experiments were conducted for the increasing number of machines and increasing number of requests per second. We looked for the moment the system is not able to handle the increasing workload. We show just a couple of the results. On all attached drawings axis X shows the time of the experiment in seconds, left (black) axis Y shows the overall number of requests initiated in that second, right (red) axis Y shows the average response time for the request started in that second (the smaller the better).

Figure 4 compares the results for 1500 requests per second for one machine (left diagram) and two machines (right diagram). It can be seen that by adding the second machine we reduce the average response time to a value imperceptible to the human.

Figure 5 compares the results for 2500 requests per second for two machines (left diagram) and three machines (right diagram). Again, it can be seen that the system scales well since one more machine allows to lower the average response time to an acceptable value of less than 0,2 seconds.

We plan to run more tests using the central server infrastructure of the University of Warsaw. With demonstrated scalability obtained on desktop computers, we may expect significantly higher performance on professional servers, as well as their clusters.

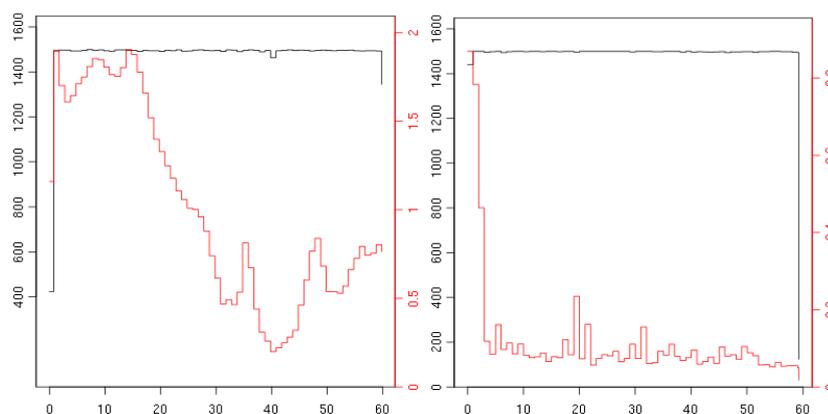


Figure 4 Test results for one machine (left) and two machines (right) for 1500 requests per second

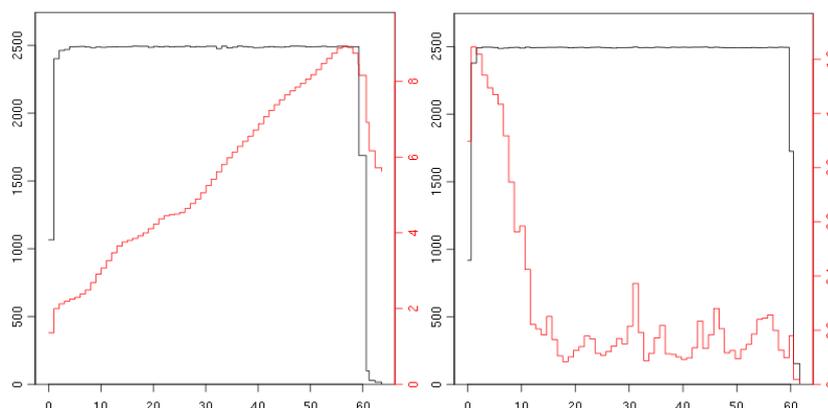


Figure 5 Test results for two machines (left) and three machines (right) for 2500 requests per second

6. CONCLUSIONS

Through the use of modern programming techniques the new registration system of USOS reaches high scalability which makes it possible to increase throughput at key moments of the academic year. It is possible to increase performance within the same machine by increasing amount of available computing resources. In case of special requirements, it is possible to run the application on multiple machines. Scaling the application vertically and horizontally is possible thanks to the use of the model of actors and non-blocking asynchronous programming. Both the operation of the server and the user interface is event-driven. The end result is a registration system capable of handling 1500 requests per second on a single desktop class computer, while preserving response time acceptable to the human. With demonstrated scalability, performance on professional servers, as well as their clusters, will be significantly better.

Behavior on multiple machines is essential to achieve reliability in case of failure of individual machines. We are ready for this thanks to the use of the programming platform that implements the model of actors along with support for distributed communication between components. In our opinion, the language Scala and Akka library were a good choice.

First real life usage of the new registration system is planned for spring 2015 registrations.

7. Acknowledgements

This paper is based on the Master thesis of Grzegorz Swatowski, Maxymilian Śmiech and Michał Żak [6], supervised by Janina Mincer-Daszkiwicz. All programming work was done by Grzegorz, Max and Michał, under the guidance of a senior programmer Michał Kurzydowski.

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9. AUTHORS' BIOGRAPHIES



Janina Mincer-Daszkiewicz graduated in computer science in the University of Warsaw, Poland, and obtained a Ph.D. degree in math from the same university. She is an associate professor in Computer Science at the Faculty of Mathematics, Informatics and Mechanics at the University of Warsaw. Her main fields of research include operating systems, distributed systems, performance evaluation and software engineering. Since 1999, she leads a project for the development of a student management information system USOS, which is used in about 40 Polish Higher Education Institutions, gathered in the MUCI consortium. In 2008, she started the Mobility Project with RS3G. Janina takes active part in many nation-wide projects in Poland.

Modularization as a path to Efficiency

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Keywords

SIIE, Management Information System, Product-oriented approach, Modularization, Quality Information

1. The need to change

SIIE is Universidade de Évora's Management Integrated Information System, in use since 1999 when it started as a semi-academic project. Today, SIIE has grown to be the main institutional management tool reaching such distinct areas as Academic management, Social support, Research, Institutional management, Teacher evaluation, Technical management, International students, Alumni or News management.

In 15 years of existence SIIE has had many twists and changes. Development architecture and procedures are well defined and known by everyone, yet pressure, timing and fast decisions often speak louder. The need to keep up with all the requests and to achieve quick results frequently leads to unstructured development.

In a different layer, government policies for the Universities in Portugal are also changing and the future clearly shows a more integrated network of knowledge and services. Universidade de Évora must be prepared for this potential inter-institutional integration. SIIE can make the difference in this future network and so it must evolve in quality and flexibility.

Obtaining the rector recognition and support assures us full conditions for the project sustainability and success.

With all these variables in hand, the need (and opportunity) to have an IS development methodology that guarantees higher sustainability and reduces the cost of changes became very clear.

2. Modularization: a means to an end

The goal we aim to achieve is to turn SIIE into a modular set of reusable building blocks, instead of the monolithic structure it has now. Using this approach will allow us to deliver customizable implementations of the system in other institutions, as we have already been requested to do so but unable to, due to the current system architecture, as well as, more importantly, streamline out internal development.

Modules will be loosely coupled although they may have inter-dependencies. Each module may span across all system tiers, from presentation down to the data layer or be limited to only some of them, depending on its function.

We have two types of modules (Figure 1): Core level modules and Information System (IS) level modules. Core modules provide basic, system-wide, low-level features such as caching, logging, session management and i18n/l10n as well as the core data structures and business logic, required by all other higher level modules, such as user management, institutional data or administrative tools. IS level modules contain the higher level business logic and processes that manage the institution's normal activity and fulfill all requests the system is expected to fulfill, spanning from academic to financial management.

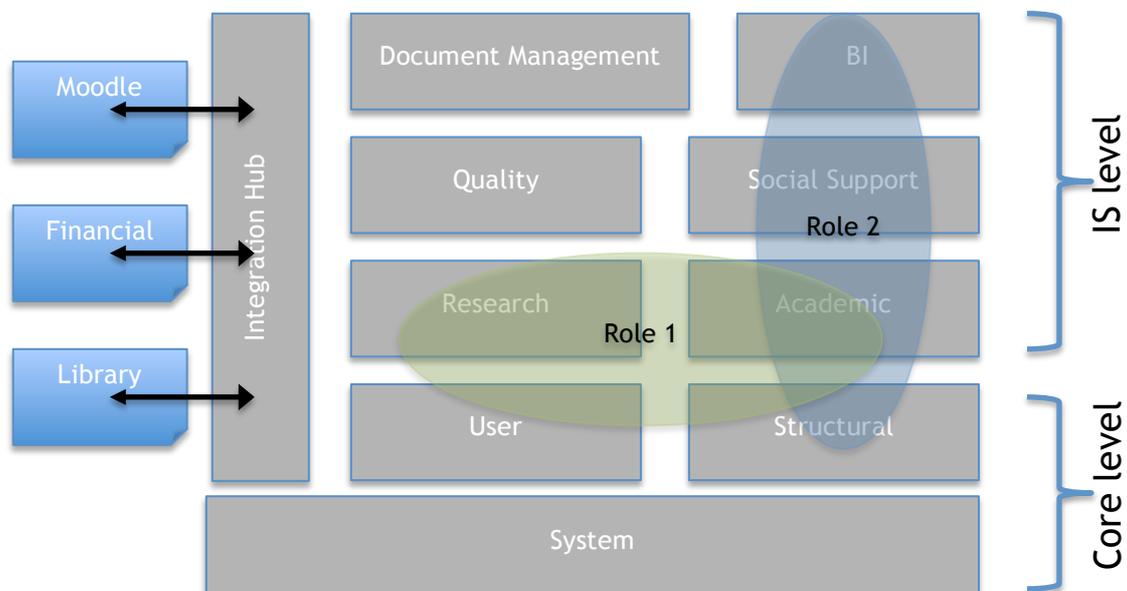


Figure 1 SIIUE module architecture / transversal roles

Using these building blocks we can create access roles, which aggregate features from one or (usually) several modules. With this approach we can easily reuse modules to provide access to the same information and features, to different parts of the institution, while still providing a differentiated experience according to the access scope, each with its own set of rules and behaviors. With this approach we can easily deliver fine-grained feature access, with tight access control, on demand.

A reference to the special "Integration hub" module which encapsulates all the API implementation, needed to transparently integrate with external developed/explored systems such as Moodle, Library or Financial Management.

SIIUE's technological architecture is a standard 3-tier web-based application, based on Open Source technologies, using MVC design pattern.

For the system core business logic we use PHP, on top of an Apache web server. We chose PHP due to its solid use base and wide knowledge and resource availability as well as the development team's solid PHP experience.

For the data layer we rely on PostgreSQL RDBMS. It was chosen for its set of features and reliability as well as its solid performance. It can, however, be easily replaced by another RDBMS such as MySQL/MariaDB or even commercial alternatives.

The presentation layer is built upon standard web technologies, HTML/CSS/Javascript, as well as REST web services using JSON/XML for systems integration/interoperability.

This structure provides us with a flexible architecture we can easily scale horizontally if resource demand increases.

3. Next steps

Forthcoming milestones include: (1) a 2nd follow-up report in the 2nd trimester of 2015, which should include detailed reference of the proposed architecture and development calendar and (2) a stage development presentation in the last trimester of 2015.

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NATIONAL SURVEY ON THE USE OF ICT IN HIGHER EDUCATION IN NORWAY

Every third year NOU conduct a national survey on the use of ICT in Higher Education in Norway. The first time was in 2008 with a follow up in 2011. The survey documents the status of ICT use and conditions for use, national development and changes since the previous surveys, students' perception of the value and progress in using technology, academic staff and administrators' assessment of opportunities and justifications for the use of technology and conditions that promote the use of ICT. The survey includes all universities and public/government and private colleges with more than 500 students. All academic fields are represented.

Who are we?

Norway Opening Universities (NOU) is a national advisory agency under the Ministry of Education and Research. Our focus is the use of ICT and we work, among other things, to:

- increase the access and quality of higher education
- encourage flexibility in education
- stimulate collaboration between educational institutes and the working place
- share experience, effective educational models and digital learning resources
- provide knowledge on a national level for the development of strategies and plans of action

What can the survey tell us about the status on the use of ICT the last three years?

First of all the study tells us that incorporating technology in the work of the academic staff and implementing it in higher education takes time. Although 6 out of 10 institutions have a strategy that include the use of ICT in teaching and about 7 out of 10 institutions has development projects or measures for the use of ICT in teaching, there is little evolvement since the 2011 study. As for MOOCs - only 2 out of 10 institutions includes this kind of education as part of their strategy. Administrators agree that they have a central role when it comes to implementing the use of technology in teaching but the findings indicate that there is a large opportunity in being a more visible and active facilitator.

So what about the academic staff? How do they participate in the implementation process? As it turns out, most administrators regard the academic staff as the driving force behind the increasing use of ICT in education. The teachers however are not as positive as the administrators in this matter, and feel they are less involved in the decision making process than the administrators think they are. The study indicates that highly committed teachers seems to be the driving force behind the increasing use of technology in higher education in Norway. Still, technology is just a supplement in teaching practice. The majority of faculty conducts traditional lectures in plenary on campus. Faculty want to see technology work and they want evidence that this is making an impact on student learning before they take it into use.

In addition to the more strategic perspective the study also contains questions about infrastructure, students and staffs competence in the use of ICT and how they use technology both in private and teaching. The preliminary findings shows that the infrastructure at the universities and colleges are good, but not without improvements. In addition, the students have a lot of mobile equipment - almost everyone has a laptop and a smart phone, but they are not incorporated into teaching. Bring your own device is neither a part of the institutions strategies. The students are also diligent users of social media but only 2 out of 10 teachers makes use of this kind of technology as part of their teaching.

Technology is today pervasive in higher education, but not necessarily for educational purposes. Both students and the academic staff regard themselves as fairly competent ICT users, but 6 out of 10 teachers feel the need to acquire more knowledge of how they can make better use of ICT in their teaching. When it comes to support, the students prefer to be able to go to their teacher for help, and preferably face-to-face communication. The result concurs to the EDUCAUSE ECAR survey 2014 of US undergraduate students. Students also prefer a more flexible teaching environment. Today campus is

the main arena, but every third student now seem to prefer a more individually organized learning environment better suited their personal preferences.

Is potential brought to bear?

- We identify a clear positive connections between
 - varied use among faculty and what they arrange for the students to use
 - and reasons for use and facilitation for students.
- Faculty has great academic freedom and they particularly emphasize academic relevance and variation in the use of digital tools.
- Students use tools in ways the faculty arranges for, as well as initiating their own use when they feel it is appropriate (practical, easy, etc.).
- Students have mobile devices. These seem to be little integrated into instruction and institutions have a small degree of guidelines for use.

50 % of faculty support mandatory training in the use of digital tools. It is interesting that so many faculty feel mandatory training is necessary considering the great degree of autonomy faculty enjoys. It may be interpreted that faculty do see the value of high competence in digital tools, and that this should not be up to the individual's own preferences or left to random initiatives.

The most active and skilled teachers (about 10 % of the total population - equivalent to innovators/early adapters) deviate from the total population when it comes to justifications of the use of technology by being considerably more concerned about increased quality (85 % vs 46 %), learning outcome (83 % vs. 41 %) and student motivation (79 % vs. 32 %). The same findings are present in the corresponding population among the students, which also constitutes about 10 % of total population. Increased quality (56 % vs. 23 %) and learning outcome (47 % vs. 17 %) are the most important motivational factors for adopting ICT.

Overall, the study indicates little trace of systemic change and substantial structural measures essential to adaptation to learning in the 21st Century. The above mentioned results is just some of the findings from our study. The study also include topics such as digital exam, the interaction between students and academic staff, in addition to if and how ICT promotes quality in education. We will also link our findings with international trends in ICT.

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Digital Assessment in higher education in Norway

The digital age is already influencing our life in a tremendously manner and new technologies are being deployed and adopted by the public sector are bringing in new, innovative ways in which citizens and businesses interact with public authorities. This causes new ways of working within the public sector, and the swift towards digital services are challenging how services traditionally are developed and delivered by public sector itself.

These digital advancement challenges those traditional education methods we are used to, within higher education. In all other aspects of society student, academic and administrative staff are used to a digital environment. Student expects to do their exam digitally and not be forced to reproduce their knowledge with a pen and paper. Today's process is ineffective and are facing several non-secure issues, as well as the need of rethinking how assessment is conducted.

Digital assessment is about working smarter, moving from paper based assessment procedures to digital procedures, reducing the time and energy spent, and improving the quality of the old written assessments procedures.

One of the top issues of student and top management at Norwegian Universities and university colleges are how to digitalize the assessment practice. Several higher education institutions in Norway have done a lot, others have just started, while others are planning to start up. Common for these institutions are that they are all facing the same challenges; "what do we mean by digitalization of assessment", "how does this influence institutions existing practice" and "which technical and security issues do we need to address".

This paper looks at the national projects that have been initiated by at and is financed by the Norwegian Government and the Ministry of Education. The project is lead by UNINETT and includes participation of thirty higher education institutions as well as participation of the student democracy.

About UNINETT AS

UNINETT is owned by the Ministry of Education and develops and operates the Norwegian research network that connects more than 200 Norwegian educational and research institutions with over 300.000 users, and linking them to international research networks. In addition to the supply of network infrastructure the company also provides production services and own experimental test network services.

About the project “Digital Assessment”

UNINETT has established a national project to ensure that students get access to digital examination, and that the whole workflow for digital examinations will be digitized. The project is operated in close collaboration with the educational institutions in the Norwegian higher education sector.

The experiences made in development will form the basis for the specification of a joint procurement.

The two-year project aims to start a public procurement process for new solution(s) by Q1 2016. We seek solutions that can handle the examination/assessment process in its entirety. The institutions’ awareness and knowledge about what should be included in a digital examination process is not yet fully formed. It was therefore difficult to accurately describe the needs and scope, at the start of the project, even with clear goals and success criteria.

The solution should facilitate a continuous process and support the working processes by making relevant information available for students, lecturers, examiners, invigilators and administrative personnel. We envisage that the system must be able to handle different types of exams, both current and future assessment methods. The sector is in the process of developing and restructuring new forms of assessment of knowledge and a solution for digital examination and assessment must accommodate this.

Digital Assessment as a whole

Digital assessment as a whole covers a wide area of issues, different aspects connected to transforming the current analog process to a digital one, need to address the pedagogical perspective as looking at what opportunities technology presents in order to “re-assess” our assessment practices and look at assessing students more efficiently and in more innovative ways, as well as looking into organizational, legal and technical issues.



Figure 1: Digital assessment as a whole

Although all aspects are important, this project has its main focus on the Technological perspective. This doesn't mean that organizational, pedagogical and legal issues are out of scope, and in some matter we have to deal with these questions as well. To ensure these areas are covered the project has a wide cooperate with different adequate units and resource persons.

Project organization

The digital assessment project is initiated and a part of the eCampus program, a program financed directly by the Norwegian Ministry of Education. The eCampus goal is to contribute to increased digitalization within higher education in Norway.

The project is lead by UNINETT and includes participation from most universities and university colleges in Norway, as well as participation of other public service providers in the sector and the student democracy.

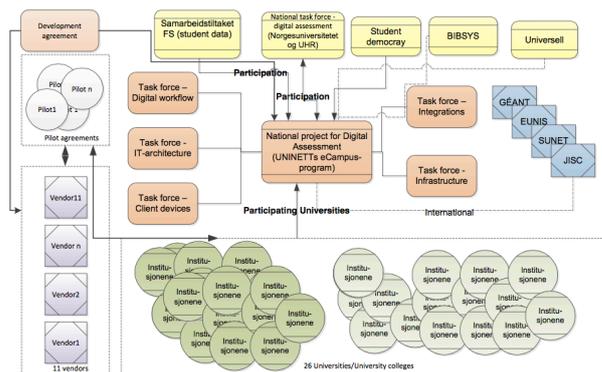


Figure 2: Project organization

To collaborate with suppliers who are working within the digital assessment discipline is also a part of the projects main focus.

Project activity

Total contributors to the project are approximately 70 persons that represent different skillset. The main group are administrative and technical resources, and there is also a wide representation of pedagogical staff as well.

The main project are divided into different work groups and task forces:

Main project group:

Mainly project managers of institutional digital assessment projects and educators, working with the project manager preparing plans and as an advisory board for project decision and priority

Task force – Digital workflow

Administrative and IT-specialist resources working with assessment and some experienced educators. Describing a national digital process for digital assessment, to ensure a digital first choice (UFS-148)

Task force - IT-architecture

Institutional IT-architects. Establish an IT-architecture description for digital assessment. (UFS-148)

Task force – Integrations

IT - architects and IT - specialists. Establish standards and a technology interface (UFS-146)

Task force - Client devices/BOYD

IT - specialists and specialist in universal design in cooperation with law specialists.
Establish guidelines for client devices (UFS-147)

Task force – Infrastructure

IT - specialists, network specialist, structural design engineer and specialist in universal design. Establish guidelines for technology and building infrastructure (UFS-145)

Reference group

Institutions primary contacts on digital assessment are used as a reference group.

Lesson learned in the project “Digital Assessment”

Working on the “edge”

The assessment processes a very essential part of operations in higher education, a part of the universities funding is linked to complete courses and passing students.

To change from paper-based procedures to digital procedures requires change in the operations procedures at the university, the assessment regulations at the university and the perception or understanding of the assessment processes, among both students and staff at the university.

Major changes in higher education

There are major changes in Norway’s higher education sector, universities are merging with university colleges, forming new larger, more attractive institutions for the students. But they become more widely spread with units hundreds of miles apart. The units in the new institution can have cultural differences, but the understanding and wish to move towards digital assessment seems to be a common goal among the management of the new institution. They often want to move to fast, and they make unrealistic promises about digital assessment to be more attractive to the future student. As new knowledge has emerged as a result of this national project, most of the universities have revised their goals for implementing digital assessment, and adjusted their implementing plan to more realistic.

New workflow for the assessment processes

Digitalization of the assessment processes, and moving to a new workflow it’s a big “change management” project. Some tasks disappear in the paper-based workflow, and new tasks are introduced in the digital workflow. And this gets even more complicated when we are operating in an immature market with no turnkey product, immature solutions from vendors, several promising solution but lacking features supporting workflow.

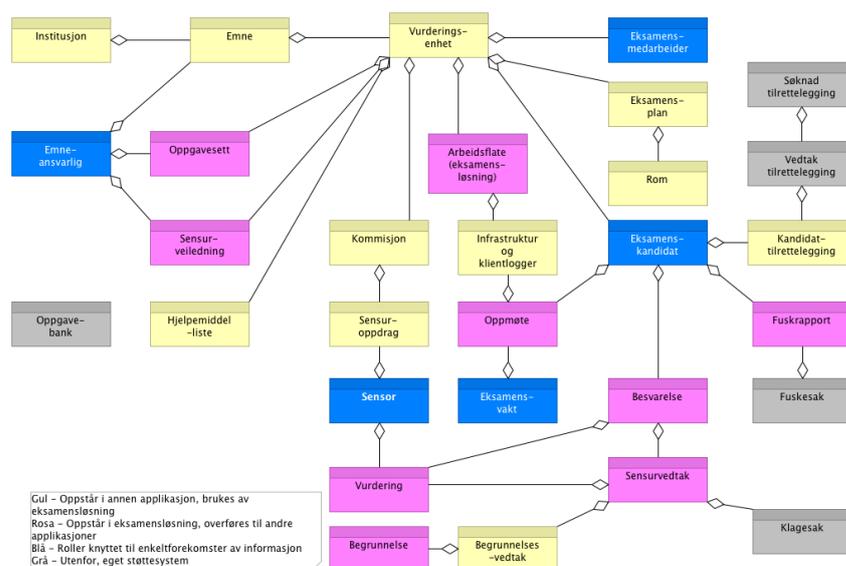


Figure 3: Digital assessment process as described in UFS 148 (translated into English, June 2015)

Legal requirements

The Norwegian Association of Higher Education Institutions (UHR), appointed an expert group, who provided input to the project. The expert group was given the task of looking at the legal aspects of moving from paper-based procedures for assessment to digital procedures for assessment. They discovered several important points in today's rules and regulation for higher education and in the regulation for assessment that create issues with the move to digital procedures.

- Bring Your Own Device (BYOD)
- Risk assessment
- Cloud services
- Rights and responsibility in a digital world

The use of commercial "cloud services" for running the digital assessment solution raise a lot of questions where the individual institution has to make their own risk assessment.

One of the main discovery from this group, was the that today's legislation for higher education in Norway does not allow universities to demand their students to have a own computer. If all exams are to be held digitally this might be a big issue, if universities must provide computers to all of it's students. However, as a result of this discovery, the Ministry of Education proposes a change in the legislation, so universities may demand that their students need too purchase their own computer.

Requirements for infrastructure and clients

Moving towards procedures for digital assessment raise new requirements for infrastructure and clients. The institutions have to treat their infrastructure as a protected resource, since failure in the infrastructure will delay or postpone the assessment and generate additional cost. Response times to incidents go down significantly, the IT-department have to act quickly.

The assessment solution may have requirements for clients to work satisfactory, in addition to this the institution may develop their own requirements for clients.

The institutions huge interest in the use of Bring Your Own Device (BYOD) clients in digital assessments is seen as a cost reducing way in deploying digital assessment to students. BYOD have a lot of new problems and challenges, and none of the pilots have started out with the use of BYOD as their first step in testing digital assessment. But all want BYOD (scaling).

In addition to the digital assessment solution, there is also a set of surrounding services that most consider infrastructure and should be treated in the same way as the institutions infrastructure.

- Domain name service
- Student registry
- IP-address life (longer than assessment time x1,5)
- Eduroam (authenticated network access)
- Federation (authenticating users)

The digital assessment workflow and services

The definition of digital assessment, involved in the transition from paper-based assessment to digital assessment is a major challenge. People working with assessment tend to dive into the definition of the workflow and make the definitions all too complicated.

Surrounding the digital assessment workflow, there are several existing services that have to be integrated or “used as is”, and these services are already in production and can’t easily be changed.

Below is one high level model showing the digital assessment workflow surrounded with already existing services.

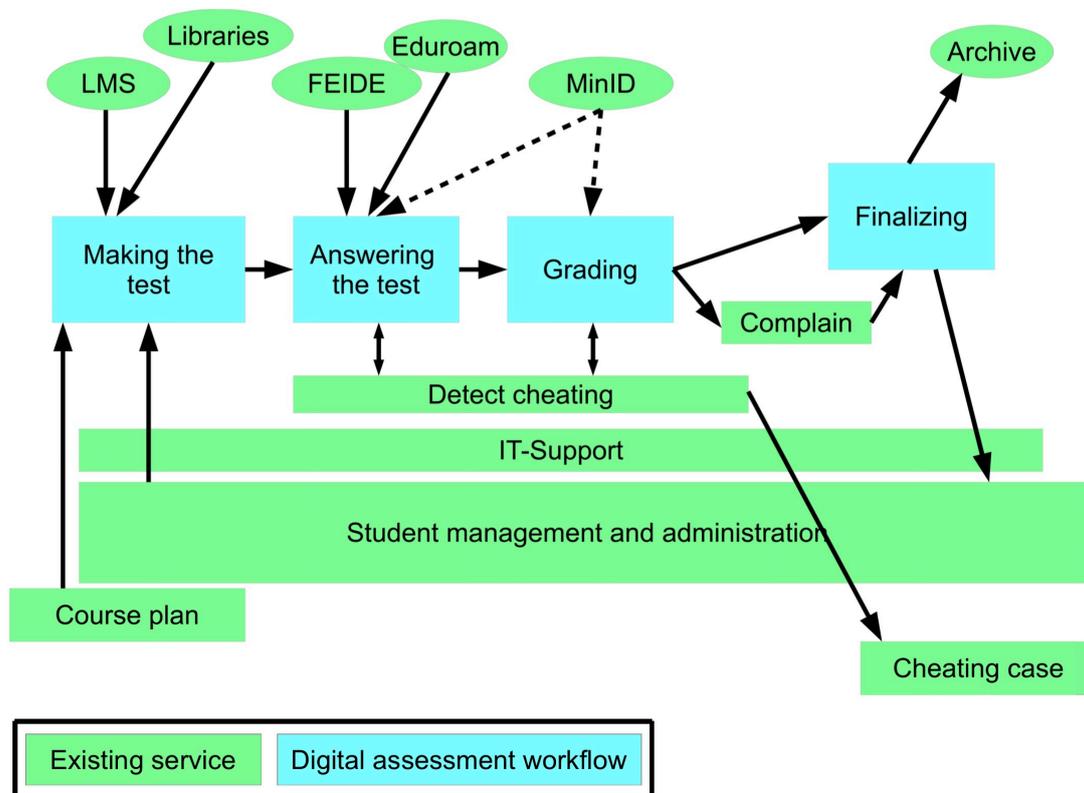


Figure 4: Digital assessment workflow surrounded with existing services

Project deliveries

The project is organized and the working is focused in these main areas;

- Sharing knowledge
- Market development
- Pre-standardization descriptions
- Establish necessary infrastructure
- Prepare procurement

Sharing knowledge

Although the knowledge and understanding of implications and opportunities that digitalization of the assessment process matures, there is still a great need of better understanding. To facilitate the sharing of knowledge between institutions, different project, with vendors and other stakeholders is an important and very appreciated task. We also strives to share knowledge with our colleagues internationally.

- Seminar series; <https://www.uninett.no/digitaleksamen/arrangementer-om-digital-eksamen>
- Web-site: <https://www.uninett.no/digitaleksamen>
- Participation: <https://www.uninett.no/digitaleksamen/nasjonal-prosjektgruppe-digital-eksamen>
- National task force for Digital eksamen: <https://www.uninett.no/digitaleksamen/status-mars-2014>
- International collaboration: [jisc](#) & [GEANT](#) & [EUNIS\(ELTF\)](#) & [SUNET](#)

Market development

In the pre-procurement phase, it was decided to run the investigation and tests of possible solutions as a "National pilot under the supplier development program¹". The project has to sign development contract with interested vendors/suppliers of solutions for digital assessment, coordinate the investigation and tests of the different solutions and give all the vendors/supplier access to same documentation about integration and standardization work. This procedure was chosen because of need to understand requirements and interact with immature market.

A market analyses has resulted in dialog with eleven interesting vendors/suppliers of different kind of solutions within the digital assessment area.

<https://www.uninett.no/seminar-om-digital-eksamen/leverand%C3%B8rer>

Testing

To facilitate and make it easier for institutions to try out different vendors and solutions for digital assessment, we have prepared a contract template, an experience report template, a common progress overview and developed a standard integration point. Information from all experience report goes as feedback to relevant task forces and will be input to upcoming specification.

Pre-standardization descriptions

In this immature market, we use Current Best Practice (CBP) documents, and other reports as pre-standardization descriptions to generate commend understanding of needs and requirements for digital assessment. In the end, CBP documents will be part of the requirements in the "call for tender" next year. We also recognize the need to update the CBP documents during test and investigation phase of the project.

- UFS 145: CBP - Infrastructure (Norwegian / English)
- UFS 146: CBP - Integrations (both in september 2015)
- UFS 147: CBP - Client devices (Norwegian / English)
- UFS 148: CBP - Digital assessment process & IT-architecture (Norwegian / translated to English in June 2015)

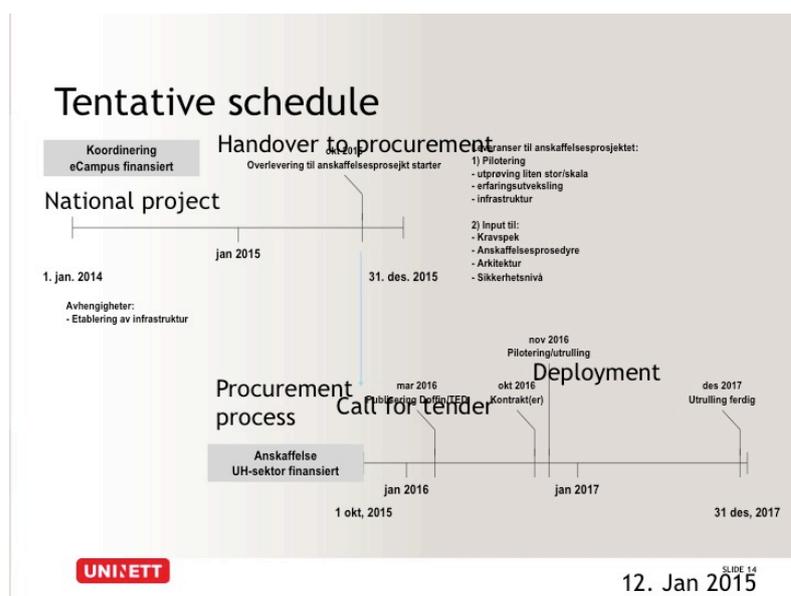
All Current Best Practice documents are/will be translated into English and be a part of GEANT standards and will be public available .

Establish necessary infrastructure

To ensure a secure and robust environment for full digitalization of the assessment process, it is necessary to establish an infrastructure that support a digital way of working. This means that we need to define the requirement to all adjacent services, e.g. establishing 24/7 emergency response.

Preparing procurement

A procurement process is under planning with a planned call for tender 1.march 2016. The procurement will be managed by a new separate project governed by UNINETT AS. Handover to this new project are planned mid autumn 2015.



12. Jan 2015

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¹ The Confederation of Norwegian Enterprise (NHO) and the Local Governments Organization (KS) are the initiators of the National Program of Supplier Development . The program is conducted as a partnership between national innovation stakeholders,

ministries, government agencies, municipalities and businesses. The program is conducted in the period 2010-2014.

The program's vision is to leverage public procurement in a more active way which promotes competition, business development and innovation in business, so as to facilitate more needs- oriented products and services to better conditions for public sector clients. Key goals are to increase awareness of innovative public procurement and increase the performance of such procurement.

UNIZIN-A Cloud Framework/Collaboration for Teaching and Learning

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Keywords

Transformation of Teaching and Learning

ABSTRACT

The Unizin Consortium (www.unizin.org) is universities coming together in a strategic way to exert greater control and influence over the digital learning landscape. It enables each institution, its faculty, and students to draw on an evolving set of tools to support digital learning for residential, flipped classroom, online courses/degrees, badged experiences for Alumni, or even MOOCs if desired. Unizin supports the differing missions and strategies of universities. Unizin Services are cloud-based infrastructure based on open technology standards. It will evolve to support content systems that empower faculty with full control over their owned content — store it or share it — and an analytics service to enable research to improve learning. As a university-owned service for universities, all of this will evolve within the longstanding values of the Academy. Unizin is membership-based and is being launched by a group of founding investing universities. It is governed as a not-for-profit service operator with a CEO and board of directors from its members as an Unincorporated Association at Internet2. Unizin's founding members include Colorado State University, Indiana University, the University of Florida, the University of Michigan, Oregon State University, the University of Wisconsin-Madison, Penn State University, University of Iowa, The Ohio State University, and the University of Minnesota and it is extensible to other investing institutions. In our presentation, we will explain the reasons behind Unizin, bring you up to date on the most recent developments, and talk about how interested universities can either join, or be sponsored. We will cover such things as the cost of joining and remaining a member, and the benefits that will accrue to members.

National Collaboration Between Swedish Institutions Concerning Enterprise Architecture - A Bottom-up Approach

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Keywords

Enterprise Architecture, Reference Architecture, Integration

1. Summary

Enterprise Architecture (EA) is proven to be an effective way of providing a holistic view and to obtain control of the business and operations. However, there are challenges in justifying the initial investment due to difficulties in describing a business case that demonstrates how EA will benefit the organization. A way to handle this is to use a bottom-up approach focusing on solving a specific problem within a specific domain that is expected to yield quick results and thus justify further investments in other EA domains.

The main driver for Swedish institutions to work with Enterprise Architecture has been the shift towards a new generation of the Swedish student information system - Ladok3. Common definitions, principles, guidelines and solution patterns, forming a reference architecture, provides a common language and becomes an effective tool for institutions to solve the specific architectural problem of how to integrate Ladok3 into the local architecture. And more important, it will also be the basis for enhanced collaboration in other domains within Enterprise Architecture.

2. Extended Abstract

Architectural issues have become more important for intuitions as modern and effective services for students and employees requires an advanced information exchange among systems. Automatic processes are essential for efficiency and is dependent of advanced system integration. A gradual shift toward cloud services makes it important to have a structured integration architecture that can handle hybrid solutions among on premise and cloud services in a way that the end-user always receives the wanted behaviour from the system. The new generation of the of the Swedish student information system Ladok3 is being developed with modern interfaces and an event-driven architecture. The implementation of Ladok3 at will require substantial changes in the business as well as the information and technical architecture of each institution. The question arises, what is the best way to solve the architecture challenge when integrating Ladok3 locally? The solution is collaboration between institutions and standardization.

