University Information Systems

SELECTED PROBLEMS

edited by

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Preface

Information systems play an important role in each area of activity that higher education institutions deal with. They are necessary for doing scientific research and are used as research and assisting devices. It is hard to imagine university management, administration and students service without them. IT technologies are commonly used in a didactic process as virtual laboratories or in e-learning. Different strategies of universities development and local limitations and conditions resulted in the situation that each European university follows its own way of developing IT structures. Very often universities face similar difficulties and limitations and solve the problems that have been already solved.

EUNIS provides the perfect opportunity to share experience among universities, academic teachers and researchers by organising working groups, making contacts between universities and informatics service suppliers and by congresses held annually – the forums for direct meetings of people involved in university's IT structure development. At each EUNIS Congress a lot of issues important for universities' computerisation are presented and discussed. Presentations include data showing the examples of using specific systems, projects being carried out at universities, technical solutions, results of research and theoretical surveys.

This monography contains the full versions of the papers presented at the EUNIS 2010 Congress. The monography reflects the character of the Congress by presenting a wide spectrum of problems that European university staff encounter. The materials in this publication have been divided into chapters following the pattern of leading topics at the Conference. Each chapter contains purely scientific papers, research data, reports on projects realisation as well as descriptions of technical solutions and tips on practical application of widely known systems. All the papers have been published in original version sent by their authors.

I would like to thank all the reviewers who did the review twice: for the first time to accept the papers for presentation at the Congress and for the second time to include them in the monography.

I am extremely grateful to Dorota Sidor and Bartłomiej Michałowicz for making the publication of the monography possible. They did a great job gathering, selecting and drawing up all the materials.

Leszek Rudak

Keynote Speakers

Revealing the Identity of Federations

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Keywords

identity federations, architecture, privacy, cost saving, inter-federation

Abstract

Identity federations allow users to access (web based) services because of what or who they are. The concept is known as ‚role based access' and may in many respects empower the users, not at least in terms of privacy and control over personal data. Three different identity federation architectures are presented along with pro et contra. Issues with crossing security, administrative and national borders are discussed.

Background

Infrastructures at the scale of sectors or nations are large and heterogeneous systems with many stakeholders. The use cases for such infrastructures are many but rarely have the same focus or priority shared by the various participants. Therefore decentralization and use of open standards and protocols are imperative as it has too many times been demonstrated that one-size-fits-all-systems and proprietary solutions do not scale and will in most cases never become widely adopted – the best solution these days seems to be 'federations'.

A 'federation' may be defined as a collaboration in a specific and well defined area of interest. The context of this article is 'identity federation' where the actors abide to a common set rules for managing and handling of personal data. This, in order to build trust in information governed and issued across security, administrative and national borders.

When the trust is sufficiently strong it becomes possible to share services, which of course provides big potential for saving costs. Identity federations are often referred to as ‘circles of trust’, hinting at the notion of being part of a collaboration or ‘club’.

Federated identity, or identity federation, as concept has a simple goal: to lower the expenses of system integration and management by enabling reuse of both services, identity management systems and user data in many contexts. The result is role based access management which, as opposed to e.g. IP-address based access management, enables users to roam between networks, geographical locations and computers as well as to ease the burdon of user authentication.

Identity federations have been developing during the last 10 years and are in many countries today operational infrastructures enabling millions of users. But please note that identity federations are still only browser based and therefore only work for web-applications.

The actors and most notable issues to be aware of in an identity federation are roughly: service providers, identity providers (IdPs), federation operator, legal framework, users and personal information about the users (see Figure 1).

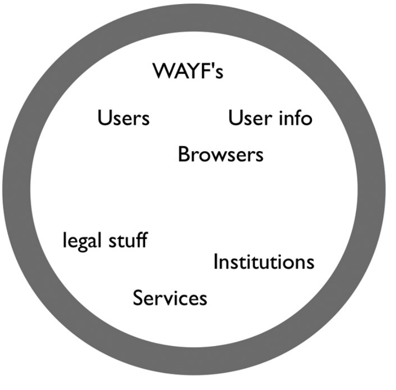

Figure 1. An identity federation, aka ‘circle of trust’

Basic concept

From a users point of view the concept of federated access management has the obvious advantage that a well known authentication mechanisms, usually username and password at the home institution, may now be reused to access services which are normally not seen as part of the home institutions’ security and/or operational domain.

The user/data flow is as follows: the user goes to a service that must authorize the user before allowing access. The user is redirected to a list of institutions participating in the federation, the wayf – where are you from service, then chooses her home institution and logs in after getting redirected to the well known login-page at the home institution. After successful login, information about the user is transferred to the service which can then decide whether to grant or deny access.

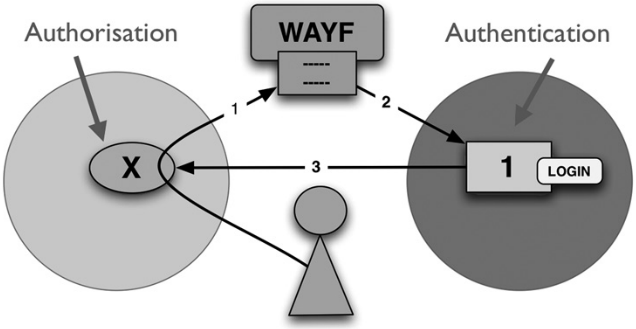

Figure 2. Conceptual user/data flow of role based access management across domains

This way the service keeps full control over the access management based on simple filtering rules in stead of keeping a full database of all users or IP-address ranges – a practice which is by the way increasingly being seen as problematic in the light of several public scandals on the mishandling of personal data.

Federation architectures

Three profoundly different architectures are known to be in operation, namely the loosely coupled federation (often know as 'Shibboleth federations', stemming from the name of federation software components (http://shibboleth.internet2.edu) (see Figure 3) and two types of hub-and-spoke federations: one with a centralized login service and de-central user information and one with multiple, de-central login services and de-central user information (see Figure 4).

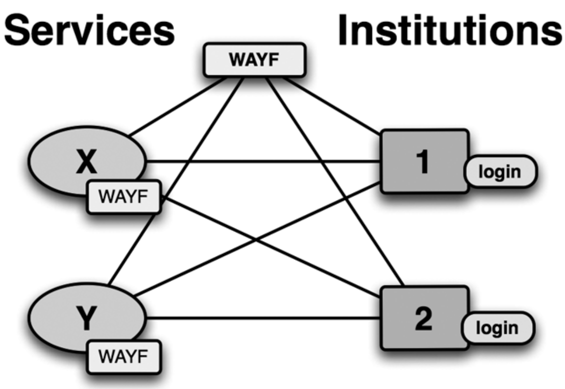

Figure 3. General architecture of a loosely coupled federation

The loosely coupled federation is in principle based on agreed standards and hence agnostic to the software implementations. In practice the Shibboleth software component is usually implemented as the technical interface, needed by all participating in the federation, both service providers and identity providers.

The list of places to login (WAYF) may be operated centrally, typically by the federation operator, or de-centrally by the services. This provides flexibility as the list of IdPs relevant to a service provider might be much shorter than the list of all IdP's participating in the federation. E.g. this would be often be the case for commercial services which would then only list their costumers.

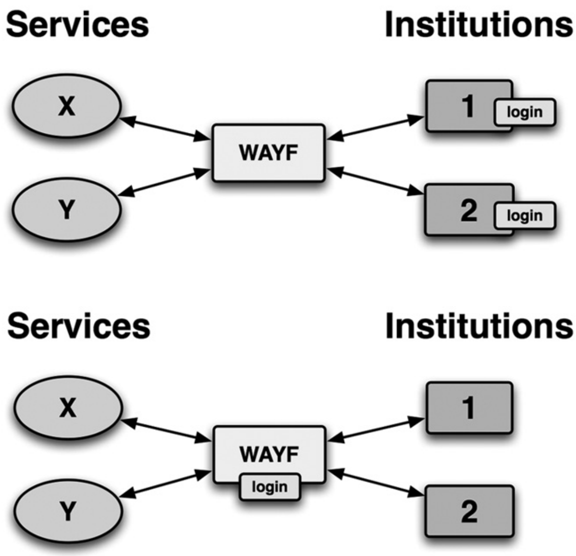

Figure 4. General architecture of hub-and-spoke federations, without and with central login systems

Common attribute release policies, defining what personal information about the users may be transferred to services, are typically negotiated by the federation operator and implemented by the IdP's. This approach unfortunately gives the services a potentially strong negotiation position as they may choose to later renegotiate directly and individually with the IdP's. The opposite is true in the case of hub-and-spoke federations, as described below.

Much knowledge about the architecture, systems, privacy issues, legal setup and requirements etc. is needed by all participants if the federation is to operate well and homogeneously across security and operational domains.

With both hub-and-spoke federation models (central and de-central login), which has a single federation component connecting all participants, much complexity is moved from the participants to the federation operator in the 'middle'. This way participating in the federation is perceived 'easy' as considerations about e.g. management of users' consent to data exchange is no longer needed, as this is handled centrally by the federation hub. Also protocol translation is possible, enabling the participants to focus on their primary systems and connecting to the federation via a multitude of protocols which in turn are managed and translated by the federation hub.

This solves the protocol-upgrade-problem of the loosely coupled federations where everyone in the federation should upgrade in a orchestered fashion in stead of doing it connection-by-connection, independent of the other participants.

One important feature of the federated approach is the ability to provide users with pseudonyms in stead of reveling their real identity to services. This enables services to recognize users without knowing who the users are, thereby respecting the users privacy rights. Pseudonyms may be service specific meaning that a user can be known at several services which can only independently recognize the users which have a different pseudonym for each service. In the case of loosely coupled federations the pseudonymisation service is operated by the IdP which must also manage the attribute release profiles to the services – both tasks are handled by the federation hub in hub-and-spoke federations (Simonsen et al., 2009).

Another core principle regarding protection the users privacy is the users informed consent to data exchange. In short it means that users should approve the exchange of data about them selves from IdP's to services, and have a clear understanding of what information is about to be transferred – and for what purpose. In loosely coupled federations both consent collection and withdrawel is managed by the IdPs, in hub-and-spoke federations this it can be done centrally by the federation-hub.

In the hub-and-spoke federations attribute release to services always happens from the federation-hub which can in addition perform syntactic as well as attribute value checks – none of which can be garantied to be neither homogeniously nor consistently done in loosely coupled federations. Furthermore different attributes can be derived or calculated by a federation-hub, based on the attributes received from IdPs, moving even more complexity away from the IdPs. This could e.g. include generation of user pseudonyms, or derive the users' year of birth from the social security number. A simple but effective anti-spoofing measure is to let the federation-hub tell where the attributes originate from, in stead of letting the IdP's themselves state where the user is coming from.

An important, albeit not essential, feature of federations is single-sign-on where information about the user may be reused by multiple services within the same browser session. Both federation architectures support single-sign-on even though provided by different entities. As the Shibboleth software implements this feature many IdPs get this functionality 'for free' in addition to the connection to the federation. In hub-and-spoke models the IdPs need not to implement the single-sign-on component to get the functionality as it is provided by the federation-hub. IdPs operating local single-sign-on systems are able to automatically extend it with services in the federation domain, simply by transparently initiating browser sessions with the federation-hub as part of the local login-sequence (Simonsen et al., 2010).

Documented cost saving

As stated initially, the goal of the described systems is to lower the expenses of both system integration and management. The return on investment for shared services is often hard to document, not at least because of lack of usage statistics and differences in cost calculations between partner organisations. In loosely coupled federations it is in principle possible to collect the information from all participants and compute an overview of the usage distribution even though this has never been done systematically. In hub-and-spoke federations accurate statistics can be collected as all requests and responses pass the federation-hub. This way usage information can be collected, thus providing hard numbers about the actual patterns of service sharing etc. An interesting calculation is the 'integration cost saved'.

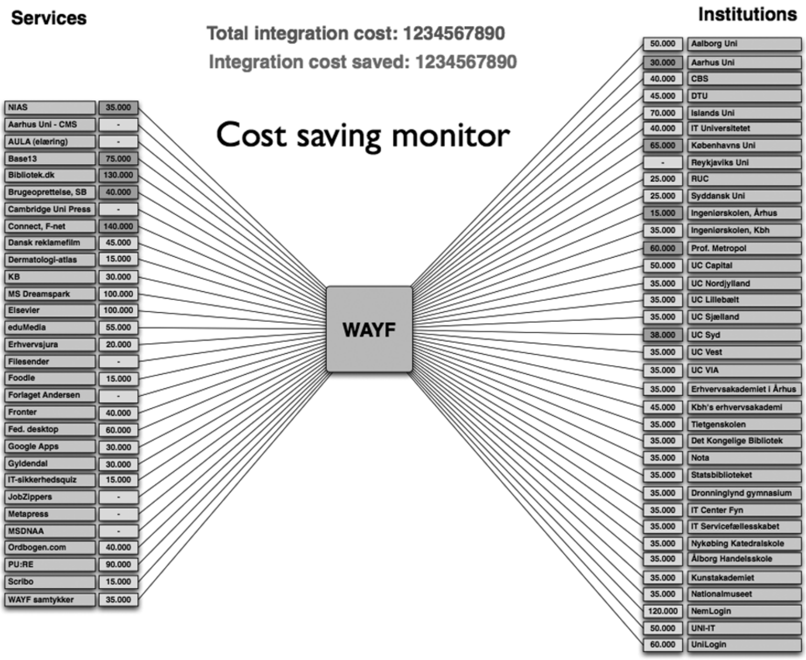

Figure 5. Conceptual view of a federation cost saving calculation

Here the number of active connections between services and IdPs can be multiplied with the integration cost for each connection which is estimated for each connection. As all participants have only established a single connection to the federation-hub, this amount can be subtracted from the total integration sum of active connections, resulting in an indication of the cost saved by the federation.

Interfederation

The Internet provides easy access to services in different domains and different geographical locations. Therefore is seems natural to interconnect the many national federation infrastructures. An obstacle is of course the federations are based on trust between entities which again often relates to (national) culture. From a practical point of view, this means that various federation architectures must be interconnected which in the case of the Nordic Kalmar Union2 (http://www.kalmar2.org) has been shown to be doable.

Again the two types of federations, loosely coupled and hub-and-spoke, have different implications for the IdPs configuration with the federated environment. In loosely coupled federations all IdPs must handle the common metadata describing the inter-federation setup, attribute release policies, user consent etc. whereas this is all done by the federation-operator in the case of the hub-and-spoke federations. All services must likewise retrieve the common lists of participants, stating which IdPs take part in the various federations – and can be trusted to live up to the minimal requirements for participation. A positive consequence of having the IdPs of loosely coupled federations acting directly in the interfederation setup is that they become immediately visible and accessible to the services. This is not the case for IdPs in hub-and-spoke federations with de-central login, where the user must first choose which federation she comes from, then which institution and because of this flow needs to have larger knowledge about the configuration of the infrastructure.

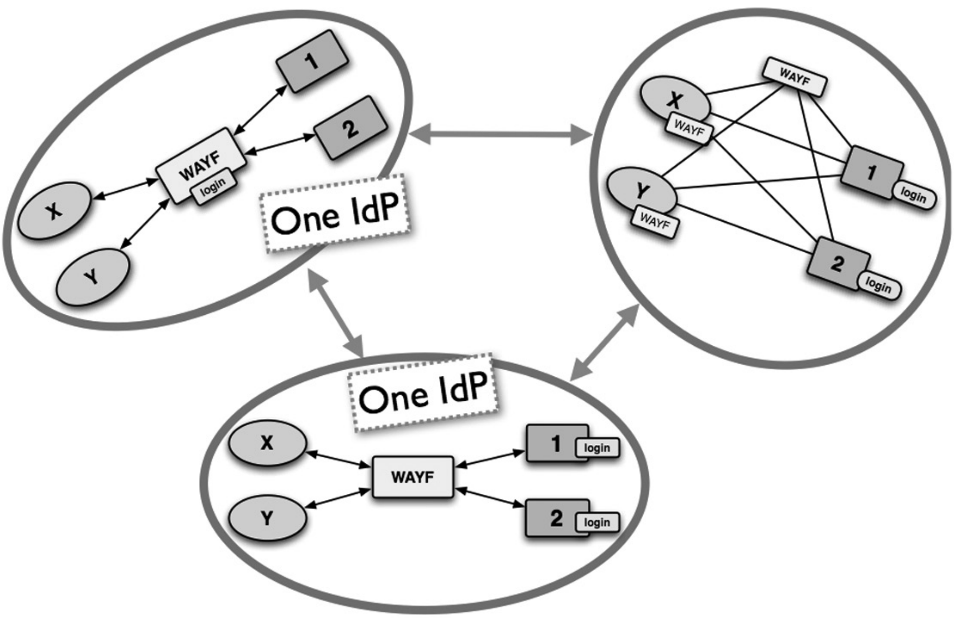

Figure 6. Interconnecting multiple federation architectures

Conclusion

Identity federations have within a decade grown to enable millions of users at thousands of institutions to a multitude of services. The primary driver is cost reduction of both service integration and management. The means to do so is better identity management which is the basis for establishment of trust in user data across domains. Several federation architectures are operational and have been proved to be interoperable. A driving force for the hub-and-spoke federations is the ability to move complex questions, knowledge and operational tasks from the IdPs to the federation operator. Also support for multiple protocols and protocol translation, as well as several privacy enhancing abilities (both organisational and technical) have shown to be important features of the hub-and-spoke model. Documentation of cost savings as well as usage statistics are areas of interest for all participants, albeit handled rather different by different federations. Not at least due to the diverging architectural natures described above. All mentioned federation models have been shown to interoperable in the Nordic Kalmar Union2, an example of interfederation, which is anticipated to accelerate strongly in the near future.

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“Blended Learning” at the Macro Level — The Experience of the Bavarian Virtual University[1]

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Summary

The Bavarian Virtual University (BVU, Virtuelle Hochschule Bayern; www.vhb.org) is an institute set up in 2000 by the nine universities and the 17 universities of applied sciences of the Free State of Bavaria. Like its member universities, the BVU is financed predominantly by the Bavarian Ministry of Higher Education (Bayerisches Staatsministerium für Wissenschaft, Forschung und Kunst). The BVU provides online-courses with an equivalent of two to six credit points (by ECTS) which the member universities can integrate into their courses of study. The BVU helps its member universities to enlarge and enrich their programmes, and it helps the students to organize their studies in a more flexible way.