A national collaboration was initiated by UNITCF which is an independent group of CIOs and IT managers from Swedish universities. The aim was to have a specific focus on Ladok3 integration issues that each instruction has to manage in order to implement the system locally. A group formed of 20-25 architects from different instructions in Sweden and a Task Force was assigned with the mission to develop a reference architecture focused on system integration. The group forms a national team of architects that have a focus of enhancing collaboration by working with standardization and architecture reviews.

The reference architecture that was developed addresses the following domains:

Application areas - A taxonomy used for grouping of applications from one or many perspectives such as process-based, a particular activity or more functionally oriented perspectives.

Integration patterns - Basic integrations patterns based and inspired from EAI patterns and has adapted to the needs in higher educations.

Solution patterns for new Ladok - Describes conceptual solutions patterns that could be used as an abstract implementation model for integrating with the new Ladok system.

Documentation of the architecture - A step towards a common language. All institutions should use the standard ArchiMate for documenting the architecture.

Documentation and naming for integrations - Guidelines for naming integrations and how to document integrations.

Guidelines for integration architecture - A common set of design principles for integration developments

The need to rationalize IT-cost throughout the sector and at the same time become more efficient when it comes to implementing services for both student administration and students with a limited amount of recourses institutions have to seek knowledge outside its own organization. The reference architecture aims to express different implementations in the same way by mapping solutions to a Meta-language. By doing this it is possible to find common patterns and to exchange logic or in the best of worlds, code.

This increases the possibility to reuse different solution across the sector and which will cut cost and give the ability to adopt faster to changes. When using a common language across the sector in domain of integration, a Ladok3 adapter implemented in one institution has the same meaning to another institution logically. The intention is not to dictate how services are realized in a business perspective but to use the same pattern in an infrastructure perspective.

The reference architecture for integration will be the starting point for developing a complete EA framework for higher education in Sweden. The bottom-up approach have been the injection needed to develop and introduce EA in every domain to combine important business and technology aspects.

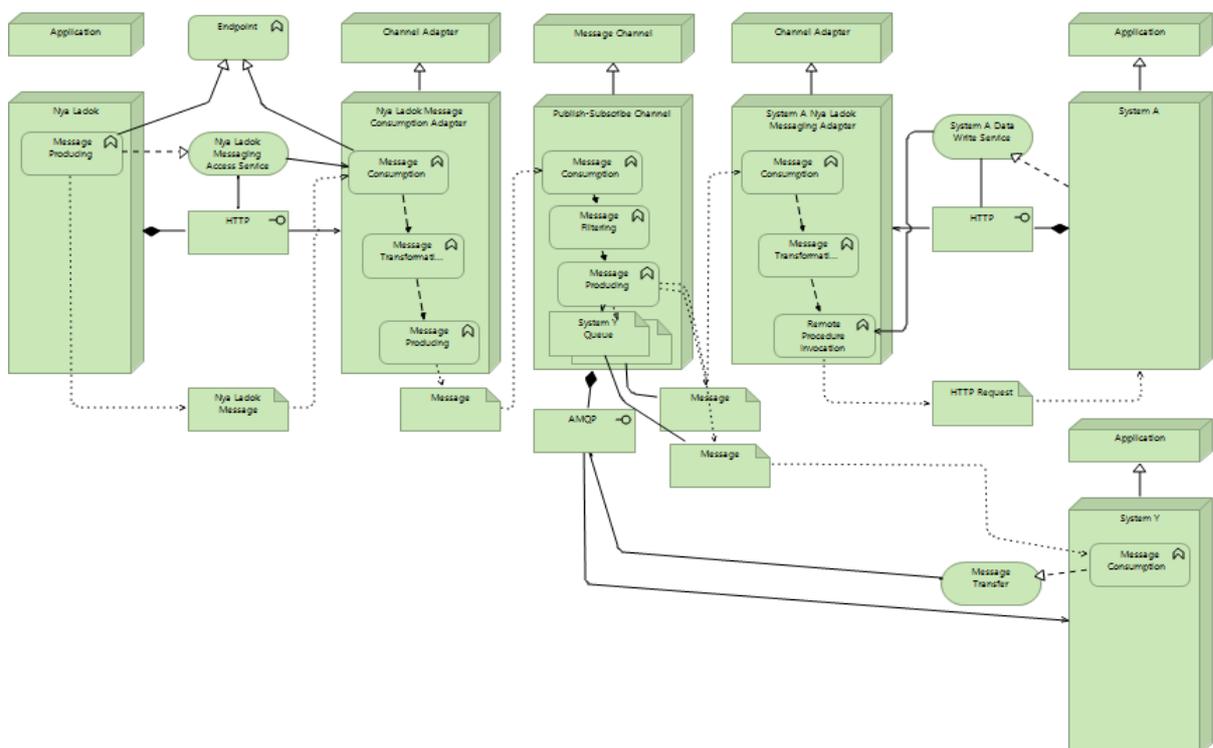


Figure 1 One of the solution pattern for integrating with new Ladok

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Enterprise Architecture in Finnish Higher Education: Increasing adoption readiness with EA training

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Keywords

Enterprise Architecture, challenges, solutions.

1. ABSTRACT

Enterprise Architecture (EA) has been mandatory in Finnish public sector organisations since 2014 by legislation. EA maturity and adoption rate are still low, even among 11 Finnish Higher Education Institutions participating to EA pilot between 2009 and 2011. Recent researches conducted on the Finnish public sector field has recognised that the main challenge in EA adoption is the lack of understanding of EA concepts.

EA adoption is a teleological organisational change aiming for realisation of EA benefits. In order to overcome the adoption challenges, the organisation's readiness for change needs to be increased. Providing a proper training to enhance the EA understanding helps when acquiring the mandate for EA adoption, but also during the actual adoption.

2. EXTENDED ABSTRACT

The Finnish Parliament ratified the Act on Information Management Governance in Public Administration in 2011 (Finnish Ministry of Finance, 2011). The Act mandates all public sector organisations to start adopting Enterprise Architecture (EA) by 2014. This includes Higher Education Institutions (HEIs), except universities. However, before the legislation in 2009, a group universities and Universities of Applied Sciences (UaS) started an Enterprise Architecture pilot. Eleven HEIs participated to the pilot. According to a recent report, the level of EA maturity in Finnish HEIs is still low - even among the pilot participants (Kella, 2014).

Since the ratification of the Act EA has been in interest of academics. Number of studies have been conducted to research the challenges of EA adoption. Two main challenges are that EA concepts are vague and not easy to understand, and that general EA knowledge is low (Hiekkänen et al., 2013; Lemmetti & Pekkola, 2012; Pehkonen, 2013; Seppänen, 2014; Tuomola, 2014).

The EA adoption challenges can be generalised to the lack of understanding of EA concepts. From organisational theory point-of-view, EA adoption is a teleological organisational change aiming for realisation of EA benefits (Syynimaa, 2015). As such, organisations' readiness for change needs to be increased.

When organisations are adopting EA, they are actually moving from "business" silos towards standardised operations and the need for learning is strong (Ross, Weill, & Robertson, 2006). Besides learning, also unlearning the current behaviour is needed (Becker & Karayan, 2005). Therefore, in order to increase the readiness for change, a proper training needs to be provided (Syynimaa, 2015). The need for training covers the whole organisation. In order to get a mandate for EA adoption from the top-management, understanding of the EA needs to be increased. Therefore, in order to acquire the mandate, EA benefits needs to be explained to top-management. After the mandate is acquired, the learning for the rest of organisation needs to be organised before conducting the actual adoption, as illustrated in Figure 1.

By providing a proper EA training, understanding of EA concepts will increase, leading to increase readiness for change.

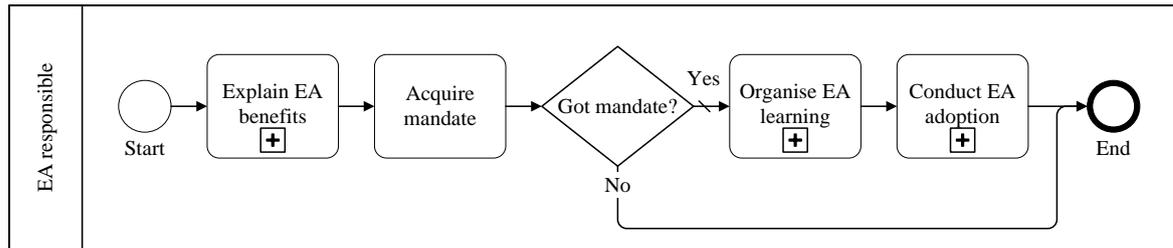


Figure 1: Process of EA Adoption (Syynimaa, 2015)

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Setting goals and measuring the value of Enterprise IT Architecture using the COBIT 5 framework

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Keywords

COBIT 5, Enterprise IT Architecture, goals, metrics, governance.

1. Summary

You will be introduced to how we are taking input from the COBIT 5 framework building the model we are using to identify goals and metrics to measure the Enterprise IT Architecture framework we have developed and what conclusions and decisions we have taken. As a result of the session, you will be able to relate to a model that describes one way to communicate the value Enterprise IT Architecture is adding to the business.

2. ABSTRACT

Our IT department is asked to deliver greater value for money, improve efficiencies and remove duplication of IT service. We have taken control over the IT landscape by following our IT information assets from the project phase until they are phased out. For us it was important to have an Enterprise IT Architecture framework in place to help with decision making, with IT portfolio management, with investment and to set strategic direction. With this framework in place is it important to maintain the information - priority number one for us. It is like taking care of a garden, you need to clear the weeds and for that you need money to buy a gardener. We needed a budget to finance our architects.

It is a challenge to communicate the value of Enterprise IT Architecture. We have many stakeholders and creating value means different things to each of them. My focus was to get the University management to understand the value that Enterprise IT Architecture is adding to the business. So, we needed to improve our ability to measure and monitor our work and create greater transparency. We needed to identify goals and define a set of measurements.

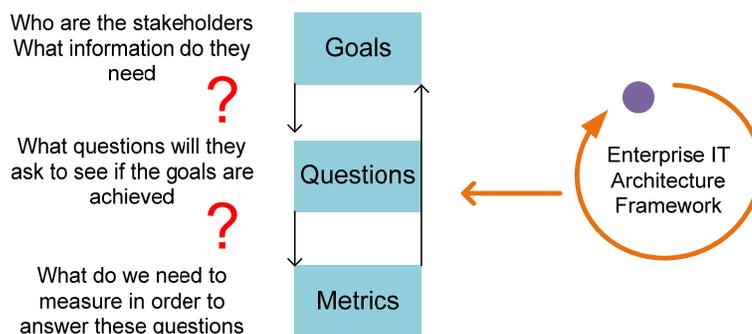


Figure 1 Identify goals and metrics

To identify appropriate goals and metrics I took help from COBIT 5, an ISACA framework. COBIT 5 provides a comprehensive framework that assists enterprises in achieving their objectives for the governance and management of enterprise IT. COBIT 5 contains 37 processes and one of them is

Manage Enterprise Architecture and there they point out examples of goals and related metrics. Going through the examples I set up four questions:

1. What does it mean for us, is it relevant for our stakeholders?
2. How do we measure it?
3. Where do we find the data?
4. How do we collect the data?

I made some changes and customized it to what I thought were our needs. I invited the EA-team that helps to transform my ideas into reality, presenting my draft, asking if we could meet these goals and metrics. We needed to collect some data over the year and set up reporting routines and appoint responsible persons. Today we have identified four goals and twelve related metric that we are measuring over the business year and reports in our budgeting process.

Goal 1: The architecture framework and its content provides effective support to the business	
Related metrics	Status
1.1 Number of requested and applied deviations from the architecture	A routine is established. Total received: 10 Number of granted: 5 AD-policy approved.
Goal 2: Services within the enterprise architecture promotes flexible business change	
2.1 Percent of projects using enterprise architecture services	100% of all central projects with IT is using the EA services
2.2 Percent of maintenance objects using enterprise architecture services	100% of all the maintenance IT objects are using EA services

Figure 2 Example - Excerpts from the report Goals and Metrics - calendar year 2014

3. REFERENCES

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4. AUTHORS' BIOGRAPHIES



K. Westerlund. I work as an IT-strategist at Umeå University since 1997. I am a part of the IT-Office and we have a mandate from the University Management to take strategic responsibility for all common IT at the university. Between the years 1994 to 1997 I worked as a project manager and was responsible for the development of an IT system supporting human resources, named Primula, for higher education in Sweden. At the beginning of the 90s I worked as a development strategist at Umeå University and in the sector. During the years 2006 to 2012 I was a member of the Ladok Board. I have studied informatics, economics and law at Umeå University. The past four years I have put a lot of effort into developing the Enterprise IT Architecture area - doing it my way- at our university. On an annual basis, I give a number of seminars in various fields such as Enterprise Architecture, Governance, Management and Information Security.

The Biggest Security Risk Is You!

Asbjørn Reglund Thorsen, University of Oslo, Norway, asbjornt@usit.uio.no

Keywords

Hacking, Security, Security Awareness, Live demos, BYOD

ABSTRACT

Almost every day in the news we hear about how companies and private persons get attacked by hackers. Old and insecure programs and technologies is a gold mine for hackers to compromise you and your organization.

IT security issues are often very technical and it's often hard for non-technical people to understand. To increase the security awareness in your organization it is important for all the employees to understand some basic concepts of it-security. The best way to make people understand what not to do is to see how hackers work and how they can attack you without them even noticing.

Seeing is believing and with several demos I'll try to make people understand some aspects within IT security better, by showing how a hacker can attack them, without the victim even knowing it.

What is a hacker, and how does a hacker think? To defend yourself from hackers, you'll have to start to think as one!

Free Wi-Fi often is without proper encryption and if you choose to spend a work day at e.g. a coffee place, it's important to think security the right way, or you will get hacked. However if the right precautions are made, one can enjoy free Wi-Fi with a smile.

How you use the internet at work and at home differs. Many feel safer at home, where they pay their bills, buy stuff from internet stores with their credit cards. Are you sure you configured the wlan switch correctly? How old is your wlan switch? Does it even support up to date security?

The talk will give insight into how hackers think and how they easily can eavesdrop on your cell phone, laptop, iPad etc. The goal is to show different hacking techniques and how hackers can exploit your systems and your lack of security awareness.

This talk has been held several times in 2014 in Norway and it got really good feedback from different organizations like:

- The Brønnøysund Register Centre
- Altinn
- Ministry of Defence
- The Accident Investigation Board Norway
- The Norwegian Society of Graduate Technical and Scientific Professionals.

The weakest link of Office 365 security

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Keywords

Office 365, security, mitigation, risk.

1. ABSTRACT

Office 365 service is widely adopted in Higher Education field all around the world. It is a cloud service provided by Microsoft, including Office applications and services like Exchange Online and SharePoint Online. Although the Office 365 is audited by many external bodies, there have been continuous discussions about the information security of the service.

One of the top current security risks of web applications is Security Misconfiguration. This paper introduces some techniques a rogue administrator may use in order to exploit users' confidential information. Symptoms, detection techniques, forensics, and mitigation techniques of these are also introduced. As a conclusion, it can be argued that the weakest point of Office 365 security is organisation's on-premise misconfiguration. This paper helps organisation's security officers and IT administrators auditing their on-premise environment security.

2. INTRODUCTION

Office 365 (O365) is a cloud service provided by Microsoft. There are several different service plans available, which usually includes Office applications, such as Word and PowerPoint, but also other productivity services, such as Exchange Online and SharePoint Online. In Higher Education field O365 is widely adopted, especially due to its aggressive pricing. For instance the E1 plan (Office applications not included) is free for students and faculty staff, and the E3 plan £1.80 and £3.30 per month per user, respectively (Microsoft, 2015b). Besides the Office 365 platform, Microsoft has also published productivity tools for education. For instance in September 2014, OneNote Class Notebook Creator was launched to help teachers to easily set up their classes (Microsoft, 2014a).

As the adoption rate of Office 365 is increasing, so are the security concerns. Especially the concerns about the confidentiality of data and information has generated discussion (see for example University of Bradford, 2014; University of Concordia, 2014). To address these issues contractually, some government bodies, such as Janet in the UK, has negotiated amendments to standard Office 365 agreements (Janet, 2013).

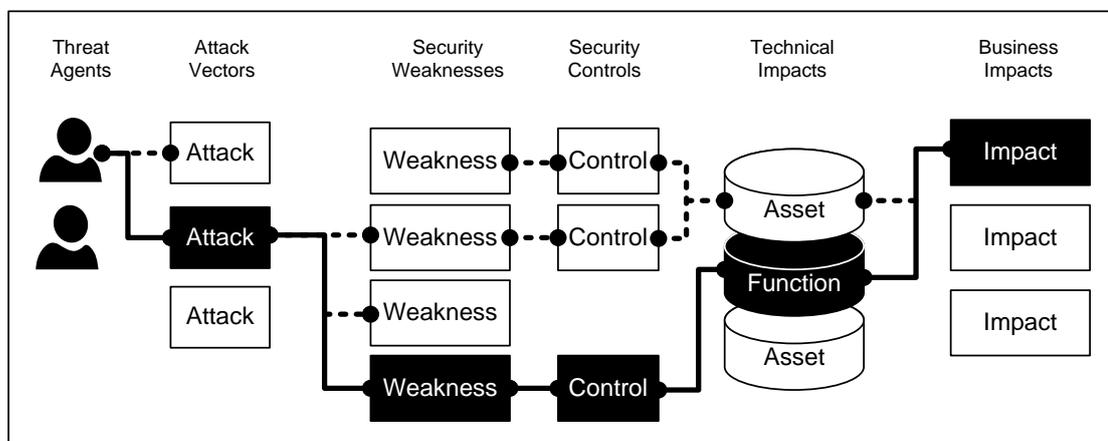


Figure 1: Application security paths (adapted from OWASP, 2013)

There are many different paths to impact organisations business through security weaknesses, as illustrated in Figure 1. Sometimes these paths are easy to find, sometimes they are difficult. After identification of a weakness, actions need to be taken to control it. In this paper, we will introduce some of the paths how a rogue administrator may gain access to users' confidential data in O365. We start by introducing the Office 365 security basics, including three O365 identity options. Next we demonstrate how the misconfigured on-premise security allows exploitation of O365 confidential data. We will also show how to detect such rogue behaviour, how to forensic, and finally how to mitigate it.

3. OFFICE 365 CORE SECURITY

Office 365 runs on another Microsoft cloud service, Microsoft Azure. Azure is an infrastructure-as-a-service (IaaS) and a platform-as-a-service (PaaS) (Microsoft, 2015c). O365 is a software-as-a-service utilising the Azure IaaS and PaaS services. It is accessible from the internet regardless of the user's location and is therefore exposed to massive security attacks.

In cloud services, the service provider is taking care of the hardware level security, and most parts of the software security. O365 is provided using a defence-in-depth strategy (Microsoft, 2014b) as illustrated in Figure 2. The physical layer consists of facility and network security, the logical layer host, application, and admin user security, and the data layer the data security. These layers are taken care of Microsoft. Customers also have a number of security controls. They can control for instance data integrity, data encryption, and end-user access.

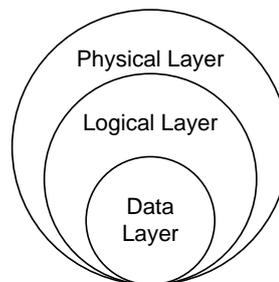


Figure 2: Defence in depth (Microsoft, 2014b)

The Open Web Application Security Project (OWASP) has identified ten most critical web application risks (see OWASP, 2013). In O365, all server-side risks are handled by Microsoft. However, when O365 is integrated with on-premise environment, the Security Misconfiguration risk needs to be mitigated by the customer. Description of the Security Misconfiguration is as follows:

Good security requires having a secure configuration defined and deployed for the application, frameworks, application server, web server, database server, and platform. Secure settings should be defined, implemented, and maintained, as defaults are often insecure. Additionally, software should be kept up to date. (OWASP, 2013, p. 6)

3.1. Users and admin roles

Office 365 uses role-based access control (RBAC) system. Accessing O365 requires an identity, e.g. an entry in the O365 internal directory. O365 uses Azure Active Directory (AAD) as a directory solution. Each user added to AAD, either using the O365 admin center, DirSync, or PowerShell, is given by default a user role. A summary of O365 admin roles can be seen in Table 1. Adding user to AAD does not require a license. However, in order to use O365 services, such as Exchange Online or SharePoint Online, a license such as E1 or E3 needs to be assigned. It should be noted that Exchange Online has its own RBAC which is different from the O365 RBAC. Having said that, the O365 *Global admin* role maps to *Organization admin* role in Exchange Online. Similarly, SharePoint Online has its own access control, which is different to the O365.

Table 1: Office 365 Administrator roles and rights (Microsoft, 2015a)

Role	Description
Global admin	Access to all administrative features. Only role that can be used assign admin rights to others.
Billing admin	Can make purchases, manage subscriptions and support tickets, and monitor service health.
User management admin	Resets passwords, monitors service health, and manages user accounts, user groups, and service requests.
Password admin	Resets passwords, manages service requests, and monitors service health. Password admins are limited to resetting passwords for users and other password admins.
Service admin	Manages service requests and monitors service health.
User	No access to administrative features.

Each O365 environment (tenant) has at least one domain. The default domain, also called a service domain, is formed when the tenant is deployed. The form of the service domain is *<tenant>.onmicrosoft.com*, where tenant refers to the name of the tenant. Customers may also use their own domains in O365, as long as they are registered and their ownership verified. Domains can be used in identities, in email addresses, and in public site url in SharePoint Online.

3.2. Identity scenarios

Office 365 has three identity scenarios as illustrated in Figure 3. The first scenario is called *cloud identity*. In this scenario identities are managed in AAD, either by using O365 admin center or PowerShell. This suits for small organisations or organisations not having an internal Active Directory (AD). Each time users accesses O365, the authentication is performed against the AAD. This means that users have two sets of credentials, one for O365 and one for the on-premise environment. These credentials may or may not be same in terms of username and password.

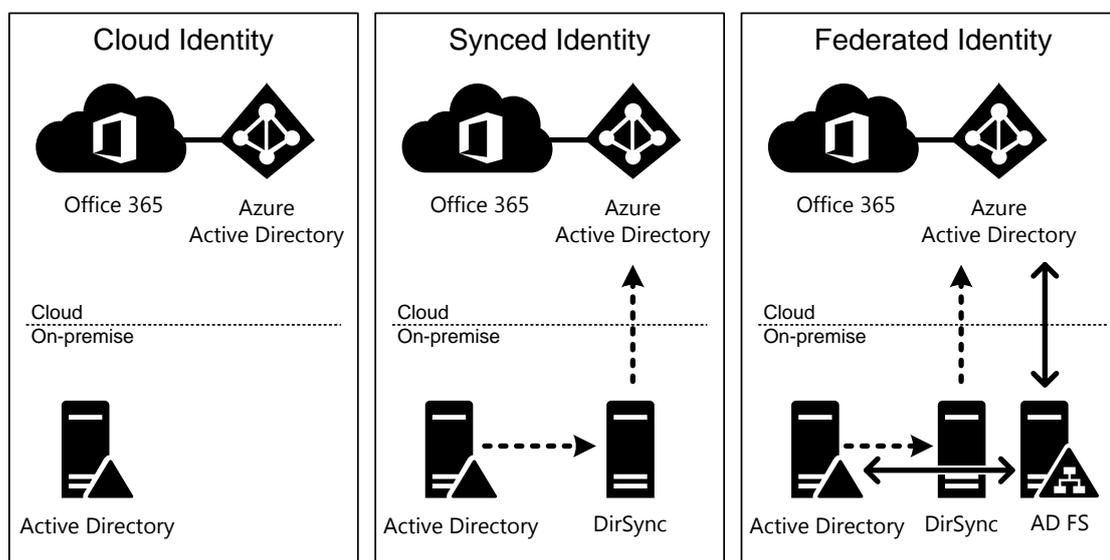


Figure 3: Office 365 identity scenarios

The second scenario is called *synced identity*, which suits for larger organisations having internal AD. In this scenario identities in on-premise AD are synced to AAD using a directory synchronisation software, such as DirSync, AADSync, or FIM. Synchronisation can be configured to sync also the users' passwords, which enables same-sign-on. This way users can use their on-premise credentials to access O365. However, authentication is still performed against the AAD, although the credentials are

populated from internal AD. By default, synchronisation takes place in every 3 hours, passwords are synced in every two minutes. Objects which are synced from the on-premise AD, i.e. users and groups, cannot not be edited in AAD. It should be noted that the directory synchronisation does not prevent creating users directly to AAD. The DirSync software requires *Global admin* level access to AAD, and *Enterprise admin* level access to internal AD.

Third scenario is called *federated identity*, which suits for large organisations and for organisations willing to use single-sign-on (SSO). Also in this scenario, identities are synced to AAD. However, the authentication is performed against the organisation's on-premise AD. Technically this is implemented by using Active Directory Federation Service (AD FS). AD FS needs to be installed on a domain joined server. Accessing such a server directly from the internet would be a security risk, so the access is provided by using internet facing AD FS proxies. When SSO is used, authentication requires access to AD FS each time users are logging in. This makes AD FS a single-point-of-failure. Therefore both AD FS and proxy services needs to be provided using at least two servers in a high availability configuration. This requires in total 2+2=4 servers.

When SSO is turned on, one of the organisation's domains are converted to a federated domain. Every users using that domain as an identity, is switched to using SSO. Only way to add users to the federated domain is to use directory synchronisation. From technical point-of-view AD FS provides a claims-based identity service. Claims are statements made about users, such as identity information (Microsoft, 2011). In O365, AD FS is using UPN and organisation' on-premise AD GUID for user identification. These claims are transferred in security tokens, which are signed by AD FS server by a certificate.

When the domain is converted to federated, on-premise AD FS server and O365 are exchanging information needed in SSO. This information includes two key components; FQDN of the on-premise AD FS server, and the token signing certificate. When user is accessing O365 with a federated username, O365 uses this information to forward the authentication to a correct on-premise AD FS.

There are three authentication endpoints in AD FS for different clients, as illustrated in Figure: 4. *Active endpoint* is used by Outlook and devices using Active Sync protocol, such as mobile phones. These devices are sending username and password to Exchange Online, which authenticates user with AD FS proxy on behalf of the user and acquires the security token. *MEX endpoint* is used by rich clients, such as Lync and Office 365 ProPlus subscription. Those applications are connecting either AD FS or AD FS proxy directly, regarding to their location (on-premise/internet). *Web endpoint* is used by web browsers accessing O365 services, such as Outlook Web App and SharePoint Online. When authenticating, web browser is redirected to AD FS server or proxy. Authentication information is transferred in HTTP POST data.

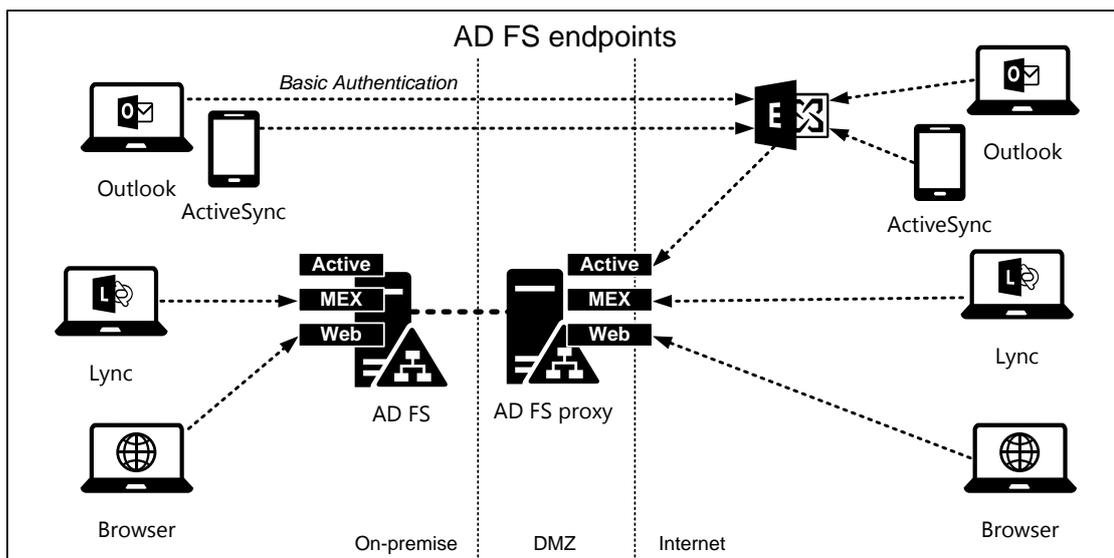


Figure: 4 AD FS Endpoints

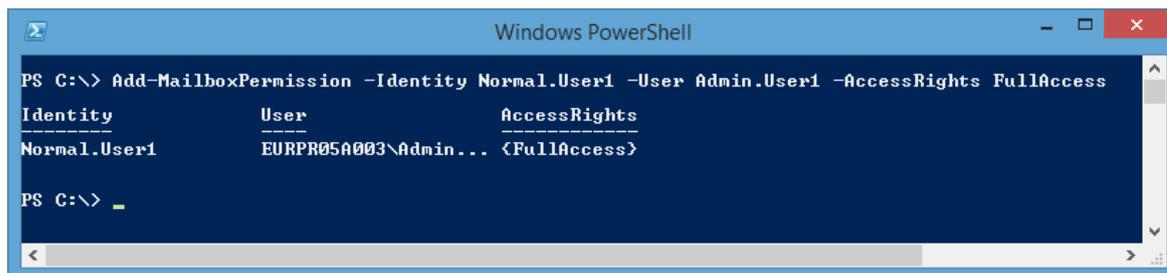
4. ACCESSING CONFIDENTIAL INFORMATION

Office 365's internal security certified being high level, which guarantees that users can only access information they are allowed to access. All control for giving access is on customer's hands. Therefore only way to access other users' information is to use administration privileges.

In this section, we will demonstrate techniques a rogue administrator can use to access confidential data, how to identify and detect such an activity, and techniques for mitigation.

4.1. Accessing information by altering permissions

Simplest way to access user's mailbox is to give someone permissions to user's mailbox. This can be performed with a simple PowerShell command (Figure 5).



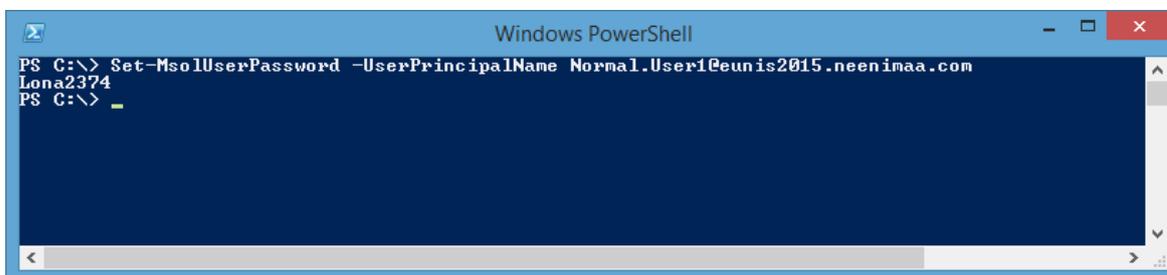
```
Windows PowerShell
PS C:\> Add-MailboxPermission -Identity Normal.User1 -User Admin.User1 -AccessRights FullAccess
Identity           User                AccessRights
-----           -
Normal.User1       EURPR05A003\Admin... <FullAccess>
PS C:\> _
```

Figure 5: Giving FullAccess permissions to user's mailbox

Similarly, in SharePoint Online, administrators may change the owner(s) of the site collections.

4.2. Accessing identities by changing password

Simplest way to access other user's identity is to change the user's password. This can be performed in O365 admin center, or by using PowerShell (Figure 6). Naturally, user would notice the change of the password when next time accessing O365.



```
Windows PowerShell
PS C:\> Set-MsolUserPassword -UserPrincipalName Normal.User1@eunis2015.neenimaa.com
Lona2374
PS C:\> _
```

Figure 6: Changing user's password

Changing users' passwords in AAD is possible only in *cloud identity* scenario, and in *synced identity* without password sync.

4.3. Accessing identities by changing password of synchronised user

It is also possible to change user's password in *synced identity* scenario with password sync enabled, although it is more difficult. As stated earlier, when using directory synchronisation, synced objects are not editable in AAD. When objects are synchronised, the object in AAD has an attribute *ImmutableID* which contains the GUID of the corresponding object in internal AD (Figure 7). This is called a hard link.

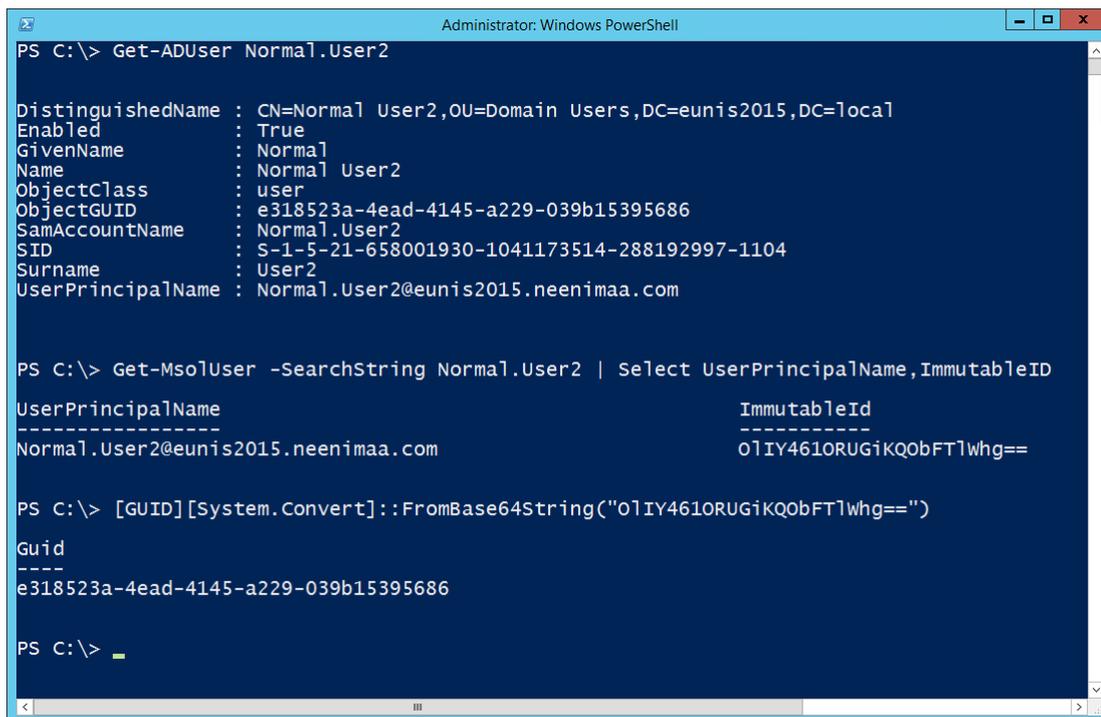


Figure 7: AAD ImmutableId refers to user’s internal AD GUID

First step to change the user’s password in this scenario is to make user to unsynced. By default, the whole AD forest is synchronised by directory synchronisation. Typically this is not the case, as the sync is usually limited to a certain scope, such as seen in Figure 8. In this case, the *Domain Users* container is synced but *Do not sync OU* is excluded from the synchronisation.

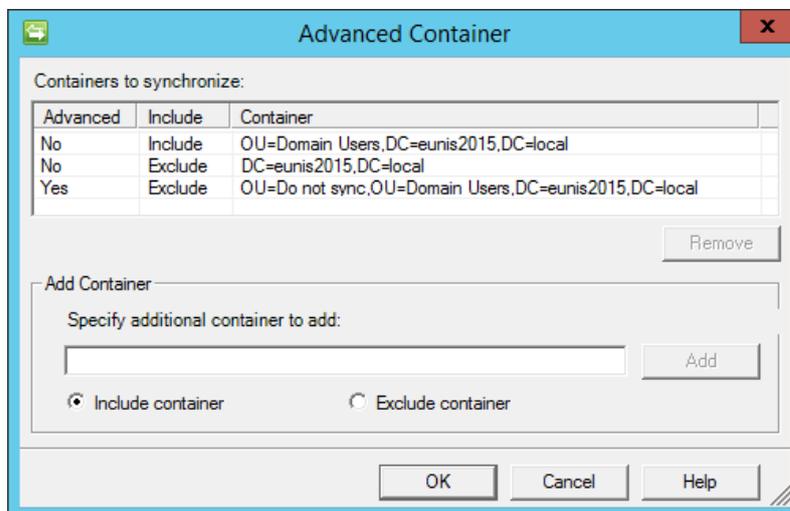


Figure 8: Directory synchronisation scope

Next step is to simply move the user to the excluded OU using Active Directory Users and Computers (ADUC), as in Figure 9, or by PowerShell. This stops the user being synced.

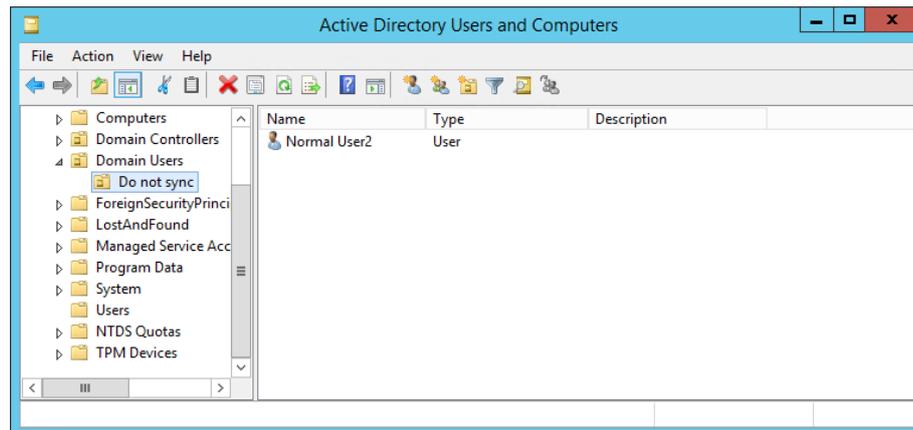


Figure 9: Moving user to OU excluded from synchronisation

After moving the user to another OU, the synchronisation needs to be started manually. When synchronisation is completed, the user will be deleted from AAD if it was originally created by directory synchronisation. In the PowerShell example in Figure 10, we first check the last synchronisation time, start the synchronisation manually, and restore the user. As the user is restored within the grace period (30 days) no data is lost. Finally, the password is changed for the user and O365 may be accessed with the user's identity.

```

Administrator: Windows PowerShell
PS C:\> Get-MsolCompanyInformation | Select Last*
-----
LastDirSyncTime                               LastPasswordSyncTime
-----
2/8/2015 9:09:35 AM                            2/8/2015 8:53:36 AM

PS C:\> Get-Date
Sunday, February 8, 2015 9:17:53 AM

PS C:\> Start-OnlineCoexistenceSync
PS C:\> Get-MsolCompanyInformation | Select Last*
-----
LastDirSyncTime                               LastPasswordSyncTime
-----
2/8/2015 9:19:02 AM                            2/8/2015 8:53:36 AM

PS C:\> Get-MsolUser -ReturnDeletedUsers
-----
UserPrincipalName                               DisplayName                               isLicense
-----
Normal.User2@eunis2015.neenimaa.com             Normal User2                             True

PS C:\> Restore-MsolUser -UserPrincipalName Normal.User2@eunis2015.neenimaa.com
-----
UserPrincipalName                               DisplayName                               isLicense
-----
Normal.User2@eunis2015.neenimaa.com             Normal User2                             True

PS C:\> Set-MsolUserPassword -UserPrincipalName Normal.User2@eunis2015.neenimaa.com
Sumu0703
PS C:\>
  
```

Figure 10: Restoring the deleted sync user and changing user's password

After accessing O365 with the user's identity, changes need to be reversed so that the user does not notice that the identity has been compromised. First the user is returned to the original container in AD, which makes it again a synced user. Next step is to manually start the synchronisation and check the *miisclient* for any errors. Sometimes the user is not properly linked, if so, the *Windows Azure Active Directory* connector needs to be disconnected (Figure 11) in *miisclient*. After another directory synchronisation the user should be linked properly.

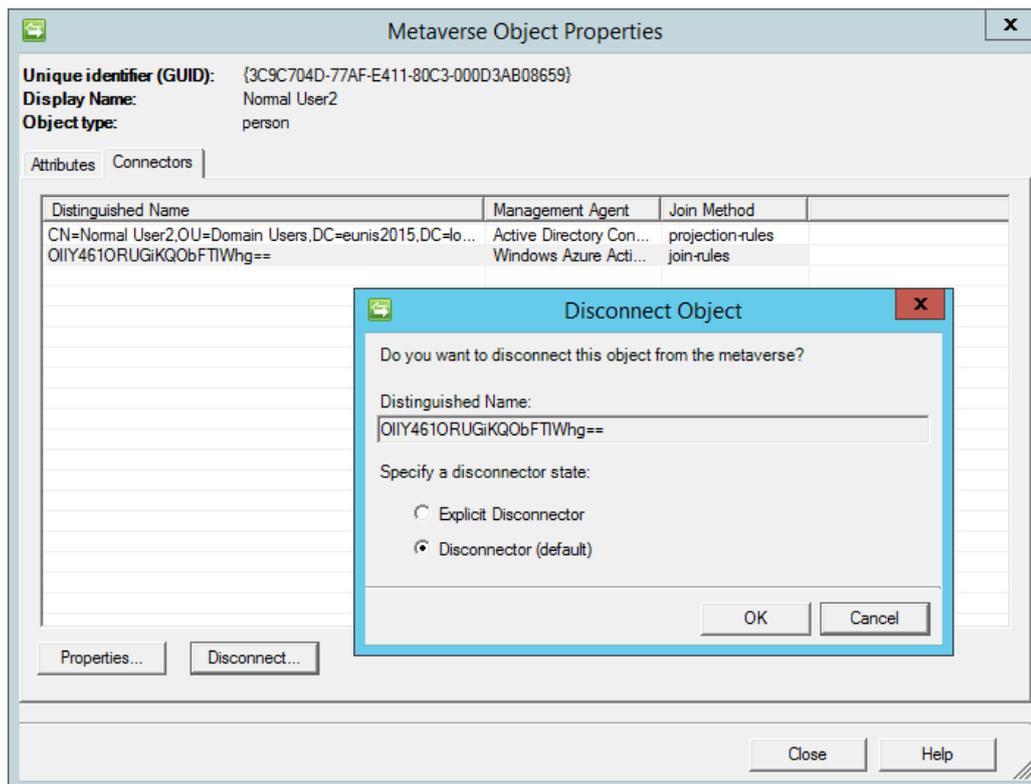


Figure 11: Disconnecting Windows Azure Active Directory connector

When the user in AAD is linked properly with AD, we need to force full synchronisation of passwords. Otherwise the AD password is not synced, because it is triggered only when the password is changed in AD. Password synchronisation can be initiated using PowerShell (Figure 12).

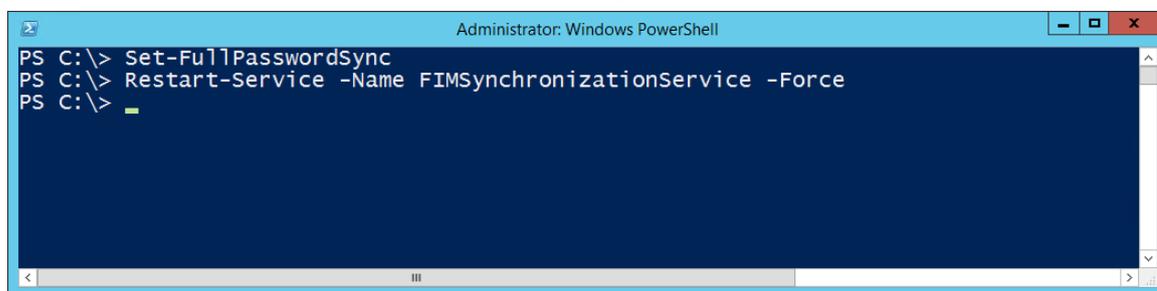


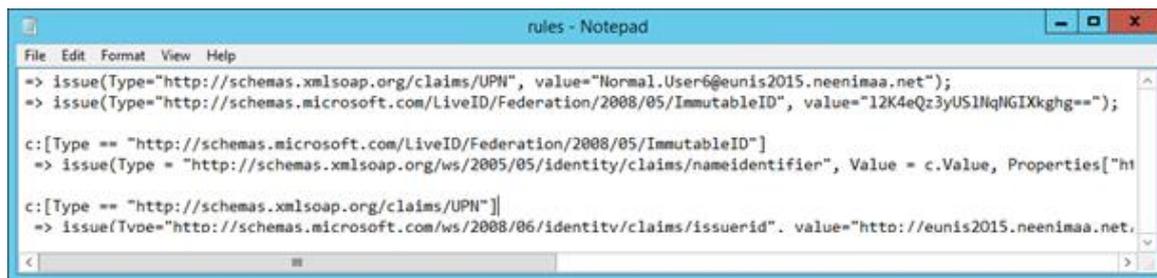
Figure 12: Forcing password full synchronization

After the password synchronisation, everything is returned to original state. So the user may use O365 normally, using the same credentials. This means that the user might not even notice that the account has compromised.

4.4. Accessing federated identities by configuring AD FS

AD FS uses claims to provide authentication information to O365, as described earlier. In AD FS claims are issued using *claim rules*. When the domain is converted to federated, a Relaying Party Trust is created to AD FS. The name of the party is *Microsoft Office 365 Identity Platform* and has contains 2 or 3 issuance transform rules, depending on the configuration. These rules extract UPN and GUID of the authenticated user from the internal AD and issues corresponding claims.

Accessing other user's identity can be achieved simply by altering these claim rules. As an example, in Figure 13, claim rules are altered so that no matter which user logs in, the user is having the identity of Normal User6. The first rule issues the UPN claim and the second one user's ImmutableID claim. ImmutableID is a Base64 encoded GUID of user's AD object.



```

=> issue(Type="http://schemas.xmlsoap.org/claims/UPN", value="Normal.User6@eunis2015.neenimaa.net");
=> issue(Type="http://schemas.microsoft.com/LiveID/Federation/2008/05/ImmutableID", value="12K4eQz3yUS1HqNGIXkghg=");

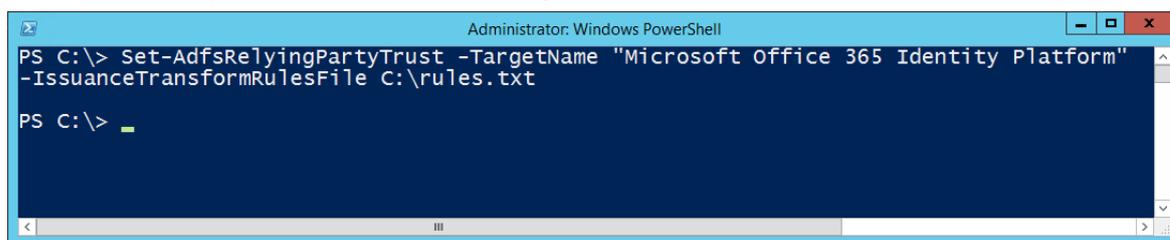
c:[Type == "http://schemas.microsoft.com/LiveID/Federation/2008/05/ImmutableID"]
=> issue(Type = "http://schemas.xmlsoap.org/ws/2005/05/identity/claims/nameidentifier", Value = c.Value, Properties["ht

c:[Type == "http://schemas.xmlsoap.org/claims/UPN"]
=> issue(Type="http://schemas.microsoft.com/ws/2008/06/identity/claims/issuerid", value="http://eunis2015.neenimaa.net,

```

Figure 13: Altering claim issuance transform rules

The altered claim rules can easily be imported to AD FS using PowerShell (Figure 14). This can be performed remotely without a need for desktop access.



```

Administrator: Windows PowerShell

PS C:\> Set-AdfsRelyingPartyTrust -TargetName "Microsoft Office 365 Identity Platform"
-IssuanceTransformRulesFile C:\rules.txt

PS C:\>

```

Figure 14: Importing claim issuance transform rules to AD FS

Obviously, in our example, the changes in the rules would be noticed by users as they would be logged in as another user. In real life, rogue administrator would use more sophisticated rules which would give another identity only to a specific user. The user used to log in does not have to be in AAD, or not even use the same identity domain. As long as the user is in AD and can log in, AD FS can be used to access other user's identity.

As we have demonstrated, the rogue administrator can quite easily access other users' information. All of the techniques presented above can be detected and actions can be taken to prevent their exploitation. However, the rogue administrator may have access to backups or virtual hard disks used by the servers. These can easily be copied to a different location and a copy of the on-premise environment could be started. Given the AD FS web endpoint implementation technique, one can alter the name resolution so that the FQDN of the AD FS points to the new environment. In this case, the AD FS configuration could be altered without any chance of noticing it. Therefore the physical protection of backups and limiting access to virtual machines is crucial.

4.5. Gaining administrator access to Windows

Gaining administrator access to Windows and AD is relatively trivial (see Laiho, 2013), as long as certain conditions are met. First, you need to be able to boot from external media, such as the Windows installation media. Secondly, Bitlocker must not be used. If these conditions are met, you may take following steps to gain administrator rights to the computer (or server):

1. Boot the computer from the Windows installation media and start the command prompt
2. Go to C:\Windows\System32 and copy cmd.exe to sethc.exe
3. Boot the computer normally and in the login screen hit the left shift key five times. Command prompt starts as SYSTEM account and you may add yourself as an admin (Figure 15).

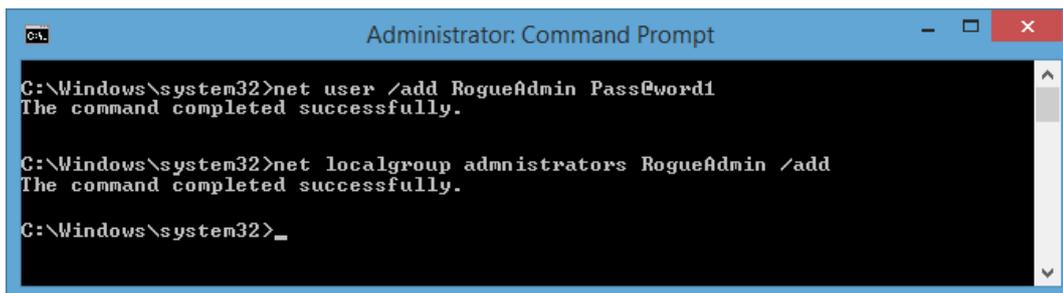


Figure 15: Adding user as local administrator

Getting a domain admin rights is a bit trickier as it requires help from an existing administrator:

1. Create a scheduled task that runs the following command on every logon:
`NET GROUP "Domain Admins" RogueAdmin /add /domain`
2. Get an existing administrator to log on to your computer, for instance by using excuse such as a need for help in configuring a printer. Note that the user needs to exist in AD.

4.6. Summary

A summary of techniques how a rogue administrator may access other users' information in Office 365 is listed in Table 2, including the end-user symptoms, detection and forensics methods, and mitigation techniques.

Table 2: Summary of information access techniques

Accessing information by giving permission	
End-user symptoms	None, unless content is altered.
Detection	None.
Forensics	For Exchange Online, run <i>Mailbox access by non-owners</i> report in Office 365 admin center. For SharePoint Online, view audit log reports in <i>Site Collection Administrator</i> section.
Mitigation	Give only minimum admin rights.

Accessing identities by changing user's password	
End-user symptoms	Unable to log in. Multi-factor authentication requested when not logging in (if configured).
Detection	None.
Forensics	Check the value of <i>LastPasswordChangeTimestamp</i> property of the user with <i>Get-MsolUser</i> cmdlet. View the <i>LastLogonTime</i> property of the user mailbox with <i>Get-Mailbox</i> cmdlet. Check audit reports from Azure AD, such as <i>Password reset activity</i> (requires Azure premium).
Mitigation	Give only minimum admin rights. Configure Multi-factor authentication.

Accessing identities by changing password of synchronised user	
End-user symptoms	Unable to log in. After a some period of time login may be possible. Multi-factor authentication requested when not logging in (if configured).
Detection	Monitor directory synchronisation events in <i>Application log</i> with <i>Event Viewer</i> using for instance Source filter for <i>FIMSynchronizationService</i> , <i>Directory Synchronization</i> , and <i>MSOnlineSyncScheduler</i> .
Forensics	Check the value of <i>LastPasswordChangeTimestamp</i> property of the user with <i>Get-MsolUser</i> cmdlet. Check the value of <i>LastDirSyncTime</i> property of the user with <i>Get-MsolUser</i> cmdlet. View the <i>LastLogonTime</i> property of the user mailbox with <i>Get-Mailbox</i> cmdlet. Check audit reports from Azure AD. Check <i>miisclient</i> for synchronisation events.
Mitigation	Give only minimum admin rights. Configure Multi-factor authentication for users. Prevent unnecessary access to DirSync server.

Accessing federated identities by configuring AD FS	
End-user symptoms	None (if rules configured properly)
Detection	Monitor Kerberos authentication events in <i>Security log</i> in <i>Event Viewer</i> for event IDs 4768 and 4769. Compare for instance to Azure AD login logs.
Forensics	View the <i>LastLogonTime</i> property of the user mailbox with <i>Get-Mailbox</i> cmdlet. Check audit reports from Azure AD.
Mitigation	Give only minimum admin rights. Configure Multi-factor authentication for users. Prevent unnecessary access to AD FS server. Disable remote PowerShell.

Gaining administrator rights to Windows	
End-user symptoms	None
Detection	Monitor event logs for unnormal activity
Forensics	View <i>Domain Admins</i> group members, check the computer and server logs.
Mitigation	Give only minimum admin rights. Never log on as Domain Admin to other user's computer. Use Bitlocker.

5. CONCLUSIONS

In this paper, we have demonstrated techniques a rogue administrator may exploit users' confidential information in Office 365. Some of the techniques cause symptoms that end-users may notice, most of them not. Administrator may detect usage of some of these techniques but not all. All of these weaknesses are related to organisation's on-premise security.

It can be argued that the weakest point of Office 365 security is the customer's on-premise security misconfiguration. Organisation's security officers and IT administration may use this paper as a guideline when auditing their on-premise security. Software and service versions used in demonstrations are listed in Table 3.

Table 3: Software versions used in the demonstrations

Product/Service	Version
Office 365 plan	E3
Windows Server 2012 R2 Data center	6.3.9600
Microsoft Online Services Sign-in Assistant	7.250.4551.0
Windows Azure Active Directory Module for Windows PowerShell	1.0.0
Windows Azure Active Directory Sync Tool	1.0.7020.0

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7. AUTHOR'S BIOGRAPHY



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EUNIS 2015 - IRIS: supporting and managing the Research life-cycle

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Keywords

CRIS, DSpace, DSpace-CRIS, CERIF, Interoperability, Open Source, Reporting, Evaluation Assessment

1. Summary

IRIS is the new CRIS (Current Research Information System) developed by Cineca, resulting from the merge of two different solutions that have been used by Italian universities in the last 10 years (U-GOV Research and SURplus). By the end of 2015, 65 Italian Universities will be using IRIS: 46 coming from U-GOV Research, 9 from SURplus and 10 completely new installations. One of the main components of IRIS is Dspace-CRIS, an open source stand-alone solution (developed by the Consortium) that extends and already running in 18 Institutions outside Italy. DSpace-CRIS is a mixed repository-CRIS platform that combines the agile OA content management provided by DSpace with additional CERIF-compliant CRIS features built on top (such as persons, organisations and projects). Besides that, it has 5 different modules that can work independently, but at the same time they interoperate through standard protocols and interfaces.

2. IRIS and its components

There are many players working within the Research domain, each of them with different needs and requirements: researchers, librarians, administrators and governance. A CRIS system needs to be able to meet all those different needs: researchers should easily input their data into the system; those information should be easily stored and collected in a repository in order to be promoted and disseminated; projects, activities, funding must always be tracked; the system has to interoperate with internal and external DB to share data; Governance should have the opportunity to produce reports and analysis for decision making.

IRIS has been developed in collaboration with several Italian Universities following this very approach: researchers, administrators and evaluators are given all the tools needed to monitor research results, enhance visibility and efficiently allocate available resources.

IRIS is a best-of-breed solution based on JAVA technology. It has 5 different modules that can work independently, but at the same time they interoperate through standard protocols and interfaces such as REST/SOAP. SSO among the different modules is assured via an embedded CAS and the platform architecture is divided in three different levels following the MVC (Model-View-Controller) paradigm.

The modular nature of the system and the flexibility of its data model facilitate processing, organising and transmitting information in accordance with the international CERIF standard (Common European Research Information Format). At the same time IRIS provides the chance to easily shape local and national requirements. The compliance with CERIF offers several advantages to a CRIS: it strengthens relations among research entities (people, resources, activities, publications, etc.); it supports evaluation activities and dissemination; it helps the exchange of information among different CERIF compliant Research Systems at national and international level.

For reporting and statistical analysis IRIS uses different technologies:

- Mondrian: as OLAP engine;
- Saiku: interface for OLAP cubes analysis;
- PDI (Pentaho Data Integration): ETL engine;
- Jasper Report + Ireport: to create and use reports on XLS, Pdf, word, etc;

The Modules:

Resource Management (RM)

This module collects all data that populate the “world” of research: information comes from the legacy systems of an Institution: people, groups, skills, organizational structures, internal and external laboratories, instrumentation, scientific committees, etc.

Activities & Projects Module (AP)

It collects information on projects, contracts, collaborations, scientific initiatives, and all activities related to research, from proposals to final results. It allows to enter data for highlighting the scientific value, partnerships and collaborations related to a research, connecting them to the institutional research’s assets (people, groups, equipment, etc.). It allows the customisation of workflows assigning authorizations to each user depending on the project and the role of each user.

Institutional Repository/Open Archive Module (IR/OA)

The repository of the University’s Research Products allows the storage, consultation and enhancement of outputs reflecting its various activities. With this tool, the University has a unique and interoperable system, able to communicate with the central national and international databases for the management and dissemination of publications. The module complies with the requirements of the Ministry of Education and the European Commission for Open Access (OpenAIRE). While it sends information to national and international databases, it also collects data from external systems such as Scopus, WoS, PubMed, mEDRA, CrossRef, etc.

Evaluation & Review Module (ER)

The ER Module supports the process of research and scientific evaluation based on data analysis and performance indicators.

It allows the management of internal evaluation cycles and supports evaluation initiatives promoted by the Ministry (e.g. REF). It gives the opportunity to create sophisticated reports on research activities to support the decision making processes of the Governance.

Expertise & Skills Module (ES)

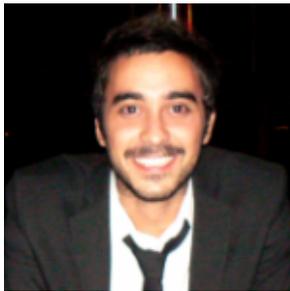
This module supports the enhancement and promotion of the University’s competences and characteristics. It is open to the public for consultation and it allows institutions to promote cooperation and exchange with industry and other partners. ES is strongly optimised for all search engines in order to make sure that the activities of an Institution always appear in the first positions of a search.

3. AUTHORS' BIOGRAPHIES



Andrea Bollini is a member of the release team and a long term DSpace committer. He has been directly involved in the development of the major functionalities as the JSPUI redesign. He works at CINECA, a registered DuraSpace Service Provider based in Italy that, among other activities, provides professional services and IT solution for the Research Management. He is the Product Manager and one of the key Architect of both CINECA's solutions: the Open Source system (DSpace-CRIS) and the Enterprise edition (IRIS).

IRIS uses DSpace as Institutional Repository and DSpace-CRIS as a dissemination module for the other Research Entities.



Michele Mennielli is International Relations Manager at Cineca. He is a Board Member of EUNIS as well as euroCRIS and he represents the Consortium in the DSpace Steering Committee.

OMEGA-PSIR - A SOLUTION FOR IMPLEMENTING UNIVERSITY RESEARCH KNOWLEDGE BASE¹

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Keywords

knowledge base, digital library, scientific resources, repository, research management, open science, open access

1. ABSTRACT

In 2010 a nation-wide strategic program SYNAT, aiming at building a scientific information infrastructure in Poland, has been launched. Originally, the program has been scheduled for the period of three years, in due of the program implementation it was extended till the mid of 2014. It was financed by the National Centre for Research and Development (NCBiR) in Poland. A network of 16 academic and scientific partners has committed to implement the SYNAT's objectives in the form of a universal open knowledge infrastructure for the information society in Poland.

The scale of the SYNAT program was unprecedented for the Higher Education Sector in Poland. Beyond the system development, a comprehensive portfolio of research problems has been addressed by the partners (Bembenik et al. 2013; Bembenik et al. 2014). In the view of the limited implementation time, the primary goal of the program consisted in meeting the challenges of global digital information revolution, especially in the context of scientific information.

One of the outcomes of SYNAT is the software OMEGA-PSIR (in the sequel $\Omega\text{-}\Psi^R$), designed and implemented by a team of Warsaw University of Technology. We present the software - a cutting edge solution for building a research knowledge base of academic institutions. We present functionality of the system, as well as, sketch some applied AI technologies aiming at providing features attractive for the system beneficiaries. It is shown that although a classical repository is the main part of the system, the essential value of the solution is in providing analytical tools, especially useful for the "research management", but also for the researchers, students, and the university administration. Lessons learned from deploying the software at Warsaw University of Technology and other Polish universities are also discussed.

2. BACKGROUND

The last decade has shown an increased interest of the universities in the systems concerning research data management and access to publicly funded research data. In 2010, a dedicated project, SYNAT, has been launched in order to address deficiencies of the scientific information infrastructure in Poland. The ultimate goal of the planned infrastructure was to ensure the dissemination of the Polish nation-wide scientific achievements, and to improve integration and communication of the scientific community, while leveraging existing infrastructure assets and distributed resources.

The main SYNAT construction has been based on two levels of distributed knowledge bases, with a central database at the highest level, and the university ones at the lower levels. Schematically the two levels of scientific knowledge bases are shown in Fig. 1:

1. the central level (the main SYNAT platform - INFONA portal);
2. the university level (repositories held by the universities).

¹ Note: The paper has been submitted with the intention to take part in the Elite Award contest.

The software for building the university level knowledge base has been designed and implemented. By now, it has been already successfully deployed at Warsaw University of Technology (in the sequel WUT), and with its use the university knowledge base has been implemented. In addition, it is currently subject to use for implementing research knowledge bases at other six academic institutions in Poland.

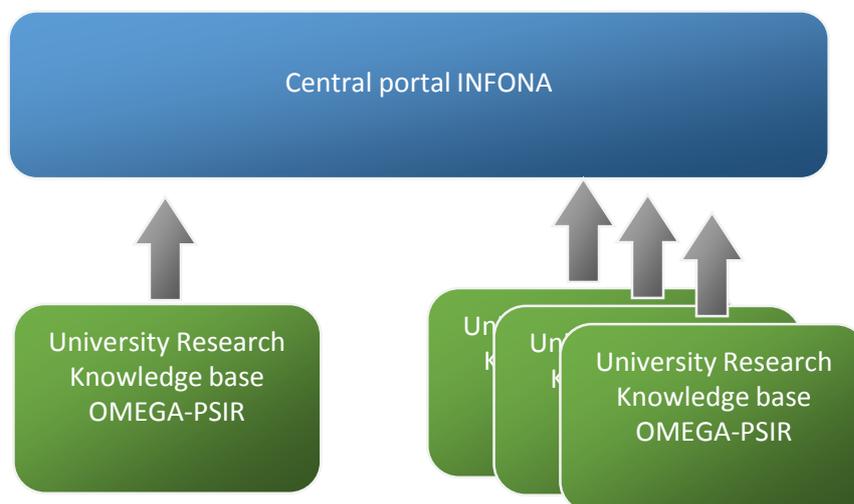


Fig. 1 A general view of the SYNAT network

3. MOTIVATION, GOALS AND KEY ASSUMPTIONS

Observing contemporary information systems dedicated for institutional research knowledge bases, one can see an approach represented by systems like Fedora-Commons or D-space (see e.g. Berman (2008)), which focus mainly on the repository functions, such as storage and indexing of research-related documents, including also aspects of long term durability. It is actually a dominating way for building institutional research knowledge databases. The systems within this approach provide rather simple end-user functionality, mainly limited to browsing and querying the repositories. They are bibliography oriented, usually document-centric ones, and do not provide end users with any analytical functionalities, or with sophisticated presentation capabilities. Additionally, the data acquisition procedures are rather straightforward, based on human work, or harvesting data from well-defined resources.

Although the systems of this kind are in wide use, based on experience of US universities some essential problems have been presented by Davis and Connolly (2007), and Salo (2008). The main criticism of the document-centric approach focuses on a very weak interest of the researchers communities to use such repositories, and can be summarized in one sentence that the institutional repository is "like a roach motel - data gets in but never gets out" (Salo 2008). In particular, it is observed that typical software solutions do not encourage scientists to actively contribute to the institutional repository content:

"The institutional-repository software platforms, plagued by innovation-hostile architectures and an ideology-driven rather than user-centered understanding of the problem domain, have been slow to align development with needs. Interested faculty, librarians, administrators, and developers must reframe their approaches to institutional repositories if they are to recover from their current neglect"

Recently, another approach can be observed - it is researcher-centric and community-oriented approach, like Microsoft Academia, Arnetminer, ResearchGate or Academia.com. Unfortunately such global systems do not cover many of the typical research institution needs. One can therefore observe some initiatives towards building institutional research-centered knowledge base systems. A good example is the Stanford VIVO system (Kraft et al 2010). The VIVO project aimed at creating "Semantic Web-based network of institutional ontology-driven databases to enable national discovery, networking, and collaboration via information sharing about researchers and their

activities". Still though, many prominent Stanford researchers cannot be found in the system, probably because too much effort (and cost) should be paid to the database maintenance.

Yet another solution has been offered recently. It is a commercial system PURE proposed by Elsevier². It is an institutional solution, and to a large extent it simplifies the maintenance processes. In general, the idea of building the $\Omega\text{-}\Psi^R$ platform has emerged from similar motivations. However, as the PURE technologies are not public and are quite expensive, we have focused on elaborating ours. A significant requirement imposed on our system was to make it free, open source, fully customizable and localizable, so that it can be fully adjusted to varying local university conditions.

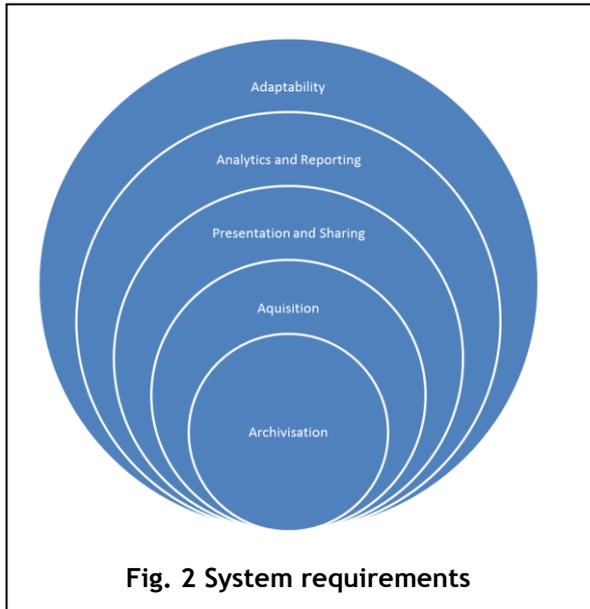


Fig. 2 System requirements

We concluded that the successful software for building institutional research knowledge base has to integrate various, sometimes conflicting, needs of different user groups. It should be beneficial for, and motivating to, quite different user groups, including (but not limited to) researchers, students, university strategic management, administration, librarians. What is very important, it should guarantee low maintenance cost, on the other hand should be as much user friendly as possible. These were the key assumptions for developing the $\Omega\text{-}\Psi^R$ software.

As the result of the analysis, a multi-level structure of requirements was defined for the system, as illustrated in Fig. 2. The core requirement refers to the needs of archiving the published material, but additional forms of scientific activities of the researchers should be covered by the system. The consecutive important requirement is to provide mechanisms for acquiring data. In this respect, in order to minimize the maintenance costs, the system should be able to acquire data from Internet, as well as, by means of crowd-sourcing. Special requirements refer to the presentation and sharing issues. In particular, special importance has been given to the functions of promoting researchers, university units and informal research teams. Then, the requirements referring to analytical information, strongly related to the presentation requirements, expressed the needs for implementing data mining and knowledge discovery algorithms in order to present the most successful researcher individuals and groups, discover the research maps of the units, and provide statistical information on dynamically changing research potential of individual researchers, informal cooperating groups, or organizational units. The next section presents the functionalities of the system being results of the requirements.

4. MAIN FEATURES AND FUNCTIONALITIES OF OMEGA-PSIR

The main idea for $\Omega\text{-}\Psi^R$ was:

1. to build tools on top of a classical repository for acquiring data from various sources, and for simplifying the repository maintenance procedures;
2. to provide a number of analytical researcher-centric functionalities, in order to make the system attractive to the users.

Many problems have been solved with the tools of artificial intelligence and text/data mining. In particular, we concentrated on data acquisition from WWW, along with extracting information from the retrieved pages, and then building the knowledge base with the extracted facts. Additionally, in order to improve the quality of the functionalities of the system we concentrated on semantic enrichment of acquired data and facts by automatic indexing and classification of objects, and the presentation of knowledge extracted from the repository data.

² <http://www.elsevier.com/online-tools/research-intelligence/products-and-services/pure>

Repository oriented functions

With any defined object in the knowledge database it is possible to predefine various “digital attributes”. The digital attributes are devoted to store digital objects, which then are accessible by a unique “object identifier”. The text objects are subject to indexing, so that the index for full text retrieval is built automatically with the new objects added to the database. Also the updates of text documents are automatically reflected in the indexes. The knowledge base can be seen as a network of interlinked objects. For the flexibility reasons, all the object structures are definable by means of XSD definitions, extended by some extra constructs. The definitions contain relationships between the types. From the XSD definition the system automatically builds the forms for data entry, search and result list presentation (Fig. 3).

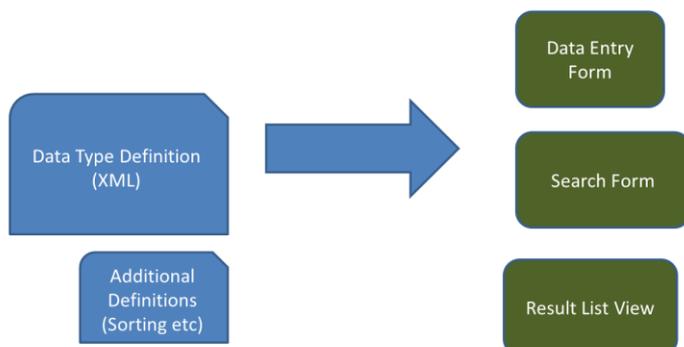


Fig. 3 Defining object types and corresponding interface elements

An important feature is that the repository preserves “historical values” of linked objects in the course of changes (e.g. if an author changes a name his/her publications can be searched equally by the old name and the new one). At WUT the main object types that have been defined are: *researcher*, *publication* (with a number of subtypes), *patent*, *thesis* (with the subtypes BSc, MSc, PhD), *project*, *project_document*, *researcher_activity*. In the near future we expect to add other new types, such as *experiment_data*, *benchmark_data*, *software_tool*, etc.

Acquisition functions

A specialized acquisition module Ψ^R (Platform for Scientific Information Retrieval) has been developed to acquire data from the Internet in a reliable way and import various formats. The main capabilities of the subsystem refer to acquiring data from WWW, along with extracting information from the retrieved pages and building the knowledge base with the extracted facts, and performing semantic enrichment of acquired data and facts by automatic indexing and classification of objects.

Advanced artificial intelligence tools have been implemented for performing a pipeline of acquiring new data, enriching them semantically and integrating within the knowledge base (see Koperwas et al (2014b)). To perform the pipeline the following components have been implemented:

- Web Search Module that finds resources related to the scientific world on the Internet. This module is triggered by users’ actions or Scheduler that periodically invokes predefined searches on Web;
- Classifier and Extractors modules. The modules are used to decide whether found resources are of a given type, e.g. conference homepage, and extract information for the found resources;
- Disambiguation Module, which assigns publications to the proper researcher record from a set of people with the same first and last name.

It is worth noting that during the implementation of the knowledge base at WUT at the end of 2013, some 20000 bibliographic descriptions of the most important publications of the WUT researchers have been acquired from WEB.

Independently of the AI based means, involvement of researchers directly into the data acquisition process was presumed as a psychologically important factor for achieving data completeness. Bearing in mind a possible drop down of data quality, unavoidable for such approach, a variety of specialized tools guarantying high level quality of the acquisition process have been developed in addition (Koperwas et al 2014a).