Today, in the BVU there are more than 65,000 course enrolments by more than 25,000 individual students per academic year. For the academic year 2013/2014, the BVU expects nearly 100,000 course enrolments by approximately 40,000 students.

The basic and most important working principles of the BVU are:

- Focussing on blended learning at the macro level of the course of study, not at the micro-level of the single course, lecture or seminar, giving priority to asynchronous forms of communication,
- Thus facilitating the import and export of online-courses between all member universities.
- To develop and offer courses tailored to the needs and the actual demand of the member universities, with an elaborate quality management.

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[1] Earlier versions of this paper were published in the Polish online journal “Edu@kcja. Magazyn edukacji elektronicznej”, 1/2010, pp. 33–41, and in the Proceedings of the EADTU Annual Conference 2010, “Strategies and business models for Lifelong Learning”, pp. 337–350, published online: http://www.eadtu.nl/conference-2010/files/Proceedings%20EADTU%20Zermatt%202010.pdf.

The author thanks his colleagues Torsten Kaiser, Rosalinde Kicherer, Ingrid Martin, Georg Seppmann and Christina Weidner, who took part in the preparation of this article.

– Financing the production of courses as well as the operation of these courses, especially the online-tutoring of the students.

Distance teaching at university level in Germany, higher education in Bavaria and online teaching in higher education

Due to multiple factors, distance teaching at university level plays a minor role in Germany compared with e.g. North America, Australia or the Nordic countries. To mention just two of these factors: first, there is hardly any place in Germany from which you would have to travel more than 50 km to the nearest university. Secondly, where student fees in state universities exist, they do not exceed 1,000 € per year, so there is no competition between expensive face-to-face tuition and more affordable distance education, as in some parts of the world. One specialized German university, the FernUniversität in Hagen, offers complete courses of study and degrees, and the demand for additional courses does not seem big enough to justify the investment in a second German large-scale distance university.

With a population of about 12.5 million, Bavaria is the second largest of the 16 German states (Länder). Bavaria currently has a little more than 270,000 students[2] and feels the need to expand the proportion of its population with a university degree. The BVU is part of Bavaria's strategy to enhance and to improve the possibilities to attend and successfully complete higher education.

According to the German constitution, all matters of education, from school to university level, lie within the exclusive jurisdiction of the Länder, not of the federal government. This explains the fact that there is no "German Virtual University". In general, the federal structure of Germany results in a large variety of approaches to most aspects of education, including online teaching and learning at university level[3]. Most of the states leave the strategy for e-learning completely to their universities, and by far not all German universities have developed a comprehensive strategy for the use of information technology and multimedia in teaching and learning. Bavaria is among the minority of German states which actively motivate and support cooperation between universities in online teaching, and it is the only German state financing online teaching across university borders.

Blended learning at the macro level

To make possible online teaching and learning across university borders, i.e. to facilitate the "import" and "export" of courses between universities, it is pivotal that these courses work completely online, without any face-to-face components except for the final examination. If students have to take part in face-to-face meetings, you cannot expect them to

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[2] Cf. http://www.statistik.bayern.de/veroeffentlichungen/download/B3110C%20200922/B3110C%20200922.pdf.

[3] For a survey of the activities of the German states cf. Bremer et al. (2010).

travel for hours. Therefore, online courses with face-to-face elements can be used jointly only by neighbouring universities.

"Blended learning" is interpreted by many experts as the combination of face-to-face teaching and web-based teaching within a single course. We call this type of blended learning "**micro-level** blended learning". While micro-level blended learning has many pedagogical benefits, it does not necessarily make full use of the economic possibilities of e-learning. Teachers who use single e-learning elements in their courses do not necessarily gain additional teaching-time, and micro-level blended learning is hardly a remedy e.g. against the shortage of lecture rooms many universities face. For the students, this type of blended learning offers rather limited flexibility. In many cases, especially when the web-based elements are exploited by only one professor at only one university, micro-level blended learning seems to offer higher quality or added value only at additional costs.

By contrast, the BVU focuses on **macro-level** blended learning with the aim to offer high-quality teaching with intensive tuition in a cost-effective way. By macro-level blended learning we understand the integration of single online courses into courses of study or curricula which otherwise (and for the most part) consist of "traditional" face-to-face courses (seminars, lectures et cetera). Thus, students can earn some credits in online-courses, but not their complete degree. This combination of face-to-face courses with courses that are delivered completely online (possibly with the final examination being held face-to-face) allows the students much more flexibility than micro-level blended learning. At the same time the students enjoy all the benefits of a traditional face-to-face university. Therefore, macro-level blended learning minimises the dangers of social isolation sometimes associated with e-learning.

Moreover, if online courses are developed once at one university, but used at several universities, the comparative cost-effectiveness is obvious. Thanks to macro-level blended learning, universities can "import" courses from other universities, including the support of their students by tutors of the "exporting" university. In contrast to micro-level blended learning, this kind of import also helps universities to compensate a possible lack of teachers as well as room shortages.

In its initial phase, the BVU experimented with micro-level blended learning courses. Students taking part in those courses generally appeared to be satisfied with the face-to-face elements, but an unknown (and for obvious reasons unidentifiable) number of students did not choose to take part because those courses did not offer the students the flexibility they needed or desired. Moreover, from the point of view of the university the import of blended learning courses is hampered by the fact that the importing university has to provide staff and rooms for the face-to-face activities. Several member universities of the BVU have explicitly declared that for them blended learning courses would not be a desirable and helpful contribution by the BVU.

Macro-level blended learning combines the social and pedagogical benefits of face-to-face teaching and learning with the economic effects of online teaching and learning, and it is therefore one of the responses to the challenge of growing student numbers in times of strained public budgets. The cost effectiveness of macro-level blended learning, in turn, is the major motivation for the Bavarian Ministry of Higher Education to finance the necessary structures and the development of new content.

Programme structure

In the winter term of 2010/2011, the BVU offers 217 courses in 13 fields of study. A further 34 courses are currently in preparation, and the call for proposals in 2010 has resulted in an additional 33 courses to be financed by the vhb. Figure 1 gives the details of the programme structure by fields of study.

Sometimes the question of the "onlineability" of different subjects is raised. Within the BVU, successful online courses have been developed for various subjects and with different pedagogical concepts. Of course, some subjects appear to be especially suitable for online treatment (as opposed to traditional paper-based distance education) because of the additional pedagogical benefits which electronic communication and multimedia elements provide. On the other hand, the economical benefits of offering courses online instead of paper-based or face-to-face solutions can be just as significant and important. The BVU bases its decisions to develop and offer an online course on pedagogical as well as economical considerations.

Field of study	Courses offered winter 2010/2011	Courses in preparation
Business Sciences	31	4
Computer Science	16	0
Cultural Studies	3	0
Engineering	19	0
Health Care / Health Management	2	2
Key Skills	18	1
Languages	36	6
Law	25	4
Medical Science	32	12
Natural Sciences	1	0
Social Sciences	2	0
Social Work	15	0
Teacher Training	17	5
Total	**217**	**34**

Figure 1. Courses winter term 2010/1011

Owing to the large variety of fields of study with their different traditions, there is a corresponding variety of pedagogical approaches in the BVU's courses. You will find virtual seminars with intensive student cooperation, there are online lectures with tutorials, and there are virtual laboratories. In many courses students deliver papers. Self-study environments play a minor role, as the BVU puts individual interaction at the centre of its concept.

Synchronous communication places severe limits on flexible start-up and progression, and it limits the students' possibilities to organize their studies in a flexible way.

Therefore, teaching and learning in most of the BVU's courses are based on asynchronous forms of communication.

The courses of the BVU are developed at the individual member universities; there is no central production unit. Generally, within the universities (or within their institutes which provide online education) there is a clear division of labour. Content is usually provided by professors, who then employ skilled staff for the transformation of that content into an online course. In some cases (mostly at universities of applied sciences), professors also take part in the technical implementation.

The process of choosing new courses for the programme of the BVU consists of two main steps: first, a call for proposals, and then a call for tender. Detailed information about this process can be found on the BVU's website. In short, the process is organized as follows:

Call for proposals: Once a year, member universities are invited to submit proposals for new online courses. For each course the interested universities form a consortium with a consortium leader. Proposals by only one university are not eligible, with the rare exception of cases where a subject is taught at just one Bavarian university, e.g. veterinary medicine. Proposals for such subjects are eligible if they are submitted in cooperation with a university outside of Bavaria.

The proposals are submitted in a standardised form which can be downloaded from the BVU's website[4]. There must be a demand for the given course at least at two member universities, and the online course, once it is completed, must replace part of the face-to-face teaching at the universities of the consortium, so that an actual relief of the teaching load in the given subject will be accomplished at these universities. The consortium must define the curriculum or curricula (courses of study) in which the new online course will be employed, and they must give an estimate of the number of students they expect to participate per academic year.

The consortia and their courses do not function as "closed shops". All member universities are entitled to employ the courses, and students of all member universities can attend the courses free of charge[5], no matter whether their university is a member of the given consortium or not. Students from universities outside a consortium are advised to make sure whether their home university will acknowledge credit points earned in such courses before they enrol.

The proposals are examined by the BVU's Programme Committee. The Programme Committee selects the proposals most suitable for funding and passes its recommendations to the Steering Committee. The Programme Committee does not necessarily favour the proposals with the highest demand, i.e. with the largest number of expected participants. Special attention is paid to proposals for courses which make possible the establishing of new curricula at member universities, e.g. M.A. programmes at universities of applied sciences.

On the basis of the recommendations of the Programme Committee, the Steering Committee decides which proposals to fund. The consortia supporting those proposals are then invited to submit detailed descriptions of the courses.

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[4] Cf. http://www.vhb.org/ausschreibung.

[5] Persons interested in lifelong learning can take part in the courses if they pay a fee, but this plays a minor role.

Call for tender: These descriptions are the basis for the next step of the process, the call for tender. Generally (but not necessarily) bidders make a bid both for the production of the course and for the tutorial guidance of the students. The production of standard courses with an equivalent of two hours per week and semester (mostly 3 ECTS credit points) can be funded with up to 40,000 €. Costs exceeding this sum must be born by the consortium. Up to now, there have hardly been any such instances.

For the majority of proposals one bid is submitted by a member of the given consortium, but there are instances where competing bids are made. There are also instances where the only bid comes from a university outside of Bavaria.

The call for tender is published on the BVU's website. In addition, it is distributed to organisations similar to the BVU in other parts of Germany and the German speaking countries. The BVU encourages the use of courses which have been developed at universities outside of Bavaria; it is the policy of the BVU not to fund the design and development of courses if a suitable course for the given purpose exists elsewhere and a license for the BVU can be obtained.

In order to be accepted as producer of a proposed course, bidders have to conclude a contract with the BVU where, as a rule, they transfer to the BVU the exclusive right to use the course in online form. In cases where the BVU is not the exclusive financer, appropriate arrangements are made.

The producers further commit themselves to arrange personally for the operation of the course (i.e. to provide tutorial services and guidance) for at least five years. Should the producer not be in the position to operate the course any more, the BVU can transfer the operation to somebody else. Up to now there have been few instances where a transfer of course operation has been necessary. In most of these cases the course operation was taken over by another professor of the producer's university.

All members of a given consortium have the right to take part in the quality assurance process during the production of the course. They are encouraged to do so, especially by taking part in milestone meetings where the state of the work in progress is presented and discussed. Members of the BVU's project management take part in these meetings. Thus, all members of a consortium can make sure that the final course will meet their expectations; problems can be solved at the earliest possible stage.

Intensive tutorial guidance

Learning is to a large degree based on interaction. In comprehensive online courses without sufficient interaction, i.e. without communication between the participants and a teacher or tutor, a considerable dropout rate is to be feared. Therefore, the BVU funds not only the developing of courses, but also their regular operation. Moreover, the idea of state-wide utilization of the courses, i.e. of the "import" and "export" of courses between universities, would not be viable if there was no funding for the tutoring of students from universities other than the home university of the course provider. There must be a sufficient incentive for this additional teaching effort. Therefore, the BVU funds the tutorial guidance of the students in standard courses with 25 € per student. This money is paid if the student has taken part in the final examination.

This regulation has been questioned as there are instances where a student makes intensive use of tutorial guidance but does not take part in the final examination. On the other hand, there are instances where a student merely enrols but does not take part in the course, so mere enrolment would be unsuitable as an indicator for the amount of tutorial work. The most objective measurement of the tutorial work spent on every student would be the tracking of the student's online activities, but this would infringe laws on data privacy protection. The present regulation appears to be acceptable because it also applies to students of the teacher's own university, so that this university gets additional funding.

The question has also been raised whether the successful passing of an examination rather than the mere participation should be the criterion for the funding of tuition. This idea has been rejected after thorough discussions in both Programme Committee and Steering Committee, because this solution might be interpreted as an incentive for course providers to offer "easy" examinations. This, in turn, would not be in accordance with the BVU's effort in quality assurance.

Quality assurance

Evaluation and quality assurance play a central role in the BVU's overall concept. The development of every new course is closely supervised by experts from the consortium which submitted the proposal for the course, and by the project management of the BVU Office. Together, they approve the new course for inclusion into the BVU programme.

Students evaluate their courses every semester, and the results of these evaluations are discussed with the course providers. After five semesters of operation, each course is evaluated by two peer experts (always professors from outside of Bavaria), one of them focusing on matters of media pedagogy and didactics, the other on the subject content. The results of the students' evaluation are made available to the peer experts, too. For the student and expert evaluations, standard evaluation sheets are employed[6]. The results of the peer evaluation are discussed by the Programme Committee and the Steering Committee and with the course providers. Any problems in the sphere of tuition addressed in the student evaluation can usually be solved by the BVU Office and the individual teacher.

Course providers can apply for the funding of the updating of their courses if the necessary work exceeds the occasional updating university teachers are expected to perform in face-to-face teaching. The BVU provides the necessary funds as long as there is a sufficient demand for the course.

Providing courses for tutors in BVU courses as outlined above is also part of the BVU's quality assurance activities. Furthermore, the BVU supports competence development for professors of its member universities by organising workshops on e-leaning.

Technical issues

In the BVU with its 31 member universities, a variety of learning management systems (LMS) is in use. This variety is a consequence of the variety of the subjects taught as much as of the history of the BVU: The BVU started in 2000 with a portfolio of 36 courses which had been prepared for different subjects by different universities.

6 An English version is available: http://www.vhb.org/fileadmin/download/vhb-QS-Kri terienkatalog_Englisch.pdf.

No central server is used; all courses are on servers of member universities, and they are administered by responsible persons at member universities, i.e. by professors of the member universities or by members of their staff.

It has been argued that this decentralised approach might not be the most effective solution, but as far as can be judged from the students' evaluation, the plurality of LMS and platforms does not constitute a problem for the students. Critical remarks related to specific features of specific systems (which were then improved) did not refer to the fact that a variety of systems is used. Besides, the migration of the existing courses to a single system would not be economically sound. The gradual introduction of a central LMS has been discussed by the member universities, but the vast majority is not in favour of such a solution.

While unification of LMS does not seem to be an urgent issue, the establishment of an authorisation and authentication infrastructure (AAI) is making progress. As a first step, a way of data exchange has been established with all important member universities that makes online-registration with the BVU possible. Data on participation in examinations and on their results are a sensitive issue. These data are exchanged directly between the examining university and the students, and between the students and their home universities, not via the BVU. An AAI based on Shibboleth is being introduced in cooperation with the Leibniz Computational Centre (Leibniz-Rechenzentrum – LRZ*)* in Munich.

The BVU's organizational structure

The basic body of the BVU is the Assembly of Member Universities, in which each member university is represented by a Commissioner, who in turn is the key person for all BVU affairs within her or his home university. Each university has one vote per 5,000 students. The Commissioners usually are members of the governing body of their university. The Assembly elects the Programme Committee and the Steering Committee, which appoints the Managing Director.

The Steering Committee consists of three persons. Both the President and the two Vice Presidents are presidents of member universities and in this function represent the BVU in the Conference of the Presidents of the Bavarian Universities (Universität Bayern e.V.) and the Conference of the Presidents of the Universities of Applied Sciences (Hochschule Bayern e.V.). The President of the BVU usually is President of a university, one of the Vice Presidents is President of a university of applied sciences. The Programme Committee consists of eight persons. Five of these must be Vice-Presidents for questions of teaching and studying at their respective universities, one must come from a university outside of Bavaria. At present, four members of the Programme Committee come from universities of applied sciences, and four from universities.

While all offices mentioned so far are held by professors as part of (in fact, in addition to) their ordinary workload, the Managing Director and the employees of the Office or Service Unit (Geschäftsstelle) work for the BVU full-time. In the Office, 16 employees work in the areas of finances, project management, public relations, student registration and technical support. The Office is located at the University of Bamberg.

In addition to its regular responsibilities, the BVU has been assigned by the Ministry of Higher Education with the organization of projects within the framework of the European Social Fund for the period of 2007 to 2013.