Presentation and Sharing Functions

The presentation aspects were subject of our particular interest. Special focus has been put on presentation and promotion of researchers, as well as, university units, and informal research teams. To this end, advanced algorithms have been elaborated and implemented for:

1. tagging the researcher expertise and visualizing it by a cloud;
2. discovering experts in a given domain, based on the research achievements registered in the knowledge base;
3. finding the networks of cooperating researchers.

These algorithms have been used for implementing the main knowledge base functionalities, such as e.g. looking for experts, presenting the researchers profiles, showing the achievements of the university units (institutes, faculties, departments, etc), and generating reports. A sequence of the steps with functions using the algorithms mentioned in (2) and (3) above is illustrated in Fig. 4.

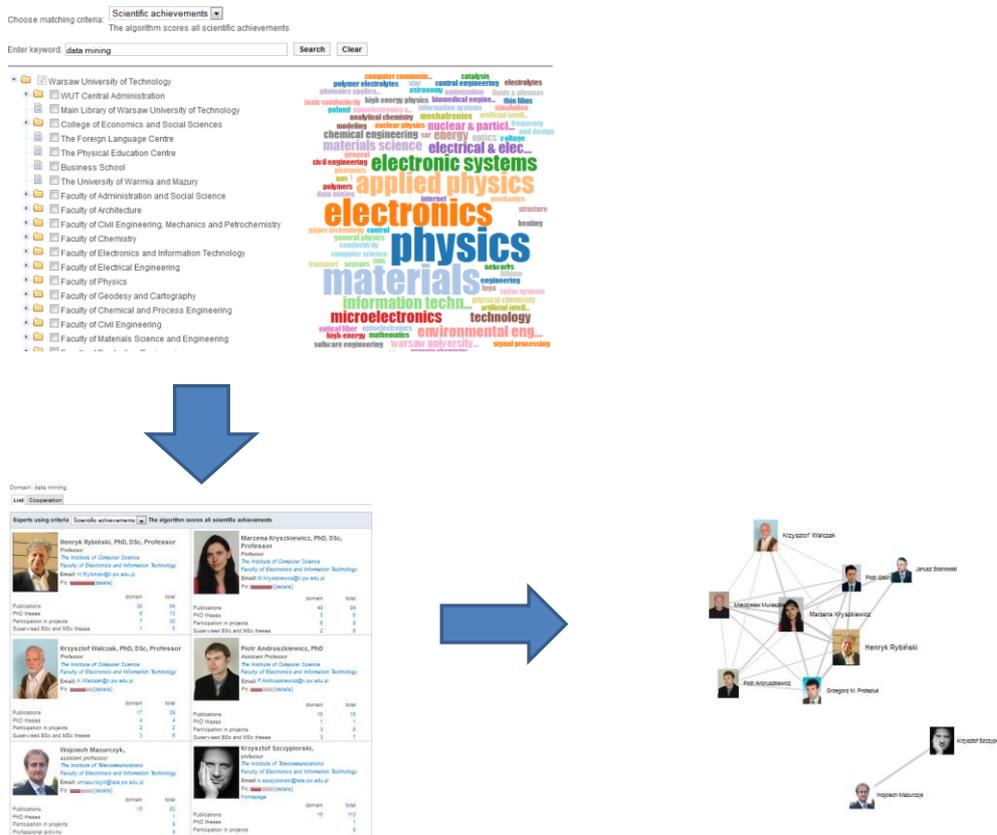


Fig. 4 Cloud of tags and experts search

Another important issue is that the system takes advantage of storing the knowledge base as a graph, so one can easily navigate between various objects. In addition, fairly standard functionalities, such as building a query, presenting search results of bibliographic data, etc., are provided with highly ergonomic and customizable GUI, with semantic support, and various sorting, reporting and exporting methods available, accompanying all the result screens. For the promotional reasons screens provide means for integrating with social networks (Facebook, ResearchGate, etc.).

The exporting functions make possible to provide data in typical formats, including the ones of publishers (e.g. MODS), and those preferred by researchers (BibTeX). The system can communicate with other systems by means of OAI-PMH interface³, but also SOAP and REST.

³ A general idea for the repository was to take into account the paradigms of Open Access.

The presentation mechanisms are researcher-oriented with the purpose not only to present but to promote the achievements of the researchers.

5. IMPLEMENTATION OF KNOWLEDGE BASE AT WUT - IMPACT AND BENEFITS

The $\Omega\text{-}\Psi^R$ system has been built iteratively over the period of three years. It was installed in production environment in its early development stages - at the beginning only at Institute of Computer Science, with functionalities limited to the basic repository functions. In the course of the development of new functionalities the system was providing more functions, and was delivered to wider range of users, first, in 2011 at Faculty of Electronics and Information Technology, and then in 2013 to the whole Warsaw University of Technology⁴, still being subject of further development.

Such approach caused that the system was confronted with its users from the very beginning, and the developers were confronted with real user needs, so that when the system was finally ready to be shared with other universities in the form of a complete $\Omega\text{-}\Psi^R$ package, it was already mature, well-tested and well-documented.

Already in 2013 the functionality of $\Omega\text{-}\Psi^R$ went beyond the typical functionality of institutional repository, so it had chances to become a central knowledge source for all types of the WUT research activities, the more that, due to applied intelligent tools (acquisition tools, reporting functionalities), the maintenance efforts of Knowledge Base are essentially reduced, compared to the typical solutions. The process of moving the system to the University level was already simpler, as the team had experience with organizational and training issues at the faculty level. In addition, by 2013 we had at our disposal a number of means to mine web for the publications of remaining faculties, and whenever possible to import data from local faculty repositories, web pages, or even files. It is worth noting that the most important and valuable bibliography (some 20000 records) has been harvested from web in 2 weeks. The remaining 10000 historical records have been imported from legacy databases.

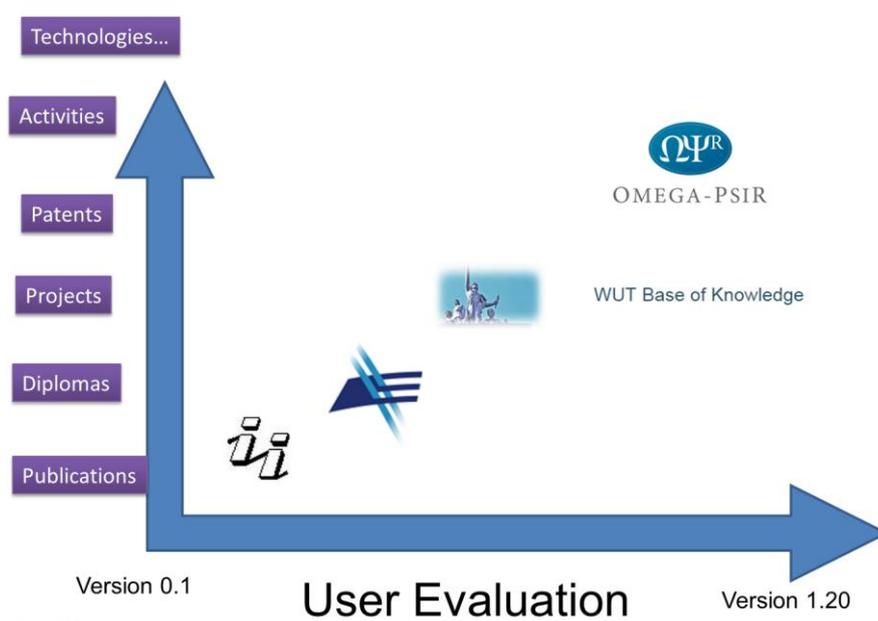


Fig. 5 Evolution of the $\Omega\text{-}\Psi^R$ system

As mentioned already, the groups of the system users and beneficiaries are very heterogeneous. As for the internal users, the following groups can be distinguished:

1. Researchers

⁴ <http://repo.bg.pw.edu.pl/index.php/en/>

2. Students (graduates, undergraduates);
3. University administration;
4. Scientific bodies (faculty councils, senate, promotion commissions, etc.);
5. University top management, responsible for research strategies.

As a matter of fact, at the beginning all groups of users were rather skeptical, but the main skepticism was coming from the researchers group. In the course of the knowledge base development the researchers could immediately observe their profiles, so that they gradually turned to be more and more involved in the process of the database maintenance. The main trigger for the staff involvement was the fact that they have noticed correlation between the way the system was presenting their own profiles, and their achievements in the repository. Usually, they were not satisfied with the automatically generated expertize cloud, which was clearly the result of missing publications in the database. Getting familiar with the integration of repository functions, visualization of research, and reporting the university staff became the first beneficiary of the research knowledge base.

Now the system is subject of integrating with other university systems, as well as, with national systems in Poland. Due to the service oriented architecture it is a fairly simple process. In particular, the system is now integrated with Student System USOS, and with the financial systems for research projects. It also integrates resources from all the local repositories and bibliographic databases into one central repository. Due to its analytic functions the system has been easily integrated with staff evaluation and promotion system. It serves already as the main reporting tool for the university authorities. Last but not least, it becomes a source of knowledge about the research teams at the university, and it refers equally to all the users groups, starting from the top management responsible for building research strategy, through project leaders recruiting teams for the research projects, and ending with PhD students looking for their potential supervisors. An immediate result is the process of integrating the researchers groups sometimes from thematically quite far faculties.

Also the efforts to disseminate the University achievements to the external communities start bringing positive results. Also for the external users, the role of the system is multifold. The system integrates various functions, but the main ones are:

1. to provide a complete and up-to-date information about the research areas of the University researchers, and their strength to the potential external partners for building scientific cooperation links;
2. to provide means to the governmental authorities concerning the research potential of the University, and the currents achievements, *inter alia* for the evaluation and assessment reasons;
3. to provide a complete and up-to-date information about the research areas of the University researchers, and their strength to the international evaluating bodies.

The usage statistics of WUT Knowledge Base shows an increasing interest from visitors from all around the world, especially from Western Europe and North America. It is expected that those effects could be enforced with time.

6. THE APPLICABILITY OF THE PROJECT TO OTHER INSTITUTIONS

While building the Ω - Ψ^R software, one of the more important requirements was the flexibility of the system and its adaptability, so that developing new features and changing business rules should be possible by system administrator without involving programmers. In particular, it was planned from the beginning that the system should be:

1. easy to extend (with new data types, views, validation rules, etc.);
2. capable of handling differentiated faculty-specific requirements (for example the procedural ones), even within the same running instance;
3. easy to install and adopt to other universities, also with other interface language

Referring to p. (1) above, a number of scripting tools has been elaborated. As a result, a lot of functions can be expanded or even developed without any need to change the main code. In many cases it can be done in a declarative way, like, e.g., the mentioned above possibilities to define new types of data structure (see Fig. 3) along with the accompanying validation rules, data entry forms and search screens. The system administrator can define custom reports and statistics. Other

advanced scripting options refer to definitions of access privileges and data protection, or even the ways of ranking publications or the researcher expertise.

The system can be embedded in different web pages of the university. For example, at the university level it can be used as a central knowledge base, whereas at the faculty level it can be used for presenting the achievements of the faculty staff. This way the system can serve as a centralized repository for the whole university, on the other hand, each faculty or department may want to promote their achievements on their local homepages and provide a customized look and feel (also by means of colors, and layout). In addition, at the lower level one can provide local reporting styles, local statistics, or export options.

All the flexibility features, as well as the service oriented architecture of the $\Omega\text{-}\Psi^R$ software make it possible to adopt the system to the needs of other universities. The process of distributing the system in Poland has started. In September 2014 the system has been presented to a group of leading universities in Poland. It turned out to be very attractive for the universities. There are already some 20 requests for providing means for the test evaluation of the system.

The system is available for free of charge, with the access to the software source code. There are already 9 academic and research institutions testing the system, and adapting to their needs. In addition to WUT, yet another university has already implemented its research knowledge base. Interesting enough, they were able to do it without too much support from our side.

It is worth noting that the system is multilingual, so various interface languages can be implemented and the system can be fairly easily adapted to the requirements of universities in other countries.

7. FURTHER DEVELOPMENTS

One of the lessons learned was that with building an information system, for the first glance looking as a fairly typical one, we have encountered many interesting real life research problems in such areas like knowledge acquisition and discovery, text mining, or information retrieval.

While the practical goals of the SYNAT project have been achieved, within this the $\Omega\text{-}\Psi^R$ platform has been successfully implemented at WUT as the research knowledge base, and now, it is subject of implementing at other universities in Poland, we are going to continue the development of the system. Two types of work are planned: on one hand we would like to take advantage of the existing system flexibility and add more functionality using the system options; on the other hand we can see a lot of research possibilities that can essentially influence the system functionality and quality.

Within the first track (implementation oriented) we can already enrich the existing system with interoperability with other national and global scientific information systems (e.g. ResearchGate, Google Scholar, Web of Science, Scopus, etc.). Special tasks towards this direction are already planned. Other fairly easy task is to add the functionality for looking for "rising stars" (some research in this direction has been already performed. We also have already tools to enrich the journals database with information harvested from the publishers' sites, e.g. concerning the information about call for special issues.

Within the second track (research oriented) we can see that the already built repository of scientific publications, mostly in English, is quite heterogeneous in terms of the covered research areas, and as such, it provides a lot of challenges. Special emphasis will be put on semantic cross-lingual search, giving rise to a more symmetric retrieval for English and Polish, i.e., giving similar results for queries regardless of the language. Some work in this direction has already been started (Krajewski et al 2014). In addition, our existing web mining tools aiming at discovering knowledge about conferences still require some more research.

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Łukasz Skonieczny, Ph.D, assistant professor at Institute of Computer Sciences, is one of the main developers of the $\Omega\text{-}\Psi^R$ system. His research interest is in database systems, data-, text- and web-mining, graph theory and web development. He has in his record 10 scientific papers and, 3 edited books. He participated in a bunch of research projects, and cooperated with many institutions, *inter alia* France Telecom, Samsung, UNEP, FAO, IUCN.

DSpace and Open Access in Serbia: Two Problems, One Solution

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Keywords

DSpace, digital repository, open access, doctoral dissertation, plagiarism, OpenAIRE, agriculture, CaSA NaRA

1. SUMMARY

In recent years, Serbia has been trying to improve online availability of scientific output through legislation, deployment of digital repositories in open access and promotion of aforementioned services. As a response to public affairs involving multiple high-ranking officials and plagiarism allegations, Serbian government has made amendments [1] to the Law on Higher Education [2] which stipulates that doctoral dissertations shall be available online to the public prior to the defense. After careful consideration whether to develop a new platform or to use an existing open source solution, a decision has been made to use widely adopted open source DSpace repository. This article covers the reasons for choosing DSpace, customizations made, deployment issues and experience after a few months of use. As an example of DSpace versatility, two open access implementations will be discussed: University of Belgrade Pre-defense Doctoral Dissertations Repository (UviDok) and National Repository for Agriculture (NaRA).

2. BACKGROUND

In the spring of 2014, a group of young Serbian academics living abroad decided to review several theses of highly positioned politicians. The group found such theses to "suffer from other irregularities" and "fall far below academic standards in terms of both content and scientific contribution", in addition to alleged plagiarism. Not only did their report provoke a storm of reactions throughout the Serbian society, but it was also an "open call" to the Serbian Government (Ministry of Education in particular) to quickly come up with a solution.

In accordance with the principle of openness of science and knowledge, as well as the principle of openness to the public and citizens, amendments to the Law on Higher Education (September, 2014) are legally binding for higher education institutions. They stipulate that doctoral dissertations will be made available to the public prior to the defense. This change complies with the guidelines of the EU Commission Programme for Research (Horizon 2020), and OpenAIRE2020 goals.

At the same time we were approached by another EC Tempus Project (CaSA NaRA) with similar requirement – to establish a repository for exchange of agricultural scientific results. Having analyzed the requirements, we realized that it was only rational to choose the same solution for the repository for both projects.

3. RESEARCH AND APPLICATION

Considering necessary resources and facing a narrow time frame to provide a fully functioning platform for the University and CaSA NaRA project, we have decided not to develop a completely

new platform, but rather to use an existing open source solution. After analyzing available open source repositories, we realized that EPrints and DSpace were the frontrunners [3][4]. We chose DSpace for the University of Belgrade as a platform for meta-data and full-text storage, as it was widely adopted and built using technologies we are well versed in (Java, XML, PostgreSQL). We have adapted the interface, translated it from English to Serbian, formed collections and work-flows. Additionally, we have devised multiple add-ons which help with everyday maintenance. Another requirement was to make theses partially closed, as to make them difficult for copy-paste attempts. We tried locking PDF documents, but that proved to be quite easy to unlock using third party open source software. So we decided to convert doctoral theses from PDF to SWF file format. This solution has been working well, but we hope there may be a more elegant way of protecting documents. At the same time, one of the requirements for National Repository for Agriculture was to establish a connection between this repository and their Moodle e-learning platform used by students of agriculture in Serbia. Existing Moodle plugins for integration with DSpace proved to be difficult to customize, so we opted for development of our own solution. We developed plugin that allows easy browsing and selection of DSpace content as material in Moodle courses.

4. PROMOTION

One of the ways of promotion of the doctoral dissertation service was a presentation given to the Senate of the University of Belgrade. We were surprised with the quick reaction of all the faculties – they started depositing theses on the next day. We were further surprised by the reaction of the public. In the course of the following weeks we graced multiple front page articles, TV interviews, online blog reports.

As regards the quantitative volume of the deposited dissertations, we have already gathered over 80 theses, after only a month. This figure accounts for around 9% of the total annual number of dissertations defended at the University of Belgrade. The workload on the system and staff is optimal, and our helpdesk has been responding successfully to every request.

At the moment, CaSA NaRA repository is being promoted at Serbian HEIs and is in early stages of dissemination.

5. FUTURE IMPROVEMENTS

We are currently working on connecting data from the UviDok portal to the University of Belgrade Information system (ISU). We also plan to establish a channel between UviDok and the University Library Repository of e-theses. In the next couple of months we expect to have this repository well-integrated with other information systems operating within the University of Belgrade.

CaSA NaRA will also enter its fully running phase in the weeks to come. We hope to receive valuable feedback from students across the country.

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EUNIS 2015: Bringing a 10-year old admissions system into the future

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Keywords

Admission, administration, system development, integration

1. Summary

The national Swedish admissions system NyA will in 2015 have been operational for 10 years and is now in a phase of technological renewal. New tools, methods and environmental changes as well as regular hard to predict political initiatives keep up the need for further development at a high level.

Annual improvement investments and maintenance since the handover from the development project to maintenance has averaged approximately 5-6 million Euros, compared to the development cost of approximately 20 million Euros.

Our technical strategy defines how we analyse as well as meet the challenges in the coming three-five years. The strategy will be revised annually.

2. Background

2.1. The Swedish Council for Higher Education (UHR)

The Swedish Council for Higher Education is a government agency whose responsibilities span across the education sector. One of our main focus areas is higher education.

We are tasked with providing objective and relevant information about higher education and the Swedish Scholastic Aptitude Test (Högskoleprovet). The agency's responsibilities include stimulating interest in higher education and promoting widening participation. We are contracted by Swedish universities and university colleges to manage admissions, and also provide support for student administration. As a result, we possess detailed knowledge of admission regulations. Additionally, the agency works to prevent discrimination and to promote equal treatment at universities.

More information about UHR is available at <http://www.uhr.se/sv/Information-in-English/>

2.2. The NyA Admissions System

Practically all admissions to Swedish higher education at undergraduate levels are done through the national admissions system NyA. The process is highly automatized as practically all applications are made through the applicant web interface at antagning.se or the international interface universityadmissions.se.

Domestic upper secondary school leaving certificates as well as university results are gathered electronically in order to be used for applicant selection and foreign qualifications can be entered as scanned documents as supplements to the application.

The system has been in operation for 10 years in 2015. Modernization has always been an issue and will especially be so the coming years as we adapt to major changes in our environment.

The system is custom developed for UHR and used for practically all admissions to Swedish universities and university colleges.

3. Meeting the challenges - strategy for renewal

3.1. Organizational change

As a first step on the road to agile development the organization has been divided into five tracks based on the different user categories of the system. Each track has a product owner with supporting business experts and a dedicated development team with a Scrum Master.

There are tracks for rules management, admissions administrators, department administrators, production co-ordination, applicants and infrastructure. We have also introduced a sixth track for the prioritizing of technical maintenance and system architecture.

The technology track is also responsible for developer support, development pattern introduction and maintenance as well as integrated third party products. Presently the organization is in a transition to integrated User Acceptance Testing (UAT) that has replaced an earlier two month acceptance test phase.

3.2. Internal modernization and reduction of technological debt

Stressed schedules in the final phase of the development project as well as years of continuous intense change have resulted in quite some technical debt that needs attention. Dependencies are reduced and flexibility enhanced in order to prepare for future requirements as well as increase the system maintainability.

The introduction of a technical track with a product owner for technical issues has also made it easier to prioritize refactoring over functional development.

3.3. Environmental changes

A major change in our near environment is the introduction of a new generation of the student information system Ladok, planned to be rolled out in 2016. A part of our adaptations is the introduction of message based communication that will replace the present exchange of flat files. The Atom based messaging will also be completed with a REST-based API for need based supplementary information.

Applicants can when admitted use their accounts on antagning.se/universityadmissions.se for authentication when logging in to the University networks. The solution is based on the SWAMID federation where a new initiative has resulted in a general, non-university based, student ID service that could replace the remaining internal authentication.

In the near future new legislation on national and European levels are about to change the whole field which will affect our strategic planning.

3.4. Technological trends

General technical trends that offers new functionality, lower costs, improved usability or just are due to changes in user behaviour that we prioritize in the coming three year period are

- Browser based GUI replacing fat clients
- Agile (and related) methods
- Service based architecture
- Statistical needs and tools
- DevOps, continuous integration and deploy as well as improved system monitoring
- Mobile terminals taking over, introduction of responsive design

All in all NyA is a system that was built according to a previous paradigm of system development and now is to be brought into a new world of constant change.

We can work it out: Student Systems Partnership and the University of Edinburgh

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1. SUMMARY

The University of Edinburgh faced a significant leadership and management challenge following the partial implementation of a significant change project designed to transform student systems and administration. This paper explores how the development of a formal partnership acted as a catalyst for the transformation of the leadership, management, enhancement and support for the key student record system(s) and process at the University of Edinburgh.

2. INTRODUCTION

The University of Edinburgh embarked on a significant change project to modernise student administration and implement a new student record system (internal name EUCLID) in 2006. The EUCLID business case envisaged a transformation project delivering a very wide range of functionality over the web over a number of phases. A separate project team was set up, with limited Information Services and Registry involvement, instead seeking to configure the SITS/Tribal system mainly by colleagues who were not developers. Despite the best efforts and intentions of the staff on the project team, the project unfortunately delivered systems and functionality to the University which was often of poor quality, unreliable and non-performant. There was a loss of confidence within the University regarding the project and eventually senior management took action.

The project scope was cut, possibly too far, and deadlines to close the project imposed. There was no real agreed exit strategy. In early 2011 the project closed and responsibility for the system passed to Academic Registry with Information Services supporting the system. Difficulties emerged during the business as usual period. The perception of the EUCLID project and the difficult feedback from the community put a significant strain on the relationships between colleagues working on EUCLID with a culture of blame emerging between the Academic Registry and IS Applications. The processes used led to Business Analysts writing large specification documents and passing them to developers with no real handover and discussion taking place. The search for perfection at the expense of utility led to slow delivery, priorities being questioned, little opportunity to learn, and little opportunity to celebrate success. The work was under resourced and the style of working further exacerbated the problem.

3. STUDENT SYSTEMS PARTNERSHIP (SSP)

The then Director of Academic Services and the Director of IS Applications understood if the student record was to be appropriately resourced and confidence was to be restored, structural and cultural changes would need to be introduced.

The SSP was developed as the vehicle for change: a co-located team of business analysts, testers and software developers which would be responsible for setting the strategy for the development of student administration services, the delivery of key projects involving both business change and IT systems development, the introduction of effective methodologies and the efficient use of resources. The team would be encouraged to use and develop skills within the team, to innovate with new technologies, encourage user participation and challenge processes and introduce more effective workflow management.

4. DEVELOPMENT OF STUDENT SYSTEMS

Student Systems has developed in four key phases. The first phase focused on the development of the Student Systems Partnership (SSP). The Directors proposal was approved and the SSP established in December 2012. The development of the partnership came with a resource commitment for both business analyst and developer skills.

This made the second phase of work possible. The Student Systems Roadmap 2013-16 has been developed, setting out the strategic direction in the University for the development and support of key student and academic administrative systems in the University. This provides the department and the wider University with a clear sense of our priorities, key stakeholders, governance and the approach we will take when working with colleagues.

Phase three focussed on the operational side of our responsibilities (which covers live support, management information, training, statutory returns and student records). The continuous improvement of our processes and live systems needed to receive the same level of attention and focus as new enhancements and developments. The service name 'Student Systems' was adopted in December 2013 which combined the SSP and the Operations team and four key objectives were articulated around: leadership; service; impact and place.

Phase four has been to embed these changes across the teams. The Student Systems Annual Plan provides the structure for this and relates our activities back to the roadmap and the departmental objectives.

5. WHAT WE HAVE DELIVERED

The change initiative has led to the creation of a department which is beginning to reach its full potential and more consistently meet the needs of key stakeholders.

The service has developed a number of areas of practice which are in a position to be shared across the organisation: working effectively across operational boundaries; managing student innovation to enhance service provision; project management (spanning policy, business process and system changes); and building confidence and enhancing service delivery in a large, devolved institution.

We have made a clear impact on the business over the past two years, through a number of areas including: increased student self-service and access to their student record; the administration and communication of awards, assessment & progression information; enhanced admissions processes and systems in a devolved structure; supporting Personal Tutors and Student Support Officers in their relationships with students through the delivery of Personal Tutor Tools; enhanced programme and course information and tools to support decision making; tools to support student engagement & attendance monitoring; and enhanced use of technology to enhance usability of systems.

6. AUTHORS' BIOGRAPHIES



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An enterprise innovation: University of Reading Video Publishing System

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[Entry for EUNIS Elite Award 2015](#)

Keywords

Leadership, innovation, organizational culture, technology management, video

1. ABSTRACT

Technology innovation in universities can be formidable tasks due to size of user base, the increasing distance between campus and students, but also increasing proximity that technologies such as video could establish.

University of Reading, UK, having invested in smaller installations Helix and iTunesU, then decided to implement an enterprise-level transcoding and publishing system. The process faced many challenges. The passion and commitment from a core community provided enough impetus for senior management to move the project forward. A major innovation process ensued which saw further engagements from increasingly more and diverse users. By championing best practice and demonstrating excellence in technology, entrepreneurship that is fundamental for successful innovation, this paper demonstrates evidence of excellence in many ways. The innovation remains operational and is sustaining high use with very few issues and problems for over four years. The paper suggests methodologies that others could consider in their own innovation.

2. BACKGROUND

Universities have been seats of technological innovation and entrepreneurship in recent decades, e.g. industrial partnership, start-ups. There have also been many internal technological innovations within such institutions, e.g. research in network protocols which led to the internet in the 1990s, as well as the configuration of commercial enterprise applications, e.g. email. Knowledge and entrepreneurship are two factors that enabled many technology personnel to understand the problem or limitation of a given product or service, develop the interest and passion to evaluate possible options, implement the accepted solution and continue with service improvement thereafter.

This paper analyses the innovative efforts that created the video publishing system (VPS) in the University of Reading (UoR), UK. It is a journey of discovery in technological implementation, organizational culture, vision and strategy formulation, and strategic alliance. The paper will discuss VPS benefits to UoR, innovation and efficiency gain, collaboration, imagination, technological integration and transferability.

Internal to UoR, the VPS project name is AV Dropbox (short for audio-visual dropbox) as it transcodes audio and video files (as Figure 2 shows). The name remains so today. This paper refers to the video part being the majority of the innovation, and uses VPS to avoid confusion.

The university's Marketing, Communication and Engagement (MCE) decided, having consulted with IT Services (ITS) with experience running a Helix streaming server, to purchase an Apple server in mid-2009 to set up an iTunesU online presence. I joined the University after they purchased the server.

As I explored functional requirements with MCE, we soon realized the formidable task of dealing with video as knowledge content, and how to engage with users, both academic and MCE staff to begin experimenting and using it. While university staff were keen to have something central for hosting videos, there was seemingly a wide array of requirements, perception and expectation which Trompenaars & Prud'homme (2004, pp. 13-45) regards as cultural conflicts. Complacency was easy to creep in when faced with the trauma of the likely change. Without a guiding coalition, the lack of a sustained effort in communicating the vision worsened the situation (Kotter, 2012, pp. 169-181, 145-150; Valikangas, 2010, p. 8). As van den Bosch & Duysters (2014, pp. 120-121) explained, a major effort was required for an enterprise innovation, ideally a dedicated team with primary stakeholders, delegated responsibility, clear mission and protocols, and the resources and infrastructure to act with significant urgency.

Faced with several major outreach initiatives, including numerous campus facilities upgrades and initial phase of the Malaysia campus, the university was not able to commit additional innovation effort to developing the VPS and so halted the project. Having lost commitment from the owner-sponsor from whom the work was first commissioned, ITS leadership decided there were enough stakeholders in UoR community to collaborate with and to use it that the work should continue. We formulated the vision and strategy, and assessed necessary technology components to build a solution, similar to Lafley's (2013, p. 14) "integrated cascade of choices" approach: discovering your winning aspiration, deciding where and how to win, what capabilities to use, and what management system to require where choices earlier cascade down to refine the process.

By the end of 2010, VPS went live. About a year later, MCE decided to transfer all existing video files over to VPS and started using it for their new videos. While MCE owns the design principles (e.g. choice of screen dimensions and encoding format) of video assets, the system is a technology-led innovation. It has required technologists to be entrepreneurs to align technological options with business requirements.

The tables below provide a snapshot of the number of video files processed by the system. (I left UoR in 2014. I am grateful to ITS for the updated stats.)

Table 1 Annual upload totals

Year	T&L	MCE	Total
2011	200	530 ¹	730
2012	260	170	430
2013	237	203	440
2014	248	156	404

Table 2 Top 3 uploads per year

Year	Months	Total
2011	Sep, Oct, Nov	530
2012	Mar, Sep, Nov	180
2013	Feb, Jan, Sep	203
2014	Mar, Feb, Jan	207

Table 3 Lowest upload per year

Year	Month	Total
2011	Apr / Jul	5 each
2012	Apr / May	20 each
2013	Apr / Nov	17 each
2014	Dec	2

Legend

T&L: teaching and learning

¹MCE transferred existing videos from a 3rd party supplier to the VPS in 2011.

3. BENEFITS

The VPS is the first enterprise-level end-to-end video upload, transcoding, storage and publishing workflow system in UoR. It is an important asset for the 17,000 students (13,000 UK and EU, 4000 non-EU, 9,300 undergraduates, 7,700 postgraduates) and 4,000 staff (2015 statistics, see <http://www.reading.ac.uk/about/about-facts.aspx>). Apart from teaching and learning purposes (missed lectures, revision, distance learning etc.), it provides a brand- and clutter-free solution for

marketing and recruitment purposes, compared to external social platforms (YouTube etc.). Its heightened significance was realized several times when confidential video communication to staff had to be disseminated by the University Executive Board quickly, the innovative open architecture made re-configuration easy. Although external social platforms had more features and global brand prominence, the knowledge community in UoR demonstrated sufficient passion for the vision to commit development and use. ITS collaborated with the stakeholders to produce an open collaborative architecture. This strengthened ownership of hardware, software and concept.

I implemented short-term win strategies (Kotter, 2012, pp. 121-135) to gain traction for uptake of the service and this benefited the community. MCE required transcoded videos to be stand-alone so that users had the options to play the video files directly, and content editors could embed files into web pages. MCE also stipulated h264 format in mp4 container to support progressive download. The open architecture supported these requirements. The benefits were immediately realized when more than 500 video files were re-transcoded for the VPS with no downtime and insignificant impact on ITS support. ITS decided to produce a high (640x360) and a low (320x180) density versions for each video, and from the 2013 upgrade, the option of webm format.

According to Kotter (2012, p. 126), a series of short-term wins the earlier in the innovation the greater the success rate of the innovation. I used this approach to gain stakeholder support, e.g. beginning in early prototypes, videos will play back on modern browsers on any devices. Another benefit is the community's shared terminology on video creation and publishing. It means removal of communication barrier which otherwise is a multitude of different words and phrases which could refer to the same standard or procedure, making community building extremely difficult. This early short-term win makes it very easy for any member of staff to communicate about video, in relation to teaching and learning or outreach campaigns, with other colleagues across the university.

Along with campus facilities upgrade, a number of departments began developing courses for distance learning (Law), professionals (Business), and materials for student recruitment (International Study). The Centre for Quality Support and Development (CQSD: for development and enhancement of teaching and learning) invested in several projects: the ASSET project "to encourage staff to experiment with the use of video media to provide feed-forward and feedback to students on their assignments", with funding from the Joint Information Systems Committee (<http://www.reading.ac.uk/videofeedback/>), progressing to DEVELOP (Developing and Enhancing Virtual learning environments and E-Learning Options, <http://blogs.reading.ac.uk/develop/>) integrating pedagogy with lessons learned from ASSET and then realizing the gains on the Blackboard learning management system.

The VPS was becoming a consistently visible, positive asset witnessed by many people (Kotter, 2012, p. 126). It benefited them by providing a single easy-to-use solution to publish videos that conform to best practice standards. To them, VPS was reliable, backed up by sufficient technical support. Several departments (Education, Theatre etc.) built on the above realized benefits to implement alternative e-learning materials (e.g. Flipped Classroom), and student-generated content for assessment.

With video becoming increasingly central in UoR, MCE and CQSD independently increased engagement activities (e.g. video shooting and production best practices) with their respective communities. Both were virtually walking in one pace with their realization that a change effort was being realized which in turn would benefit their work (recognising change effort, Kotter, 2012, p. 126). Very soon, both communities merged in a series of joint workshops and seminars, leading to creation of the Digital Development Forum central resource, which then formed several specialized interest groups (social media, video production etc.). As Trompenaars & Prud'homme (2004, p. 145) explained: "...on the one hand a corporate culture needs to fit the company's business strategy and business environment, so that corporate culture and value proposition are aligned, while on the other hand corporate cultures need to be adaptable to a changing environment... The challenge is to develop a corporate change that can recognize change in the environment, and which has the versatility to implement new ways of working and new value propositions while retaining the core."

The above benefits show that deliberate plans for short-term wins at the early phase of creating VPS led to long-term organizational-wide transformation (Clark, 1998, p. 4). Retrospectively, it's true that organizational culture change as precursor to innovation would have little progress without a

visionary champion to lead the innovation, but the champion would require a collection of deliverable promises - short-term wins leading to long-term gains - to secure organizational support.

4. Efficiency and productivity gains

VPS shows very high efficiency and productivity gain. Customers use a web site to upload their video file for transcoding to afore-mentioned acceptable standards. A few minutes later, they receive an email containing instruction for embedding their transcoded video in the Blackboard learning management system and the ActivEdition content management system. As VPS is fully automated, support personnel rarely get involved in day-to-day operation.

This is a huge gain since it presents a single, predictable and easy-to-use solution that is internally owned, against other solutions not fully in user's control in terms of operation, specific format or branding (e.g. YouTube), not built with resilience or incapable to scale (e.g. a department solution, postgraduate experiments).

The percentage of files that fails to complete transcoding is less than 5%. This is often due to unusual encoding used in the uploaded video, or the video is more than 90 minutes duration, causing transcoding errors. Upload failure rate is much higher, estimated at 20%, the single factor being the upload file is near to or over 2GB in size. I upgraded Episode in February 2014 and changed the host from the Mac to a Windows server. There have been no incidents or problems with VPS for over a year. This is proof of VPS' high efficiency and productivity gain, and contributes to improving staff efficiency and productivity.

VPS does not provide tools on video creation or live streaming. It's impossible to support an ever-changing video recording market, even high resolution webcams could generate unusual encoding formats. This ensured that project had a clear and narrow focus that would still have a very wide user base.

Technically, we gain efficiency in system components. By using open source (or public domain) software, we choose what parts of each component to use. Figure 1 shows several independent low-resource servers. Dropbox2, available at <https://turin.nss.udel.edu/wiki/dropbox/>, is free and customizable. With the exception of a Windows server on Dell hardware to support Episode, and JW Player, the others run Ubuntu operating system and Apache web server. ITS expertise evidenced in the hardware, system and communication methodology ensured high efficiency in this architecture.

Figure 1 VPS components

Component	Purpose
Upload webserver	To support upload, and workflow routine
Server with Dropbox2	To run modified Dropbox2 script, read and send emails
Storage server	To save uploaded and transcoded files
Transcoding server	To run Telestream Episode (licensed)
Delivery server	To disseminate files, and JW Player (licensed)

Figure 2 provides a representation of the system. It is clear that we could harness the high efficiency and productivity gained elsewhere in UoR along with the cost savings and knowledge transfer, e.g. the university standard PC configuration with its own expert team, and the use of NetApp which is already widely used in ITS with international large user base for peer support.

Figure 2 VPS overview

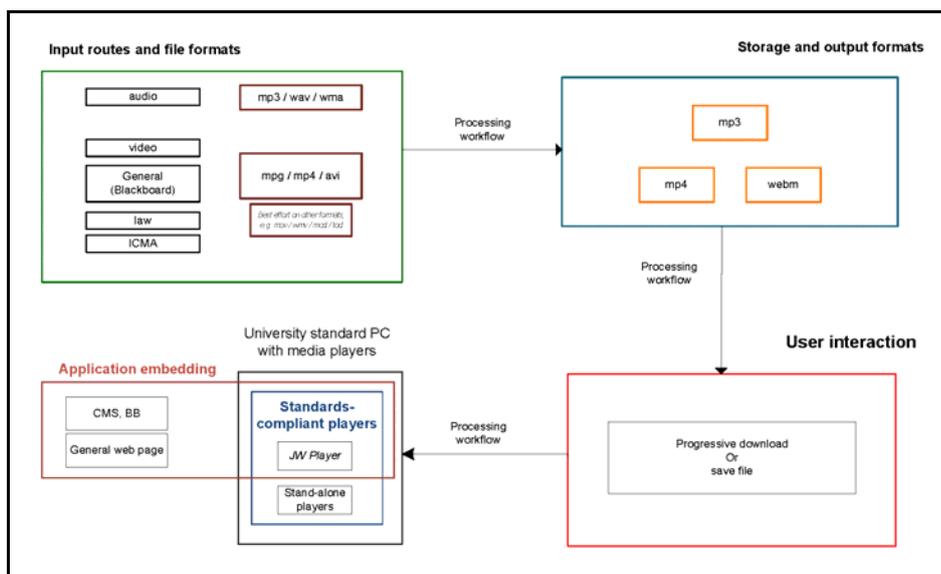


Figure 2 notes:

1. VPS also transcodes audio file to mp3
2. 'video' and 'General' in "Input routes" are teaching & learning and MCE videos respectively

As project manager, I gain further efficiency working closely with colleagues in ITS' Project Management Office. This ensures that the project has sufficient resource (time, experimental hardware and software, collaboration etc.) to commit each project stage to targets. It will be able to satisfy business requirements but also maintain a variable set of portfolios. The core technology being able to scale is a major benefit (Dees, 2001, pp. 188-192; Kearns, 2000, p. 154). It scales and adapts to meet a range of business expectations, e.g., integrating Business School's post-processing of scheduled lecture capture files.

5. Innovation

ITS took a pro-active approach, similar to Lafley's (2013, p. 14) "integrated cascade of choices", to lead this innovation to completion. Such an approach could impact at a scale too much to handle because innovation could cause unacceptable level of disruption to the organization (Meyer, 2014, pp. 9, 13). However, I have also taken a strategic approach to align with UoR's vision, in particular the potential gain that MCE and CQSD customer bases knew they could have a 'usable' system. Defining what different people mean by 'usable' is a formidable task. ASSET and DEVELOP had already created significant momentum along with a group of developers and users available for knowledge exchange, development and testing. This constituted the 'push' factor where they want to build on their lessons learnt to develop further.

The 'pull' factor came from the several departments developing courses that will use many videos as their primary media for teaching and learning. They need a system not only to handle a much larger scale than ASSET or DEVELOP, but also a much refined business requirement that undergraduates and professionals undertaking certification courses must be able to access the videos anytime anywhere. Meyer's (2014) Innovative Optimizer type fits this description where innovation output is roughly balanced on the radical-incremental scale.

The four principles in the strategy are:

1. Identify, engage with and manage potential stakeholder groups using project and service management best practices
2. Core system supports open framework, thereby supporting different types of users and different purposes

3. Ease of use for customers, supported by user guide and user community
4. Technical documentation to support training and knowledge transfer for administrators and support staff

To accomplish the above, I learnt that social engineering and entrepreneurship skills were useful to establish collaborative links and create a community of like-minded people to contribute ideas to the design of the technology and eventual use. I showed Dees' (2001) characteristics of social entrepreneurs in creating a core community and distributing responsibility. I was a 'dreamer' who drew up many detailed plans, pictures and drawings to engage with stakeholders. I used my leadership skill to create a 'crisis' to focus resources (Trompenaars & Prud'homme, 2004, p. 196) - the crisis being that we had to seize the opportunity now for the innovation before potential users became too much locked in to multiple other solutions which were less than ideal.

I recognized the leadership 'phases' associated with organizational lifecycles (Koplyay, Chillingworth, & Mitchell, 2013): beginning with a broad focus to engage stakeholders with an idealized future, innovation moved from large technical gains to incremental refinement. Using my leadership skill, I managed the gradual integration of the innovative product and services into ITS service catalogue. ITS provided the resources for me to "build authority through empowerment, to stimulate teamwork through individual incentives, to show courage through taking calculated risks, and to become consistent through learning from exceptional situations" (Trompenaars & Prud'homme, 2004, p. 56). My innovation exemplifies the Excellence model (Hudson, 2009, p. 192) where a result-focussed approach is backed up by a set of enablers on skills, knowledge and transfer, and policy and strategy. The loop completes with performance reviews leading to further learning and innovation.

I used SSADM (Structured Systems Analysis and Design Method) at the initial phase of the project to determine MCE's perception of current provision of video resources and intended future ideals envisioned in iTunesU. This drew out impact of implementation of their strategy which demanded staff resources throughout the project and lifetime of the product, at an unsustainable level for reasons already mentioned. The use of 'physical' and 'logical' diagrams ensured this process was as objective as possible. The key with this approach was to engage with stakeholder's perception of their intended product as fully as possible, providing room to formulate functional requirements.

In the numerous sessions of workshops I had with MCE, we discussed technology and procedure with respect to strategy and current organizational orientation towards the innovation and impending culture change. Brown (2014, pp. 212-214) stressed that organizational culture change is key factor for introducing innovative products and services, without which new policies and procedures, and new systems are unlikely to sustain for long and the innovation will fail. Taking risks might be seen as gambling with resources and opportunities. Dees (2001, pp. 125-160, 188-192) argued for enterprising skills to build and push organizational capability. Over time, through numerous consultations, I established there were enough substantive factors for innovation but I needed to closely monitor and deal with risks. With numerous campus upgrade and extension projects going on, the organization has demonstrated its strong resilience. An enterprise resilience, according to Valikangas (2010, p. 37), is not about refusal to change, but the capability to strengthen its core values through innovation and organizational transformation. When I completed the VPS innovation, I reached the point of organizational culture change that the iTunesU project had aspired for.

Taking an entrepreneurial approach with the stakeholders who were passionate for technological and cultural transformation was relatively easy. I organized numerous workshops and meetings for knowledge exchange and drawing up ideas to encourage change of organizational parameters (e.g. allow all staff to publish videos with no quality check) for short-term wins. I worked closely with systems colleagues to learn about and experimented with suitable technologies. I used Agile methodologies to maximize gain in technology-business alignment. I included a range of stakeholders at different stages of development, supported by the Excellence framework (Hudson, 2009, p. 192). This ensured that I had scope to manage technical and business priorities and risks in each workshop, avoiding a linear "develop - test - deliver" approach. Utilizing the benefits that came with high performance teams as I found in the stakeholders, I was confident that they would commit reasonable time to the project to explore outputs from different combinations of technologies to determine best options.

6. Imagination

I conceived VPS development in four “win formulae” communicate the strategy to stakeholders and users.

6.1. Win by vision

Championing a single-platform solution in a largely heterogeneous organization has its risk that it could be seen as a top-down implementation with little regard to requirements. This is even more so with a technology-led innovation since there is a tendency that too much priority is given to innovating technology constraining business practices to fit in. However, the strategy was successful having gained major support and commitment from stakeholders, with whom I then developed communication strategy to convince end users. A winning corporate culture needs to be “open for change and for diverse views ... to pursue paradoxical criteria simultaneously and reconcile them.” (Trompenaars & Prud'homme, 2004, pp. 23-24) It was a successful vision with endorsement from senior management.

Using project management best practice and entrepreneurial methods, the innovation gained further capabilities: that it will be clear, predictable and easy to use. Here, ‘clear’ means it does exactly what it claims to do and nothing else. In other words, no strings attached, available to any member of staff.

The innovation wins by having a strong cost leadership (Lafley, 2013, p. 82) where infrastructural expenses is very low (around £5,000), no cost at point of use, and stakeholders activities enhanced a forward-looking and dynamic organizational culture. It also wins by differentiation to support alternative configurations, e.g. support upload of video files larger than 2GB, and integration with Business school’s lecture capture architecture.

6.2. Win by being open

Forming an open community to identify requirements, steer development and undertake improvement was a winning formula because it encourages ideas and distributes responsibility. It further gives the project a greater sense of legitimacy and purpose when we began receiving positive feedback from senior management and wider community including external users. Hudson (2009, p. 173) explains that such a strategy increases the organization’s competitive edge because it builds on skills and abilities already present in the organization, and the internal stakeholders who are also developers and users are the best people to ensure the service fits the organization’s mission.

I acquainted with people from other institutions in conferences and workshops related to best practices in institutional video solutions. The open nature of such networking brought about a strong sense of community for support, ideas, learning and friendship. In particular it gave me richer and wider scope of user stories of innovation. This strengthened our mission that, given UoR context and available resources, the innovation is achievable.

By adopting a widely-accepted mp4/h264 format, the videos can be played back on the widest set of computers and devices. Another aspect of the winning formula is the additional support we provide to end users to manually transcode video files for them when resources allow. I have taken opportunity to engage with new collaborations and integration ventures to promote open-ness, e.g. alternative input process for videos for distance-learning Law students.

6.3. Win by being adaptable

When MCE withdrew from the project, ITS was able to consolidate resources and adapt to the situation. It tasked me to develop vision and lead the project so we could adapt to a more flexible set of stakeholders.

VPS architecture is very adaptable since the components (see Figure 1) are independent of each other. I have avoided a single point of failure scenario. When Episode software was upgraded which included a change from Mac to Windows server, I did not need to amend the architecture, including the period of testing with the operation of two transcoding servers.

Another winning formula is that transcoded video file formats (file types) can be amended in real-time with insignificant impact to the workflow. Episode on Windows was much more reliable in dealing with file format change than the older version we had for the Mac server. Further, the rest of the architecture, e.g. workflow routine, sending instruction email, required minor change to deal with changed file types. Producing both high and low resolution versions for each video ensured that there was room to adapt to low bandwidth connections so that users could still access the materials.

The architecture is adaptable in economies of scale in that Episode will handle a long queue of files for transcoding without causing runtime errors. The workflow script, however, is currently not saleable until a major modification to the code to allow for multiple instances of workflow supporting multiple extractions of uploaded video to the storage server. The architecture is also adaptable in each component's input and end points, which enabled integration with Business School's workflow.

6.4. Win by knowledge

The project has a winning formula by knowledge in the sense that we built on the latest stable file encoding types and architecture. We keep up with industrial best practice in server configuration, security, and browser integration and implement them where possible.

The project wins by knowledge in its critical analysis of existing business and technological shortfall. For an innovation to be successful, it is critical to understand the current situation, e.g., UoR culture, constraints and strengths. Having evaluated this knowledge with senior managers, I was in a much clearer and decisive position to design the innovation. I led the project to integrate business requirements and environmental awareness, and technological insights.

The link between organizational learning and accountability in innovation is noted by Hudson (2009, p. 192). Grouping stakeholders together enhanced knowledge and communication to set up VPS. I had some of the most talented and committed UoR colleagues in the stakeholder group. The group dominated the change agenda. Dees (2001, pp. 63-102) reported that mobilizing resources at critical phases of the innovation increased success rate of the work. In our case, the size of this community reinforced the project's legitimacy, accountability and commitment to its continual success.

7. Collaboration

The project began as a commission from MCE to ITS to install iTunesU to provide a workflow that supported video upload, transcoding, quality management, editing and publishing. As explained above, the lack of clear vision, strategy and commitment hampered progress. When MCE halted the project, the lack of closure and lessons learned was indicative of some turmoil within the organization. A project without owner, executive, sponsor or senior user, ITS senior managers decided that the knowledge and resources I had built up was sufficient for the project to continue with a different set of stakeholders, since the afore-mentioned ASSET, DEVELOP and other communities already had successful outcome and with whom we could collaborate for an enterprise solution. We reconfigured the project with an ITS Assistant Director as sponsor, while senior users was MCE as they were the design authority.

I established contacts with CQSD to discuss how we could collaborate on developing VPS. Their energetic engagement proved very useful. Two representatives - a lecturer who was also software developer, a learning enhancement officer who was also application developer - were pivotal in project lifecycle and service improvement. We collaborated on details of the working of each component (Figure 1) and their pros and cons. We reviewed benchmarking data within VPS and between alternative possible solutions for a thorough performance improvement profiling (Hudson, 2009, pp. 211-212, and Excellence model, p. 192), with respect to academic users where a simple, straight-forward, clutter-free, reliable operation will significantly increase uptake.

I re-established contacts with MCE to reinforce their role as senior user and resumed discussion about design specification, as well as gaining access to a wider set of stakeholders so that we had a richer set of user stories and requirements. While I preferred MCE being the sponsor, I gained insufficient support for this end. To contrast with another project taking place about this period, CQSD became sponsor for the Blackboard system: this was a better arrangement for the organization and ITS in particular, achieving a clear division of roles and responsibility to manage Blackboard.

Collaboration with MCE was useful to review quality management and user engagement requirements. We decided that user education is paramount to ease entry into video creation and editing, along with suitable documentation on how to use VPS. This effort contributed to the creation of series of events under the Digital Development Forum initiatives including the later formation of special interest groups. There was an uneasy balance between what different stakeholders viewed as 'simple and easy to use' even within the MCE community. Some preferred instructions and options available on the upload page; while others prefer an interactive submission process. These concerns remained unresolved.

This stalemate echoes Lafley (Lafley, 2013) who says many organizations that failed in innovation was because their leadership did not translate vision and mission into actions. Recognizing potential repeat of the iTunesU stalemate, I proposed a modified version of the CQSD workflow for MCE. Following testing, they transferred the hundreds of existing videos from a Flash server hosting provider to VPS. Further collaboration with MCE continued to prepare suitable documentation and events to publicize VPS and encourage uptake. To this day, the users from the MCE community who upload videos tend to be the 5-6 individuals in the MCE office. This is largely because they are sponsors of outreach and enhancement campaigns where video is part of several activities. They carry out quality approval and then publish the video to VPS.

Collaboration with systems colleagues was fundamental to progress in VPS. My role was to align technical solutions to business requirements. Fundamental design principles included (1) scalable: available to all staff, multiple instances of upload, transcoding and delivery, (2) open: architecture was adaptable and easily reconfigurable for different purposes, and (3) part of service catalogue: the technology was within skill sets of ITS colleagues, has sufficient community support and/or maintenance contract, and to merge into ITS suite of applications for service management. There was an uneasy balance between best practice principles, and the attitudes, knowledge and actions of people who uploaded video. Systems colleagues kept up-to-date with and contributed to latest developments in server and media technologies including specific strengths and pitfalls which could reduce servers and streaming (progressive downloading) performance. In contrast, end users tended to use available technology and may not take steps to protect their files. Over time, we learnt to concentrate on technologies that had the widest scope, and contributed to user education via MCE and CQSD.

8. Technological integration

At system level: on a Linux (Ubuntu) server, I have written Perl scripts to integrate with MS Exchange to extract video files and save them to a NetApp storage server. Sendmail on the Linux server sends instruction email to customer and notification email to ITS.

At application level, Systems colleagues provided a modified Dropbox2 implementation for me to further adapt to varying workflow requirements, e.g. CQSD and MCE. I configured Episode for Mac, and later Episode for Windows, to integrate with NetApp storage in order to ingest and transcode video files. Systems configured an Apache web servers (on Linux) to provide the mechanism for file upload into Dropbox2.

At delivery level, I installed JW Player to support Flash and webm embedding on web pages, and provided embedded code for CQSD and MCE who then developed their respective solution: a web tag for the ActivEdition system and a widget for the Blackboard system.

At architectural level, the above servers and their corresponding communication paths are supported and protected by Active Directory enterprise authentication and appropriate security protocols.

This technical design is an open framework to support modified integrations, e.g. file copying to NetApp instead of upload, and integration with faculty lecture capture server post-processing

9. Transferability

The technology is easily replicable since it upholds open standards and industry best practice. Linux and MS Windows servers configurations and workflow scripts are easily replicated since they are standard methodologies and have large user communities for help and support. The components (e.g. Dropbox2, Episode) can be replaced or modified given VPS' open architecture.

Project, service and technical documentations are available for anyone to consider transferring or replicating such architecture in another institution. Since each organization differs greatly from others in their operation, structure and culture, the concept (architecture) and related documentation are merely starting point. It will require an enterprising innovative effort to implement VPS in another institution, or to design anew using VPS as a reference.

10. Conclusion

VPS being a successful innovation is largely due to the outlook of the organization. According to Kearns (2000) and Dees (2001), similar organizations that are successful in their innovations have moved away from a "mandate" outlook (e.g. a center to disseminate knowledge) to one that is energized by mission, e.g. to maintain leadership in joint ventures with commercial organizations. To do that, organizations need to have sufficient resilience and capabilities and a creative culture. Within this environment, I have found that I needed to journey into working patterns that might be regarded as unorthodox, and management approach that is more results- rather than objective-driven.

I often recall how technology-led innovations in the 1990s, e.g. email, were successful because consumers had no choice. After the myriad choices e.g. in content and learning management systems of the 2000s, the current decade sees triumph of several suppliers in each space taking majority market share. Even so, consumers are regularly dissatisfied by the university system, whether having gone through an acceptance process or not, or more satisfied by external systems. There appears to be more to be said about consumer culture than technology. VPS is conceived with a mix of 1990s top-down one-system-for-all approach (the way videos are integrated in learning and content systems effectively states the acceptable policy of use), and integration of user stories and requirements. This is perhaps fundamental reason why the technology remains efficient, stable, and open since the service was launched, and consumers continue using it to the point where the service becomes part of the essence of the university.

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Preliminary results from a flipped classroom experience: Getting an insight from the real marks

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Learning, flipped classroom

1. SUMMARY

The Universitat Politècnica de València (UPV) has developed a flipped classroom experience during the first semester of the course 2014-2015. The design of the experience is that one group of students receive their teaching using flipped classroom schemes while the rest of the students get traditional learning. At the end of the semester there is a common evaluation test, so this allows to compare academic results between both ways of teaching.

The experience was carried out in two faculties: Computer Science and Business. The academic results from the experience have been two-sided: the best students in the experiment get best results than their common fellows, but the worst students in flipped teaching groups get worse marks than the common ones.

2. FLIPPED LEARNING AT UPV

The Universitat Politècnica de Valencia (UPV) is a higher education institution with a strong history in applying IT technologies to the learning process. Beginning with the campus-wide LMS deployment in 2002, and then with the learning objects production with the "Networked Teaching" project and the development of the Polimedia system, the Videoapuntes lecture recording system, and in the last years the integration of automated transcription and translation systems and the production of MOOC courses, being an active member of the edX consortium.

While these programs have had a remarkable success in terms of the amount of learning materials, their quality and the students' opinion, they have been mostly used in a blended-learning system, in which classical lectures are complemented with those learning objects. In other cases, as in the MOOC courses, that material has been used also to create complete online courses.

However, recently a new paradigm in pedagogy has been developed: Flipped Learning (FL). In Flipped Learning [7] [8] there is an inversion in the classical lecture system so that students receive in advance the theoretical content that they would receive in the lecture hall and the time in the lecture hall is used to clarify, reinforce and practice the subject they are studying. This paradigm requires a change in the functions of the teachers, but also a production effort in having that teaching materials before the assigned time in the lecture hall.

With all these in mind UPV feel natural to make a pilot test to know what could be the challenges and the results of actually deploying Flipped Learning in a wide scenario of courses. So, for the first semester of the 2014-2015 academic year, a group of students in two faculties (Computer Science and Business) have received all their courses with Flipped Learning.

Thinking in having a good metric of the academic results, those students have the same exams (and at the same time) than the standard students, so we have comparable measurements. We have quite a number of metrics, showing that, at least, FL approach is not worse than Classical Learning (CL) paradigm, and it is usually better. However we have a very interesting result when we compare the results of the FL students' cohort with the CL students' counterpart using the difference in differences method [9].

Our main finding is that we see that the good FL students get better results than the good CL ones, but the bad FL ones perform worse than in the CL case. In figure 1 we see the relationship between the FL students (circles) and the CL students (crosses), comparing their last year performance, to avoid a selection effect. Looking at that we see that the good FL students get better results than the good CL ones, but the bad FL ones perform worse than in the CL case.

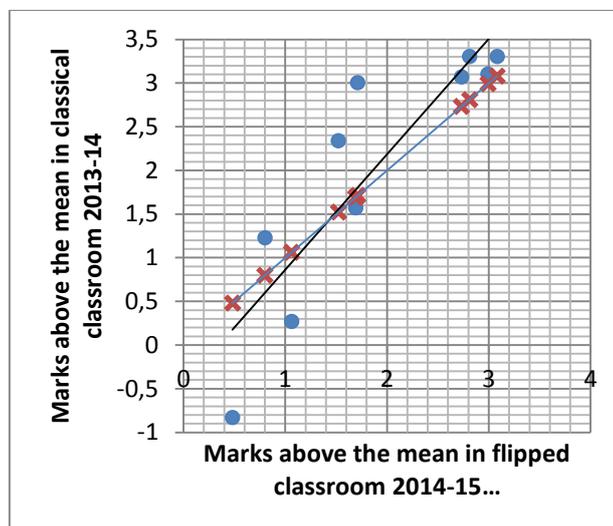


Figure 1- Marks comparison

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Developing an open architecture for learning analytics

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Keywords

Learning analytics, systems architecture, communities of interest, Apereo LAI

ABSTRACT

Carrying out learning analytics can involve a complex range of data sources, systems and dashboards, often owned by different parts of the institution. Vendors are quickly moving to try to capture the market and ensure their products are at the centre of the learning analytics landscape (Sclater, 2014b). However the architectures for connecting the various elements are still evolving as new applications for learning analytics emerge. Complicating the picture further, the wide variety of systems in place at different institutions means that architectures are not easily replicable between organisations or sometimes even between departments.

The interest in deploying learning analytics services at the campus level is increasing but there are many barriers to deployment such as: breaking down data silos, understanding the predictive models and interventions, data governance, and the lack of competences within an organisation needed to manage interventions. There is therefore a growing need for guidance to institutions which wish to develop their learning analytics capabilities as to how to integrate multiple data sources and the new systems they need to build, procure or co-develop as part of a wider community.

In the UK Jisc is spearheading an initiative to procure the elements of a basic learning analytics system for higher and further education institutions. This has involved developing an architecture comprising a number of discrete data sources and systems. The model was reviewed by a cross disciplinary team of European experts in Paris in February 2015.

This paper describes the Jisc learning analytics architecture and proposes it as a reference model which organisations can use to help develop their own architectures for learning analytics. The experiences acquired and lessons learned during development have the potential to influence and be influenced by wider international discussions around an emerging Open Learning Analytics Framework such as the Apereo Learning Analytics Initiative. The paper demonstrates how an architectural walkthrough with invited experts taking on discreet roles was used to enhance the architectural model.

INTRODUCTION

There is growing interest in deploying learning analytics services at educational institutions. Stimulating this are a number of successful examples of analytics services that have impacted on students' learning. Course Signals is perhaps the best known (Arnold & Pistilli, 2012). Another example is the Open Academic Analytics Initiative (OAAI) led by Marist College (Jayaprakash, Moody, Lauria, Regan, & Baron, 2014). Both OAAI and Course Signals predict the likelihood of students failing. However, learning analytics has the potential to impact positively on learners throughout their studies, not only through improving student retention, but also through better feedback from recommendation systems and adaptive learning systems. An all-encompassing framework would need to include: the collecting of data; dealing with crucial issues such as data governance and ethics; pre-processing of the data and sharing of the data models; predictive modelling; interventions including dashboards and other strategies, and measurement of their impact on the learning process.

With so many elements for a university to assemble, a practical approach to knowledge dissemination and initial service creation is necessary. JISC's scaled implementation will allow organisations to gain experience of learning analytics using freely-available services.

There has already been a scurry of research activity examining possible frameworks, for example in 2011 an Open Learning Analytics Architecture (OLA) was proposed (Siemens, Gasevic, Haythornthwaite, Dawson, Shum, & Ferguson, 2011). Discussions were then taken forward during a number of OLA framework meetings and summits (e.g.

<http://www.prweb.com/releases/2014/04/prweb11754343.htm>,

<https://r3beccaf.wordpress.com/2014/12/20/open-learning-analytics-amsterdam/>).

The wider discussions have strongly influenced the Aperio Learning Analytics Initiative (<https://confluence.sakaiproject.org/display/LAI/Learning+Analytics+Initiative>) which integrates a set of interlocking pieces of open source learning analytics software, supported by an international community of higher education organisations. However, a mature conceptual framework supported by a fully functional end to end reference implementation has yet to fully emerge. Jisc's model should form a reference point for further discussion and evolution.

Jisc's proposed architecture for learning analytics (see Figure 1) has been developed in an attempt to conceptualize the end to end elements of a basic learning analytics system which is being procured for higher and further education institutions in the UK. Data comes primarily from the student record system, the virtual learning environment (VLE or learning management system) and a variety of library systems. Institutions are also beginning to use data from other systems such as attendance monitoring and assessment systems.

Data is fed via an extract, transform and load process from the student record system, and from the other systems to a *learning records warehouse* which contains data in both structured and unstructured formats. Data from *existing institutional record stores* can also be integrated, and students may also input *self-declared data* from e.g. wearable technology.

At the heart of the architecture is the *learning analytics processor* where predictive analytics are carried out, and lead to action coordinated by the *alert and intervention system*. Visualisations of the analytics for staff are available in a series of *dashboards*, and a *student app* allows learners to view their own data and compare it with others. Meanwhile a *student consent service* helps to ensure privacy by enabling students to give their permissions for data capture and use.

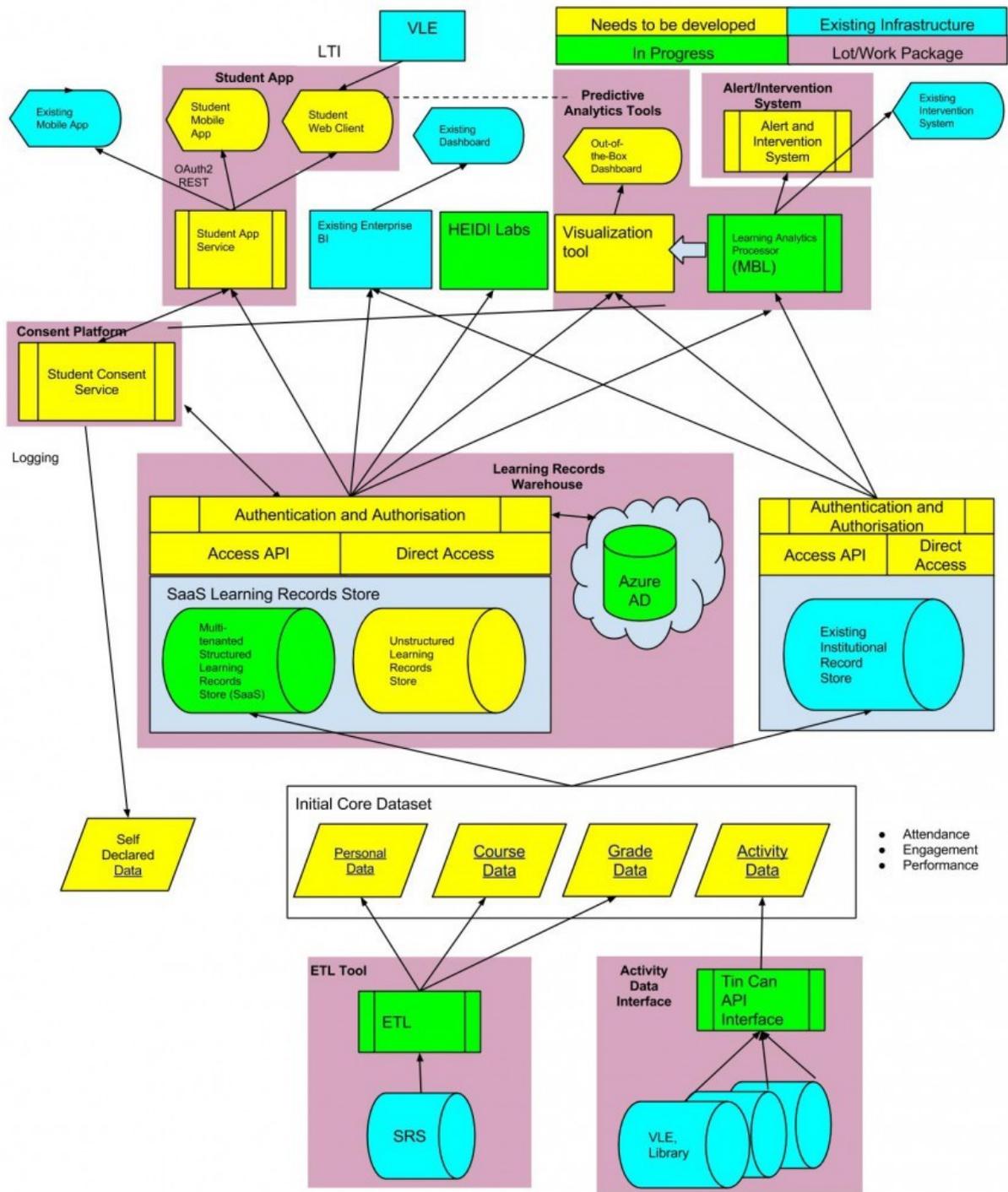


Figure 1: Jisc’s architecture for learning analytics

Jisc will procure and provide the components of this basic learning analytics service as a ‘freemium’ model from the perspective of end user organisations. A core set of functionality will be made available to institutions at no cost to them. The institutions will then be able to purchase additional features if required. The solution will be able to be run as a multi-tenanted or multiple instance solution in the cloud, either hosted by Jisc or by the vendor/public cloud, ideally with the option of being hosted by the institution as well.

The architecture enables the separation of the various elements and allows different vendors to propose solutions for specific areas of functionality. This facilitates healthy competition and the potential for an environment where components can be plugged in or replaced as required. The separation of concerns can be clearly seen by the division of lots during procurement. The bid process includes the following lots:

Lot 1) Predictive analytics tools

Including the learning analytics processor – a tool to provide predictions on student success to feed into the alert and intervention system. Predictive models must be exportable in an open standards compliant format, the Predictive Model Markup Language (PMML). PMML (<http://www.dmg.org/pmml-v4-2-1.html>) is an XML standard for describing predictive models so that they can be shared easily and then reused across different software vendors' products.

Lot 2) Alert and intervention system

A tool to be used by institutions to allow them to act on alerts and manage intervention activity. The system should also be able to provide data such as methods and success, and feed into an exemplar 'cookbook' on learning analytics. Ideally different interventions could be plugged into the infrastructure.

Lot 3) Student app

The collecting and curating of app requirements are just as important as any software artefact. There have been many dashboards built, but the requirement gathering exercises have often failed to reuse prior efforts. This leads to much reinvention and duplication.

A student app will be built from a specification based on a requirements gathering activity involving students and staff. The app will be delivered on Android and iOS platforms, together with a web app to be integrated within a VLE. Data will come from the learning records warehouse (Lot 4) and the learning analytics processor (Lot 1), and will include appropriate mechanisms for consent and authentication.

Lot 4) Learning records warehouse

A data warehouse solution will be developed to hold learning records. It is anticipated that the solution will require the ability to store both structured and unstructured data, and should scale to hold several billion data items per year.

Lot 5) Standard MIS data extraction, load and transform (ETL) tool

An ETL tool is required to take data from a range of sources and import it into the learning records warehouse (Lot 4).

The exact number of records stored in the learning records warehouse will depend crucially on how much preprocessing of raw activity takes place. For example, activity could be summarised before being stored in the record store. The compression process reduces the need for dashboards and predictive models to have to retrieve large set of datasets to perform similar calculations.

Lot 6) Activity data interface

A solution will be provided using open standards (e.g. the Experience API also known as xAPI (<http://tincanapi.com/overview/>)) to take activity data from a range of learning tools, including VLEs and library systems, and integrate the data into the learning records warehouse.

The advantage of xAPI is that it has market traction and allows the plugging of an increasing number of systems into the infrastructure. Examples of open source xAPI enabled systems enriched under the Apereo Learning Analytics Initiative include: uPortal (<https://www.apereo.org/uportal>), a widely used portal system; Sakai (<http://sakaiproject.org>), a VLE used by millions of students every day; and Apereo OAE (<http://oaeproject.org>), a cloud based next generation collaborative system used by around forty universities across the world.

Lot 7) Student Consent Platform

It is anticipated that students will require the ability to control what data items are released to the various components of the analytics solution, including additional services that are brought online in the future. This platform will provide tools to give that control to students. The issue of consent is complex and potentially expensive to properly enforce. This is an interesting area that needs to reflect the emerging national ethics and privacy policy guidelines. It is no coincidence that the day after an architectural review workshop was held in Paris to critique the Jisc framework, a second workshop on ethics and privacy was held to discuss a taxonomy of ethical and legal issues arising from learning analytics, (Sclater, 2014b, Sclater, 2015).

Lot 8) Expertise in open learning analytics to advise and support

Expert advice to the project is required in specialist areas including learning analytics, machine based learning, predictive algorithms and measuring impact. The infrastructure is by its nature complex. Advice needs to be drawn from a range of experts.

1. REFINING THE MODEL

A number of experts from Europe came together in Paris in February 2015 to review Jisc's nascent architecture for learning analytics. The event at L'Université Paris Descartes was jointly hosted by the Apereo Foundation and Jisc. Delegates included representatives from the Universiteit van Amsterdam, the Pädagogische Hochschule Weingarten in Germany, Surfnet in the Netherlands, University of Michigan in the USA, CETIS and the Lace Project, as well as Jisc and Apereo.



Figure 2: Refining the model at the Jisc / Apereo workshop in Paris

The workshop took the form of an informal architectural walkthrough and involved participants taking on the following roles for the day:

- Oracle, who knows everything about the architecture and the initial requirements
- Student
- Teacher

- Tutor
- Researcher
- Ethical hacker (security expert)
- Software architect
- Privacy enhanced technologist. Roughly speaking, the ethical hacker tries to break into the system while the privacy enhanced technologist tries to keep him/her out.
- Front end developer
- Federative log on expert
- Enterprise service bus and ETL expert
- Data governance expert
- Writer, whose role is to keep honest notes of the day
- Chair, who keeps the walkthrough discussion focused

This was an effective way of obtaining in-depth constructive criticism of the model. Details of key elements of the architecture follow, including the main conclusions from the workshop.

1. CONSENT SERVICE

The student consent platform is likely to be one of the most complex elements of this project, and it is a new and emerging part of the education space. One issue that needs to be solved is that learning analytics may require data to be used in ways that were not initially envisaged at the point it was collected, and therefore consent must be obtained to process it differently. There are two specific use cases to consider:

- The institution may wish to use data from a group of students in a new way, and therefore needs a method to get consent in bulk before it can be used.
- A student may wish to provide their individual data to a new app or service.

To draw parallels with existing services, the former may be similar to users agreeing to new or additional terms and conditions, while the latter may be analogous to a user providing consent for a service or app to access their personal data from another system, commonly seen when apps access social data via OAuth.

For this solution to work a mechanism to authenticate and authorise the student will be required. Federated authentication is available through the Shibboleth SAML based solution across the higher education sector.

It was interesting that almost immediately at the architecture workshop issues relating to privacy were raised. These were of such concern to the Germans present that they believed their students would not be prepared to use a learning analytics system unless the data was gathered anonymously. Once learners had gained confidence with the system they might be persuaded to opt in to receive better feedback. Thus the consent service was confirmed by the group as a critical part of the architecture.