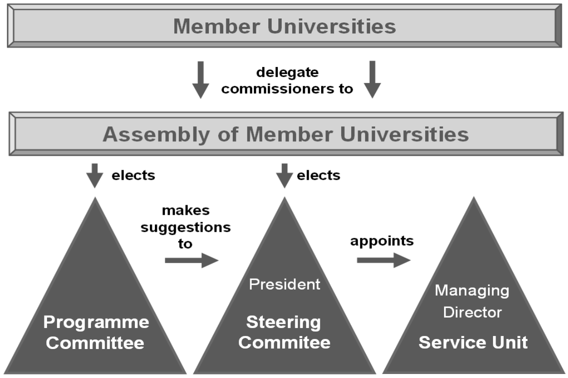

Figure 2. Organizational structure of the BVU

Results and financing

As early as 2007, the BVU was identified as one of Europe’s “mega-providers of higher education online” by the European Union’s MegaTrends project[7]. This study was based on data from 2005, when the BVU had about 20,000 course enrolments annually. Today, there are more than 66,000 course enrolments by more than 26,000 students per academic year. Figure 3 shows the development of course enrolment over the years:

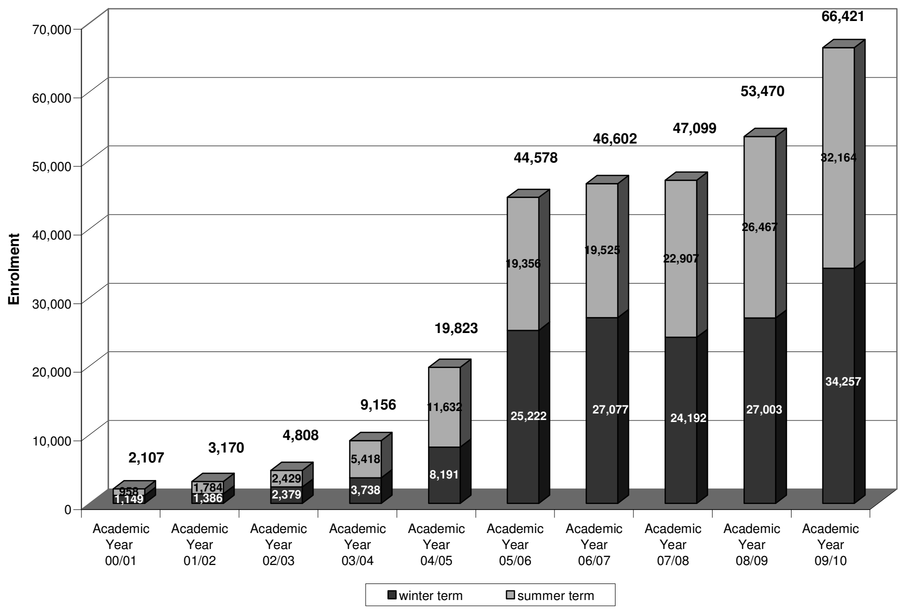

Figure 3. Development of course enrolment

7 Cf. http://www.nettskolen.com/in_english/megatrends/.

In the years for which complete data are available, 56% of the students who enrolled in a course took part in the final examination. 57.5% of the total enrolment was in courses offered by a university other than the student's home university. This shows that the "import" and "export" of teaching across university borders has become a widespread reality.

At present, the most popular subject areas are Law, Business Sciences and Medical Sciences. There is a noticeable difference between individual fields of study regarding the participation in final examinations (Figure 4). This can partly be explained by the fact that some students use BVU courses as an additional source of information and an opportunity to receive extra training and tutorial guidance, but wish to obtain the necessary credits through examinations in courses of their home university.

Financing: In the period from 2000 until 2008, the BVU was financed by the Bavarian government with more than 22 million €. For the years 2009 until 2013 an agreement has been concluded between the Ministry of Higher Education, the Bavarian universities, the Bavarian universities of applied sciences and the BVU by which the annual budget of the BVU has been raised to approximately 6 million €. The bulk of this sum comes from the Bavarian state budget and other state programmes; the member universities contribute one Euro per student and semester, i.e. a total of around half a million Euro per year.

	A	B	C
Business Sciences	7,632	14,3%	54,5%
Computer Science	1,493	2,8%	56,3%
Engineering	2,659	5,0%	66,4%
Key Skills	7,344	13,7%	60,6%
Languages	3,386	6,3%	59,6%
Law	19,509	36,5%	42,1%
Medical Science	7,486	14,0%	91,6%
Social Work	2,356	4,4%	72,1%
Teacher Training	1,605	3,0%	79,4%
Total	**53,470**	**100%**	**56,0%**

A: Enrolment in field of studies

B: Percentage of total enrolment

C: Percentage of enrolment resulting in examination

Figure 4. Enrolment and examinations by fields of study, academic year 2008/2009

Conclusion

The success and the further development of the BVU depend on its ability to serve the needs of three target groups: students, teachers and universities. By serving the needs of these target groups, the BVU serves the needs of society and state, which in turn provide the necessary funding.

Students profit from the flexibility of online teaching which is especially important for "non-traditional" students. Therefore, the BVU concentrates on asynchronous forms of communication. Students of the member universities do not have to pay any additional fees.

The quality of the courses is assured by an elaborate system which makes the quality of online teaching even more reliable than the quality of face-to-face teaching. The possibility of developing e-learning literacy while studying a subject as part of the curriculum enhances the employability of the students without requiring additional effort.

Teachers experience a wider range of pedagogical possibilities. Many of them also appreciate the possibility of reaching more students with their teaching. Where online teaching is accepted as part of the professors' workload, they also profit from the flexibility online teaching permits.

By offering online teaching and tuition on standard subjects, teachers can focus their face-to-face teaching on more advanced or specialised subjects. This can be both more demanding and more satisfactory.

Working within the BVU network is also attractive for professors because of the grants by which the BVU funds the development and improvement of online courses and because of the financing of tutors. Moreover, funding by the BVU is considered "third-party-funding" in the performance record of the respective professors and faculties.

Universities profit from the BVU in several ways. By using BVU courses, universities considerably enhance their teaching capacities. Not only can they offer additional subjects, they can also restructure teaching capacities and use them for subjects less suitable for online teaching.

Generally, universities face times of more intensive competition. But this does not exclude cooperation. On the contrary, in order to survive in a world of growing competition, universities will have to cooperate not only in research, but also in teaching. The BVU is an excellent means of establishing and developing such cooperation. One of the positive effects of this cooperation is the establishing of common quality standards for online teaching.

The BVU avoids competition with its member universities. In particular, the BVU does not develop for-profit courses for further and continuing education.

From the point of view of the **state**, the situation can be characterised by the following considerations:

1. Public budgets will continue to be strained, because debts and deficits must be reduced.
2. The number of students will rise considerably at least until 2012. Later, demographical factors indicate a gradual decline. On the other hand, Germany and especially Bavaria wish to boost the proportion of their population with university-level education, and they wish to attract more students from abroad. This could also lead to growing numbers of students after 2012.

3. As far as we can see, in Germany higher education will continue to be basically state funded. The fees introduced in Bavaria in 2007, with a maximum of € 1,000 p.a. per student, cannot fundamentally change this situation.
4. Therefore, additional high-quality education must be provided in a cost-effective way. The development with public money of similar online courses in different universities would be economically unwise.
5. Online education which is financed, organised and exploited by a joint venture of all universities together with the Bavarian Ministry of Higher Education appears to be an appropriate and necessary response to these challenges. Of course, this cannot be the single response.

To achieve its present position, the BVU has had to concentrate on the following key factors, and it will go on doing so in order to continue its successful development:

- strict orientation towards the demand of the member universities,
- cost-effectiveness,
- putting quality first, employing a thorough quality management,
- close cooperation with universities and the Ministry of Higher Education,
- drawing upon the competence of the member universities, using their infrastructure as much as possible,
- continuous improvement of courses and of administrative processes in order to reach maximum user-friendliness,
- transparency in all decisions, especially in funding,
- lean organisation, simple structures.

The development of the BVU from 2014 on, i.e. after the period of the current agreement, will depend on the priorities set by the member universities and the Ministry. Possible fields of additional effort may be lifelong learning in its various forms, further courses in English and additional courses in the Humanities, which up to now have played a minor role. The BVU is interested in developing international cooperation to promote "virtual" student mobility.

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Kuali Foundation Delivers Open Source Software

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Keywords

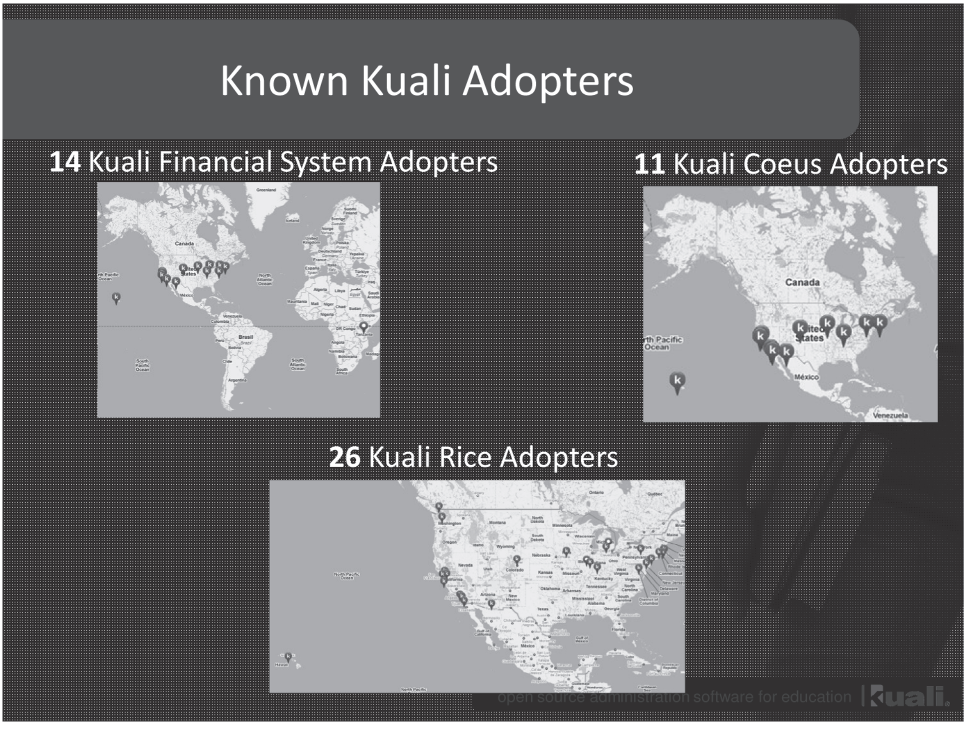
Kuali, Open Source, Enterprise Systems

Abstract

The Kuali Foundation is a not-for-profit organization that facilitates the delivery of open source systems for higher education. The Foundation started with a single project, the Kuali Financial System, in 2004, and has grown to encompass 7 projects, with others in incubation. Each project has its own Charter and set of Investing Partners who drive decisions about the system, resources, and priorities. Commercial Affiliates provide support services.

Kuali Foundation

Higher education institutions are complex organizations, serving diverse constituencies. In order to manage themselves effectively, they must be able to report in multiple systems of accountability and meet a variety of regulatory compliance conditions. These institutions need enterprise administrative systems (e.g., Financial, Research Administration, Student Enrollment, HR/Payroll, Library, Disaster/Business Continuity Planning, etc.) that will enable them to meet those needs. Vendor consolidation in the commercial marketplace for such systems has led to a combination of undesirable circumstances: very high costs, systems that often lack critical functionality required in higher education, reduced or obviated ability to control the timing and impact of upgrades, and vendors and systems that disappear unexpectedly due to acquisitions, lawsuits, and the like. EDUCAUSE (2001) estimated that institutions would spend over $5 Billion to install these enterprise systems. For many institutions this path has been not only expensive, but unsustainable. An effective answer to these problems is for institutions to pool their resources via effective models of collaboration and to build and sustain these critical and common systems themselves with a new approach for commercial partners —a daunting task that is beyond the rational ability of any single institution.



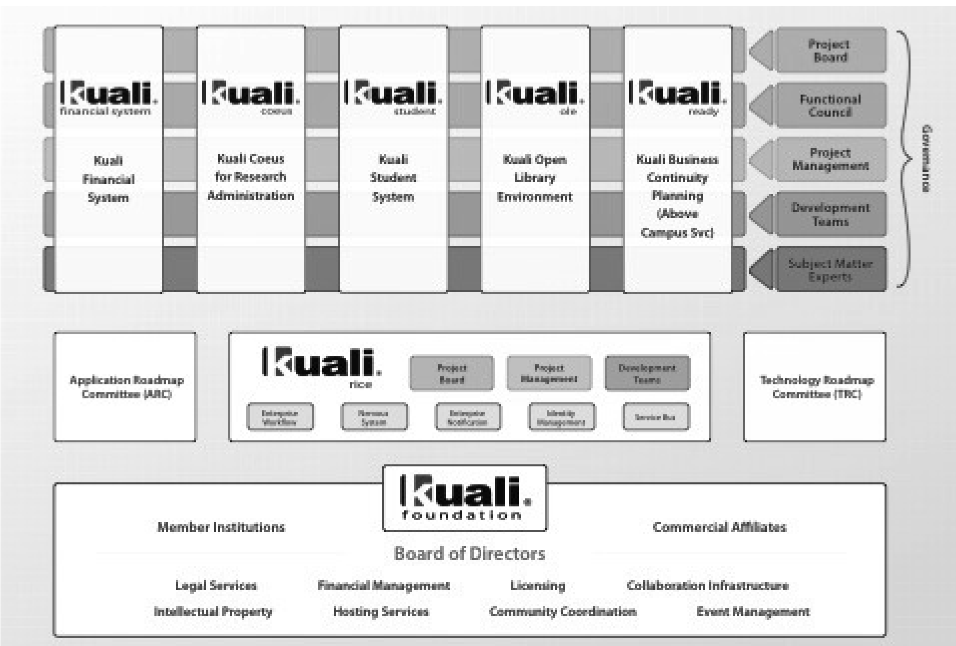
In just five years, the not-for-profit Kuali Foundation has proven itself an effective coordinating organization to leverage cash and staff resources across multiple higher education institutions. Partners collaborate on system designs that can serve the needs of all Carnegie Class institutions – large or small, public or private. The projects develop enterprise-scale applications that are distributed as freely available software to anyone, without licensing fees or restrictions on reuse (e.g., Educational Community License 2.0). Effective collaboration is hard and has a checkered track record, especially for complex endeavors. However, the Kuali Foundation evidences best practices through a community where resources across institutions are efficiently combined, influence and control of systems reside within higher education, and licensing, implementation and maintenance costs for large systems are minimized through shared development of code, while simultaneously building functional expertise within higher education. Some institutions estimate savings and added value in the tens of millions of dollars.

For example, in summer 2009, three institutions implemented the Kuali Financial System successfully. Colorado State University, the Naval Postgraduate School, and San Joaquin Delta College went into production with KFS version 3.0. CSU estimated that it cost approximately $1.9 million for this implementation rather than the $10-$20 million that is very common for institutions of comparable size. At Indiana University, the implementation of the Kuali Financial System relative to alternatives will save more than $15 million that IU can invest instead in its core mission.

In Fall 2010, the known adopting schools of all the current Kuali systems is shown below. Because the software is open source, it is recognized that there may be other institutions using the software who are unknown to the Kuali Foundation.

The entire concept of community source for enterprise-scale, big system application software is innovative, and many skeptics believed it was too innovative to succeed. However, the coordinated work of many institutions via the Kuali Foundation has demonstrated that community source systems can be delivered effectively, save money, and empower institutions and individuals to rapidly learn and share best practices.

The Kuali Foundation organization is shown below. Each project has a Board to guide its strategic direction, a Functional Council to set specification and priorities, and a team of developers and subject matter experts who report to the Project Manager who is responsible for the delivery of the system. The application projects have a shared infrastructure of middleware, Kuali Rice.



The community source model used by the Kuali Foundation provides three key best practices:

– *Kuali improves the design of software to better fit the needs of higher education.*
  Kuali projects usually begin with an existing, proven and tested code base already in successful use by one or more institutions. This methodology provides proven speci-

fications, accelerates the production and availability of the new Kuali system, and ensures the leveraging of best practices. Subject matter experts from all participating institutions bring their unique expertise and multiple perspectives to the design and testing process.

The work is organized using effective models for distributed-team software development, such as common development architectures, rules and tools, common data models, online and face-to-face developer communications, usability and accessibility testing, quality assurance testing, and careful end-user and technical documentation. This is a case where centuries-refined collaborative values of higher education have an advantage over other industries that cannot share as easily.

– *Kuali reduces the licensing and implementation costs for enterprise-scale software and effectively leverages resources among partner institutions.*
  The software itself is free of any licensing costs. However, other costs associated with a large system can be reduced. For example, during implementation, the Kuali Foundation partners provide an effective community of knowledgeable functional users and developers upon which institutions can call to provide valuable expertise. E-mail discussion lists include questions and timely answers for functional and technical challenges from many in higher education as well as commercial firms. (During the CSU implementation a query by CSU was answered by four experienced staff on the project within 24 hours.) Every institution learns simultaneously as the conversations unfold, further reducing costs at other institutions as their implementation projects mature.

– *Kuali cultivates development of expertise in best practices across higher education, including creating an ecosystem for commercial partners.*
  Functional specifications for each system are guided by councils of relevant functional officers (e.g., financial officers, accountants, research policy officers, librarians, etc.). The functional councils also determine the appropriate deliverables for each phase, manage resource allocations and timing of releases, and address the "reality triangle"—the concept of the trade-off among scope, timing, and resources.

Because anyone is free to use, modify, and redistribute the software, commercial firms can engage in a competitive marketplace for advising, hosting, and providing support services without having to invest millions to design, create, and maintain proprietary software. During their implementation of KFS last summer, CSU, NPS and SJDC all used one of the nine Kuali Commercial Affiliates (KCA). This involvement by commercial firms is vitally important to sustainability of the products, and creates a variety of options for smaller institutions, with small technology operations, to use the Kuali community source software. Smaller institutions also benefit in knowing that no company can ever take their software away, drop the product line, force an expensive and untimely upgrade, or block the ability to get future enhancements. The competitive marketplace for services provides much more attractive pricing than when services are bundled with a proprietary system.

Currently, there are over 55 institutions who are dues-paying members of the Kuali Foundation though the software remains freely available to anyone without a fee. Most are investing partners in one or more of the application projects as well. Kuali currently has seven projects underway: Kuali Financial System, Kuali Coeus for Research Administration, Kuali Student, Kuali People Management for the Enterprise, Kuali OLE (Open Library Environment), Kuali Ready which is being deployed in a SaaS model, and Kuali Rice for technical infrastructure, middleware and shared services such as workflow.

One of the parameters in the garnering of funding from the Mellon Foundation and in garnering support of the NACUBO association and other professional organizations in higher education was to ensure that Kuali systems could be used by all Carnegie Class institutions. Our founding partners included research institutions, public and private institutions, and a community college. Kuali was launched with the financial system as the first project, with an initial investment of $8 million from all combined partners. Through additional projects and investors, the foundation now coordinates well over $30 million of institution-led administrative systems projects. The fruits of this work flow freely to both software creating and software consuming institutions of all sizes.

For each new project under the aegis of the Kuali Foundation, investing partners are solicited who need to solve a system problem around the same time. These investing partners assign specific resources to the project, and gain a seat on the governing board to influence the direction of the project. Kuali is a growing community, and we are adding investing partners to existing projects, and adding projects to the Kuali Foundation portfolio.

A key concern is sustainability of the software, and Kuali has developed a sustaining partnership model to ensure that the projects and community can be maintained and enhanced over time. Recently, the KFS Project Board announced its sustainment model after Release 3.0 of the software. Ten colleges and universities and one commercial firm have become sustaining partners, which has created a fund of $1.3 million per year for enhancing and sustaining the KFS. For each of these institutions, the costs of investing as a sustaining member in KFS was less than their licensing and maintenance costs (and risks) of other alternatives. The software enhancements from the ongoing KFS institutions will continue to be freely distributed to anyone via the coordinating work of the Kuali Foundation.