Various issues arise here e.g. what happens if the student has left the institution? Will there be large gaps in the data which diminish the value of the overall dataset?

One participant suggested that students could decide if they wanted analytics to be temporarily switched off - in a similar way to opening an incognito window in a browser. This would allow them to carry out some exploration without anything being recorded. The logistics of building this into multiple systems though would certainly also be complex - and it would potentially invalidate any educational research that was being undertaken with the data.

Students may be worried about privacy, but handling the concerns of teachers was also felt to be crucial. It was suggested that statistics relating to a class should remain private to the teacher of that class; concern was expressed that learning analytics could be used to identify and subsequently fire ineffective teachers. "Could a predictive model allow unintelligent people to make decisions?"

was the way the participant with the "teacher" role summed up the perennial battle for control between faculty and central administrators.

One suggestion to minimise privacy infringements was to use the LinkedIn model of notification when someone has looked at an individual's profile. Certainly every time someone views a student's data it could be logged and be subsequently auditable by the student.

2. STUDENT APP

Putting data in the hands of the students themselves may be a key way to deploy learning analytics in order to improve the chances of educational success. A student app is therefore a crucial part of the proposed architecture (Sclater, 2014c). Functionality may include:

Measuring engagement

Students might find visualisation of their participation in a course of use, measured through a variety of metrics such as VLE access, campus attendance and library use. Comparisons with peers may be helpful. And comparisons with previous cohorts, showing the profile of a successful student might be useful too. These could be presented in a variety of ways, including graphs of engagement over time compared with others. Learners might want to have alerts sent to their device through the app if their participation shows they're falling below an acceptable level or user defined level.

Measuring assessment performance

There is clearly a need to show details of assessments already completed and grades obtained, and the dates, locations and requirements of impending ones. Assessment events transferred to a student's calendar with advance alerts could also be useful. But arguably this is simple reporting and alerting functionality and not learning analytics. A progress bar showing how they are progressing through their modules and qualifications might be helpful. A prediction of their grade if they continue on the same track and what they would need to achieve to improve may also be of interest. Otherwise assessment data could feed into one of the metrics used for measuring engagement.

Module choice

One application of learning analytics is to assist students in making module choices. Analytics can recommend modules where they are most likely to succeed, comparing their profile with those of previous students and presenting them with information such as "Students with similar profiles to you have tended to perform better when selecting xxx as their next module".

Technical Requirements

The initial specification is likely to include an Android and iOS app, along with a web/HTML5 app, potentially to integrate within a VLE via formats such as the IMS Learning Tools Interoperability (LTI) specification (<http://www.imsglobal.org/toolsinteroperability2.cfm>). The learning records warehouse and the learning analytics processor will deliver data and provide appropriate mechanisms for consent and authentication.

One idea suggested at the workshop was for the student app to use an open API, allowing other student-facing services to be integrated with it. Another issue raised was that most analytics is carried out on data sources which can be fairly "old" however there may be a need for real time learning analytics. And a student app which assessed whether learning outcomes had been achieved could also be very useful.

Real time collection tends to be more expensive than through the ETL layer using a batch process. Not only might there be an impact on the performance of the application that is sending the activity, but the ELT layer affords the opportunity to compress the activity into averages. Compression decreases the amount of data that the predictive models and dashboards need to process later. The play off between the costs and benefits of real time processing will be explored by the freemium service.

One interesting idea mooted at the workshop was whether the most important source for predictive analytics might be "self-declared" data? It may be that some wearable technology monitoring a student's sleep patterns or their exercise levels for example could be mapped onto their learning performance. Or they might want to log the fact that they had watched several relevant YouTube videos that they had discovered.

3. LEARNING RECORDS WAREHOUSE

Jisc anticipates that the learning records warehouse will be the central repository for learner activity data, plus optionally as a warehouse for other student data about the student and their courses.

The record store element should take activity data via the Experience (Tin Can) API (xAPI), currently the main standard for learning records. In addition, the overall solution should also be able to take data derived from a more traditional LTI process.

The core requirement for the learning records warehouse is to be able to receive data via the xAPI, and then provide it to the learning analytics processor, the alert and intervention system and various dashboards. xAPI has been chosen at the moment as Jisc believes it to be the most complete and well documented solution available at the time of writing. However, this will be reviewed as other options such as the Caliper sensor API become available.

It is anticipated that the storage of activity data will be a core requirement for most users of the service, in that they will not have an existing equivalent solution. Many will have warehouses in place to hold student data. However, for those that do not there should be a method of integrating this data so that it can be queried by the learning analytics processor.

Concern was expressed around the performance of dashboards when required to process big data. Thus the ETL (extract, transform and load) layer is crucial to determine what data is stored in the learning records warehouse, which data can be compressed to facts in the warehouse and which records should be filtered out as currently irrelevant. The tuning of this process potentially impacts on the accuracy of predictive models, costs of backing up systems and how real time "real time" actually is.

4. ALERT AND INTERVENTION SYSTEM

The alert component comprises the processes and workflow to notify the appropriate person that action is recommended. The intervention management component will allow institutions to manage interventions with students. It is envisaged that this will work in a similar way to a customer relationship management system, but will be focused on learner achievement, including recording communications, interactions and outcomes. This should not only be in place to help those at risk but should also allow the teacher to analyse how well things are going on overall in the class. Interventions might be to congratulate students on their progress as well as to address potential failure or drop-out.

A key requirement of the system is to allow institutions (through sharing of practice) to monitor the effectiveness of different interventions. Reporting ability is therefore of great importance, either directly within the system, or through the use of third party tools.

5. LEARNING ANALYTICS PROCESSOR

Using machine based learning techniques to develop models that predict student success is a new and emerging field. A core element of the learning analytics project is to help the sector engage in this field, to provide evidence of the effectiveness (or otherwise) of using large data sets, and then, if successful, scale-up their use through the open sharing of data models.

The system should produce predictive models based on existing data, and validate the models on new datasets.

This was deemed to be so critical that it should form a separate layer, underpinning the other applications. Meanwhile compliance with the Predictive Model Markup Language has already been specified as a requirement for the predictive models to be used by the learning analytics processor. However one member advised the group to be wary of "gold-plated pigs" - some vendors are

excellent at presenting beautiful apps and dashboards which may have unsophisticated or unreliable underlying models and algorithms doing the predictions. Most staff are unlikely to want to know the fine detail of how the predictions are made but they will want to be reassured that the models have been checked and verified by experts.

6. DASHBOARDS

The solution should provide a means to view data from the system in a visual way, with dashboards showing data applicable to the user's individual needs, for example a module overview for a module leader. Institutions may already have some existing portal technology, and it would be advantageous if the visualisations could be integrated. In addition some institutions may have their own visualisation tools which should be able to be used if required.

6. STANDARDS

A key requirement of the learning analytics solution is to provide universities and colleges with tools to improve learner performance, and provide early alert of potential failure or withdrawal from the course. Three techniques are likely to be core to this:

- Application of relatively simple but proven user defined models
- Predictive models based on techniques such as machine based learning
- Insights relating to factors affecting student success through data analysis

Openness is important to many stakeholders within the sector, and there is some evidence that models, both user defined and predictive, can be shared between providers. A solution is therefore required that can output models in open standards. The current requirement is to comply with Predictive Model Markup Language although the solution should be flexible enough to be adaptable if new standards emerge.

The use of technical, preferably open, standards is clearly important for an architecture comprising a number of interchangeable components potentially built by different vendors. The Experience API (Tin Can) has been selected as the primary format for learning records at the moment; it should be relatively easy to convert data from the VLE to this format, and some plugins e.g. Leo for Moodle (<http://leolearning.com/blog/leo-releases-major-moodle-xapi-updates/>) already exist. However there may be a maintenance overhead every time each LMS is upgraded.

It was suggested that the IMS Learning Information Services (LIS) specification would be appropriate for storing data such as groupings of individuals in relation to courses.

The problem of ensuring universally unique identifiers for individuals (and activities) was also noted. If there is not a unique ID for every user (i.e. a person or another source of activity such as an entrance port to a cafeteria) then predictions will be weakened or the data may need to be cleaned, potentially at considerable expense.

7. SECURITY

The "ethical hacker" (security expert) was concerned that security issues will be complex because of the number of different systems in place. This is because the security issues increase polynomially as the number of components increases. Meanwhile there will be ongoing requirements for patches and version updates for the different VLEs and student information systems involved. Consistent security hygiene is required across all of the systems under different ownerships within and bordering the infrastructure diagrammed in this paper.

8. CONCLUSIONS

The experience gained in a wider ecosphere of communities such as the Apereo Learning Analytics Initiative, LACE, SURF and a number of leading universities was helpful in providing neutral, critical support. Building a cross disciplinary team rather than opening up subscriptions to the workshop

ensured a broad range of expert perspectives. The informal walkthrough format was a driver for a focused discussion.

There is much opportunity for reusability of components outside the hosted framework. For example, collecting the lessons learned from a community process around building and interacting with the infrastructure will allow for the creation of advice, cookbooks, and policy documents.

The data transforms that convert and pass on raw data should be relatively easy to share and deploy within individual campuses. The use of xAPI will be an extra stimulus for vendors in the UK to adopt this activity based standard.

Jisc was reassured after the workshop that the architecture, with some minor changes suggested by the group, is robust, and it will be aiming to put in place a basic "freemium" learning analytics solution for UK universities and colleges by September 2015. The infrastructure provides the opportunity for institutions to understand their own requirements and gain experience with learning analytics in a supported, relatively low-cost way. These experiences can be incrementally fed back to improve the technical infrastructure, and help to focus research efforts on enhancing student retention and other aspects of the learning experience.

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Alan Mark Berg, BSc, MSc, PGCE, has been the lead developer at Central Computer Services at the University of Amsterdam since 1998. He is currently working in an Innovation Work Group that accelerates the creation of new and exciting services. In his famously scarce spare time, he writes including authoring a book on recipes for quality assurance (<https://www.packtpub.com/application-development/jenkins-continuous-integration-cookbook-second-edition>). Alan has a bachelor's degree, two master's degrees, a teaching qualification, and quality assurance certifications. He has also coauthored two Packt Publishing books about Sakai (<http://sakaiproject.org>), a highly successful open source learning management platform used by millions of students around the world. He has won a couple of awards, including the Sakai Fellowship and Teaching With Sakai Innovation Award (TWSIA).

Alan enjoys working with talent; this forces him to improve his own competencies. This motivation is why Alan enjoys working in energetic, open source communities of interest. At the time of writing, he is on the board of directors of the Apereo Foundation and is the community officer for its Learning Analytics Initiative (<https://confluence.sakaiproject.org/display/LAI/Learning+Analytics+Initiative>)

In previous incarnations, Alan was a QA director, a technical writer, an Internet/Linux course writer, a product line development officer, and a teacher. He likes to get his hands dirty with building, gluing systems, exploring data, and turning it into actionable information. He remains agile by ruining various development and acceptance environments and generally rampaging through the green fields of technological opportunity.

Michael Webb is Jisc's senior technology innovator, working on a range of projects to develop new digital solutions to support UK Higher Education, Further Education and skills sectors. Current projects include learning analytics, business intelligence, cloud platforms and student led innovation. Michael has 20 years experience of working in the HE sector, including ten years as Director of IT at University of Wales, Newport, and before that leading infrastructure and application development projects at University of Plymouth. He is also an experienced software architect and developer, including mobile development and scalable web based solutions.

Scalable Learning Analytics and Interoperability - an assessment of potential, limitations, and evidence

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Keywords

learning analytics, interoperability, evidence

1. Summary

Learning analytics is now moving from being a research interest to topic for adoption. As this happens, the challenge of efficiently and reliably moving data between systems becomes of vital practical importance. In this context, “scalable learning analytics” is not intended to refer to infrastructural throughput, but to refer to the feasibility of a combination of: a) pervasive system integration, and b) efficient analytical and data management practices. There are a number of considerations that are of particular relevance to learning analytics in addition to elements that are generic to analytics. This contribution to EUNIS 2015 seeks to clarify, by argument and through evidence, both where there are potential benefits and limitations to applying interoperability specifications (and standards) in the service of scalable learning analytics.

2. Extended Outline

A lot of attention given to interoperability in the context of learning analytics has, so far, been given to the capture of learner activity. Among the drivers for this are wider trends in analytics and the diversity of IT used for education and training. Some of the best-known examples of business analytics make particular use of the traces captured during consumer interactions with web sites, and with social media. These motivate interest in the almost-magical acquisition of knowledge from apparently inconsequential data. The diversity in IT presents an old problem; it is difficult to analyse data that is spread about. This naturally introduces the idea of using interoperable systems and adopting standards.

There are a number of issues that arise in this scenario, however. A critical issue revolves around the futility of attempting to define or use standards when there are no strong regularities. Except for relatively trivial processing and representation of data, analytics is an essentially exploratory discipline, and this is particularly relevant to complex and social processes such as teaching and learning. For all the term “data scientist” may have been over-used, it does capture the idea that the process of analytics involves theorizing, questioning, iterative advancement of knowledge, etc. This places severe limitations on *a priori* knowledge of what data should be used, or captured in the first place. For learning analytics, the case is more difficult because we have very little evidence from practice about the regularities that actually exist, beyond near-trivial observations such as prior academic attainment being a good indicator of future attainment, for example. Hence it is easy to fall into the trap of seeking a data model of everything, because so much data is potentially-relevant.

A compounding issue is that, whereas traditional forms of analytical processing rely on existing management data, such as student demographics, grades, and recruitment figures, more recent approaches to analytics rely on data that has greater variety and arises from traces left as people use IT systems. This is a central concern for learning analytics, where the data arises from normal use of multiple pieces of software in which the data structures are likely to have been designed not for analytics, but to realise teaching and learning use cases - e.g. for accessing video content, participation in forums - in a way is technically scalable and maintainable. When statistical processing or data mining is undertaken, it is likely that analytically-significant data has simply not been captured. In any case, it is likely data has to be re-interpreted from structures that relate to the software architecture into structures that more closely relate to pedagogically-relevant actions.

These issues suggest that a great deal of caution should be taken in applying standards to learning analytics, and yet the essential premise of achieving efficiencies by applying interoperability specifications remains. The authors have concluded that this Gordian Knot may be sliced by stepping back from the focus on learning activity data in detail, and looking for regularities elsewhere.

In particular, the conclusions that we have drawn, and which will be elaborated upon at EUNIS 2015 are as follows. Firstly, that the regularities of generalized analytics workflows are there to be leveraged; learning analytics implementers can draw on already-proven standards with cross-domain applicability. One good example is PMML (DMG, n.d.), the Predictive Model Markup Language, a mature XML-based specification from the Data Mining Group. It is supported by a range of software from the analyst desktop through to cloud computing data mining services. PMML has already been applied to learning analytics by the Open Academic Analytics Initiative (Jayaprakash, Moody, Lauria, Regan, & Baron, 2014). PMML and other standards for expressing statistical data are also desirable for their potential role in key aspects of analytics governance: audit, transparency, traceability, etc.

Secondly, that there are efficiencies to be obtained both for data acquisition and storage systems, and for analysis, for example by defining common patterns for activity data capture while leaving the specifics of the data definitions largely fluid and open-ended. This is, itself, a common pattern in computing and IT: the definition of grammars, modeling notations, etc. This is the approach taken by the Experience API (ADL, 2013) (also referred to as Tin Can API) for its Statement data model, although it also includes some activity-specific elements that work against its generic capabilities. IMS Caliper has a common pattern for its event structure but adds further activity-specific elements.

3. COPYRIGHT NOTICE

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5. AUTHORS' BIOGRAPHY



Adam joined Cetus, the Centre for Educational Technology and Interoperability Standards (www.cetus.ac.uk) in 2006. He has previously worked on educational technology and innovation in both Further and Higher Education Institutions in the UK and in the private sector. During this time he has: taught, managed learning technology development, designed and built software, conducted R&D, developed standards, and analysed technology trends and their implications. He is currently a member of the UK Government Open Standards Board, a member of the Information Standards Board for Education, Skills and Children's Services. He is responsible for the **Learning Analytics Community Exchange Project** (www.laceproject.eu) work package on interoperability and data sharing.

ERAI 2015 update

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Keywords

Higher Ed, Analysis, Research, Surveys, Collaboration

Summary

One of the challenges in the ever-faster changing world of technology is how to stay competitive. The need for continuous improvement and agility for higher education IT requires knowledge about in-sector and out-of-sector trends. While organizations like Gartner are excellent resources for pushing out our field of vision to garner knowledge about out-of-sector trends. The presentation will focus on the latest developments of the EUNIS project ERAI - Eunis Research and Analysis Initiative. What has been done since the launch at EUNIS2014? Where will the project move next and perhaps most importantly how can the community contribute and get involved.

ERAI

EUNIS started the EUNIS Research and Analysis Initiative (ERAI) to provide a platform for IT leaders to understand the uses and trends of IT for the European Higher Education system. The overall mission of EUNIS is “ *help member institutions develop their IT landscape by sharing experiences and working together.*” As of 2015 ERAI will begin to produce action-oriented publications based on research, case studies, and comparative analysis to inform technology decisions in higher education. The session will focus on the challenges and opportunities of an international higher ed tech research initiative. We will also highlight some of the results that ERAI has been able to show so far, describe our work and vision but also provide a backdrop to further highlight cross-hemisphere perspectives on Higher Education IT.

Organisation

In order to secure success there needs to be people involved in this project. Like all other EUNIS activities the work with ERAI is purely on a voluntary basis. We've tried to overcome this challenge by creating a fairly large organisation (or at least that's the ambition). As of now, there are 2 concrete organisational entities: The ERAI executive team and the Editorial committee.

The **executive team** now consisting of the authors of this abstract, are responsible for the overall governance of the project with the goal of running and developing the concept.

The **editorial committee** (EC) is a group of individuals from the EUNIS community with the responsibility to bring their expertise and networks to ERAI. The EC is doing reviews of submitted content, selecting topics to work with within ERAI but also to create own content.

Each year, a number of “hot topics” will be selected. This is to give a guide into how the work with ERAI will be conducted. A number of content would then be selected or created to fill that space. However there is no reason why additional content can be presented.

Content

This year (2015) the main content will circulate around the work of the Task Forces. The tentative content release plan looks like this:

Topic	Published by
Benchmarking	content released Q1
Congress proceedings	May/ June
BI	Aug/Sept
E-learning	Oct/Nov
Interoperability	Jan 2016

The content will, apart from articles, revolve around interviews, case studies, blogs. These could be pan-european in nature or national. The goal is, however, to attract readers from all European countries with any kind of content.

Next steps

We wish to engage the community to collaborate through ERAI. To further understand our sector through applied research and analysis. We are heavily reliant on the input from Hi-Ed leaders with an interest in international aspects of High Ed IT. Concretely this will be done through the creation of a reference group made up of IT and University leaders from all over Europe.

We will start producing own content, apart from the work created by the task forces. The long term goal is to present a Top-ten list of sorts. If that is IT challenges or Tech trends will have to left unsaid at the moment.

We are also seeking continued support and wider collaboration by growing our community. We will do so by finding new partners in defining the direction our research and analysis should take, by growing our Editorial Committee with individuals who are willing to contribute in different ways and finally by identifying writers and thinkers from the Higher Education context who can bring their expertise and experiences.

AUTHORS' BIOGRAPHIES



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organiser of the 20th annual EUNIS congress in 2014. Johan is also a programme committee member the Terena Networking Conference in 2015 as well as a Senior Reviewer ERO (Educause Review Online)



Michele Mennielli is working as an external Relations and International Affairs Manager for CINECA, Italy. His primary focus is on Research Informations systems. He is also a board member of both EUNIS and EuroCris, two pan-european organisations focusing on IT for Higher Education.



Amandine Alehyane is a Project Manager at The Digital University Paris, France where she focuses on research and analysis on the higher education sector in France. Predominantly in the field of cloud computing.

All three authors were involved in the creation of the Eunis Research and Analysis Initiative (ERAI) in 2014.

UNICAM ACTIVITY FRAMEWORK (UAF)

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Keywords

Cloud Business Intelligence Performance Evaluation

1. Summary

This presentation illustrates the framework of processing performance of the faculty of the University of Camerino. The evaluation criteria are explained and the technological structure that allows automatic performance assessment available online anywhere and anytime

2. Introduction

UNICAM has decided to implement a system to monitor and evaluate the activities of individual teachers/researchers in compliance with the European Charter for Researchers and the recommendations by the European Commission published on the Official Journal of the European Commission of 11th March, 2005, which specifies what follows: 'Employers and/or funders should introduce for all researchers, including senior researchers, evaluation/appraisal systems for assessing their professional performance on a regular basis and in a transparent manner by an independent (and, in the case of senior researchers, preferably international) committee. Such evaluation and appraisal procedures should take due account of their overall research creativity and research results, e.g. publications, patents, management of research, teaching/lecturing, supervision, mentoring, national or international collaboration, administrative duties, public awareness activities and mobility, and should be taken into consideration in the context of career progression.'

The indications concerning the monitoring are aimed at defining a data base that may be useful for any subsequent evaluations. The information collected through such a monitoring should be based on the following two criteria:

- completeness, in the sense that the information collected through monitoring should include all the activities carried out by individual researchers, which can produce a direct or indirect benefit for the University;
- verifiability, in the sense that the information collected can be controlled by third parties.

The information's completeness should be functional to the definition of any subsequent evaluations aimed at achieving different and specific objectives. Different weighting should be assigned to researchers' activities and the monitoring of individual researchers should also be integrated by other kinds of information, such as details of the facilities used, for example. The method also provides indications for the assessment of individual researchers aimed at measuring their overall commitment. The assessment considers all the activities mentioned in the monitoring, which are assigned different weighting.

Monitoring is carried out for each calendar year taking into account the previous three years (except for those cases where appointment/employment started during the three-year period in question). The evaluation allows for a comparison of the cost against the 'value' produced by the researcher in terms of commitment and results obtained. At the end of the assessment, each researcher will be given a rating, which defines their commitment and that may be translated into months. Such a

rating will then be multiplied by the value of the unit of measure (€ 5,833)¹ and compared with the average value for the reference category the researcher belongs to².

3. Researcher Rating Card

MONITORING AND MEASUREMENT OF RESEARCH ACTIVITY

This section includes both the research products and the relevant and verifiable activities related to the research. Each item is assigned a reference weighting and three corrective parameters:

K1: parameter that considers relevance;

K2: parameter that considers the individual researcher's contribution;

K3: comparison parameter that considers the special features of different areas.

MONITORING AND ASSESSMENT OF EDUCATIONAL ACTIVITIES

Course books for university students, written material or chapters of university course books, teaching hours, student rating, number of courses including those in English and e-learning ones.

MONITORING AND ASSESSMENT OF FUNDING

This refers to the funds managed by UNICAM. The relevant figures are to be equally split and distributed amongst all the internal researcher involved in the funded research.

4. Framework Development

The framework helps to develop comprehensive Business Intelligence solutions.

The platform is process-centric because it uses Workflow engine as central controller. Workflow engine uses process definitions to define the business intelligence process that it executes on the platform. The process may be easily customized and new processes can also be added. The platform includes components and reports that may be used to analyze the performance of such processes.

The platform is solution-oriented because its operations are specified in the definition process and in the operation documents that provide details of every single activity.

These processes and operations together define the solution for the business intelligence problem. The solution may be easily added to business procedures outside the platform. The solution definition may include a number of processes and operations.

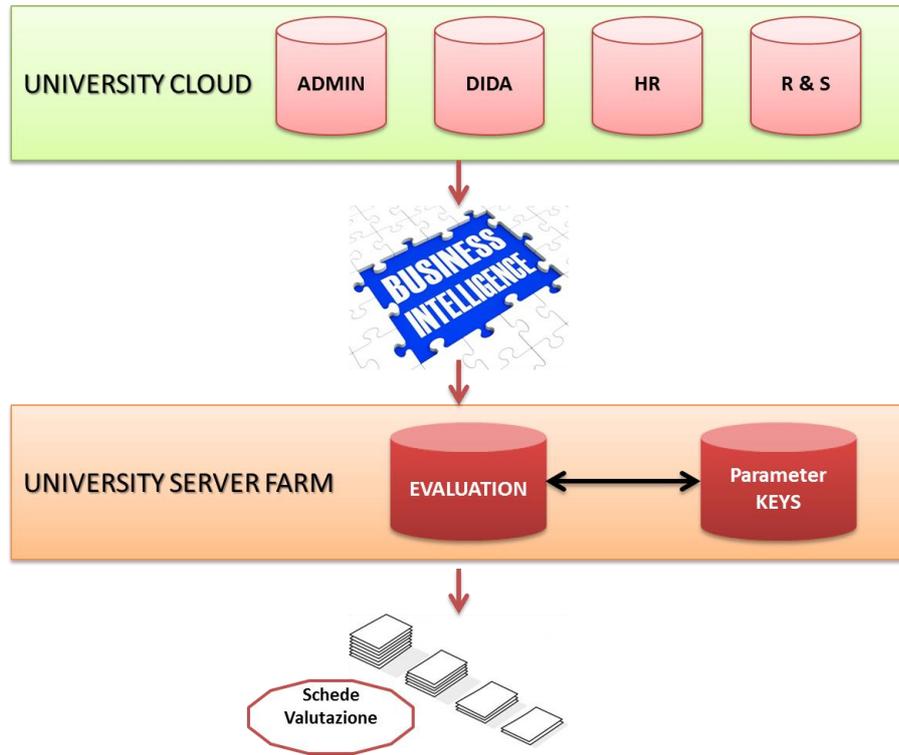
The platform is composed of:

- Business Intelligence Framework - which provides logging, auditing, security, scheduling and [ETL](#) procedures, as well as web services, attribute repository and rules engine;
- Business Intelligence Components - including components for reporting, analysis, workflow, dashboards and data mining;
- Business Intelligence Workbench - which is a set of design and administration tools enabling analysts and developers to create reports, dashboards, analysis models and business intelligence processes;
- Desktop Inboxes - which deliver notices generated by processes and reports.

¹ The researcher's commitment is assigned a specific value using Euro/month as a unit of measure (€/M) and is calculated by dividing 70,000 (average cost in Euro of an Associate Professor) by 12 (€ 5,833).

² The cost of one unit of staff has been quantified by the Italian Ministry for University and Research (MIUR) as follows: Annual cost of a Full Professor, Euro 100,000.00; Annual cost of an Associate Professor, Euro 70,000.00; Annual cost of a University Researcher/Temporary Researcher, Euro 50,000.00.

The following image shows the system's architecture.



Governance in 1st level support: Good Practices from the IT-ServiceDesk at RWTH Aachen University

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Keywords

IT support, 1st-level support, good practice, governance, quality management, knowledge management, user surveys, reporting

1. Summary

The IT-ServiceDesk supports all IT services offered by the university's IT Center to students and employees. Governance is understood as the management's ability to analyze the current quality of work and implement changes in order to improve the resulting support quality and to adapt to fulfill new tasks. To that end Quality Management has been introduced. User Surveys and Reporting Techniques are used to gain the necessary information for effective governance.

2. THE IT-SERVICEDESK

The IT Center is a central organization of RWTH Aachen University that supports crucial processes of the university, provides basic as well as individual IT services for other organizational units of the university and supports Simulation Sciences. The IT-ServiceDesk is responsible for the 1st-level support. The variety and complexity of the services and the heterogeneity of users pose a significant challenge to the 1st level supporters, their knowledge and communication skills.

3. QUALITY MANAGEMENT

Quality Management (QM) has been introduced in 2014 to improve the support quality and to help employees of the IT-ServiceDesk in their daily work. In 2015 the IT-ServiceDesk will undergo the audit for the ISO 9001 certificate. For this task an additional person has been hired.

We started with developing detailed descriptions of our work processes. Every process description has the same form and includes a brief schematic overview which summarizes the process. The processes cover support topics, but also processes regarding the handling of tools, most importantly the ITSM tool, training of new employees and organizational topics. Also the creation and maintenance of the documentation is treated within the QM processes. This will play an important role in future re-certifications since knowledge management will be part of the next version of the ISO 9001 norm.

The QM measures already proved very helpful in training, as a reference in everyday work and as a knowledgebase. Furthermore, they offer a very good anchor for critique, improvements and changes. However, there is still a lot of room for further improvements. We plan to target more knowledge related processes. To really "live" the documented ideal is an ongoing challenge.

4. REPORTING SERVICES

Using Microsoft Reporting Services, we regularly create reports out of the statistical information on the tickets in IT-ServiceDesk. At the moment these Key Performance Indicators (KPIs) reported include the number of tickets for a given timespan, the entry channels of tickets (e-mail, phone, personal contact), the topic and the first-solve-rate. It also shows the percentage of tickets which are analyzed within the first hour. However, employees' rights must be observed at all times, meaning that no analyses that allow to assess the performance of individual employees can be performed.

For the future we plan to include additional indicators in the reports. The plans include information about the time that is needed to solve tickets, their topics as well as the number of different employees that work on a single ticket. Furthermore, we will also use data from the Automatic Call Distribution (ACD) system to report availability by phone and average duration of calls.

5. USER SURVEYS

User surveys are a very effective way to get representative feedback from users. Most user feedback we receive is from unsatisfied customers. Although this feedback often includes very helpful suggestions, it does not allow assessing the average satisfaction of our users. So far three different surveys were conducted.

The first one was a paper questionnaire, which customers who visited us personally could answer. This covered only users who used our personal support. The feedback was overwhelmingly positive, but the sample was dominated by students.

The second survey was an online questionnaire that asked users to rate a specific support case. This survey reached students and employees as well as administrators equally. The results gave us a very good insight into the factors that influenced user satisfaction. These factors included the topic of the case, the number of contacts necessary to solve it, the time it took to solve the case and the communication channel. Although the information we gained was very helpful to us, many users perceived the questionnaire as too extensive and complicated.

Thus, we simplified the questions in the third survey. The online survey reached employees and students alike. However, again more students than employees participated. The results were helpful and gave us some hints concerning our weaknesses. However, we missed the opportunity to link the user's satisfaction to specific properties of the support cases.

An additional problem of this kind of survey is that it only reflects user's satisfaction in a limited timespan. In case of our third survey users' comments showed that many bad ratings were due to a high frustration to temporary problems with the e-learning platform. As a consequence we plan to introduce a direct feedback that allows every user to rate their support case within a day after it has been solved. It will be saved together with the case ID so that it can be linked to other properties of the respective ticket. By this we hope to get a big dataset that allows to determine the correlates of user satisfaction.

6. CONCLUSION

Effective Governance in 1st-level support means the ability to adapt quickly to changes in the department's responsibilities and tasks while ensuring a high quality in support. Examples for such new tasks are the management of in-house workstations and research data management.

Governance requires reliable information about Key Performance Indicators as well as users' perceptions. Reports offer objective information on some of these KPIs. In IT-ServiceDesk we are currently working on implementing the reporting of additional indicators. User surveys allow some insight in user's perceptions of the support quality. In our case the key challenge is to establish a link between user satisfaction and other properties of specific tickets without overwhelming users with the survey and still respect their anonymity.

A formal Quality Management not only helps employees in their daily work and provides a standard; it also offers an effective means to realize changes in the work processes. It proves to be especially helpful in handling knowledge and information as key assets in a service desks performance.

7. AUTHOR'S BIOGRAPHY



Florian Krämer studied Political Science, Economics and Linguistics and received his Master of Arts from RWTH Aachen University in 2010. After working as a research assistant in the Institute for Political Science he joined the IT Center of RWTH Aachen University in 2011. His tasks include support and training. He is responsible for the online documentation and works on different projects including knowledge management and research data management.

EUNIS 2015: The Future of PC-classroom - a Reality Check

Mikko Mäkelä

Helsinki Metropolia University of Applied Sciences, Finland

Keywords

BYOD, virtualization, computer, PC, statistics, resource

Abstract

Currently we are still seeing a flood of hype to implement BYOD in different ways also in higher education. This paper presents Metropolia's current plan for the future PC-classroom, as well as some data behind decisions about the future. The paper also presents the challenges that we currently face and how we plan to cope with them.

Do you really know how the computers of your organization are used? Are your PC-classrooms in all the wrong places at wrong times and also wrong size AND of course never with the software resources needed?

1. Introduction

Metropolia's need to optimize its resource usage has changed, as the Finnish financial climate has changed. At the same time we are looking for new ways to use the students' own devices for their studies.

The change in universities shouldn't be driven only by IT-departments as it will also require changes in teaching. The outcome will be sum up of multiple things.

We have to know our current status to make decisions about the future of the environment. We have collected data about how our computers have actually been used, and the data shows the problems with environment which is too stationary. Walls limit us.

2. The Past, reality check of usage

The collection of the usage data started in the beginning of 2012. Graphics shown in link are from the scholar year 2012-2013: <https://metrovd.edu.metropolia.fi/kaytto/index-2012-2013.html>

The analysis is based on certain measurement weeks, one in each of the four periods that we have in our university. The selected weeks were so called full study weeks, meaning that there are no holidays or any other breaks affecting the usage in that certain week.

How to interpret the graphics, for example Leppävaara campus, period one:

<https://metrovd.edu.metropolia.fi/kaytto/usagehourly/ety-period1-avg-graph.html>

We calculate the sum of all logons and logouts for all the classroom computers. Based on that data, an average login count (upper graphics) and an average usage time (lower graphics) on one computer in one classroom are calculated. The list on right shows the name of the classroom, the amount of computers in that classroom and the amount of event events stored during that period.

The highest average login count (22,86) was measured from classroom B137 with 14 computers, and lowest true value (4,28) in B311B with 25 computers. The highest usage hour count was measured in A1150 with 31 computers and the lowest (5,43) in classroom B311B.

Additionally we have the so called TopLess statistics, showing the situation in the whole university.

Top25 usage, all four periods separately

<https://metrovd.edu.metropolia.fi/kaytto/usagehourly/all-top-25-periods-avg-graph.html>

Less25, all four periods separately

<https://metrovd.edu.metropolia.fi/kaytto/usagehourly/all-less-25-periods-avg-graph.html>

3. Current situation

When analyzing the current usage and resource reservations, we are able to say that the normal usage of the computers is far too low. By only looking the timetables we do not see the reality. The room resource calendar might be full of teaching, but the size of the group is not optimal as the usage of the computers is low. Also we have PC-rooms that are not used. BUT when reading the feedback from students, they always complain that there are not enough PC.

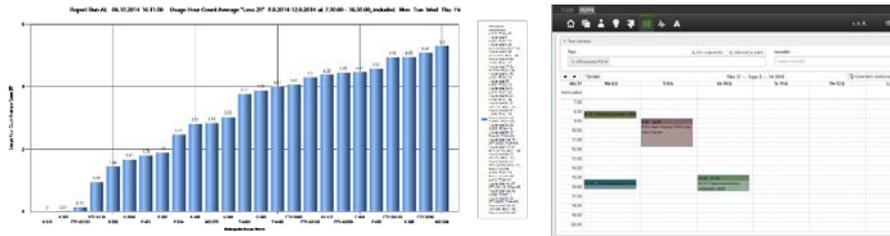


Figure1. Less25 period 1, study year 2014-2015

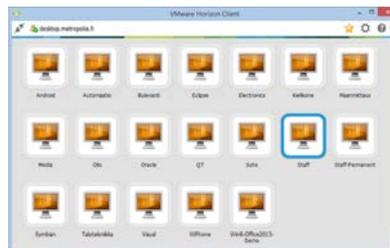
Figure2. Classroom P214 reservations period 1, study year 2014-2015

When talking with the teachers about the classrooms, they say that the PCs are in wrong places, not free when needed, with wrong software etc. We also recognize that we have challenges in creating schedules for students which is also affecting resource reservations.

4. The future

In the future we cannot be totally locked to fixed classroom. In our vision we have a PC classroom which has a small amount (4-8) traditional fixed PC's, lot's extension cords on the tables for the student's own devices, and automated laptop lending machines in the lobby for those whose laptops are broken, stolen or left at home. This is the best way to try to ensure 100% usage for the computers in the PC classroom.

Another challenge is to provide the same study environment for the students regardless of the device they use for their studies. We are currently testing the VMware View environment to do that.



By providing the environment centrally, we try to minimize the time used for fixing potential problems with BYOD-devices. Some teachers are afraid that their teaching time would be spend as acting IT-support. So our task is to try to maximize the ROI for the hardware, as well as maximize the study outcome by providing the same good quality study environment to the students on their own devices.

However, we must not forget the reality, where we still need so called design classrooms with big monitors, classrooms with special connected hardware, or any other need coming from teaching.

I predict that the amount of PCs is not going to drop dramatically in any HEI, as we need them for our staff and teachers, in laboratories and design classrooms. PC's are not going to disappear from our system for a long time.