The community, represented and funded by dues-paying members of the Foundation, is a living and evolving entity. The Kuali Foundation itself provides a small set of essential shared services for governance to ensure financial and legal compliance, but the project boards drive their own priorities and allocation of resources to benefit the institutions.

E-education & Technologies for Education

DicWiki: a Generator of Customized Multilingual Dictionaries of Academic Topics

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Keywords

dictionary generation, Wikipedia, learning materials, new academic topics, knowledge updating

Abstract

This paper presents DicWiki, a tool that generates specialized multilingual dictionaries of academic topics. The resource for compiling the entries is the Wikipedia, and the resources for the multilingual denominations are, on the one hand, the language equivalents found in Wikipedia entries and, on the other hand, multilingual dictionaries elaborated by a terminological institution. However, the tool prioritizes the denominations validated by the terminological institution. This is a distinctive feature, in contrast to the Wikipedia-based dictionary generation by Kazakov and Shaid (2009). Another distinctive feature is the scope of the tool. DicWiki is of use to teachers producing learning materials and tutorials, and organizing a course syllabus. It is also of use to pupils and researchers preparing state of the art chapters for works or theses. When the academic topic is new, DicWiki saves them the time-consuming task of searching for relevant concepts which are usually scattered in blogs, journals, etc. A third distinctive feature is the possibility of customizing the dictionaries. Since an academic topic has related thematic categories, DicWiki allows the users to generate entries for specific categories. This allows teachers and students to learn about concepts they were not familiar with and, hence, update their knowledge surprisingly.

Introduction

DicWiki is a tool that generates multilingual dictionaries of academic topics. The dictionaries compile the relevant concepts of the topic in the languages selected by the user. Since the relevant concepts are related to different thematic areas that may arise the interest of the users, Dicwiki allows them to enlarge the dictionaries with concepts that belong to these areas. Therefore, DicWiki generates fully-fledged and customized dictionaries for improving academic reading and writing in a non-native language.

However, the scope of DicWiki is wider. The tool takes advantage of Wikipedia's thematic organization to present not only a dictionary but also a concept map. This concept map may help teachers to prepare their learning materials and write tutorials, organize their course syllabus, etc. On the other hand, it may help students to prepare the state-of-the-art chapter of their works and theses. DicWiki saves the long and time-consuming task of gathering and discriminating relevant information- information which is usually scattered in journals, blogs, and so on. For this reason, as Wikipedia is constantly updated, DicWiki is useful for both teachers and students who want to update their specialized knowledge.

Background

DicWiki was first developed in 2007 as a generator of multilingual dictionaries for translators who had difficulties when translating recent topics terminology (Moré, 2009). Currently, the Learning Technologies Department at UOC is working on exploiting its potentialities in the learning field.

Kazakov and Shaid (2009) also present the generation of multilingual dictionaries based on Wikipedia. They think of students from a non-English speaking background, who do not know the English equivalents of key concepts. They also think of students who do not know the denominations of the key concepts in their own language. As a contrast, the scope of DicWiki is wider. DicWiki is aimed for teachers who prepare the content coverage of their learning materials, tutorials and syllabuses. It is also aimed for students, especially those who must prepare a state-of-the-art chapter in their works and theses, and need a concept map that guides them in their research. Besides, it is intended to be used by both teachers and students when they want to update their specialized knowledge.

Two other distinctive features of DicWiki are, on the one hand, the prioritization of multilingual denominations accepted by terminological institutions over the Wikipedia denominations. On the other hand, the users monitor the generation of a dictionary by selecting the related thematic areas they are really interested in. This avoids, for example, creating the entry *Socratic method* in an e-learning dictionary just because it is related to education, and e-learning is related to education. On the contrary, the user can select, among the related thematic areas, *virtual learning environments* and entries belonging to this area will be added to the ones that have the e-learning thematic category. This is how teachers and students can learn key concepts about areas they are not familiar with and, hence, update their knowledge.

How DicWiki works

General description

The functioning of DicWiki is simple. When the user types the topic of the dictionary (TD), the tool checks whether the topic is a Wikipedia thematic category (WTC). If so, it collects English Wikipedia titles of entries with this thematic category. Titles are extracted from the English Wikipedia because it is the biggest in size. Anyway, users can type the TD in their own language, provided both the Wikipedia in this language and the English one have an entry for the TD.

The titles of the entries are considered dictionary terms and, for each term, DicWiki looks for its equivalents in the languages selected by the user, and stores its Wikipedia thematic categories. Currently, DicWiki looks for equivalents in Catalan, Spanish, French and German in the Terminologia Oberta (Open Terminology) multilingual dictionaries elaborated by TermCat[1]. TermCat is a terminological institution that promotes the use of terminology in Catalan. The Wikipedia non-English denominations only appear when the equivalent is not found in the TermCat database.

All the terms related to the TD, with their multilingual denominations, are displayed in a table and all the new WTCs stored are options in checkboxes. If the users want to enlarge the dictionary by adding new entries related to one or more of these WTCs, they must select them and prompt DicWiki to collect new terms related to all the WTCs selected, along with their multilingual denominations.

DicWiki displays the new WTCs stored in each prompt, until the user decides to download the dictionary. The dictionary is a tabbed text file where tabs delimit the thematic categories and denominations of the term in each language, along with its terminology reference source. This file is easily converted to a spreadsheet or any other database format.

Workflow

The workflow to generate dictionaries is sketched in Figure 1.

As an example, Figure 2 shows the generation of an e-learning dictionary whose TD is written in Catalan ('aprenentatge virtual').

The components involved in the generation of dictionaries are the following:

- Topic Referencer
- Category Finder
- Multilingual Generation Engine

Topic Referencer

The *Topic Referencer* (TR) is the component that maps the TD into an identifier shared by its denominations in any language. From now on, this identifier will be referred to as

[1] The dictionaries can be freely downloaded from the TermCat site.

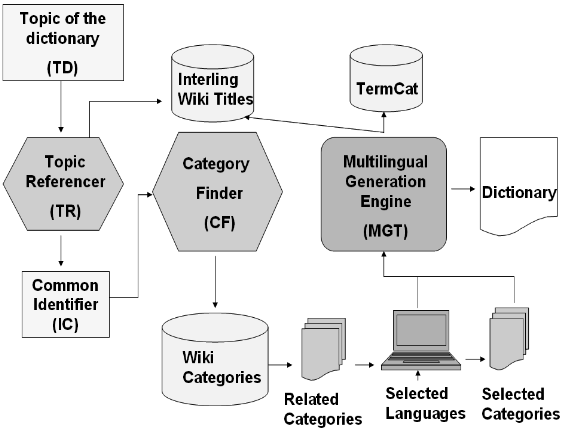

Figure 1. Dictionary generation workflow

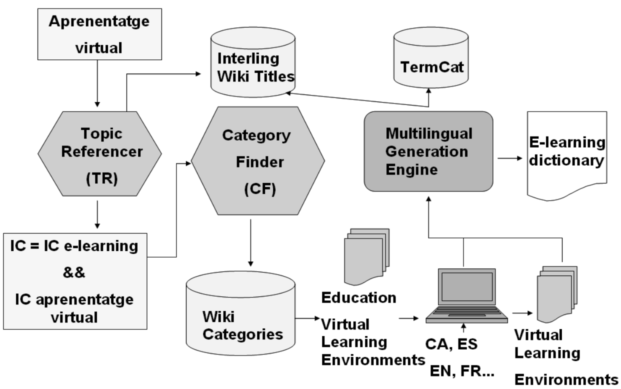

Figure 2. E-learning dictionary workflow

the *Common Identifier* (CI). So, thanks to the TR, the users can type the TD in their own language.

The CI is found in the *Interling Wiki Titles* database. Each register of the database contains the identifier for an English Wikipedia entry and the multilingual denominations that share the same identifier. So when the TD matches a denomination in a register, the CI is the identifier shared by this denomination and the English Wikipedia entry. In case the TD does not match any denomination, DicWiki displays a *do you mean* functionality, where denominations similar in form to the TD are displayed as suggestions of the topic the user wants. If the user selects one suggestion, the TR maps this suggestion into its CI.

Category Finder

Once the CI is found, the *Category Finder* (CF) displays the thematic categories of the English Wikipedia entry with this CI. The thematic categories are found in the *Wiki Cat-*

egories database. Each register of the database contains the CI for an English Wikipedia entry and the thematic categories of this entry. The categories displayed are the *Related Categories* the users must select. The categories selected are the *Selected Categories*.

Multilingual Generation Engine

The *Multilingual Generation Engine* (MGE) is the engine that generates the dictionary. By consulting the *Wiki Categories* database, the MGE collects all the CIs of Wikipedia entries that have at least one of the selected categories. Then, for each CI, the English denomination is retrieved from the *Interling Wiki Titles* and the MGE looks for the non-English equivalents in the TermCat database. If the equivalent in a certain language is not found, the MGE puts the denomination for the IC in that language as it is found in the *Interling Wiki Titles*.

Apart from finding the multilingual equivalents, the MGE prompts the CF to collect the thematic categories related to these CIs that are different from the categories selected. So, a new list of related categories is generated.

When all this process is finished, the MGE appends, for each IC, a tabbed line in the text file which contains the dictionary. The tabs delimit the thematic categories and denominations, along with their terminology reference sources (TermCat, Wikipedia).

Dictionary expansion and dictionary downloading

If the users want to expand the dictionary by adding terms with the new related categories, they must run a new process. However, the process is carried out by the MGE. The MGE generates tabbed lines for entries with at least one new category, as explained above. These tabbed lines are appended to the dictionary text file.

The dictionary can be increasingly expanded by repeating the process as many times as the users want to focus on new categories. When the users consider that the category coverage is adequate, they can download the dictionary file generated so far.

Updating Wikipedia data

Wikipedia is daily updated and it grows in a fast pace. In order to guarantee the generation of dictionaries with up-to-date information, we intend to make up new versions of Interling Wiki Titles and Wiki Categories databases every 6 months. The resources for the generation of new versions of these databases are SQL files which are freely available from the download site of the Wikimedia Foundation[2]. Interling Wiki Titles database is generated from the langlink.sql file, and the Wiki Categories database from the category.sql file.

[2] http://download.wikimedia.org/enwiki.

Conclusion and future work

In this article, we presented DicWiki, a tool that allows teachers and students to compile knowledge about an academic topic in a dictionary format. This tool is especially useful when the academic topic is very new because it saves the time spent in searching through blogs, journals, etc. On the other hand, it is useful for updating specialized knowledge.

The acquisition of knowledge is viewed metaphorically as a ‚downloading process', from the information in the Internet to the individuals. Besides, the possibility of monitoring the dictionary generation by focusing on related categories involves knowing new things unexpectedly. The related categories displayed to the users may trigger their curiosity to follow new tracks of knowledge so they acquire information surprisingly.

In the near future, we are planning to deal with term ambiguity; that is, ambiguity caused by two terms that share the same name but have different thematic categories. We intend to avoid a problem caused by this ambiguity; that is, expanding dictionaries with terms that do not have a conceptual relationship with the topic the user has in mind.

On the other hand, when a non-English TD has two or more English equivalents with different ICs, we are planning to present the categories related to each IC to the users. Then they can choose the categories they are interested in. Currently, it is assumed that the users understand the categories written in English. The translation of thematic categories into a non-English language is another goal we have at stake.

At the Learning Technologies Department, Dickwiki is planned to be used in the automatic generation of tag clouds. This tag-cloud generator would be integrated in a search engine, as a roadmap to obtain relevant information for a general query about a topic.

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The Teaching of DRAWING in the Era of Web 2.0

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Keywords

drawing, art education, web 2.0, digital technology

Abstract

Our proposal attempts to clarify some issues that seem relevant when talking about the process of using information and communications technology (ICT) [1] applied to the teaching and learning drawing. On the text we'll look at the contribution of ICT to arts education and how it seems that the implementation of networked education can contribute to a dynamic and collaborative learning, and the possibility to promote the digital tool in the conceptualization and development of a Project.

Field of action — What drawing are we talking about?

Will try to identify some changes caused by the use of technology in the construction of drawn pictures. We begin by defining in broad strokes, what we mean by drawing. There are unique features of the drawing, which distinguishes it from other forms of art. The quality of the drawing is to translate the world of ideas to the world of representation / presentation, allowed a performance over the centuries within in the visual representation. This feature allows the visualization of scientific and theoretical speculation, driven and open field to the conflict between perception, knowledge and action. While language has had the privilege of being called to other fields of knowledge, occupying a hybrid for several centuries.

We can't dissociate, or understand a drawing without first understanding its function, that is, we must realize that the purpose that the drawing's objectives. In simple terms we could say that there are two ways of drawing. Drawing from the reality, which aims to understand and mimic reality, what and the drawing of the idea or the intellect. This brief definition is intended to introduce readers to the dimension and function of the drawing concept in our work. Is the drawing like language and presentation of the idea that is important for our study? Drawing processes, drawings that make possible new discoveries and that find new possibilities that give course to ideas.

Drawing like a language that make possible "Thinking in action and action as thinking".

We think according our time. Thinking is a product of the time, the social, education and culture. Our students are "digital natives", they think with digital technology. Assuming that, we thought that visualisation and creation image knew media change and amplified our imagination field. The introduction of digital tools raises questions in image concept and in imaginary.

We know that the easy accessibility to software creation and image manipulation is present in the visual culture of our students. Most answers and demand the involvement of digital technology in the discipline of drawing from personal experience. However, these individual experiences in the context of teaching and learning of the arts are essential and extend the practical knowledge and creative. These two types of knowledge are essential for a student to communicate with the image. Successful communication depends on our ability to execute. Thinking and doing are two actions that are directly involved in the creative act. Our ability to achieve allows ourselves to be thinking ahead, further, challenging us turns our ability to do.

Most of these experiences occur within the space of the classroom, or in the studio.

Figure 1. Student working in Drawing Class

Arts education by virtue of skill requires a close relationship between students and teachers. We know that the model of arts education has traditionally been a model in person, very focused on the figure of the master / teacher, face to face.

On the one hand we have the weight of tradition, on the other hand, we find strength in computer use by teachers. The technological illiteracy, lack of knowledge of the technological potential and a certain conformity with the educational practices installed, lead to a distant position in relation to digital technologies and in particular to information technology and knowledge (ICT). However as mentioned earlier, the world is changing, our students have other ways to communicate, to relate, to investigate and seek information.

Methodology — Case Study

The choice of the research model adopted, it was made in accordance with the subject and purpose of our study. Being the subject of our study the computer analysis as a mediator acting in teaching strategies, more specifically in the teaching of drawing at the Faculty of Fine Arts in Porto, it seemed to us that the interpretive paradigm where they are the qualitative methods, would be the most appropriate research that aims to understand and interpret elements of creative production, procedures and the construction of images, with them or not image synthesis.

Following the methodology adopted, it was decided to use the case study of a representative sample, in which participants selected for the collection of information, were students of 2nd year courses Visual Arts who attended the disciplines of drawing 3. A selection of these two subjects fell the need to observe processes, strategies and solutions representation in the media and using different technologies, so as to verify the alterations provoked by extension of the classroom to online environments. The fact that the subjects are theoretical and practical and that development and implementation of projects where the image is the channel of communication was a key factor.

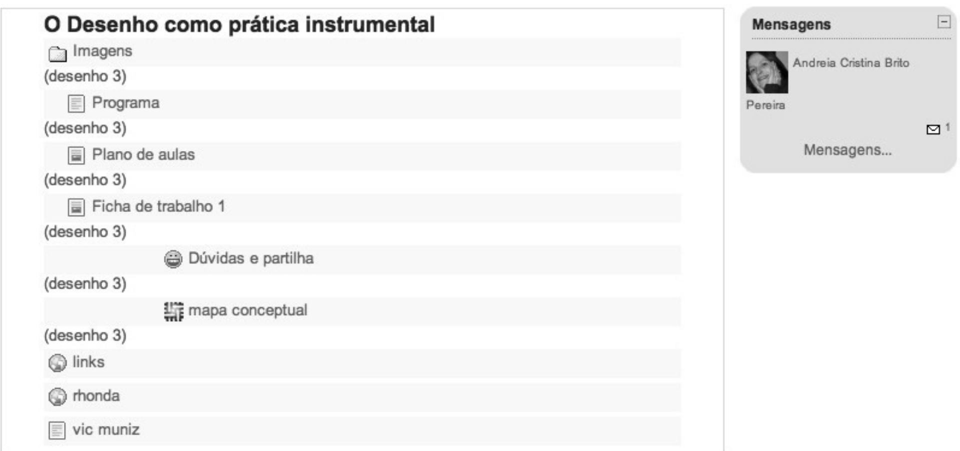

Figure 2. Moodle image

Our experience of fieldwork took place between January and May 2010 time of completion of the worksheet "Drawing as instrumental Project – Practice and Procedure". The proposal made to students in this class was to use the platform Moodle in part as complement online as to accompany the lessons. Students participated in a non-mandatory in this experience, which made caretaking that some students did not participate.

Drawing on three distinct phases of design methodology where the first uninterrupted phase was recognition and removal of space, 2^{nd}; appointment of ideas, 3rd; formalization and simulation we activated on the Moodle platform some tools that accompanied the evolution of work.

For each phase of work was assigned a discussion forum where students put their pictures of their projects. Colleagues and teacher thus make comments about the work progress and make concepts suggestions such as materials and supports. There was moments that students themselves were asking for opinions or suggestions to solve either problem. It created also a forum where *repository* characteristics where teachers and students put text, images and some Web sites that they considered significant and important to the subject under study. The chat had no membership by the failure to be scheduled, and because they don't have obligation, students don't appeared. So, as we attempted to create a conceptual map where supposedly all students should have participated in order to contribute to creating a conceptual expanded and rhizome concept map but without much success because the structure is very linear. I think that a integration on Moodle platform of a dynamic conceptual map is a very and an important tool for the development of interaction technologies, web publishing and sharing was the medium for the construction of change in the design and organization of social networking and learning. The sense of social sharing that characterizes the Web is one of the reasons for the remarkable change in the development of learning networks. More than an informational resource, learning networks supported by the Web, are, therefore, a form of immersion and collaborative construction of meaning like said Dias (2008;5).

Conclusion

After this experience, I am convinced that ICT tools that at first sight may seem distant from the artistic practices have space and can greatly contribute to more dynamic and knowledge sharing, that as in other areas of education have seen results. Another tool that we have to date not yet available but we have as an important tool in these areas is the e-portfolio. Which will enable the school community have access to the work of colleagues.

The world is changing, our students have other ways to communicate, to relate, to investigate and seek information. Therefore, we urge implanting reorganize and pedagogical practices. ICTS present us with a new paradigm on the relationship between student / knowledge / teacher social constructivist perspective which advocates teaching strategies and learning by making pupils more active in constructing their own knowledge. Most of our students were born after the 80s. In this decade although there had been major developments in digital devices and communications technologies, they were already deployed. This latest generation born connected. For these young, digital devices are the basis mediator in contact with the world. "Digital Natives" to label and describe Palfrey and Gasser in the book "Born Digital" are young adults who developed and grew differently from ours. "They read blogs rather than newspaper. They often meet each other online before they meet in person. They probably don't even know what a library card looks like, much lees have one; and if they do, they've probably never used it. They get their music online, often for free, illegally-rather than buying it in record stores. They're more likely to send an instant message (IM) than pick up the telephone to arrange a date later in the afternoon... Major aspects of their lives – social interactions, friendships, and civic activities- are mediated by digital technologies. And they've never know other way of life" (Palfrey and Gasser, 2008; 2).

It is important to be aware of the reality that our students grow; we have that obligation as responsible for Education. It is intended that these tools foster and encourage a process of shared learning, continuous, in which the participants; involvement in education goes beyond the classroom. It is based on the principle of sharing contribution for the expansion of knowledge, I think the role of Professor will be to monitor and manage the elements of learning, as a mediator that provokes and stimulates the search for knowledge.

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The State of the Nations: Current and Future Developments in Technology-Enhanced-Learning

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Abstract

Right across Europe technology is playing a vital part in enhancing learning for an increasingly diverse population of learners. Learning is increasingly flexible, social and mobile and supported by high quality multi-media resources. Institutional VLEs are seeing a shift towards open source products and these core systems are supplemented by a range of social and collaborative learning tools based on web 2.0 technologies. Learners undertaking field studies and those in the workplace are coming to expect that these off-campus experiences will also be technology-rich whether supported by institutional or user-owned devices. As well as keeping European businesses competitive, learning is seen as a means of increasing social mobility and supporting an agenda of social justice. For a number of years the EUNIS e-Learning Task Force (ELTF) has conducted snapshot surveys of e-Learning across member institutions, collected case studies of good practice in e-learning (see (Hayes et al., 2009) in references), supported a group looking at the future of e-Learning and showcased the best of innovation in its e-Learning Award. Now for the first time the ELTF membership has come together to undertake an analysis of developments in the member states and to assess what this might mean for the future. The group applied the techniques of World Café conversation and Scenario Thinking to develop its thoughts. The analysis is unashamedly qualitative and draws on expertise from leading universities across eight of the EUNIS member states. What emerges is interesting in terms of the common trends in developments in all of the nations and similarities in hopes and concerns about the future development of learning.

Introduction

This paper is a record of a conversation. It is a conversation that took place over a number of weeks and involved both face-to-face dialogue and online contributions between the members of the EUNIS e-Learning Task Force. The people involved in this group are all very different yet through their conversations they are finding an increasing number of things in common. They come from many different backgrounds within their universities including IT, Libraries, Teaching, Research and Management. They all share a passion for developing learning within their universities and it is evident from their conversations that this passion goes far beyond a shared interest in technology. It is much more concerned with education in its broadest sense and learning as a power for social good. It is in this context that the reader is invited to join the conversation. This paper remains open on the ELTF wiki and the authors welcome additional contributions from other EUNIS members.

World Café conversations

World Café is a process for bringing people together to work on issues of importance to them. The process has been used around the world in different types of cultures, communities and organisations for many different purposes. It is founded on the assumption that people have the capacity to work together no matter who they are. The emphasis on the process and the value of diversity is different to many other approaches to collaboration that focus on bringing the 'right people' together. In World Café the 'right' people are the people who are there what matters is that you facilitate the right type of dialogue. There are various 'creative commons' resources available in a range of languages to help plan World Café conversations and some of these are listed in the references section of this paper.

World Café conversations are held in pleasant informal surroundings and participants often work in small groups around café type tables with food and drink available to emphasise the social nature of the interaction. The e-Learning Task Force was fortunate to have its World Café conversation hosted by the Open University of Catalonia who provided an unlimited supply of coffee, juice and cakes throughout the face-to-face session.

Participants may discuss a single question or hold multiple conversations on different aspects of a topic. What is important is the way in which participants get to hear a range of different viewpoints and build upon them. This is achieved by having several rounds of conversation and inviting people to move tables between rounds. Each table has a facilitator or 'Host' who remains at the table while the rest of the group moves on. The Host then briefs the new group on what came out of the previous conversation. He or she will be aided by notes and doodles etc that the group has left behind. As participants carry key ideas or themes to new tables the range of perspectives enriches the conversation and leads to new insights. A few several rounds of conversation the whole group comes back together to connect the overall themes that have arisen. The ELTF looked at what appeared to be the most significant current developments in the use of technology to support learning and what factors people thought would have most impact on developments in their institutions in the future. The results of those conversations are summarized in section 5 onwards of this paper. The paper has been split into broad headings but the reader will readily identify that certain themes recur throughout the conversations.

Scenario thinking

Before turning to the outcomes of the ELTF conversation it is worth giving a brief introduction to another approach that fed into the overall discussions.

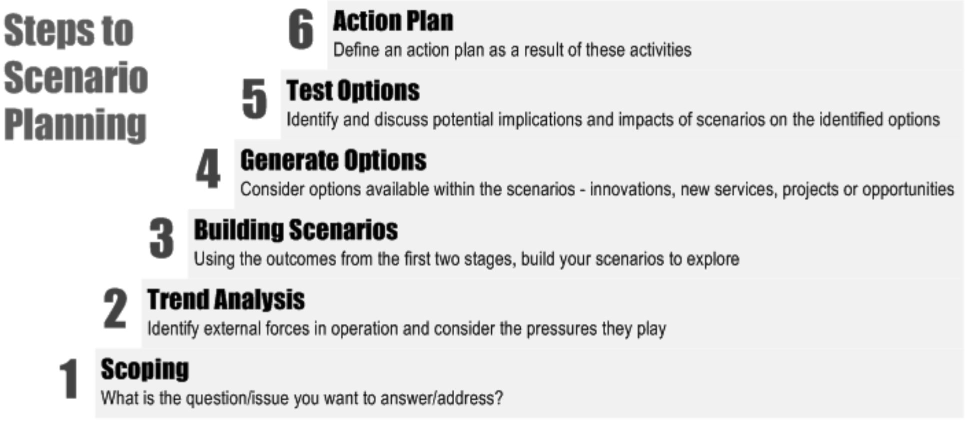
Scenario planning or **scenario thinking** is a strategic planning tool used to make flexible long-term plans. It is a method for learning about the future by understanding the nature and impact of the most uncertain and important driving forces affecting our world.

Many of the regular methods for strategy development assume that the world in three to ten years' time will not significantly differ from that of today and that an organisation will have a large impact on its environment: they assume we can mould the future. Scenario planning however assumes that the future can differ greatly from what we know today.

The method is based on creating a series of ‚different futures' generated from a combination of known factors, such as demographics, with plausible alternative political, economic, social, technical, legal and environmental (PESTLE) trends which are key driving forces. The goal is to craft diverging worlds by extrapolating these heavily-influencing driving forces. The technique can also include anticipatory thinking elements that are difficult to formalise, such as subjective interpretations of facts, shifts in values, new regulations or inventions.

It is a group process which encourages knowledge exchange and development of mutual deeper understanding of central issues important to the future of your organisation. Although the method is most widely used as a strategic management tool, it can also be used for enabling other types of group discussion about a common future.

The thought processes involved in getting to the scenarios have the dual purpose of increasing knowledge of the environment in which you operate and widening the participant's perception of possible future events – encouraging them to ‚think the unthinkable'. For each of these worlds, appropriate action plans can be considered. Asking the key question, ‚what do we need to do (now) to be ready for all scenarios?', can then inform the formulation of strategies to cope with these differing pictures of the future (or at least to address the maximum number of possibilities).



The ELTF group did not undertake a full scenario planning exercise but they used the outcomes of work done in the Netherlands and the UK to inform their discussions.

Platforms

The ELTF group is dominated by users of open source learning platforms. Moodle seems to be the most frequently used platform although the University PM Curie, France uses Sakai, Dokeos is also used in France (e.g. at Grenoble) and the University of Bragança, Portugal has recently moved from a position of having five separate VLEs to having only Sakai. Within the ELTF group the UK appears to be the last bastion of the commercial VLE although survey results show Moodle experiencing the greatest increase in use ((UCISA, 2003), (UCISA, 2005), (UCISA, 2008)). This appears to mirror trends in the US where 60–70% of VLES are now open source. The VLE used by the Open University of Catalonia is owned by the University and at the moment most of its components are being open-sourced.

Whatever platform is used the trend is clearly towards a single VLE per institution. The cost of having multiple products is a key factor in this but so also is the impact on learners. Learners seem to be increasingly taking modules of study in different departments and signalling that they find having to access and navigate multiple systems confusing and unhelpful. Participants reported that the issues to be addressed were more than purely technical and that where there were multiple VLEs there existed strong 'rivalries' between different user groups in the same institution.

Most institutions are indicating that the move to an open source VLE product has been cost neutral (unlike the rationalisation to a single product). The savings in licence costs are offset by the need to have more in-house support but there are additional benefits in being more able to customise the product to the institution's particular needs. The model used by the Open University of Catalonia is based on the interoperability among platforms. This virtual campus has been developed in such a way that it allows the integration of data, resources, components and learning tools from other platforms such as Moodle or Sakai. The objective of this model is to avoid the dependence of a single platform while facilitating the use of a wide range of learning tools initially designed for other platforms.

Most of the institutions represented are now at the point where they have a 'critical mass' of teachers involved in using the VLE and many are struggling to find the resources to support them. For some this is a relatively new phenomenon e.g. the University of Malta experienced a significant increase in interest as soon as the university decided to adopt Moodle 'officially' by re-skinning it and branding it with the university logo. In a lot of other cases the critical mass has been achieved in a much less top-down fashion with pressure from students and from other teachers causing reluctant academics to try using the technology. Many people felt that their teachers needed both technical and pedagogical support far in excess of what the institution was able to provide. Although this was a technically focused group there was clear recognition of the need for support teams to include people who could help teachers develop their pedagogy.

One subject of debate that fitted well with the World Café ethos of representing a diversity of viewpoints was the question of what world view is represented by different systems? It was suggested that portals represent the institutional view of learning, VLEs represent the tutor's view but the learner view is missing. There was discussion of whether e-portfolios might fill this gap but a lack of conviction about whether this was really the case. One participant suggested that e-portfolios may not indeed survive much longer if learners are able to find ways to use tools like Facebook for the purpose of showcasing and reflecting on their learning.

In true World Café fashion the conversation that started by looking at platforms went on to address the much more important question of what do students really want from these platforms? The participants made a point that those of us interested in learning technologies and innovation would do well to remember – most students aren't interested in learning enhancement at all. All they want is something that is useful to them. Much as we might like them to be motivated to find ways of achieving deeper and more meaningful learning, many will simply want to find the easiest way to get a degree. If we are to encourage them to make the most of the technologies available then their usefulness must be clear to the learner. In this context VLES are seen as useful where they are repositories of lecture notes or where they give ready access to administrative information. Hopefully this initial interest will encourage learners to continue accessing the systems provided and start using the full range of learning resources available.

Learning resources

As well as being a group keen to embrace the use of open source products, the ELTF is also made up of people committed to the notion of openness and sharing more widely and in particular to the idea of sharing Open Educational Resources (OER). Most people felt that the idea of their VLE as a repository of lecture notes was well established and they wanted to move beyond this to develop a richer set of learning resources and activities and to share them.

It was suggested that OER needs a primarily top-down approach to succeed. Institutions must drive initiatives and offer rewards including, most importantly, giving people the reward of time to develop their resources. It was also noted that OER requires much better communication within universities as well as with the outside world. Participants did however notice a 'snowball effect' once teachers began to help one another.

One example of a successful incentive to contribute resources to an open repository has been developed by the UK HumBox project. HumBox provides a space for storing and sharing learning resources in the Humanities area. The site currently has over 800 resources and contributors have their resources peer-reviewed and receive points for their contributions. Even in its early days contributors have been able to use this feedback in their institutional appraisal process. This has proven to be an excellent way of attracting contributions and it is to be hoped that initiatives like this will enhance the reputation of research-underpinned teaching materials and help demonstrate the impact of such research. Recognition for good teaching and the importance of transmitting research findings through teaching were themes that ran throughout the conversation. Feedback from partnership in Humbox and another OER Projects is the subject of a EUNIS 2010 paper entitled: '*Motivations to deposit: Two approaches to Open Educational Resources (OER) within Languages and Social Sciences (LSS) at Aston University*'.

A similar, though more wide-ranging initiative in France is Éducnet. Éducnet is making educational resources available at all levels from primary school through to university. It has created seven 'Thematic Digital Universities' covering several key subject areas: health, engineering sciences and technology; business and management; the environment and sustainable development; human and social sciences; languages and cultures; legal and political sciences; and basic sciences. Sixty-seven universities are currently partnering with one or more TDUs, which are committed to creating a network of partnerships (elite educational institutions and research organisations) in France and worldwide. Some 15 to 50 universities and research organisations are involved in each TDU. The TDUs pursue a consistent, validated editorial policy for the digital production of educational resources in relation to key subject areas. Based on resource pooling, TDUs contribute to intra- and inter-establishment cooperation and constitute a support mechanism for the deployment and implementation of the establishments' educational projects. They also contribute to strengthening the links between teaching, research and the professional world.

Another example of a large-scale Open Educational Resources initiative is MERLOT (Multimedia Educational Resources for Learning and Online Teaching) which aggregates peer reviewed online teaching and learning materials. MERLOT is US based but global having more than 22000 materials and 82000 members.

Participants discussed the feasibility of having a big 'European Box' of creative commons learning resources without any need for passwords but it was felt that this was a step too far for OER at present as there are still considerable legal and copyright issues to be overcome before such sharing can become commonplace. In terms of the extent to which sharing is currently feasible across the EUNIS community then language is an obvious issue. Many participants were optimistic that sharing in English would be a good starting point and that students themselves could be a useful community to help with translation (as well as useful contributors to the development of resources). It was noted that there may be fewer such barriers to overcome when it comes to the sharing of visual resources and indeed the same may be true for some areas of science as the Faculty of Engineering at the University of Porto has open access to its remote labs.

Aside from cultural issues the other main barrier to be overcome in terms of mixing and matching resources from different sources is the level of granularity of the resources. In the UK a Centre For Excellence in Teaching & Learning is exploring the issues surrounding the creation of Reusable Learning Objects. It was also noted that information on how resources have been used in the past is often tacit and there is as much need to share the design of learning activities as there is to share actual resources. The Open University, UK has created a site called Cloudworks to share learning designs and ideas and thoughts on teaching experiences. Both of these sites can be accessed via links in the references section of this paper.

The question of what types of learning objects are most useful to students was discussed. It was suggested that one of the (many) reasons why Blended Learning is a successful delivery method is that students do actually like lectures because they represent a different type of learning experience to the kind of things they can do at home. The more cynical members of the group thought a key reason why students like lectures is because they don't have to do any work in them! It is nonetheless clear that different types of activities and resources meet different needs. An issue that came up many times is the popularity of podcasts despite the basic nature of the technology used.

There was nonetheless a certain pessimism about the realities of student use of resources which relates to the issue discussed above of whether students actually want learning or whether they simply want degrees. An example of this came from the University of Porto which has examples of world-class multimedia resources yet there is a concern that students do not exploit the full potential of these resources because they only want to learn what is in the exam. A recurring theme throughout the conversation was the critical need to rethink how and what we assess if we are to ever make best use of the affordances of new technologies. Interestingly the Open University of Catalonia is increasingly offerings its distance learners a choice between continuous assessment and a final exam (provided they are able to travel to one of its support centres to take the exam) and continuous assessment is now proving to be the more popular option. Students that choose continuous assessment only need to pass a final validation exam, consisting of a few items to verify that those learners are the real authors of the continuous activities.

New technologies and tools

This topic was a natural development of the earlier discussions as the group went on to look at what tools and technologies other than VLEs were being used to deliver this richer set of learning resources. The range was extensive and this summary merely homes in on a few topics that came up many times.

Podcasting was a theme that followed through from the learning resources discussion. There was considerable evidence of tutors experiencing pressure from students to deliver more podcasts. In institutions that are only gradually moving beyond lecture notes on the VLE as the sum total of 'e-learning', technical support teams seem to be receiving more requests to help develop podcasts than other types of resources. This may relate very directly to the ubiquity of mobile devices on which the podcasts can be played. The point was made that although we often talk about 'Any Time, Any Place' learning, students do learn in very different ways in different contexts. For example the type of learning you do on a journey may be different to what you do sitting at a desk at home and podcasts are ideally suited to meeting the needs of mobile learners. The fact that students can have a 'teacher in their pocket' via a smart phone is a great bonus to learners who may need to combine work and study. Making podcasts available via i-Tunes was also noted as an effective way of promoting the university and may have a direct effect on recruitment.

Although there was widespread enthusiasm about the value of audio resources it was noted that their usefulness may vary between subject disciplines and that audio-only resources were unlikely to have the same value for science subjects. It was felt that even where the resource was for example a recording of a humanities lecture, video might be more engaging even if it only showed the speaker. In this context we noted that quality costs money and the possibility of better engagement would need to be weighed against the cost of production and the range of devices that could successfully deliver the resource.

There is a significant sub-group of ELTF members that share an interest in remote and virtual laboratories so it was natural that the conversation should turn to this topic on many occasions. Despite many excellent examples of e-learning in the sciences most delivery is still face-to-face. It is notable that the Open University of Catalonia which offers a very broad range of distance programmes to 55,000 students has not yet tackled the hard sciences. It was noted that good quality simulation tools and remote and virtual laboratories are expensive and that this is very definitely an area where technical developers must work very closely with subject specialists to achieve good results. It is nonetheless an area where return on investment can clearly be demonstrated in financial as well as academic terms.