5. AUTHORS' BIOGRAPHIES

Mikko Mäkelä, IT-service manager from Metropolia's beginning 2008. He has also taught as a part time teacher in the Media and ICT degree program for the last 15 years. Public LinkedIn Profile: <http://fi.linkedin.com/in/mikkoim/>

EUNIS 2015: Laptop lending, with zero-effort?

Mikko Mäkelä

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Keywords

BYOD, lending, license, virtualization, computer, PC, statistics, resource

Abstract

We still see a flood of hype about implementing BYOD in different ways also in higher education. This paper presents Metropolia's plan for the flexible PC-classroom of the future. The paper also presents the challenges that we currently face.

Do you really know how the computers of your organization are used? Are your PC-classrooms in all the wrong places at wrong times and also wrong size AND of course never with the software resources needed?

1. Introduction

Metropolia's need to optimize its resource usage has changed as the Finnish financial climate has changed. At the same time we are looking for new ways to use the students' own devices for their studies.

The change in universities should not be driven by IT departments alone as it will also require changes in teaching. The outcome will be the sum of multiple things.

We have to know our current status to make decisions about the future of the environment. We have collected data about how our computers have actually been used, and the data shows the problems with environment which is too stationary. Walls limit us.

1. Current situation

We have planned a new 6000 student campus for us and it is going to have only six traditional PC-classrooms. Is BYOD the answer to the situation? We cannot to say how the future will be in five years and that is why we must have a PlanB for a situation where we are not able or allowed to use the students' own laptops in the learning process.

When analyzing the current usage and resource reservations, we can say that the usage of the computers is far too low. By only looking at the timetables we do not see the reality. The room resource calendar might be full of teaching, but the size of the group is not optimal as the usage of the computers is low. Also we have PC-rooms that are not used. BUT when reading the feedback from students, they always complain that there are not enough PC's.

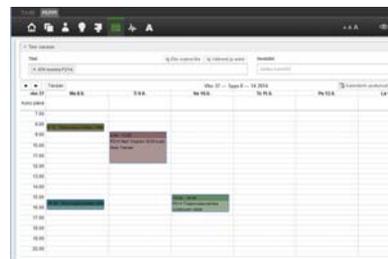
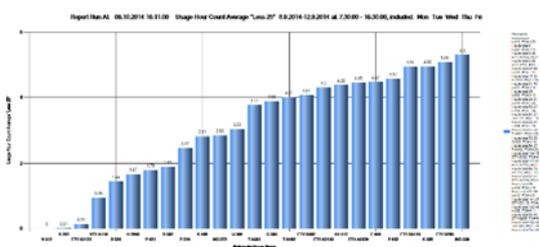


Figure1. Less25 period 1, study year 2014-2015

Figure2. Classroom P214 reservations period 1, study year 2014-2015

When talking with the teachers about the classrooms, they say that the PCs are in wrong places, not free when needed, with wrong software etc. We also recognize that we have challenges in creating schedules for students which is also affecting resource reservations.

2. The future planB, an automated unmanned lending machine

In the future we cannot be locked to fixed classroom. In our vision we have a PC classroom which has a small amount (4-8) traditional fixed PC's, lot's extension cords on the tables for the students' own devices, and automated laptop lending machines in the lobby for those whose laptops are broken, stolen or left at home. This is the best way to try to ensure that the computers in the PC classroom are used to a 100%.

In the new campus we might have a situation where we need have 400 laptops for short term lending as the six PC-classrooms are not enough for 5000 students.

With an automated lending machine we try to tackle multiple challenges.

- 1) Manpower needs: Lending normally requires manpower, which means more expenses
- 2) Fixed size classrooms: a fixed PC classroom is always wrong size for the group
- 3) Licensing issues: we are either not allowed or cannot afford to provide some programs on the students' own laptops, and there is no alternative program as freeware etc.
- 4) Flexibility: Any classroom can be transformed into a PC classroom wherever and whenever needed.
- 5) Availability: By integrating the lending machines to the mobile info system of our building we can easily tell the users where the lendable laptops are or where to return one.

Another challenge is to provide the same study environment for the students regardless of the device they use for their studies. We are currently testing the VMware View environment to do that. By providing the environment centrally, we try to minimize the time used for fixing potential problems with the borrowed devices.



The concept is currently tested at our university <https://wiki.metropolia.fi/x/14GZBg> and the first impressions about this service are really positive. The students can lend a laptop when they need one. Technically, the laptops are running with Wioski locked down Windows 8.1 environment. The basic Windows Shell is replaced with a VBS script on the laptops. The script only launches VMware View client which is used to connect to Metropolia's VDI environment. When the user turns off the client, the user is automatically logged out. The laptops are domain joined, so we have a working SSO with VMware Client. The laptops also have a bundled Task Scheduler task, which automatically shuts them down when the laptop is plugged into a power cable. This also initiates a full laptop reset. The laptops report their battery usage percent to the lending machine every couple of minutes, thus we have constant up to date information on the charge level of the laptops. This information is used to calculate how long the laptop needs to charge to reach the required minimum charge percentage for lending.

Our goal is to create a PC classroom which is used to a 100%.

3. AUTHORS' BIOGRAPHIES

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Portal of Slovak universities - Present and future

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Keywords

Portal of Universities, electronic application, a central register of student, mobility, e-learning

1. Summary

Project Portal of Slovak universities was founded by EUNIS-SK association in 2005. The Portal was introduced to the Ministry of Education, Science, Research and Sport (MESRaS SR) on November 28th, 2006. Since then it has been supported by the MESRaS SR and it is still developing new functionalities. The Portal of Slovak universities is closely related to Electronisation of university application, Central register of students, Central register of employees, Information system for grant scheme administration and partly also to project Development, analyses and interconnection of mobility online system concept (Erasmus plus online). The visit rate of the Portal of Slovak universities is increasing every year, mainly during the period of sending application forms.

2. Current state of projects

University Portal is accessible from URL: <https://www.portalvs.sk>. The portal currently includes the following modules:

- Information about university

Ensuring the creation and presentation of the information regarding universities based on different criteria that are systematically organized and professionally supervised. Information on study programmes serve mainly for applicants that are interested to study at particular universities. It is the most visited part of the Portal.

- Electronic university application form

University applicants are offered solution that enables transparent environment and consistent way of application for the university. The system uses a central database of accredited study programs and other central databases, including electronic pupils' books. In case that applicant applies for more than one university he or she enters data about himself/herself only once. The applicant gets information necessary for electronic application form in short time from one place during application filling. He or she can use data about applicant from previous year, than the applicant can send application forms to various universities without the repetition of identical input data. The application form can be corrected before it is sent; it can be also checked online. The applicant can get SMS notifications. This model has strong user support. There is data exchange between electronic application form and particular academic IS through web services.

- Projects

An on-line solution which is used to administrate the entire life cycle of submitted / processed / funded / completed projects within the internal grant system of the MESRaS SR.

- Conferences and Seminars

The module provides insertion of conferences and seminars in a simple form, giving an overview of the various events, allows filtering of information. Registered events is also in the events calendar.

- Publication activity

Link to Central Register of Publication Activity. The module is connected to the Central Register of Publication Activity. It enables users to search publications.

- **E-Learning**

The module is designed especially for university teachers to gain an overview which courses are developed at Slovak universities and to what extent. University teachers can establish cooperation with the authors of these courses, in order to avoid unnecessary work - making duplicates course, once the course with a specific topic has been developed, it can be used in the curriculum as an additional learning support. The module can also serve as a possible choice of guarantors with already prepared teaching support. The module is also designed for students, who can find additional sources for studies due to the fact that many courses or objects are accessible.

- **News**

This module is strength of the portal. The author of this module determines the target reader, the news appear when using selected module (option of multiple choice).

- **Central register of students, Central register of employees**

The central register of students is a non-public system, which has been created for the statistical and budgetary purposes. Register of employees serves for the evidence of the staff at universities, for statistical purposes, budgetary purposes, and control purposes and for the needs of the Accreditation Commission in carrying out its tasks.

3. Measurable indicators and objectives for the following period

Measurable indicators: Functional application, location and interconnection of different national dials, strong user support - Call center, HelpDesk, involvement of all universities in the module "Information about universities". Most of the universities are involved in Conferences and Seminars, eLearning, communication interface (SMS tokens, e-mails, discussions, and intranet), access dials to external applications.

The objectives for the following period: Portal redesign based on research (results will be presented at the conference), portal personalization, innovation of existing modules and functionalities, extend the application of new modules, namely a module DEKA - module designed to support e-learning in order to ensure continuous availability of courses and documents. Module Further Education will be added - database providing information on training programs for lifelong learning based on rich filtering rules.

Presentation of the results of questionnaire surveys

The presentation will publish survey results from the years 2011-2014 from the use of portals, and Central electronic university application form, as well as, the results of contact surveys in order to redesign Portal of Slovak universities. The methods: Evaluation dependencies of ideological issues of identification data using Chi-square contingency test, Kruskal-Wallis test of opinion matters. Electronic support was tested by LSD test of contrasts - testing of mean values compliance.

4. Conclusion

Portal of Slovak universities is as a gateway to the information for prospective students, as well as university students and the general public. It is also a gateway to a nationwide projects and other IS, such as KEGA, CRPA, and Electronisation of the university application process. It is great asset especially for universities that provide information about their activities, publish events organized at the university and e-courses. The Portal has been built since 2006 and continuing its operation is of great importance. There are published plenty of information, universities can exchange information with their IS with help of exchange formats.

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Using cloud computing to foster closer links between higher education institutions

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Keywords

Cloud computing, federations, interoperability platforms, electronic administration, student mobility.

1. Summary

The main objective of this work is to present the aims and the preliminary results of an ongoing project between four higher education institutions in Portugal. The project short title is “IES+Perto” which means “higher education institutions closer”. This project began in January 2011 and will run until September 2015. The total investment of the project is 2 million euros, corresponding to 1.7 million of funding. The consortium of the three universities of Porto, Aveiro and Coimbra, and the Polytechnic Institute of Porto proposed to set advanced and useful services to the community, exploring the benefits of interoperability, open standards and cloud computing, to help bring around a development strategy for administrative modernization and rationalization of costs in the higher education context.

2. INTRODUCTION

Over the last few years the Portuguese higher education institutions (HEI's) have managed to maintain high quality operating standards and have followed international best practices in order to achieve better levels of effectiveness, efficiency and quality.

In respect to the information and communication technological context (ICT) this attitude has been very evident, especially the involvement of Portuguese HEI's in several innovative projects that have sought the answer to an equation not always easy to solve: achieve greater rationalization and cost reduction in ICT, grounded on a strategic long-term vision related to excellence in scientific research, technological innovation and higher education qualifications. However, apart from some projects led in the past by the National Foundation for Scientific Computation, i.e. the Portuguese NREN (National Research and Education Network), as the Wi-Fi (eduroam) and the authentication and authorization infrastructure (AAI) projects (<http://www.fccn.pt/en/services>), other joint projects led by the HEI's themselves for shared ICT services and resources are rare. The “IES+Perto” project (<http://iesmaisperto.up.pt/>) aims to take advantage of the cloud computing information technology model to change this paradigm, increasing HEI's confidence in using cloud infrastructures securely and fostering the adoption of cloud based services, facilitating the creation of new sustained processes of administrative modernization and offering new services to the academic community, in particular for supporting student mobility and for enhancing the communication and exploitation of academic information through mobile devices.

3. INTEOPERABILITY PLATFORM

Following some investments on the existing data centers of the participating institutions to transform them into certified cloud-like architectures (Sousa, José António, Correia, Fernando, Bernardes, Mário, Martins, 2014), an aggregated cloud architecture (Moreno-Vozmediano, Montero, & Llorente, 2012) is presently under construction. This architecture will support an interoperability platform (PI) also under development (see Figure 1). Through the PI the acquisition and the

exchange of data from and between the participating HEI's information systems (IS), as well as the provision of data to other applications, e.g. the mobile client applications, will be possible.

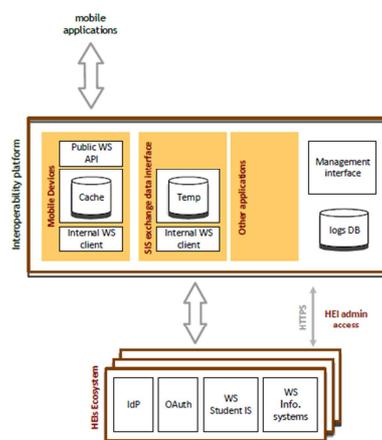


Figure 1 - Interoperability platform

It is required that each HEI has an identity provider (Shibboleth IdP), an authorization service, e.g. OAuth, to authorize the access of the PI to the HEI's web services and the web services applications. Consider for example the interface relating to mobile devices. This interface aims to virtualize and adapt for mobile devices the reception desks of the HEI's, in what respects to services, taking advantage of the interoperability middleware layer through which the communication and the access to information contained on the HEI's information systems will be processed.

4. CONCLUSION

In this work we will present the main objectives and some preliminary results of the project "IES+Perto" - Higher Education Institutions Closer, a Portuguese project involving four HEI's, the Universities of Porto, Aveiro and Coimbra, and the Polytechnic Institute of Porto. The project was financed by the Administrative Modernization Support System (SAMA) of the Operational Program Competitiveness Factors, COMPETE, under the National Strategic Reference Framework (QREN) and the European Union (EU).

In the context of this project the four HEI's scaled out their local existing data centers creating a larger virtual infrastructure and put up an interoperability platform for providing shared services, including the support for joint courses and national student mobility programs, as well as a technology solution for backing the development of API's to communicate and explore academic information through mobile devices. This work will focus the interoperability platform and the services implemented over it.

In terms of future perspectives, it is expected that the results of this project may drive a greater sharing of resources and ICT services between HEIs, taking advantage of virtualization and cloud computing.

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6. AUTHORS' BIOGRAPHIES



Lígia Maria Ribeiro is Principal Researcher at the Faculty of Engineering of the University of Porto since 2002. She was pro-rector at the University of Porto between 2006 and 2014, being responsible for ICT. She was vice-president of the Institute for Common Resources and Initiatives of the same University between 2003 and 2006 and director of the Computer Centre of the Faculty of Engineering of the University of Porto between 1997 and 2002.

Lígia Maria Ribeiro received her degree in Applied Mathematics in 1977 at the Faculty of Sciences of the University of Porto and holds a PhD in Engineering Science from the University of Minho.

Her main research areas of interest are Computer Simulation, High Performance Computing, Information Systems, Electronic Administration and Informal Learning Spaces.

She was President of EUNIS between 2004 and 2006, after being vice-president for two years. She is presently member of the EUNIS Board of Directors. She was also member of the Technical Committee of TERENA between 2008 and 2011. Since 2014 she is a member of the Task Group Best Practice/DRIS of euroCRIS.

She is author or co-author of more than 70 publications and was responsible of 11 financed projects. She was also responsible for several University of Porto projects, specifically the information system, SIGARRA, the institutional repository, the grid project and the e-learning cafés project. In relation with the information system SIGARRA she received two awards, the Descartes 1998 award and the EUNIS Elite award in 2000, and in the e-learning field she received the Jens Dørup E-Learning award in 2013.

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Luís M. Valente has an MSc in Network and Information Systems Engineering and is currently work in implementation of Electronic Administration projects, integrated in Digital University of the University of Porto and a researcher in the field of computer security at the CRACS/INESC-LA Port.

Working straight in the U.PORTO Campus Card Project, his main assignment is the implementation of cryptographic functionalities, especially for secure authentication and digital signing.

Since November 2014 is a ISO 27001 Lead Auditor certified by PECB.

SIGMA CLOUD: FROM AN ON-PREMISE SOLUTION TO A CLOUD ONE FOR SIGMA CONSORTIUM

Jordi Cuní

Keywords

Sigma, CRIS, SIS, CLOUD.

1. Abstract

SIGMA Gestión Universitaria is a nonprofit consortium established in 1996 by a group of 8 top level Spanish Public Universities to provide technological solutions to their needs for managing academics, learning, research and organization processes. SIGMA represents 20% of the students in the Spanish university system. The consortium's objective has evolved towards the continuous technological modernization of university management through the development of IT solutions aimed at automating the administrative processes and, as a result, guaranteeing their effectiveness.

So in 1996 the 8 universities that created SIGMA were trying to sum their efforts in a unique SIS & CRIS solution core. The project let develop fully functionality software with their entire specific casuistic and in terms of costs were affordable for all of them.

Nowadays as the price of storage and bandwidth continues to drop fast, Cloud-Based services are becoming more and more attractive and are affordable to small and medium-sized businesses which are seeking to reduce licensing costs, avoid recruiting IT staff and focus fully on their core responsibility-growing the business.

The concept of the cloud is a simple one: a service provider processes, manages or stores customer data in a remote data center either as a substitute for, or as a supplement to, customers' on-premises infrastructure.

2. SIGMA GESTIÓN UniversitAria Consortium

SIGMA Gestión Universitaria is a nonprofit consortium established in 1996 by a group of 8 top level Spanish Public Universities to provide technological solutions to their needs for managing academics, learning, research and organization processes. SIGMA represents 20% of the students in the Spanish university system.



Figure 1: SIGMA consortium

The consortium's objective has evolved towards the continuous technological modernization of university management through the development of IT solutions aimed at automating the administrative processes and, as a result, guaranteeing their effectiveness.

Technology and innovation are the backbone of the services and solutions provided, based on a highly open source development and deployment platform for J2EE certified application servers compliant on a multi-tier and high performance proven open architecture.

Internationalization is also one of SIGMA's top priorities. For years, SIGMA has established relationships with other European university consortiums. Lately, SIGMA has open new strategic areas of interest such as SaaS, BI, eLearning and Mobile. SIGMA focuses the development and support of two main suites of solutions:

3. SIGMA Student Information System

The European Higher Education Area (EHEA) was created to construct the Europe of Knowledge and place it at the international forefront, in order to benefit mobility and employment opportunities, and also to unify higher education studies in the EU. Since then, one of the main priorities of SIGMA [1] has been the adaptation of its products and services to the requirements of the EHEA, thus assisting the universities in the group as they go through this important transformation process.

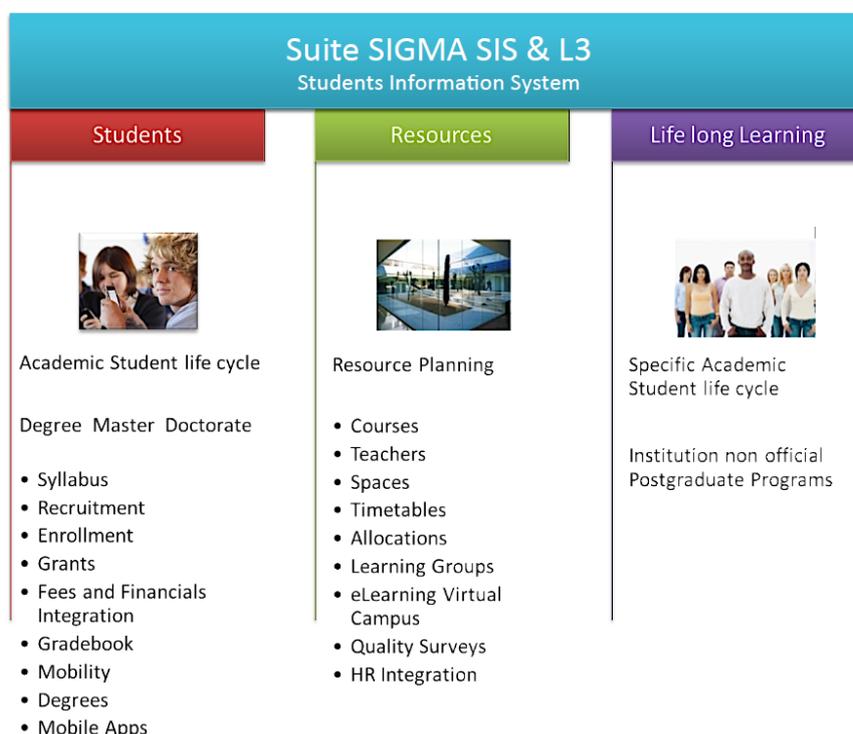


Figure2: Suite SIGMA Students Information System

4. SIGMA Current Research Information System

The European Research Area (ERA) [2] was created to facilitate the mobility of researchers, attract the best world researchers and coordinate the national and regional programs. Since then, SIGMA [1] has incorporated in its products - adaptations and new functionalities to support the scientific activity as well as its promotion, and has aligned its SIGMA CRIS Research Project with the ERA requirements.

Sigma is also aware of the new research trends (mobile devices, EuroCRIS Common European Research Information Format - CERIF [3] initiative, unique author identifier studies (i.eiraLIS [4]), altmetrics [5], ...) through continuous studies and the experience provided by the joint collaboration with the universities that compose the consortium.

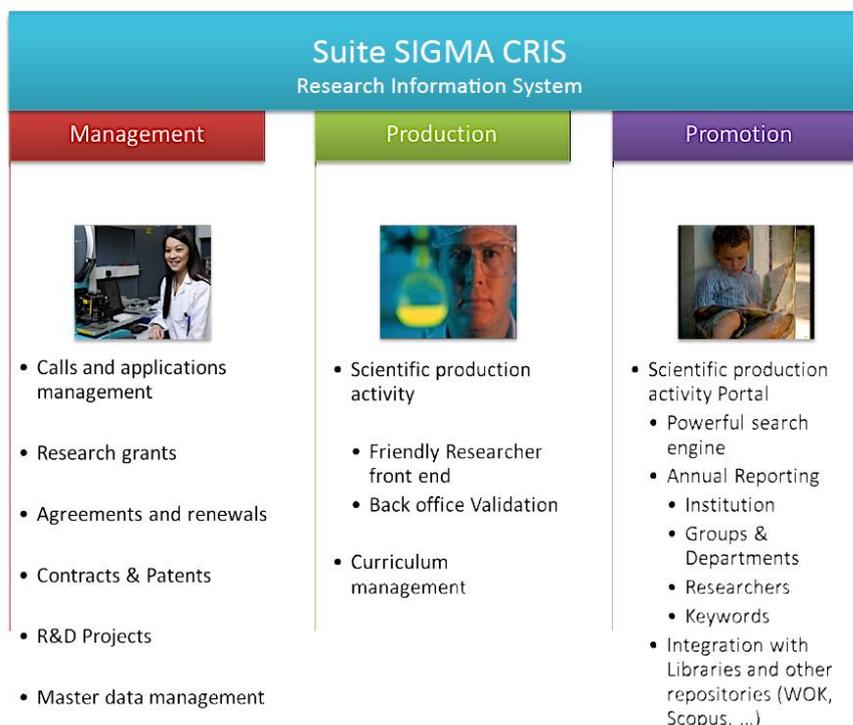


Figure 3: Suite SIGMA Current Research Information System

5. From and On-Premise solution to the CLOUD

Traditionally we were focused on the development and distribution of software for our clients that were installed on their own in their own systems, which means that in the 90s we had to compile the software for different platforms from several vendors such as SUN, HP or DEC.

One first step that SIGMA face with in the early 90's was to unified all the platforms in only one, in order to earn time and efforts in the development side.

In the middle of 90's SIGMA consortium decided to migrate to Java the SIS and CRIS solution. We achieved a significant milestone; we optimized the software engineering and development process, returning a cost reduction by minimizing points of failure because of the platforms unification.

Due to the European crisis the market for large Spanish public universities was in a situation that did not offer many opportunities for us to enlarge our clients.

In this context, we find out that our suites SIGMA Student Information System and Research Information System solutions that were designed with a very wide functional coverage, suitable for the needs of large universities, but we had a big drawback, anyone who would like to use SIGMA SIS or CRIS solutions should buy the necessary infrastructure and invest on licenses that were not cheap. This made difficult for us to enlarge our number of clients.

In order to offer to the markets a more competitive solution, we decided to offer our software solutions as a service model.

Software as a Service (SaaS) model had a number of advantages:

- Less or no initial investment in infrastructure and licences for the possible new customer.
- Reduced costs, because it's paid for use.
- The customer does not require dedicated staff to maintain the software nor infrastructure.
- Support more agile and fast. The application bugs have a direct treatment and the solution was put into service more quickly than in in-house facilities.
- The client could focus their efforts on the core business.
- Increased availability and data security, having infrastructure that, despite being shared, is more powerful and secure.

Our objective was that SIGMA solutions could be addressed to relatively small private colleges but of great reputation and large centres attached to public universities. All of them, on budget and human resources, not eligible for a suite like SIS VEGA but yet with a SaaS solution could become part of the community of users of SIGMA.

The SIGMA approach for the new clients, required a review of the organization of the software offered to universities, so as to define lighter suites to be used by higher education colleges and centres, more process-oriented and focused on the end user, who would have also a more specialized and nearer support from SIGMA.

The main technical milestone was to convert an On-Premise software developed for ages to a multitenant one. After this change in our SIS and CRIS solutions we were able to reduce the costs dramatically because not only we implement a platform shared by multiple clients (multi-tenant), where the infrastructure and licences costs were divided by all the clients, but also share the same software version in a single environment to reduce administration costs. The same infrastructure, and with once software deploy could serve multiple clients, each clients with its own environment, configuration, data, and look&feel.

After that we had an oriented to a service solution for SIS and CRIS suites, we set up our SaaS journey with our first client in 2011 the Institut Quimic de Sarria (IQS).



Figure 4: SaaS costumers evolve

Since early 2011 the service provided by SIGMA has gone through several phases during which it has matured both the solution core and the service delivery, so that it can address the large universities market.

SIGMA is now offering its software suites in a complete SaaS model to some medium-big universities, based on the same business and service premises as described above. Likewise, the integration of new services in the SaaS model, such as Business Intelligence, eLearning or mobile apps, allows the SIGMA SaaS clients to enter in a continuous integration model to use this new services is an easy way.

That opportunities with medium-big institutions furthermore the assimilation of several small centres attached to large universities is consolidating the service model in 2013 and expecting to grow in 2014.

After gaining experience in SaaS service, in early 2014 we defined the SaaS model for those universities that belongs to SIGMA consortium. But in this case, we upgrade our SaaS solution to a cloud one.

A cloud means that applications that run on the cloud take advantage of the flexibility of the computing power available. The computers are set up to work together so that it appears as if the applications were running on one particular machine. This flexibility is a major advantage of cloud computing, allowing the user to use as much or as little of the cloud resources as they want at short notice, without any assigning any specific hardware for the job in advance.

So that, the idea behind for our universities of the consortium was that they should continue deciding the evolution of SIGMA SIS & CRIS solution, which modules have to be update or deployed at the platform and which not, as if the infrastructure was On-Premise. But the infrastructure and the database were allocated at SIGMA

6. Project and methodology

Early in 2014 one of the SIGMA universities asked us to design a migration project of their SIS and CRIS environments to the SIGMA SaaS model.

The project was divided in the following phases:

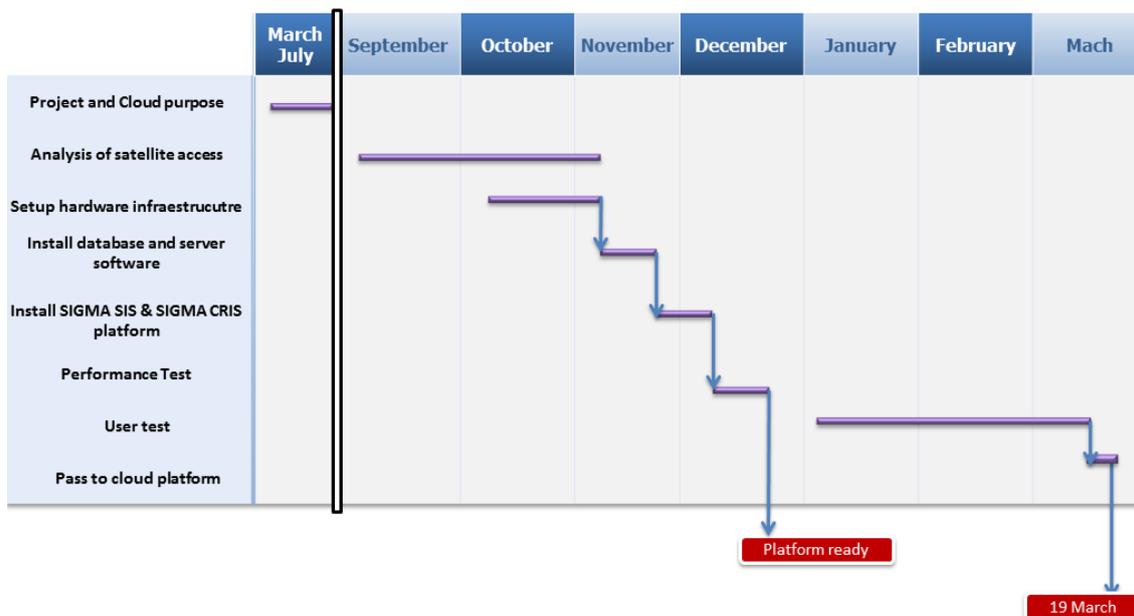


Figure 3: Project plan

Project and cloud purpose

The first part was to develop a document which specifies what services SIGMA SaaS could offer and how we thought that the interaction should be. This document was built together SIGMA and the university Staff, notice that each SIGMA university are owners of the complete SIS and CRIS solutions even the company. The main roles involved in this project were:

University staff

Technological vice-rector, the CIO, the responsible of hardware and communications and the responsible of the SIS at the university

SIGMA staff

The CIO, the responsible of hardware and communications, and the university consultant

The result of this study was a document which defines the SaaS model purpose. And it was presented to the university to obtain its approval.

Analysis of the satellites access

On premise systems usually has a layer of extra services that the IT department has developed over time. In addition, is common to be used to access to the database by direct SQL queries or by automatized scripts.

A critical point in the transition to SaaS is the analysis of the different types of access and the resolution of each of them. In our case these kinds of services were:

- Satellite applications accessed via an API well-known
- Satellite applications accessed through direct connection to the database
- Shortcuts to the base of automatic / manual data

Satellite applications accessed via API

In this case, the shift to SaaS model has no impact. A web-based service for data from external systems architecture allows changes without impacting system components.

Satellite applications accessed through direct connection to the database

The university may have developed applications that access data itself and some SIS system interchangeably, these applications are those we call satellites.

To avoid changing the application we decided to use links to the remote tables so that the satellite data applications continue accessing by the same way despite some of the tables of the schema were remote.

In this scenario the big deal was to achieve the same performance as if the satellite applications were on premise. This was a huge goal to achieve. In fact the access that has poor performance where those which the same query mix data from both schemas the client's one and the remote one.

We try different choices (build views from the remote table on the client side, study changing the queries, adjust the VPN from client to SaaS CPD. At the end we decided to set up a dedicated communication line between Sigma SaaS infrastructure and the CPD of the university. This line has response time as if was local network extends.

The database replication was dismissed by costs of extra infrastructure and licensing involved.

Direct access to the database

In order to let the ICT department the access to the database as it was on premise, the database users were defined with the minimum permissions and all their actions are audit.

Note that in the SIGMA consortium universities own the software and database. Therefore it is lawful to have access to their data freely, but controlled to guarantee service.

Once solved the communication needs and demonstrate its performance to the university the follow task involved only SIGMA staff. We build the platform. The project continued by creating a fully operational environment. And in early January 2015 the SaaS platform was completely built. It was given to the university to be tested by the ICT department and end-users mainly.

Again we defined a test plan that it lasted 2 month. The objective of this end-user test was in on hand that the end-users get confident with the new platform and service. An on the other hand test all the main activities before the pass to the SaaS model in the production environment.

Finally the end-users decided to migrate to the platform on mid-March 2015.

Nowadays SIGMA is offering a for the entire SIGMA universities consortium a Private cloud solution.

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EuroCRIS - CERIF initiative <http://www.eurocris.org/Index.php?page=CERIFreleases&t=1>

IraLIS - International Registry for Authors <http://www.iralis.org/>

Altmetrics - A manifesto: <http://altmetrics.org/manifesto/>

Institut Químic de Sarrià: <http://www.iqs.edu/en/>

8. AUTHORS' BIOGRAPHIES

Jordi Cuní was born in 1976 in Barcelona Spain. Computer Science degree at Universitat Oberta de Catalunya (2006 - 2012), Computer and Software Engineer at Universitat Autònoma de Barcelona (1997 - 2000).

He works for SIGMA since 2000, being the current Manager of Architecture Area and Software quality assurance Area. He leads a development team counting on 7 people for those areas.

His role focuses mainly on maintenance and develop the own Sigma framework in order to increase the productivity, define the methodology among the different areas and establish the software development tools for the rest of the company. At last but not least his area takes part on technical and performance support for our customers and helps them in the migration projects of their back-end resources. Previously, he had been project management for developing SIGMA's area for 5 years. His main efforts was focused on develop software solutions on resource planning necessities, stock management of static and mobile resources and physical and on-line surveys.

Ad-hoc Workflows for Higher Education

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Keywords

Workflow, Ad-hoc, Timeline, Information Systems, Innovation

ABSTRACT

It is commonplace in higher education institutions, for a large number of informal business processes to be handled through e-mail. However, e-mail fails to properly support traceability, and it fosters artifact duplication. This paper introduces GEARS: a solution to the e-mail overuse phenomenon. GEARS is a new approach to ad-hoc workflow systems that focuses on keeping the simplicity of the e-mail user experience while implementing a participation-driven process execution.

1. INTRODUCTION

Nowadays, higher education institutions usually resort to workflow systems to automate business processes that are well-structured and have a large user base. However, a significant number of other processes is usually executed by e-mail [1], either because their structure is not clearly defined and amenable for implementation in a typical workflow system, or because the small number of users does not render such implementation cost-effective. The bulk of these informal business processes starts whenever someone needs something, in which case he/she sends an e-mail to another person who may or not delegate part of the request and handle the other part. Although many of these e-mail interactions regard authoritative and informative actions, other e-mails result in the production of data artifacts.

Most often, business processes are handled informally via e-mail instead of workflow systems due to their dynamic and loosely structured nature. There have been research works that focus on uncovering interaction patterns and processes by mining e-mail logs [2]. Dynamic processes are too complex to be implemented in a system that enforces a given behavior because the behavior has many exception cases. Furthermore, the effort of implementing such rules is overkill when the process rules change and the existing model is no longer adequate to the process requirements.

One of the main reasons that e-mail is used to support such dynamic informal processes is that e-mail is a general-purpose communication tool, generic enough to adapt to the most subtle business process changes: there is no underlying rule model except request and a possible response. However, the traceability that e-mail provides is inadequate for business process execution. Also, the amount of replication and dispersion of data artifacts among the participants hinders an efficient execution of the process. Finally, the execution of a given business process can be scattered among different e-mail threads with different e-mail subjects. There is no central system where all the interactions, subjacent to the execution of a given process, are handled.

This paper is organized as follows. In Section 2, we present a case study that serves as an introduction and motivation for the contributions proposed in this paper. Section 3 introduces the proposed system as a novel approach to tackle the problem of e-mail overuse in loosely structured business processes. Afterwards, Section 4 describes relevant implementation details. Finally, Section 5 presents a few concluding remarks and highlights topics for future work.

2. A CASE STUDY

In Técnico Lisboa, a higher education institution in Portugal, the most relevant academic and administrative business processes are already automated using the FenixEdu¹ Education Management System. However, either due to their dynamic nature or because they are of interest only to a small portion of the school's population, a wealth of other business processes is still informally executed resorting to e-mail. We confirmed such behavior when we conducted an informal survey on a small group of faculty and administrative staff.

One of the first processes that we identified, within the informal survey, as being highly dynamic, and mostly based on e-mail, are all the interactions and decisions of the various committees within each department. Departmental committees are groups of faculty that either coordinate or provide guidance on different aspects of the daily operation, governance and strategy of each department. Either because each committee addresses issues of very specific nature, or because each department has a distinct culture, departmental committees tend to operate in a very diverse and heterogeneous manner. Therefore, departmental committees tend to have different workflows through different sets of interactions among different members. Usually, such processes are executed via e-mail, where the participants share their opinions through comments, while simultaneously providing and building documents. Nevertheless, the complexity associated to these processes is too high to consider them as case study of the approach that we are proposing in this paper.