Possibly the clearest example of this is preparing students to use laboratories effectively in a blended learning environment. An example was given of a 45,000 euro piece of equipment being damaged by one lead being plugged in the wrong way. The resulting repair cost over 5,000 euros and meant that the equipment had to be sent away for several weeks. Preparing students to use the equipment by having them practice online can avoid the possibility of this type of error. The University of Bristol e-BioLabs Project (University of Bristol, 2008) is giving students just such preparation with excellent results as is the Faculty of Engineering at the University of Porto.

Allowing students to interact directly with remote equipment in real-time is also a means of allowing learners access to specialist equipment that may only be available in a few places. The Universities of Porto, Minho and Coimbra in Portugal share laboratory resources and are working with laboratories as far afield as Hungary, Slovakia and Brazil (for more on this see the (Restivo et al., 2010)). In terms of web technologies, these universities find that Skype is invaluable in facilitating interactions between the teams in different countries. Skype appears to be commonly used among the members of the group for real-time interactions although in France the NREN (National Research and Education Network) supports EVO.

e-Learning is delivering huge savings and benefits in the field of medicine, a subject discipline where the use of simulation tools is well established (see for example projects involving virtual patients at the University of Edinburgh and St George's University of London (JISC infoNet, 2007)). Possibly the most quotable excerpt from our World Café conversation is the comment '*Cutting up an avatar is much more realistic than cutting up a corpse*.' Most of us will have to take the contributor's word for this but the educational benefits are clear.

Going back to the issue of student motivation and actual learning outcomes it is also clear that this type of simulation and experiment involving active learning is promoting deeper understanding. Participants felt that having more engaged students definitely has a positive impact on the tutors' own research as well as on their teaching. The point was made yet again however that new technologies are challenging for many academics and there is a need to invest in their professional development. Accreditation, reward and recognition were phrases that were used many times.

As well as the need to develop tutors the conversation also touched on the skills needed by students to make the most of the new technologies and resources available to them. The issue of 'Digital Literacy' is one that resonated throughout all of the discussions. Just because many learners may be more comfortable with technology than their tutors does not mean they have the information and critical thinking skills necessary to evaluate the range of resources available and judge their usefulness in a particular context. As one participant commented, '*Students think Wikipedia knows everything.*'

This issue was highlighted again in discussions on the usefulness of Facebook as a means of supporting learning. Opinion was divided as to whether learners really welcome the use of social software tools for learning or whether they prefer to keep their studies and social life separate. There are examples of course groups using Facebook to good effect, mainly where the tutor is an active facilitator. French academics in particular have however raised concerns about some of the information sharing that goes on via such informal technologies. There are examples of students posting their own lecture notes, which may be inaccurate or misleading, on the Internet. In some cases these are presented in such a way that they can easily be mistaken for 'official' course materials written by lecturers who are named in the material and there are instances where universities have had to request that such materials be deleted. It is easy to see how such problems can arise in a situation where universities themselves are making resources available by similar channels e.g. using i-Tunes or YouTube and where learners do not necessarily have the learning literacies they need to discriminate between academically sound resources and other materials.

Twitter is another tool that appears to have educational affordances that are not being fully exploited at present. It was noted that most participants had experienced its value mainly at conferences rather than in teaching situations but it was felt that Twitter could be of value during fieldwork and in tutorial situations. One project exploring the use of Twitter for learning is the JISC ScaLe Project (Scaffolding Learning with Twitter – (JISC, 2009)).

The question of ethics came up many times in the conversation. It was discussed in relation to re-use of creative commons materials by tutors and is perhaps worth flagging here in relation to student use of Internet resources. The extent to which resources are freely available and can be cut and pasted or combined online in Mash-Ups makes it understandably difficult to convey to learners what constitutes plagiarism. One body that is attempting to address this in the UK is the Academic Integrity Service (see references: (Academy JISC)).

Political and economic drivers

In looking to the future the group spent a little time exploring the differences in how universities are funded and the relationships between universities, government and business in the different nations. It was noted that in Europe universities are much more highly state regulated in the US. UK universities seemed to have the greatest levels of autonomy and self-regulation of the countries represented. Malta has only a single university so the situation there is one of close collaboration with government. Elsewhere from France and the Iberian peninsula to the Scandinavian countries the government plays a strongly directive role.

The level of government intervention is of course strongly correlated with the levels of government funding. The UK (excluding Scotland) stands out as having significantly higher levels of fees paid by its students (up to 3,000 pounds per year). It was indeed pointed out that the City of London is full of people who did part of their degree in Paris and paid a tenth of the UK fee that year. There is a strong push from English universities for the government to raise the cap on fees or even remove it altogether so that universities can charge even higher prices. Such a move would be almost inconceivable in France, where fees are mostly less than 300 euros per year and where student protest can still topple government ministers. Elsewhere fees are being introduced only gradually and stand at around 1,000 euros per year. Finland stands out in having an education system that is entirely free even for overseas students from outside the EU although this is likely to change soon.

One area where the UK government is giving a strong steer to universities is in asking them to consider the possibilities for Shared Services. This might mean sharing IT systems but could also cover other areas of activity such as procurement, sports facilities, support services etc. A similar initiative throughout Scandinavia in the 1990s seems to have had some impact in Denmark but little in the way of results elsewhere. Other nations had examples of top-down initiatives that failed such as an attempt to create a Catalan Campus in Spain (although they did achieve interoperability across multiple campuses). A Portuguese national project created a SCORM based framework for content exchange thus meeting its technical goals but there is, as yet, little motivation amongst teachers to share educational content.

There is recognition in Finland that the country has too many small universities resulting from government intervention in the 1970s and there are likely to be a number of mergers in the near future. In France the 17 Paris universities are moving towards a set of 3–4 'federations' and are prepared to discuss issues such as shared VLEs.

The relationship between universities and business is an increasingly important topic in most countries. Finland is looking at new funding models that relate research funding to engagement with enterprise and the provision of matched funding from industry. It is inevitable however that the needs of universities and enterprise do not always match up in straightforward ways. In Portugal it was reported that many employers are reluctant to pay for graduates with PhD degrees. Universities, for their part, are reluctant to take a steer from industry when it comes to defining what the curriculum should cover. Many participants felt that employers see it as the business of universities to turn out graduates ready for the world of work and are not prepared to contribute to their education. A particular problem in many countries, including the UK and France, is finding employers willing to offer short-term work placements e.g. 3–6 months. Most employers seem to want longer placements of at least a year.

In most countries the current economic climate means that governments are looking for ways to reduce public funding to universities and achieve new income sources. Reducing the cost of tertiary education was a key factor behind a report recently commissioned from a panel of international experts by the Portuguese government on the potential for the expansion of distance learning as a means of widening participation especially amongst the adult population (see (Bielschowsky et al.)). It is interesting that the report sticks to the term 'Distance Learning' even though it considers a range of online interventions and blended learning situations.

The message in most places nonetheless seems to be about doing more for less rather than doing things differently. In this context the possibilities afforded by technology to do different things and to do things differently cannot be overlooked. Looking outside Europe for a moment the group also discussed the size of the education market in the developing world, the possibilities this offers and also the threat posed by competition from developing countries.

Students and their expectations

Learner demographics are changing right across Europe. Many participants reported an increase in mature students in their universities. To use the Open University of Catalonia as an example 45% of its 55,000 students are aged 31–40, 35% are 21–30 and the remainder are under 21 or over 40. In other words the traditional 18–21 year-old learners are a minority. This may not be unexpected in a purely distance learning institution (where a fully online learning system is a big advantage for learners who need to juggle their professional lives with their studies) but it is mirrored in many other types of university elsewhere. The stated reasons for young people making the Open University of Catalonia their first choice of university upon leaving school are however interesting. The university believes that school leavers come to them not because they have difficulty travelling to a physical campus but because they are 'digital natives' who are used to managing their own time and who want to be in control of their own pace of study.

The question of fees unsurprisingly arose again in the context of student expectations. Increasing student fees do give rise to increased expectations. People who have worked hard to pay for their education see themselves much more as consumers. This imposes a need for greater accountability on the part of universities and on individual tutors but many people felt there was a beneficial effect in terms of students trying harder to succeed when their own money is at stake.

Many participants cited basic economic reasons why people are putting off taking a degree until they can work to support themselves. They are also seeing an increase in people returning to education either because they have been made redundant from their job or want to start a new career and 'portfolio careers' are likely to be much more common in future. It was noted that, although education professionals now commonly talk about lifelong learning, many young people do not yet realise they are lifelong learners and we need to think about how we prepare them for a world where the currency of knowledge is getting ever shorter. The need for flexible pedagogy and andragogy to support the needs of new types of learners was widely agreed. The topic of development for academics came up yet again in this context as many current academics have a focus on knowledge that is relatively static and narrow.

There was much discussion about how much flexibility should be learner driven and the extent to which it is beneficial for universities to expose learners to 'rules' or indeed specify that they should use a particular tool or the university's email system. Some people felt that a stronger steer from educators was needed to combat declining academic standards e.g. literacy suffering as a result of 'text speak' creeping into the language. There is a risk that universities are simply following technology rather than leading where necessary. There was a feeling that flexibility in terms of timing and means of delivery must be set within a 'learning contract' that covers standards and behaviours as well as learning outcomes. The whole question of learning literacies surfaced again and it was noted that France has introduced a compulsory certificate in digital literacy.

This discussion on flexibility and rules mirrors one that took place at a recent seminar held at the Open University of Catalonia: 'Student-centric learning may function best within the necessary constraints of institutional expectations and academic requirements. "When architects look for where they can make a breakthrough in design, they don't look at the structure. They look at the cracks and interstices. Real insight, real brilliance often comes from within those openings. That is because constraint is an impetus for learning." The same might be said for education. Subversion occurs in the joints, but you still need the structure' (Glenn, 2009).

Participants also challenged what they saw as a certain complacency on the part of universities in terms of us thinking we are leading the way in online learning and also not paying sufficient attention to what his happening as regards informal learning. We still think we are the 'experts' and assume that other people will necessarily value resources that carry our branding. The point was made that lots of people out there are doing things for themselves. Some of what goes on may be of questionable quality but we need to recognise that informal learning is increasing everywhere not just in education institutions or the workplace. With so many learning opportunities out there we need to work harder to convince people of the value of a university education that may be costly and appear restrictive in many ways. Universities cannot afford to underestimate the power of the Internet and the 'wisdom of crowds'.

Conclusions

The most striking thing to come out of these conversations was the commonality in the issues faced by ELTF members in all countries. We expected to spend a lot of time exploring differences yet we found very quickly that we seemed to be at different points on the same trajectory. The basic premise of the conversation was 'How can we best use technology to enhance learning?' but the conversation kept turning back to what it actually means to be a university in the 21st century.

The strong message throughout was a commitment to openness. We approached this via a discussion of platforms and resources but the underlying theme was an open and diverse community of academics and researchers supporting an open and diverse community of lifelong learners. The concept of universities as 'Ivory Towers' does not seem to fit the ELTF world view although the themes of academic rigour and quality are deeply entrenched in our values.

The role of the teacher is shifting from one concerned with imparting scarce information to a point where the primary focus is to help learners undertake critical evaluation of the vast amount of information available to them. Our conversation hosts, the Open University of Catalonia, sum this up in a publication summarising conversations with their networks: '*Where the traditional business model was fueled (sic) by content, the new educational model rest on mentorship. Putting this in economic terms what is scarce today is not content but sense-making*' (Glenn, 2009). We need to help learners develop the literacies required to extract meaning and knowledge from a range of disparate sources and apply this learning to solving 21st century problems. If it is indeed true that 'Literacy means being able to consume and produce the media forms of the day' ((Glenn, 2009) quoting Jason Ohler, University of Alaska) then we may indeed be simply reinventing the notion that the purpose of a university is to promote scholarship.

We also need to understand the diversity of our learners and their needs and provide support for them in the full range of situations where learning takes place. It is encouraging that, although ELTF members are enthusiastic about technology and innovation, there was never a hint in our conversations of them offering 'a solution looking for a problem'. The key focus of their endeavours seems always to be the ways in which technology can promote deeper and more active learning or the ways in which technology can support delivery at times and in places that make study more learner-centred.

The pressures to do more for less are being felt right across Europe. It is evident that the ELTF community has knowledge to share that can help in a variety of ways. There is clear evidence that the appropriate use of technology can have direct financial benefits and ELTF members could do more to share examples of this. Remote and virtual laboratories are one area where the benefits are clear and it would be useful to develop further examples. Technology also offers opportunities to do different things and to do them in different ways and the ELTF community should not be afraid to contribute to areas such as the development of assessment practice. The plea for better reward, recognition and accreditation of good teaching and for the development of teaching practice to have parity with other types of research is echoing around Europe as is the desire for learning technologist to work more closely with academics. It is to be hoped this is one area where the power of the community and the 'wisdom of crowds' will have impact.

A final thought concerns what it means to be part of the EUNIS ELTF community. As someone who spends a lot of time future-gazing and talking about trends, innovation and cost-benefit analysis, the editor of this paper found it both surprising and comforting to be part of a community that has such a strong set of shared values grounded in rather traditional notions of what it means to be part of a scholarly community. It is evident that, however much the mechanisms for creating and dissemination information develop, there remains a vital role for universities in terms of turning the data into knowledge that can be applied. Communities like ELTF that provide opportunities to share and question amongst individuals from such a diverse set of educational settings have real value in developing our thinking about our own practice. The common ground we found in our conversations helps us to realise that the issues that concern us personally are important and that we are not alone in trying to tackle them. We hope that our observations will be of interest to others and will stimulate more of you to join the conversation next time.

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Use of Training Materials in the Self-regulation of Learning Processes in Virtual Environments

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Abstract

Introduction

In the context of IL3, some training materials were created and applied to support the learning processes of adult students (postgraduates but also made-to-measure learning and/or varied-profile students), so as to make them useful in the development of self-regulation processes and favor life-long learning (LLL).

Context

IL3 (Institute of Continuous Training at the University of Barcelona) combines experience, methodology, and both in-site and off-site training programs through blended learning. IL3 means "Institute for Life-Long Learning" and its training comprises all scientific and artistic disciplines and fields through a wide set of courses of different duration (from master and postgraduate courses to seminars). IL3 also disposes of made-to-measure training for companies.

Theoretical Framework

This experience, carried out in IL3-UB, is focused on including not only the knowledge and skills of a particular disciple, but also the cross-curricular competence of learning to learn from self-regulation, in student training.

'Competence' (Perrenoud, 2004) is understood as the capacity to activate the necessary resources to give an efficient response to a complex situation in a particular context. Competence involves selecting, among one's knowledge, skills and attitudes, those most appropriate to solve a complex problem, combining them with wisdom and judgment. Therefore, the nature of this competence is: **integral** (cross-curricular to diverse disciplines and fields), **wide** (competences influence one another, so the promotion of one of them also enriches the remainder), and **recurrent**, so their process of formation is lifelong — they began with initial and permanent training, and are widened through professional experience (Roegiers, 2004).

In this sense, disposing of tools helping us to improve our competences is essential. These tools must be understood, within the framework of constructivist learning processes, as resources at the service of the learner. According to this, we decided to elaborate support materials for learning processes in the framework of the online courses scheduled by the IL3 with the aim of boosting, especially, the students' learn-to-learn competence.

The most suitable tools and resources for learning to learn throughout life were selected to elaborate these training materials. The first selection was: information management (location, extraction, organization and evaluation), time control, fostering reading comprehension, management of both autonomous and team work, exam preparation, project design and elaboration, and oral presentation development. These axes allowed us the initial articulation of 11 training materials.

All materials were designed and planned to be tested in a virtual platform, so they should follow certain didactic and methodological patterns and features which characterize online training materials. In this sense, the following materials were proposed:

These materials are brief (no longer than 4 hours) and structured so as to make students review the basics, verify how they have done so far (self-assessment), deal with some examples, and particularly practice the skills proposed in each case. Materials are structured into common sections such as:

– What is this unit for?
– What should I know?
– How have I done so far?
– How is it to be done?

– Have your try…
– In short…

Final Reflections

The self-regulating capacity of the learning process itself (Boekaerts et al, 2000) have widely dealt with led us to reflect on the role played by teaching professionals in these processes, which can be broken down into two main tasks:

– We will have to set mechanisms and strategies to help students in this process of becoming aware of how they learn and how this learning takes place. Setting self-assessment processes, enumerating their main learning issues, verbalizing their difficulties, working with KPSI questionnaires and taking them up again at the end of each didactic unit, establishing relations between the activities and the objectives of the subject, or elaborating a portfolio are some of the proposals of the elaborated material which improve students' self-regulation capacity
– We will have to articulate useful feedback mechanisms (Nicol, Macfarlane-Dick, 2006) to help students to learn. Therefore, the materials include self-assessment proposals and instructions for reflection once tasks have been finished.

Setting off from the implementation of the materials in the virtual classroom, we have received inputs not only from students but also from companies in relation to the usefulness of these learning-to-learn resources. The interest of companies has been so great that they have suggested their implementation in their own working intranets. Therefore, the interest arisen by self-regulation mechanisms goes far beyond formal learning and opens new ways toward workplaces and informal learning.

Background experience

This experience, carried out in IL3-UB, is focused on including not only the knowledge and skills of a particular discipline, but also the cross-curricular competence of learning to learn from self-regulation, in student training. IL3 (Institute of Continuous Training at the University of Barcelona) combines experience, methodology, and both in-site and off-site training programs through blended learning. IL3 means "Institute for Life-Long Learning" and its training comprises all scientific and artistic disciplines and fields through a wide set of courses of different duration (from master and postgraduate courses to seminars). IL3 also disposes of made-to-measure training for companies.

Cross-curricular competences and learning self-regulation

Curricular designs are currently based on approaches design according to competences. 'Competences' (Perrenoud, 2004) are understood as the capacity to activate the necessary resources to give an efficient response to a complex situation in a given context. Competence involves selecting the most appropriate skills and attitudes — among one's knowledge — to solve a complex problem, combining them with both wisdom and judgment. Therefore, the nature of this competence is: **integral** (cross-curricular to diverse disciplines and fields), **wide** (competences influence one another, so the promotion of one of them also enriches the remainder), and **recurrent**, so their process of formation is lifelong — they began with initial and permanent training, and are widened through professional experience (Roegiers, 2004).

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The most suitable tools and resources for learning to learn throughout life were selected to elaborate these training materials. The first selection was: information management (location, extraction, organization and evaluation), time control, fostering reading comprehension, management of both autonomous and team work, exam preparation, project design and elaboration, and oral presentation development. These axes allowed us the initial articulation of 13 training materials.

The self-regulating capacity of the learning process itself (Boekaerts et al., 2000) have widely dealt with led us to reflect on the role played by teaching professionals in these processes, which can be broken down into two main tasks:

– We will have to set mechanisms and strategies to help students in this process of becoming aware of how they learn and how this learning takes place. Setting self-assessment processes, enumerating their main learning issues, verbalizing their difficulties, working with KPSI questionnaires and taking them up again at the end of each didactic unit, establishing relations between the activities and the objectives of the subject, or elaborating a portfolio are some of the proposals of the elaborated material which improve students' self-regulation capacity.
– We will have to articulate useful feedback mechanisms (Nicol, Macfarlane-Dick, 2006) to help students to learn. Therefore, the materials include self-assessment proposals and instructions for reflection once tasks have been finished.

Objectives

Our main objective is the provision of a training resource aimed at boosting the development of cross-curricular competences which favour learning self-regulation and can be applied to IL3 courses so as to involve our students. This resource shall be available for all students, regardless of the area/field they have registered in.

Specifically, these training materials are aimed at:

– Boosting competences which favour continuing learning-to-learn and its subsequent self-regulation and -learning. Rather than providing closed training materials, we attempt to provide each participant with initial clues so as to enable him to get to know, develop, increase and deep into competences according to his personal interests.
– Facilitating and acquiring tools which can be applied in academic (tools related to IL3 or non-IL3 training courses) and professional spheres. Regardless of their discipline

or professional sector, we intend to support useful strategies which can be applied as daily routines.
- Homogenizing basic competences so as to enable participants to begin every new course they want. Much of the IL3 training involves putting into motion (either directly or indirectly) a set of competences linked to learning-to-learn. Thus, reaching certain agreements regarding concepts and processes is considered necessary.
- "Refreshing" some competences which, although belonging to the wide scope known as "self-learning", are sometimes neglected when not used in the everyday life of a professional sector.

Finally, covering the gap which some participants may have regarding the contents which can be included under the term "academic". Some IL3 courses are offered to all publics, even those with non-regulated higher studies. Guidelines on information searches, presentation and quoting are understood as a useful tool to face new training processes, both in IL3 and non-IL3 training.

At all times, we set off from the idea that the competences related to learning-to-learn can be acquired and practiced independently from the participants' discipline or sector of origin and that, in all cases, can be "learned".

Target individuals

The set of training materials we have created includes a wide range of possible targets. The common denominator of all these targets is that they belong to the collective of participants in IL3 training courses and are therefore interested in receiving information, training and/or accreditation on any particular aspect. In any case, the initial group segmentation was:
- Graduates registered in short- or long-duration training courses from different sectors and disciplines. This would be the case of post-graduate students or those registered in master courses.
- Participants from institutions which have been offered (through their previous request) IL3 made-to-measure training focused on particular needs. The profile of the participant in this case is rather specific and is due to the requests estimated as convenient by the institution at a particular moment.

In both cases, these participants are part of any of the IL3 courses. Therefore, they are registered in the institution's on-line or b-learning courses and, consequently, have access to the on-line platform devised with this purpose (Moodle 1.9.2), which contains all the necessary information and training materials referred to the course.

Training materials and learning self-regulation: general features

Once the main objectives of the materials were determined and the target individuals who would become their users were identified, we proceeded to design the access conditions and their didactic structure.

Materials' access conditions and location

Some internal studies on publics were used to fix the kind of access to materials. These studies report that many of these participants have higher studies in which, theoretically, those contents had already been taught and learned. Given the widely-varied profile of the registered participants, we opted for optional training materials available for participants according to their needs. Nevertheless, in certain courses we detected certain lacks which may suggest openly recommending all participants the needs and use of the training materials devised for their correct progress in the courses they have registered in. Therefore, participants dispose of these materials with no additional cost, but are recommended to complete some of them according to their needs. Logically, this influences evaluation directly: they are not evaluable modules and therefore do not determine any score when it comes to obtain the title of the completed course.

These materials undoubtedly constitute a **source of self-regulated learning** in all senses: they demand predisposition and previous motivation, involve regulating time – since materials were designed to be completed within a period of 4–5 hours of study, require participants certain discipline, propose self-assessment elements, etc. Participants regulate their participation in these modules according to their training needs, time and discipline.

The field we attempt to cover with the development of these materials was another aspect to be taken into account among those related to participant access and profiles:

- On one hand, we attempt to cover **academic needs** (i.e., related to course development): strategies applicable to the achievement of the participants' training objectives, thus supplementing their training with the acquisition of learning self-regulatory competences.
- On the other hand, we attempt to provide them with useful tools for their professional fields, applying such competences outside the training framework they were involved in. In this sense, the materials are intended to be capable of covering also **professional needs** such as teamwork, public speeches, portfolio design, etc.

Finally, we focused on the **place or space** where materials can be accessed. With this purpose, we opted for locating an access to materials next to the group of basic "Resources" available for each participant. The lateral menu contains an item known as "Study Improvement Techniques", which displays a brief presentation and gives access to the set of 13 materials.

Thematic blocks

Once access and general conditions were defined, we proceeded to articulate the set of thematic blocks and the didactic sequence of each material.

The initial design contains a total number of **13 training materials, comprising a wide variety of aspects linked to the learning self-regulatory competence**. These materials set off from the previous study completed by IL3, which determined the procedures, skills and abilities participants must have and develop to achieve success in new training actions. The particularity of these should be the following:

– Not being part of a particular discipline (i.e., being cross-curricular) and, at the same time.
– Creating the necessary base to boost learning self-regulation and learning-to-learn.

From the initial study, the themes more linked to the **learning self-regulatory competence** were:
– Learning styles
– Boosting reading comprehension
– Benefitting from in-person sessions
– Graphic representation of ideas
– Tools for information search
– Drafting and basic guidelines for written works
– Drafting and basic guidelines for an oral presentation
– Organization of autonomous work and individual time of study
– Teamwork organization
– Preparation and response to different types of exam
– Portfolio design and development
– Elaboration of a final project
– Quoting bibliography and information sources

These varied procedures or topics of study correspond to the following thematic blocks:

Learning styles: improving concentration, attention and memory

When acquiring new information and putting it into practice, each of us turns to different resources and mind strategies, analyses in depth different aspects of the same situation, and activates varied rhythms and intensities. Each new learning situation triggers different mechanisms for new knowledge incorporation, re-elaboration and use. These differences influence the way we learn and how we learn to learn.

Boosting reading comprehension

Reading is one of the basic skills for knowledge acquisition, since it involves getting to know the reality from other viewpoints and reflecting on our conceptions. It is an individual, self-teaching and essential method to learn. Nevertheless, to benefit from reading we must get to the bottom of the author's ideas and be critical. Understanding texts through the identification of key ideas, expressing criticism, differentiating between mechanical and detailed reading, or knowing the best conditions for comprehensive reading are essential issues to learn to learn.

Benefitting from in-person sessions

The learning activity developed by participants in a training action can be partly developed within the framework of an in-person classroom context. In-person sessions involve a series of competences which should be developed, especially if we intend to benefit from the taught contents. This material offers tools for collecting information and key ideas, and expressing these ideas so as to build new knowledge. All these tools involve basic abilities to face a wide range of both academic and professional situations.

Graphic representation of ideas

One of the ways to understand a text or document is trying to express its ideas by means of graphic representation. This is a technique of study which can be used within different fields and may also provide personal and professional, individual and collective help. It is about acquiring strategies to create graphic representations of the ideas in a text, keeping the message's underlying logical structure by means of the interrelations among its main and secondary ideas, and paying special attention to the different existing graphic representation forms: outlines, conceptual maps, diagrams or synoptic charts.

Tools for information search

The development and application of information and communication technologies (ICTs) has undoubtedly contributed not only to the diversification of the origin of the published information but also increased the volume of available information and improved the existing conditions for the shared use of information resources. This demands the development of informational strategies. Digital competence includes information searches but, at the same time, is also related to information processing and management.

Drafting and basic guidelines for written works

New training actions, as well as professional fields, shall often demand written work: preparation of reports and monographic documents is rather frequent along a wide range of different sectors. Our training materials teach how to organize and compose a written document through the development of its objectives and criteria, the elaboration and organization of tackled and transmitted ideas, up to the preparation of a preliminary draft and the final version to be submitted.

Drafting and basic guidelines for an oral presentation

At academic level, oral presentation is an essential tool to put forward the ideas derived from a monographic work, study, research, etc. From a professional viewpoint, many sectors demand public presentations, so oral expression strategies turn out to be essential. The study of the audience, the preparation of an appropriate outline, the use of visual resources or the attention to verbal and non-verbal aspects are some of the necessary strategies and processes for successful oral expression.

Organization of autonomous work and individual time of study

The organization of our individual time of study is a general competence which can therefore be taught and learned. We must individually manage our own time of study by adapting our personal needs and priorities to our dedication requirements so as to obtain satisfactory results. This is one of the essential abilities involved by self-learning and learning-to-learn. This thematic block analyses several related issues such as discipline, work organization and planning, priorities, evaluation, etc.

Teamwork organization

It is one of the most relevant cross-curricular competences, since it is highly useful for present and future personal and professional development. In academic and professional spheres, teamwork constitutes not only a frequent practice but is also often a real need. The current complexity of many academic and professional areas demands the configuration of work teams so as to face challenges at different levels. Although we make an effort to implant teamwork, we often observe the existing difficulties we face when approaching teamwork in practice.

Preparation and response to different types of exam

This material is basically oriented to academic spheres and responses to the need of getting to know strategies aimed at improving study habits in relation to different evaluation typologies. It is not only about providing tricks on how to answer exam questions and thus instrumentalizing evaluation processes, but its objective is boosting strategic and positive strategies upon evaluation, promoting the application of the study abilities and cognitive processes demanded by each kind of exam.

Portfolio design and development

It is a progressively more frequent practice in both academic and professional spheres. The book or portfolio of an artist contains his selected works, thus showing his different contributions. This folder allows considering his evolution along time and provides evidence on his artistic competences. Analogously, the learning portfolio or folder is an appropriate instrument for the evaluation of the results of the learning processes developed throughout a given academic year. The elaboration of a portfolio demands following a particular methodology, and the development and put into practice of multiple competences related to learning self-regulation (organization, selection, information assessment, etc.).

Elaboration of a final project

Also with a marked academic line, this material guides the steps for the elaboration of a globalizing monographic project. In spite of the specificities of each discipline or course, there is a set of issues and cross-curricular processes which are considered in every project. Therefore, it is about acquiring competences of planning, coordination, selection and put into practice of ideas, teamwork, expression, etc. This thematic block is related to most other training materials such as elaborating a written work, quoting bibliography, graphic representation of ideas, oral presentations, etc.

Quoting bibliography and information sources

Repeatedly, the presentation of reports, documents, studies, projects, etc. demands the use of varied information sources which should be included to provide the reader with transparency regarding the bibliography and references used for work elaboration. The bibliography reflects the decisions made upon selecting particular information sources, being a key issue in the development of works, reports, projects, etc. Thus, we provide the main tools to learn to elaborate a bibliography and, specifically, to get to know how information sources and pieces must be quoted.

Thus, the set of thematic blocks offer a synthesis of some of the basic cross-curricular competences which should be acquired and applied to a learning self-regulatory context.

Didactic sequence of each training material

Upon developing the internal structure of each material, we opted for providing the whole set of materials with the same sequence. Setting off from the idea that materials should be approached from a **practical** viewpoint, we conceived an outline which sets off from the participants' possible needs and expectations for the elaboration of different practical cases and simple learning activities which shall ask them about their own practices and impel them to optimize them.

At general level, these were the premises followed for the organization of the didactic sequence:

– Boosting the practical perspective of the developed competences.
– Relating the different training materials among them, thus creating a network of competences for learning self-regulation.
– Involving participants in simple but significant activities from the viewpoint of the application of competences in academic and professional spheres.
– Creating self-evaluation spaces.

According to these premises, each training material is structured around:

– Usefulness of the present unit: this point is aimed at a fourfold objective: 1) presenting the material's core topic (answering the question: what's all about?); 2) presenting the objectives and expectations we intend to reach at the end of the sequence; 3) forcing participants to face a problem or situation related to the developed competence; and 4) working as a lure for subsequent reading.
– "You must know": the main ideas to be taken into account are presented in a very practical and structured manner, so as to provide participants with a quick conceptual framework, avoiding excessively-dense theories or conceptual frameworks. Therefore, participants shall be provided the key issues of each competence.
– "For example": to enable participants to observe the operation or put into practice of the developed competence, the material provides related examples. In this sense, it allows the visualization and practical development of the ideas in the "You must know" (the previous step). Participants find themselves in a particular situation and are asked about the correctness of applying the developed competence. It includes different types of examples: good practices, frequent errors, common academic and

professional situations, etc. and varied presentation typology: hypothetical cases, description of personal past experiences, real situations known by third parties, etc.

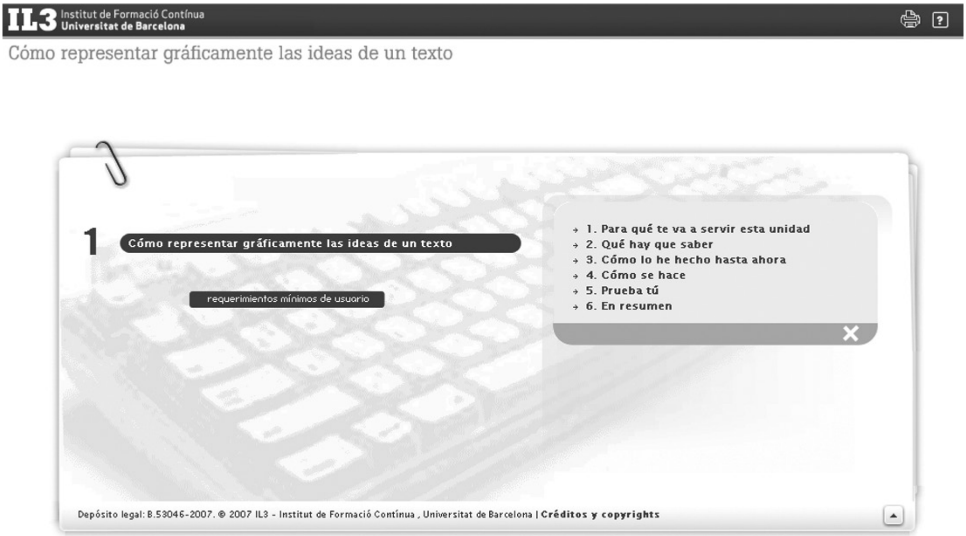

Figure 1. Initial summary of one of the training materials

Figure 2. Visualization of the “What participants must know”

– Performance assessment: to get to know the scope and application of the developed competence in depth, participants are requested to analyse their own practices regarding the developed competence (i.e., they are asked to complete self-evaluation and reflect on how they apply the developed competence in their everyday academic or professional life). This point is conceived as basic for every learning self-regulatory process, since it contributes knowledge on the processes each participant usually puts in practice. Different modalities are presented with this purpose: brief questionnaires with true/false questions, multiple choice, autobiographical activities, simple practical exercises, etc. This, together with the following step, shall allow us getting to know the weaknesses and strengths of each participant in relation to the knowledge of the developed competence.

Figure 3. Visualization of a self-assessment test. Questionnaire "How to search for information"

– "How it is done": at the end of the self-evaluation process, specific guidelines and strategies are proposed for appropriate put into practice of the developed competence. In this sense, specific steps are shown: suggestions according to certain variables, examples applied to different situations, procedural outlines, etc. Rather than closed protocols, we intend to provide participants with possible action lines so as to make participants adapting them to their personal features.
– "Have your try": Participants are again asked to act and apply the developed contents. Once the key concepts were presented, contrasted with the participants' experience, and the latter is revised according to theoretically-agreed parameters, participants are

asked again to put the developed concepts and competences into practice. With this purpose, participants are proposed new learning activities, as well as the basic criteria for the evaluation of their learning process and obtained results. Thus, participants apply again self-evaluation to their own work.

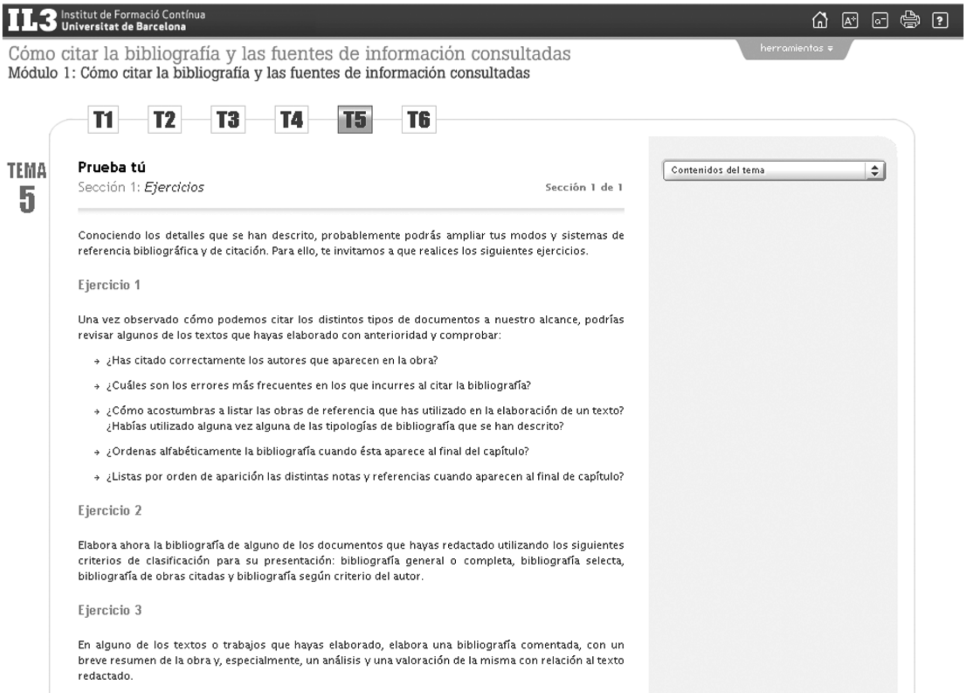

Figure 4. Presentation of the exercise after the self-learning process related, specifically, on how "Quoting bibliography and information sources"

– Bibliography and information technologies: The last point in the training material provides the set of bibliographical sources used and also technological resources to practice or deepen into the developed competence. These resources correspond to usually-free software proposals, interesting websites, platforms and social networks where information can be obtained or the developed competence can be applied (e.g., graphic representation of ideas, bibliography quoting, outline elaboration, etc.).