We focus our case study in the Master Thesis process, which is also a good example of a process that we found hard to implement in a rigid workflow due to its dynamic nature. To begin with, Master Theses have a varying number of committee members. Also, apart from the advisor, the candidate may have a co-advisor, which would trigger a set of different interactions between them. During the process, the candidate may change the dissertation topic, maintaining or not the advisors. Depending of the situation, the process needs to consider different steps. The same happens during the defense phase: the student may fail to defend the thesis, or the jury may change according to rules like: the candidate must not share publications with any member of the jury besides his supervisors. There is high variability during the different phases of the process. Also, every year, the rules tend to change to adapt to unpredicted situations that were faced in the past year(s) or simply due to external governance events. An interesting aspect is also the fact that, in parallel with the execution of the process, several of the actors involved in the process will most likely need to exchange information (notes, files, comments, etc), and typical structured workflow systems do not provide a practical method to store such information in a format that is easy to later retrieve and access.

3. THE NEW APPROACH

Given the dynamic aspect normally associated to informal processes, and the clear disadvantages in using e-mail to support them, we implemented GEARS, which introduces a new approach to their execution. Commonly, workflow systems either drive process execution through activities or data. However, both approaches require pre-specification of the rules that guide the process flow, i.e., a process model that an engine can interpret and use to guide the process execution. Informal processes, that are complex and constantly changing, are no fit for model-based approaches. Moreover, workflow models usually assign a given activity to an executor, hindering collaboration among the stakeholders.

¹ <http://fenixedu.org>

3.1. USER EXPERIENCE

One of the most important aspects when introducing a new information system is the user experience. Since users are already familiarized with e-mail, we tried to be extremely careful while disrupting that communication experience. A great example of such disruption is related to the request-response synchronization paradigm that is so built-in into the user experience. Such paradigm is also one of the main limitations that we listed before: the number of copies and communication channels exponentially increases with the number of participants (for N participants in an e-mail thread, there are $((N-1)*N)/2$ possible communication channels). Hence, we need to drop the request-response paradigm, and inherit the multi-participant collaborative aspect. Although we dropped support for request-response interaction pattern, we kept a User Interface (UI) similar to that of e-mail folders (see Fig. 1).

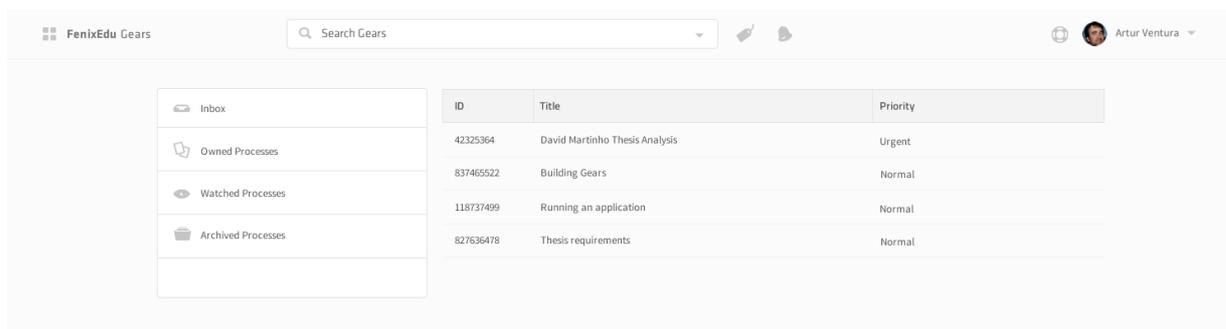


Fig. 1: Folders View: Inbox

While in the Folders' View, users can access their Inbox folder, where all new process instances, for which they are invited to participate on, are listed. Process instances created or managed by the user are listed in the Owned Processes folder. Also, users can choose to follow specific processes by watching them. Such processes will be listed in the Watched Processes folder. Finally, when the processes where the user participates are marked as being concluded, they will only be listed in the Archived Processes folder. In addition to these built-in folders, the user can create "smart folders", which essentially are filters that list all the processes that match a particular set of tags, specified for each of such folders. For example, if the user wants to list all the processes related to Master Theses submitted in 2015, it can create a "smart folder" that matches the tags "master-thesis" and "2015", assuming that such tags were used to categorize all the processes related to Master Theses submitted in 2015.

3.2. PARTICIPATION-ORIENTED

During our case study, we identified several key interactions that would drive the process execution progress. Such interactions have two or more participants who communicate and may then trigger new interactions with other users. In GEARS, any such interaction is designated by participation. All the actors of any given participation can exchange comments and files.

3.3. PROCESS VIEWS

In GEARS, there are four main process views: the Participation Feed, the Timeline View, the Process Event Stream View, and the Process Files View.

PARTICIPATION FEED

The Participation Feed lists all the active participations that are relevant for the user, ordered by relevance. The relevance is based on the timestamp of the last interaction between the users and the participations. When a user performs some action in a participation, for instance, posts a comment, the relevance value for each participant, other than the user, is updated to the current timestamp. In the Participation Feed, participations are ordered by decreasing order of their relevance value.

TIMELINE VIEW

In the Timeline View the user can see all entries from a given process, such as participations and events, from the most recent one to the oldest one. Fig. 2 depicts an example of the Timeline View of a process. In the example, there are 5 different participations within the timeline. Each participation has four main perspectives: the discussion perspective, the participants perspective, the files perspective, and the summary perspective. The discussion perspective contains a list of all the comments made by the participants, along with the stream of actions such as file uploads and their updates. The participant perspective shows the list of current participants, and allows any participant to invite more participants to the participation. Moreover, the files perspective lists all the participation files, along with their previous versions. Finally, the summary perspective displays an optional statement that summarizes the participation outcome when it ends.

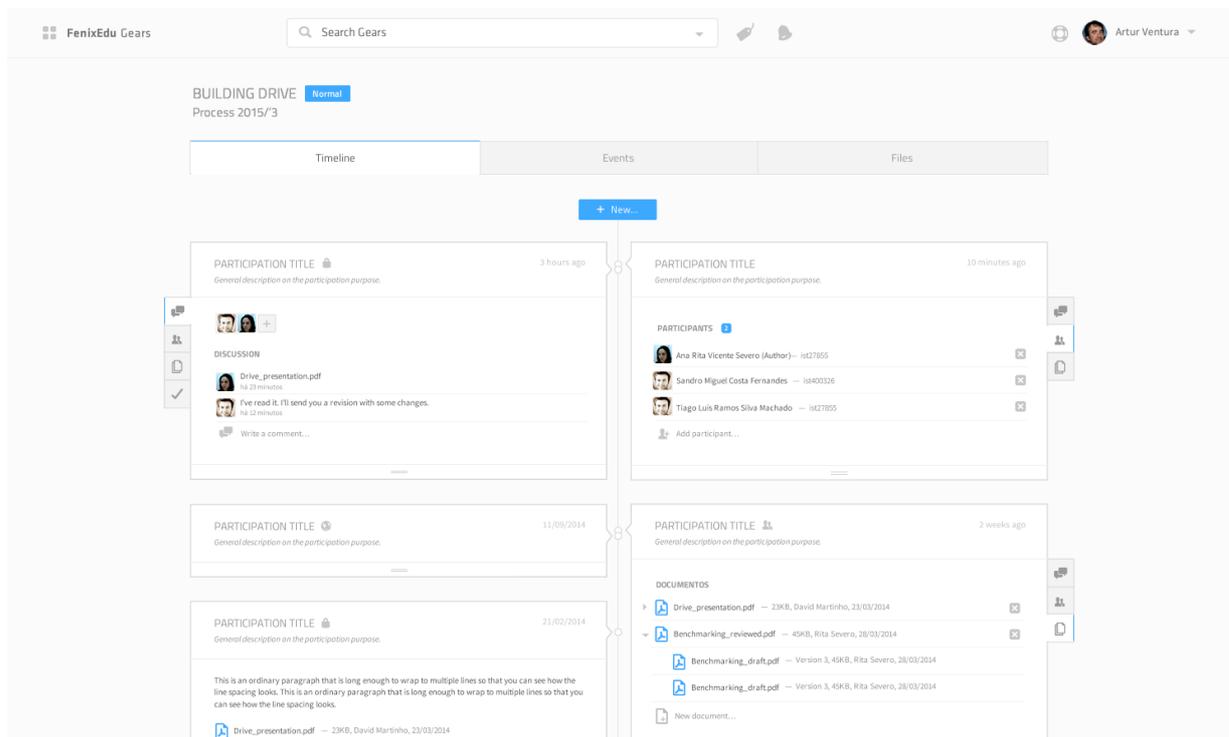


Fig. 2: Example of the Process Timeline View

PROCESS ACTION STREAM VIEW

The Process Event Stream View lists all the action events executed within the process by its participants (e.g. participation creation, file uploads and updates, new comments, etc). The entries of this stream are ordered chronologically. This view is particularly important for participants to acknowledge the latest actions that took place on the process instance.

PROCESS FILE VIEW

To enhance the efficiency of finding a file within a process, instead of checking each participation, GEARS offers a Process Files View that lists all files that can be accessed by the user within that process. With the Process Files View, the user can lookup and access process files much faster than by using e-mail, where he would need to check all the e-mails and their respective attachments. Additionally, the user would need to check whether a given e-mail contains in fact the latest version of the necessary attachment. GEARS offers a list of all the latest versions of each file, allowing the user to access older versions if necessary (see Fig. 3).

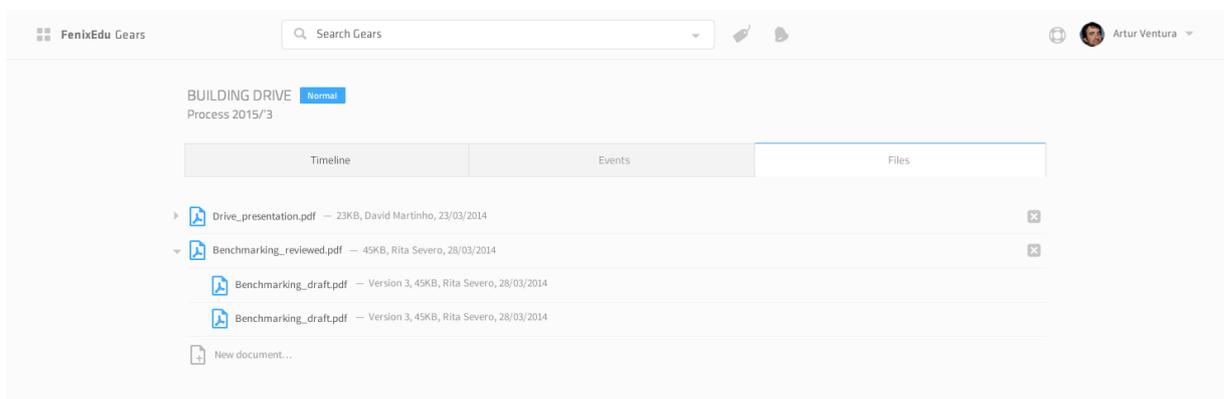


Fig. 3: Example of the Process Files View

3.4. INTERACTION PATTERNS

In GEARS, the most granular interaction context is called a participation. Participations exist within processes, and consist on a focused discussion between two or more participants. Within a participation, the participants can essentially write comments and upload files. When such interaction is finished, any of the users can propose a public summary, which represents the outcome of such participation. A participation is like a virtual meeting between several participants, where they discuss one or many subject and can, optionally, make a public summary (statement and files summarizing the conclusions of the participation) available to other people involved in the process but not necessarily involved in that specific participation.

PARTICIPATION PRIVACY POLICIES

Each participation is created according to a particular visibility policy: participations can be hidden, private or public. Hidden participations are only visible to their participants, meaning that other process participants do not even know of their existence. If the optional summary is proposed within the hidden participation, only its participants can view that summary.

Private participations are known to all process participants, but only the participants of the participation can access its content (participants, files and comments). In the end of a private participation, any of the participants can propose a public summary that is voted by all the participants. If the summary is approved by all the participants, it is made available to the remaining process participants. Until then, all other process participants can only see the private participation's title.

Public participations are participations where everyone participating in the process can see its content: title, participants, comments and files. However, only the participation participants are allowed to interact within the participation (i.e. make comments and upload files). Although public, if the participation is too long, the participants might optionally create a summary that summarizes the outcome of that participation. It is more efficient to check the summary than to read the whole participation and cherry-pick its real outcome.

PROCESS EVENTS

Sometimes, in specific processes, there are events (dates) that are relevant to the process development and should to be remembered. For example, in the Master Thesis process, the defense is an important event, therefore its date should be clearly presented in the process given its relevance both for the jury and the candidate. Hence, besides participations, GEARS allows any process owner to also create process events within the process timeline (Fig. 4). These events display a title, a small description, date and time of the event, as well as the place where it will occur. All process participants may manifest their attending intention by stating if they are Going, Maybe Going or Not Going.

CALL FOR PAPERS 
General description on the event purpose.

EVENT DETAILS

 21st March 2015

 16h00 — 19h00

 Instituto Superior Técnico
 Avenida Rovisco Pais, 1, 1049-001 Lisboa

ATTENDEES

 Ana Rita Vicente Severo (Autor) — ist27855

 Sandro Miguel Costa Fernandes — ist400326

NOT ATTENDING

 Artur Félix Ventura — ist400326

Fig. 4: Example of the a Process Event Entry.

PARTICIPATION FEED

When participating in multiple processes, participants become less productive if they have to open the Process Timeline view and search for participations of interest that need immediate action. To address this problem, GEARS offers a Participation Feed view where all participations of interest, despite their process, are listed. Although the participation feed lists participations from different processes, the process context (title and ID) is always included so that the user can have context of execution. Using this view, users are able to perform actions on their different participations without having to jump among process timelines.

4. IMPLEMENTATION

Currently, the GEARS project is about one year long, and its implementation status just reached the first release candidate. In a near future, GEARS will be released as an open-source sub-project under the FenixEdu project umbrella.

4.1. DOMAIN MODEL

As mentioned before, GEARS allows users to create new business process instances, in which they can create new events, and interact with other users within participations. In Fig. 5, there is a simplification of the GEARS Domain Model.

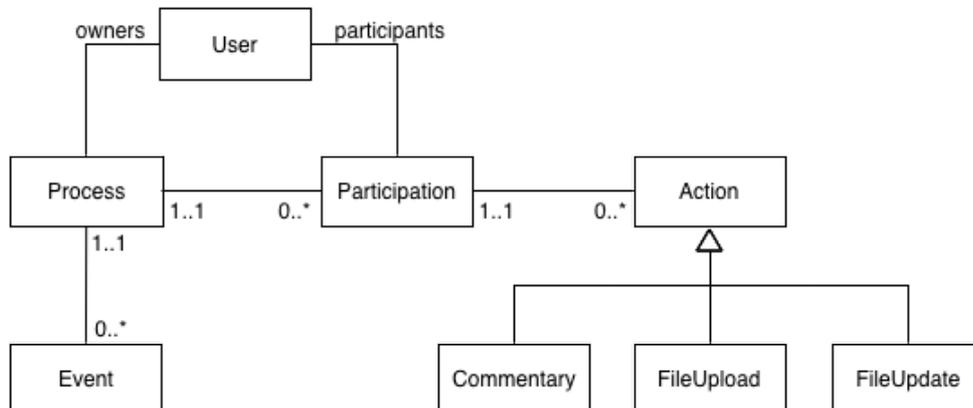


Fig. 5: GEARS Domain Model

Process owners are allowed to create new events and new participations. Events consist of information like the event's name, place and date. Such information is accessible for all process participants, i.e. to process owners and anyone that is member of at least one participation. Within a participation, any of its participants can execute one of three main actions: upload a new file, update an existing file, and write a comment. Participants can also invite additional participants to their participations, but such action is not logged within the action class.

This model is simplified for the sake of simplicity, and to focus on the main underlying concepts of the GEARS system. There are more details in the model, such as the public response, which is not relevant to understand the main entities that compose the GEARS system.

4.2. TECHNOLOGY

The GEARS system is implemented in both Javascript and Java. More specifically, the client-side is fully implemented in Javascript, using AngularJS² framework, while the server-side is developed in Java, using the BennuFramework³ which is a web framework developed and maintained by FenixEdu⁴ team. In an architectural perspective, the client-side consumes a REST API that implements the main business logic of the GEARS application.

This project is composed by two main modules: one is the Core module where all the REST API endpoints that handle all the business logic are implemented; the other one is the UI module where all the frontend is implemented (see Fig. 6).

The application's data is stored in a MySQL database. FenixFramework⁵ is used because it offers an abstraction layer around the persistence mechanism, in such a way that developers handle domain's persistence using usual Java classes instead of having to deal with the database itself.

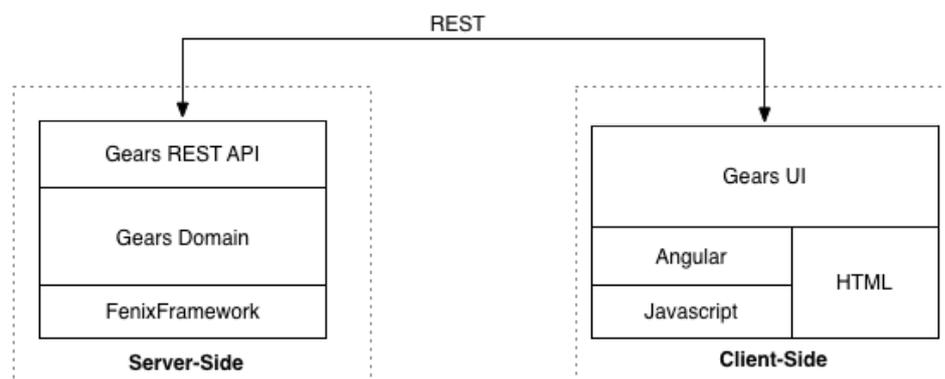


Fig. 6: GEARS Architecture

Also, during build-time, Browserify⁶ is used in the client-side to allow frontend Javascript code that uses require statements, similarly to NodeJS⁷ modules. To manage third-party frontend dependencies, such as AngularJS, Bootstrap and others, we use Bower. To integrate all these tools in our build process we created a maven plugin for that purpose. Such plugin essentially downloads all the required artifacts such as NodeJS, Bower⁸, and other NodeJS libraries, and configures them easily to help build a more efficient development environment, as well as preparing the code for production (minification of Javascript for example).

² <http://angularjs.org>

³ <http://github.com/FenixEdu/bennu>

⁴ <http://fenixedu.org>

⁵ <https://github.com/fenix-framework/fenix-framework/>

⁶ <http://browserify.org>

⁷ <http://nodejs.org>

⁸ <http://bower.io>

5. CONCLUSIONS AND FUTURE WORK

This paper presents GEARS, a new approach to ad-hoc workflow execution that focuses on providing the traceability that e-mail messaging fails to provide. In e-mail, the same business process execution is scattered among different threads with different subjects, and their attachments are replicated in different messages. GEARS provides a single point of communication to each process instance, allowing people to interact seamlessly. In such interactions, users can share their insights by writing comments or uploading files (for which versioning is supported). Each process instance is viewed in a timeline format, that lists the participations in chronological order, as well as events of interest to the process instance participants.

The application will be deployed in Técnico Lisboa, to a community of 15000 users, by the end of May 2015. We intend to capture usage statistics for both e-mail and GEARS in order to understand to what extent are people migrating from e-mail to GEARS.

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7. AUTHORS' BIOGRAPHIES

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EUNIS 2015: Path: From Student Innovation to Central Service

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Keywords

Student choices, excellence in innovation, student experience, learning and teaching, student transitions, provision of course information and structures.

1. Summary

To exploit the innovation demonstrated by two students in the School of Mathematics and improve the student experience by developing their web-based course selection tool into a university-wide supported service. The vision for Path was not just to validate a student's choices, but guide them to making better and more balanced choices to build the degree programme that's best for them.

This project contributes directly to The University of Edinburgh's strategic goal of providing Excellence in Education: the provision of course information and structures through Path supports the key transitions that students go through; provides Personal Tutors and other staff with the information and tools to enhance the support provided to students, and overall forms part of the programme of activity seeking to enhance the student experience. The process of producing the Path system demonstrates Excellence in Innovation, taking a system that was developed by two students in one school and developing it into a University-wide system. The process is analogous to starting with the in-house equivalent of a start-up company and providing the venture capital it needed to develop a fully-fledged system.

2. ABOUT THE EXTENDED ABSTRACT

The University of Edinburgh has a very wide curriculum and offers an enormous choice which is fantastically flexible but has complex rules around which courses (modules) are eligible for which degree programme. Before Path, information about courses was available via the University's Degree Regulations and Programmes of Study (DRPS) system. This is a legalistic system modelled on a paper-based original system and was primarily designed to satisfy university regulations rather than supporting students in their course selection.

Using a modern web-based presentation, Path showed which courses depended on others as prerequisites and took information about the user's past courses to show which future courses were open to them. Path enhanced this official information with moderated feedback about each course from students who had taken that course. Integration with timetabling enables the student to check for clashes. Enhanced functionality proving popular amongst students is the topics function. In use within Physics and Mathematics, this functionality enables the student to browse the course catalogue and filter by topics such as nuclear and particle or quantum physics aiding a degree programme to be built within fields of interest.

This was the starting point: an innovative prototype that had demonstrated its utility within just one of the University's 22 schools. This development was an innovative process for the University. A working prototype is not the same as a robust, scalable and centrally supported service and the development of this service involved some risk-taking from the management in supporting the idea and paying the salary of the two developers. The initiative faced resistance and concern around a number of areas: using an IT system developed by students instead of professional developers, allowing students to give feedback on courses that was accessible by other students and reluctance to show data which may have been out of date or otherwise lacking in quality. However, the risk has paid off.

Phase 1 extended the initial Path prototype from the School of Mathematics to the School of Engineering Science and the School of Physics and Astronomy. This involved changing the system to

support multiple schools, which was an essential step on the journey of supporting schools across the university. It also demonstrated that the system had benefits beyond its original school. Having proven the capability of the system in phase one, the second phase transformed this nascent service into a fully-fledged service under the wings of Student Systems. The system was migrated onto the university's corporate infrastructure, providing a resilient dual-site capability. The program itself was rewritten to take its data from corporate data feeds providing a more robust interface.

The result of this project is a service which is available to students across the university. Usage of the service has expanded with 20 of the University's 22 Schools now fully engaged with Path. Path has been accessed by 11,500 unique users (9700 students, 1800 staff) with 100,000 sessions since the full service was launched in July 2014.

Path was a huge improvement in student information systems and its authors had shown great initiative and innovation in developing it. The success of this process sets an example for future initiatives. Information Services and Student Systems will be open to adopting similarly innovative systems in the future. We are considering sponsoring a competition for student projects in this vein.

"Path has been a tremendous development on a number of fronts: it is a student-led initiative which has grown to have a positive impact across our student community; it has greatly enhanced the way we present our course information to students and as a result has improved the quality of the information we publish; it has provided tools which support both students and Personal Tutors navigate key transitional stages; and has been an excellent example of colleagues working in partnership to enhance the student experience." **Professor Ian Pirie, Assistant Principal (Learning & Teaching).**

Further Development

The Path tool is an exploratory tool. Choices from students can be saved and printed but do not feed into more advanced workflows. Path is being developed to enable students to send their proposed course choices to the Personal Tutor ahead of their first meeting to aid discussion. This enhancement will be introduced for the 2015/16 academic year.

Opportunities arisen from the success of Path are to integrate the course evaluation information from Evasys with Path as this is a quality approved process. Integrate data to support undergraduate students from the Key Information Set (KIS) to provide guidance about course choice. Have an open version of Path which supports conversion.

The system has hugely improved the student experience by helping students to predict the impact of their course selection and by providing feedback on courses. The system has reduced the reputational risk to the institution by removing problems of students finding too late that they were ineligible for their desired courses. Other benefits include student feedback was almost uniformly positive, staff learned about how students regard their courses and made changes, the quality of programme and course information has improved markedly.

Path was written for University of Edinburgh deployment but is written with open source software therefore could be used by other institutions with modification. Path can be accessed via <https://path.is.ed.ac.uk/>; please follow the instructions to create an EASE friends account.

Example student feedback: *"... I wish that I could have used Path when I was in first and second year to choose my outside courses more carefully, using the student reviews and the prerequisites features. As it is, I hope to benefit from it choosing my courses for fourth year!"*

"Good for letting students know about courses from a student perspective, needs to be advertised more. Helpful and clear, would like to be able to see timetable clashes."

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Building Comprehensive Video Services for Education with Open Source Tools - Case: University of Helsinki

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Keywords

Open Source, Lecture Capture, Video Portal, Media Processing, Flipped Classroom, Video Evaluation

1. Summary

The IT department of the University of Helsinki has been an active implementer of the Opencast Matterhorn - Open Source Lecture Capture & Video Management System for Education - since the beginning. Over the four years since the start of the initial pilot the local setup has grown into a full fledged production system called UniTube, which is based on Opencast backend servers with integration to Moodle and other university systems such as the intranet, complemented by Galicaster lecture capture setups in selected lecture halls, in special teaching rooms and a self-service video studio. In the presentation the setup and the lessons learned in the first four years as well as the plans for the future will be discussed, with special attention paid to the more novel implementations like the self-service video studio for making lecture videos, or the practice pharmacy, where students' interactions with customers are recorded in a realistic setting.

2. THE TECHNICAL SETUP

The current service is divided into the following parts: UniTube Arena (viewing videos at the university's Flamma-intranet), UniTube Uploader (for uploading and administering user's videos and series via the intranet), UniTube Studio (a self-service video studio) and UniTube Lecture Capture Theaters (i.e. lecture halls or special rooms equipped with Galicaster-based self-service lecture capture devices). Integration to Moodle via LTI provides the possibility to limit the visibility of videos to certain Moodle courses. A special viewing arena for university's public web pages is in development, as is the possibility to use the recorders, besides recording, to live stream the events.



Figure 1 The UniTube Studio

The UniTube Studio setup consists of two HD video cameras, 3 LED panels, 2 large screens, 3 automatically mixed microphones with an audio dynamics processor, a presentation PC and a recording PC running Galicaster. The lecture capture theaters usually feature a slightly lighter setup, consisting of a recording PC with a HD camera plus audio and projector screen image recorded from the theater's AV-matrix. Initially the cameras in lecture theaters were fixed in position, but now the process of exchanging them for movable PTZ cameras is under way due to requests from users. There is also interest to try an automatically controlled tracking camera, perhaps using the open source Lecturesight solution.

3. USE IN EDUCATION

The most actively used lecture capture facility at the University of Helsinki is the UniTube Studio, where one often has to make a booking a few weeks in advance. The studio is used both for making lecture videos for flipped classroom teaching (i.e. talking head and slides) as well as recording interviews panels, short news bulletins for faculties, etc. Most of the recordings from the studio are sent directly to the Matterhorn servers for publishing, but a minority are post processed by the users themselves, using their preferred editing or authoring tools, and then uploaded to the Matterhorn via UniTube Uploader in the Flamma-intranet. The lecture capture devices in lecture halls are also used regularly, albeit not as much as the studio, and many teachers have stated that they don't want "just to encapsulate the old-style lectern based teaching" but instead want to use the technology to make shorter videos specially aimed for online teaching, often following the flipped classroom style of making short and more concentrated video clips.

A completely different use case of video technology in education is going on in the practice pharmacy, where the recordings made are usually only viewable for the student doing the practicing while being recorded. The setup consists of two mounted and remote controllable PTZ video cameras, which can be used to record interactions with the student and the 'customer' in different 'real life' settings in the practice pharmacy. For audio clarity, both participants are wearing wireless microphones, and the audio is routed through a dynamics processor. After the recording of the interaction is finished, the media feeds are processed in the Opencast backend in accelerated workflow and published in the local intranet only for the student in question to view or download. In some courses the recordings are then evaluated from the projector in the same teaching session in which they were recorded, with other students and the teacher present giving also their comments and suggestions.

4. STATISTICS

The current record of 97 new lecture capture videos made within a single week at the UniTube Studio occurred in February 2015. Most of the recordings that week were 5-15 minutes long video lectures for a fully online course on human paleopathology (there were real bones involved and presented). Roughly two thirds of all of the videos stored in the local Matterhorn system are set on limited visibility, i.e. viewable only to the participants on the linked Moodle courses. The easy Moodle integration seems to have been one main driver for the adoption of the system, as one can just upload video files via the UniTube Uploader on the intranet, and have them appear in the selected Moodle course - and not to be viewable for anyone outside the Moodle course.

Roughly half of the public videos in the system are published under a Creative Commons license (selectable when uploading), allowing for re-use of videos with certain limitations. The number of public videos will multiply during the rest of the year as thousands of old videos from the university's old video service (which are mostly in the old RealVideo format) will be ingested to the UniTube to be re-encoded and republished via the new system. A new public video portal for the university's public site is also being planned, which would be directly based on the data and videos hosted in the Opencast repository.

5. CONCLUSIONS

The University of Helsinki jumped on to the Opencast Matterhorn bandwagon almost from the start, and has over the years participated in the progress of Matterhorn, and the related lecture capture tool Galicaster, by commenting, suggesting, developing, testing, contributing and collaborating to the projects. From the start the solution of recording two HD quality video feeds using H.264 as the delivery format was selected. Time has shown this to be a good choice, allowing us to keep the same basic approach and protocols throughout the project while also constantly pushing the quality.

Some universities have taken the way of fully automated lecture capture, where recording turns on and off automatically by pre-set schedule. In Helsinki we dropped that methodology after initial pilot phase due to problems with ad-hoc recording as well as 'orphan recordings' where the owner was not clear. Currently our setup requires the user to login and manually start, stop and send the recording to the server, thus making sure that every recording has a corresponding owner responsible for the resulting video and it's content. Although requiring a little more effort, this hasn't been a showstopper, and has allowed the backend to run without hands-on supervision, as the administrators of the system don't need to evaluate and control the videos before publishing. As the usage of the system keeps going up, this is a huge time saver and allows better scalability.

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Sami Andberg has M.Sc. in Computer Science from the University of Helsinki with a certificate in IT Education, and a M.Sc. from Karolinska Institutet's and Stockhom University's joint Health Informatics program. He has worked extensively in the field of IT, educational technology and media in multiple countries, and currently holds a position at the IT Centre of the University of Helsinki while also doing occasional consulting and projects to other institutions via his company Andberg Consulting Oy.

eCULT

eCompetence and Utilities for Learners and Teachers

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Type

Good Practice

Keywords

E-Competence, Organization of Teaching and Learning, Learning Management System, Video-based Teaching and Learning, E-Assessment

Summary

The project *eCULT* is carried out by 11 universities/colleges and 2 registered associations in Lower Saxony, Germany (for the full list see www.ecult.me). The project's goal is to improve the quality of academic teaching and learning by using digital technologies in a meaningful didactical way. For this purpose, three spheres of action were identified: organization of teaching and learning, video-based teaching and learning, and e-assessment. In all of these spheres, round about 50 staff members of *eCULT* provide both the improvement of digital utilities and consulting and training in order to both ease the use of the utilities and improve teachers' and learners' didactical and technological competences (e-competence). The main approach was to identify digital tools which are appropriate to support classroom-based teaching in a meaningful didactical way. Besides online-self-assessments or the recording of lectures, the focus was to improve the learning management system that is used by more than 60 educational institutions in Germany, which is called Stud.IP.

Extended Abstract

The project *eCULT*, which is funded by the Federal Ministry of Education and Research, is carried out by 11 universities/colleges and 2 registered associations in Lower Saxony, Germany (for the full list visit www.ecult.me). The project's goal is to improve the quality of academic teaching and learning by using digital technologies in a meaningful didactical way.

For this purpose, three spheres of action were identified: organization of teaching and learning, video-based teaching and learning, and e-assessment. In all of these spheres, round about 50 staff members of *eCULT* provide both the improvement of digital utilities and consulting and training in order to both ease the use of the utilities and improve teachers' and learners' didactical and technological competences (e-Competence). In this way, the project provides the knowledge of professional didactical experts and technical developing experts, which form a network across 13 locations, to support local activities that aim at the optimization of teaching.

The first inducement for this project was caused by several organizational challenges in Germany's higher educational system: The implementation of the objectives from the Bologna process, the increasing disproportion between teachers and learners (e.g. overcrowded lecture rooms), the lack of efficiency in organization of teaching, which leaves less time for good teaching practices, and a lack of qualification in the use of digital teaching technologies. As a result of this, the preconditions of learning and teaching in higher education had to be revised.

The second inducement was caused by changes in practice: Learners massively using digital and mobile technologies, and teachers facing a *shift from teaching to learning*, which leads to more collaborative learning in groups.

So the task was to improve teaching and learning methods – not only, but also – by means of technology. Research shows that, for instance, online-self-assessments or video-based contents can improve the success of learning, and the use of learning management systems can facilitate the organization of teaching. Therefore, the main approach was to identify digital tools which are appropriate to support classroom-based teaching in a meaningful didactical way (i.e. blended learning). Besides online-self-assessments or the recording of lectures, the focus was to improve the learning management system that is used by more than 60 educational institutions in Germany, which is called *Stud.IP*.

Stud.IP was improved in several ways. First, the underlying technology was renovated by fully implementing a model-view-controller framework called *Trails*, and by providing an improved REST-API. This made it easier to create new features later. Second, the GUI was renovated to heighten the usability of *Stud.IP*. Third, users were provided with new help functions: Feature tours that explain how to use certain functions, standardized help pages that are easier to understand, a plugin page that explains the function of didactical plugins to lecturers, and a help bar that provides easy access to all the new help functions. We also plan to create a scenario-based web advisor that helps lecturers to choose the best-fitting tools and didactical methods. Fourth, already existing functions were made personalizable (e.g. an adjustable startpage, a personal file storage area). The goal is to create a personal learning/working environment for everyone within *Stud.IP* where users can share their files, texts, ideas and so on. Fifth, we are also working to didactically improve the e-assessment section of *Stud.IP* by creating an e-portfolio solution and an easy to use all-purpose e-assessment tool. Fifth, we constantly help the *Stud.IP* community to test new functions that have an impact on teaching and learning (i.e. a Doodle-like scheduling tool, a Facebook-like chat, a modern forum, an Android app, and a system-wide WYSIWYG-editor).

The main difference between usual software improvement projects and eCULT lies in the advantage that our software developers are advised by professional didactical experts that are consulted by teachers and learners every day. This helps to identify the recurring problems that teachers and learners run into when using *Stud.IP*.

In December 2014, the project was evaluated by the central evaluation agency in Hannover, Germany, which is funded by the local government of Lower Saxony. Results showed a very good nationwide ranking of eCULT in so called e-learning activities, and a good success in managing a large-scale cooperation project. Currently, the application for the second period of funding from 2016 to 2020 is in progress. During this period, we aim to improve blended learning even further. First, we want to focus on (tools that support opportunities for) autonomous learning, collaboration and student participation. Second, we want to increase students' and teachers' knowledge about blended learning. Third, we want to acquire students as generators of new ideas and as evaluators of our measures. This new approach leads to a different focus for the development of *Stud.IP*. First, we focus on features providing content and communication independent of and spanning over individual courses in order to further the students' autonomy, and to better support course modules. Second, we want to create new features that help teachers and students to collaboratively create and use content, new APIs that help teachers and students to use content in other platforms, and new virtual spaces where teachers and students can collaborate across universities/colleges.

Our presentation will mainly address organizational and technological aspects, but attendees are also invited to ask questions about didactical aspects. We are looking forward to integrate international experiences from other projects in the didactical usage of digital technologies in higher education throughout Europe.

Authors' Biographies



Dr. M. Rohangis Mohseni graduated in psychology at the University of Cologne in 2005. After that, he became a scientific assistant at Osnabrück University. Until 2011, he worked at the university's Teaching Evaluation Service Point. After that, he worked at the Center for Information Management and Virtual Teaching as a project coordinator for the section of organization of teaching and learning within the e-learning project eCULT. For a brief time, he also filled the position of an e-didactician at the University of Applied Sciences and Arts in Hildesheim.

His diploma thesis about moral courage inspired him to write a doctoral thesis about virtual emergency assistance. He attained his doctoral degree in 2013. His research interests include computer game studies, e-learning, mobile learning, and forms of (im)moral behavior like aggression, helping and moral courage.

He is currently member of the Digital Games Research Association.



Peter England graduated in law at the Martin Luther University in Halle/Wittenberg in 2001, where he became a scientific assistant at the chair of Criminal Law and Criminology afterwards. In 2005, he worked at the Agency Prevent GmbH in Oldenburg, educating teachers in crime prevention and conflict management. After that, in 2007, he worked at the Northern Cross GmbH as a project coordinator for EU-funding. In 2009, he founded his own company and is currently consulting SBE's, schools and other public organizations in conflict management. Since 2014, he is also working at the University of Oldenburg as a project meta-coordinator within the e-learning project eCULT.

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THE JOURNEY TO DISCOVERY