Put into practice and assessment

Since October 2007, 13 training materials have been put into practice. They have been available for all IL3 students registered in virtual courses or b-learning through the virtual campus homepage. The IL3 community, the space previous to the access to virtual classrooms, is meant to work as a meeting point for all students. It is a passing area for courses: the source of supplementary training activities (conferences, contests, associations, lists of practices and job vacancies, etc.) and basic informative activities shared by all courses. Among them, Techniques of Study are published within the block called "Resources".

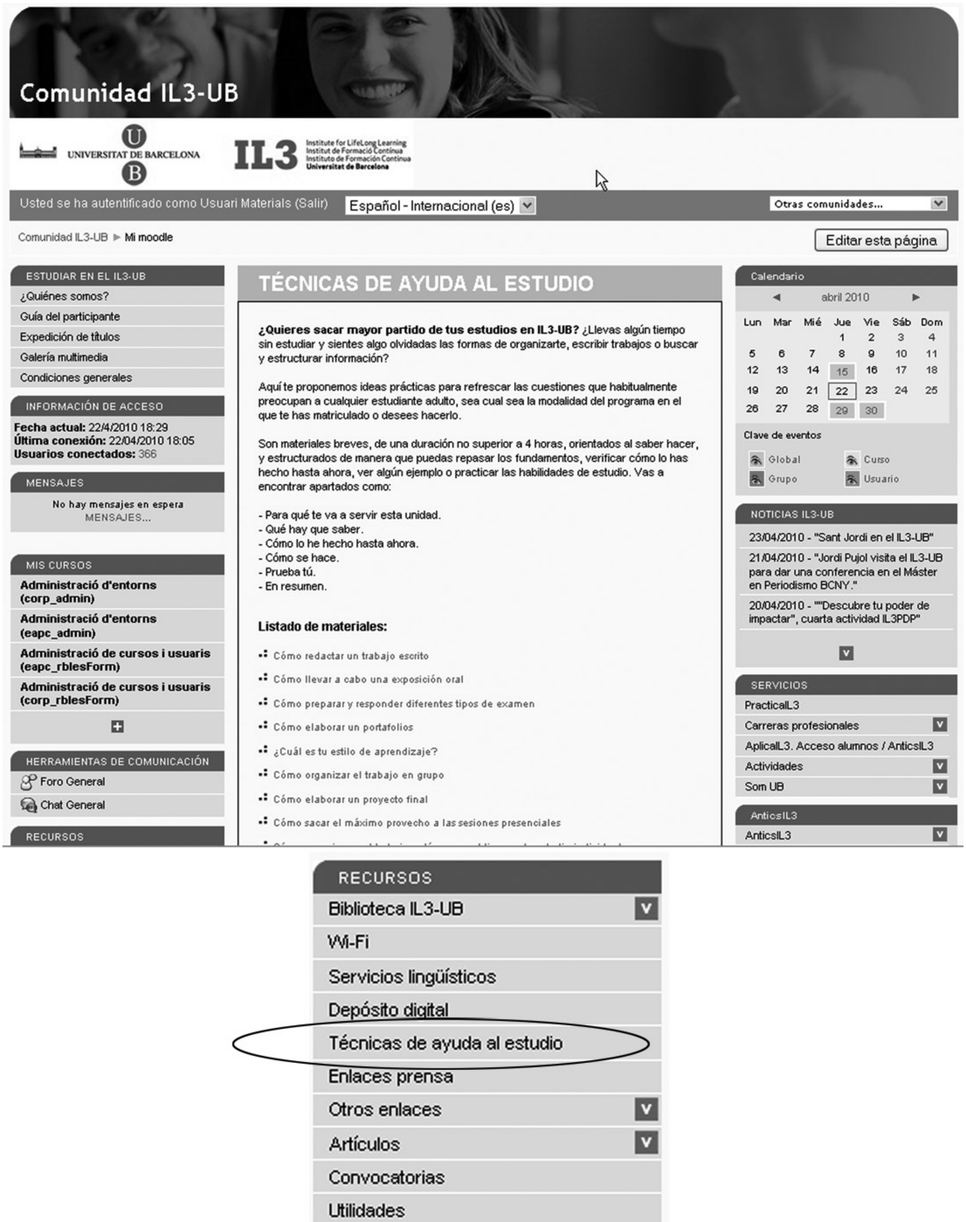

Figure 5. Location of training materials in the participant's virtual classroom "Techniques of Study"

As observed in the log-ins to the virtual campus, the "Techniques of Study" materials were accessed by 1631 participants along two years and a half: 5.14% of the students accessing the virtual campus.

In general terms, it is a modest ratio. However, it leads to a positive assessment due to several reasons:

– It is the third most visited option in the virtual campus after the "Job Vacancies" (15.09%) and "Participant's Guide" (10.26%) applications.
– It is a voluntary-access tool among 31 additional options.
– Advertising was also rather modest, since it coincided with the implementation of campus in Moodle (previously in WebCT).

Access profile: 70% correspond to individuals who have lost study habits, since it is several years that they gave up studying. This agrees with our initial forecast, although the academic aspect acquires special relevance, since we deal with training updates. The users were contacted and those interviewed agree in the contents' usefulness and, particularly, in their practical, guided, direct and clear approach. All of them agree that the materials' usefulness lies in the learning self-regulation they promote.

Setting off from the implementation of the materials in the virtual classroom, we have received inputs not only from students but also from companies in relation to the usefulness of these learning-to-learn resources. The interest of companies has been so great that they have suggested their implementation in their own working intranets. Therefore, the interest arisen by self-regulation mechanisms goes far beyond formal learning and opens new ways toward workplaces and informal learning.

Finally, we can identify some contributions and lines for future improvement. The actions planned for the immediate future are related to the promotion of the virtual campus through banners and taking advantage of the launch of a new institutional web with more outstanding resources, which shall promote a greater use of the available materials.

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Multimedia Resources as a Complementary Tool of Teaching and Learning. Case Study of a Game Designed to Teach Immunology Contents

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Abstract

In 2003 the University of Porto recognized the potential of internet based learning systems and in that year started a project to implement the use of learning management systems (LMS) in classes based on a blended-learning model.

The implementation of this project at universities large as the University of Porto (U.Porto) was a complex process that necessarily involved a large number of actors, so it was necessary for the University to define new ways to resolve their constraints. One of the strategies defined was through the Unit for New Technologies in Education (GATIUP) gives

direct support to the teachers who wants to use e-learning platforms and also support the development of relevant educational multimedia contents to be used in the courses.

In the last years the number of teachers at U.Porto interested in multimedia contents with educational purposes grew, and the number of requests that arrive at the unit increased. To demonstrate the importance of this type of resources we intend to shortly present here one of ours recent works: a game based on basic immunology learning contents.

In this paper we intent to provide a brief description of what is one of the biggest concerns of today's University of Porto, the support of use and development of educational multimedia resources. We intend in a few words present a successful example of an Immunology course that uses multimedia contents – specifically games conceptualized by students – to support learning.

Development of multimedia resources at University

The word multimedia means using two or more digital contents in a single application. These contents may be text, video, images, animations, sound, and simulations. This is an area that is constantly evolving and we can say that they are always emerging innovations in the development of multimedia and its application.

GATIUP has eight graduate collaborators, with different backgrounds, as Biology, Chemistry, Engineering, Multimedia Technology and Education & Technology, but all with specializations on e-learning as well as continuous professional development on this area. In combination with their daily work with focus on e-learning, to encourage a more completed teaching and learning process using new technologies, one of the most relevant activities that GATIUP also sustains since 2003 is the development of educational multimedia resources. The office has a small multimedia production team (four persons) that develops several contents requested by teachers that use the University e-learning platform.

The content types for which the team has development capabilities include: animation; simulation; video and audio (capture and edition); image (photo, illustration, paging, brochures/posters…); and web design (websites and other type of web documents).

In the last years the number of teachers interested in multimedia contents grew and the number of requests that arrive at the office increased. This service is available to all the teachers regardless of their area and the only requirement is that the content is requested by teachers who are following a blended or e-learning model.

All the requests are made through a form at the e-learning portal (http://elearning.up.pt). After receipt in the 1st stage the request is evaluated to see if it is liable to be executed by the team and achievable within the time appointed. If there is any probability that the team can not do the work for lack of expertise or short deadline, the teacher is immediately notified. However, regarding the deadline – which are often too short taking in consideration the number of products requested and the number of elements that work in development – the office always tries to discuss the delivery in order to satisfy the request.

Once analyzed and accepted in the 2nd stage the request goes to one member of the multimedia team and is allocated according to the type of content (who has more knowledge in the area), time available and priority level.

In the 3rd stage is necessary to organize a meeting between the teacher and the developer in a way to better define the concept of the product/content, this is probably the most difficult phase because most of the contents will concentrate on educational issues on which the team is worldly (e.g., civil engineering, pharmacology, psychology, etc.) and sometimes even though the teachers are asked to bring some materials to facilitate the developer understanding they only bring a vague idea of what they would like to do. So in recent years, the teacher is asked to send to the meeting a storyboard of the content, for example, if it is an animation in the storyboard they should describe each objects to be included and their behavior and specify the type of interactivity that the user will have with the interface. With this storyboard the developer can have a clearly idea about what is expected and it will be easier to understand the concept. To design the product is necessary to understand the concept, so it's almost as if the teacher had to teach a class on a particular issue to the development team and together they have to "build" a prototype.

After the elements of context have been defined the developer proceeds to the 4th stage. This is the phase in which all ideas will be implemented. By this time, is important to have detailed ideas on the content like the interface, language, interactivity, objects and what will be the combination of media elements. During this process the communication between the parts still active. When the prototype draw in the previous phase is developed, the product is sent to the teacher for correction and validation. Following the corrections indicated we enter in final stage, the changes are made and the product is sent back for validation, when approved is given as finalized and is sent to the teacher.

Is important to point out that the copyright of the product belong to the University, however, because the scientific coordination is made by teachers and the contents are mostly developed to be used in theirs course units, they are never published or used without mutual authorization.

Immunology case study

Background

The Immunology Department from the Faculty of Medicine is responsible for the undergraduate medical education in the field of immunology both to medical and dentistry students from the University of Porto. Immunology is a diverse and growing unit course that can be defined as the study of the cells and molecules involved in host defence mechanisms and disease processes where these mechanisms are disrupted. The goal is to provide students the knowledge of how the immune system develops, how the body defends itself against disease and what happens when it all goes wrong. One hour lectures are given twice a week and 90 minutes seminaries every other week. Final grade is based upon final examination score (0 to 20) adjusted with student's performance during seminars and online quizzes.

Aim

In the last few years the appearance of new educational technologies, namely the use of web based systems, has provided educators with new tools to enhance the teaching of several areas.

In the academic year of 2007/2008 was proposed to students the creation of games based on the course unit learning contents. The results obtained with these games on paper were the motivation for a web-based knowledge game (based on the original board game by *Eckert GU et al. Med Teach. 2004 Sep; 26(6):521–524*) named "Who wants to B a lymphocyte?", that will be described. The aim of the teachers of Basic Immunology was to develop a web-based knowledge game on immunology for third-year medical students and compared the performance of students that had contact with this game with students that only had access to classic teaching lecture.

Game development

A game was designed to boost student learning in the field of B cell development, activation, and differentiation. The game consists in a simulation, built in Adobe Flash 8, which includes, 80 questions elaborate by students.

The game software was developed by the GATIUP and is played with virtual dice and "B cell-pawns" by as much as 3 players (Figure 1). At the end of the game board, there is a path with a total of 55 squares. This path contains 16 numbered squares with a question mark (Figure 2). The players roll the dice to decide to move their pawn according to the number rolled. Whenever a player lands on a green square has to provide the correct answer to two questions, that are sort randomly, in row in 30 seconds each (Figure 3). The objective is to reach first square 55.

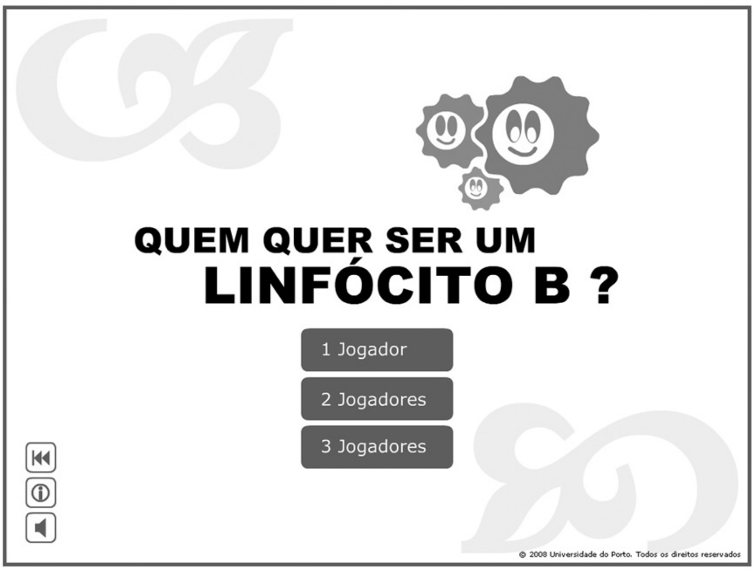

Figure 1. Beginning of the game and selecting the number of players

The importance of this game was confirmed by some tests made with students in the presential classes, and from our point of view is clearly a relevant study tool to the

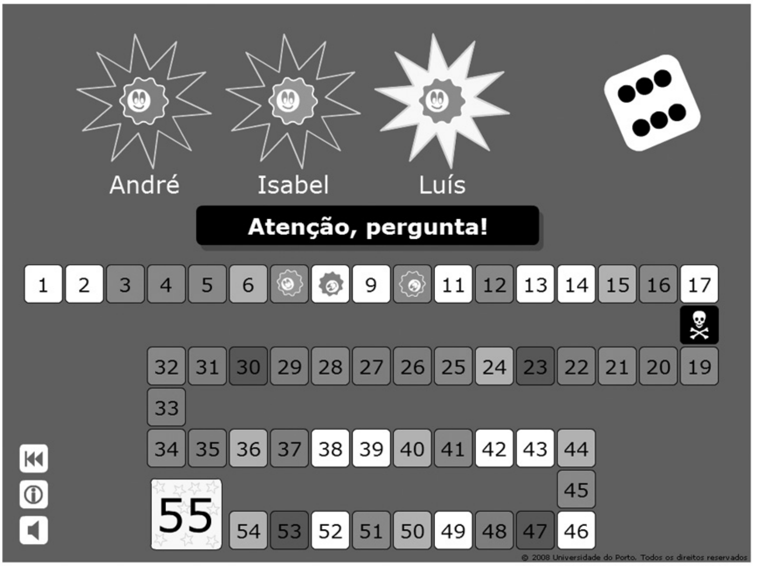

Figure 2. Game board with players in action

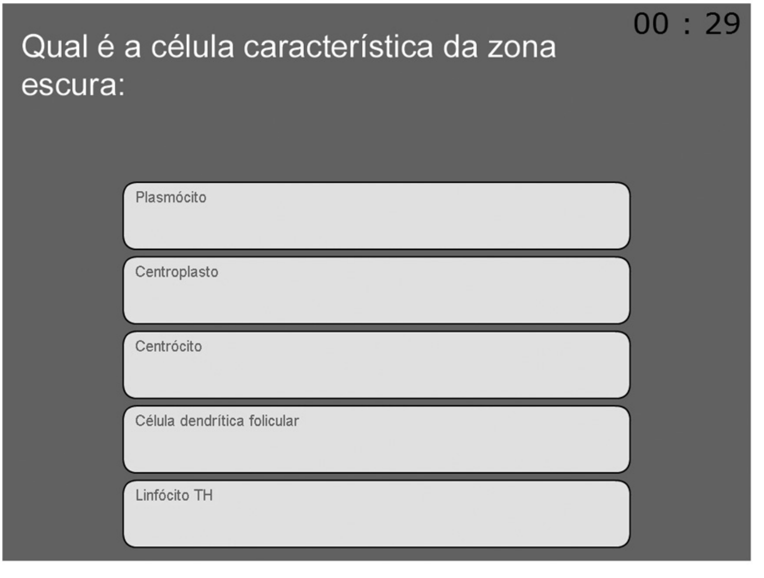

Figure 3. Page with a question and the time counter on top

students. Students were randomly allocated into game (GG) and lecture (LG) groups. The LG consisted of an exposition of 60 minutes of the ontogeny, differentiation and activation of B cells. The GG played for 45 minutes. During the lecture students were able to discuss the subjects, while in the game the faculty did not intervene. An evaluating quiz based on 28 questions of immunology text-books was administered before and after the intervention. Changes in scores within groups were compared using paired t-test and differences between LG and GG were compared by analysis of covariance with baseline value as covariate.

Results

A significant improvement in number of correct answers of the quiz was observed after the lecture and the game in both groups, however the mean increase was significant higher in the LG (p=0.003; mean change LG: 5.29 [95% CI, 3.57 to 7.00], p<0.001 vs. GG: 1.81 [95%CI, 0.70 to 2.93], p=0.005). A non-significant decrease in the number of wrong answers was observed in both groups with no differences between them (see Table 1).

Table 1. Changes in test scores in Lecture and Game student groups.
Data are presented as mean (±sd) unless otherwise indicated

Score	Lecture, n=14			Game, n=11			Lecture vs Game
	Before	After	Change*	Before	After	Change*	p-value**
Correct	7.6 (2.92)	12.9 (3.40)	5.29 (3.57 to 7.00); p<0.001	8.6 (2.50)	11.5 (3.53)	1.81 (0.70 to 2.93); p=0.005	0.003
Wrong	12.3 (4.60)	10.5 (3.50)	-1.78(-4.77 to 1.20); p=0.219	11.0 (5.20)	10.4 (2.01)	0.45 (-1.91 to 2.82); p=0.679	0.303
Final	-4.7 (2.98)	2.43 (6.30)	7.07 (3.25 to 10.89); p=0.002	-2.5 (4.00)	-1.09 (3.67)	1.36 (-0.96 to 3.69); p=0.222	0.056

Conclusions

Yet it remains common and necessary traditional teaching methods, the use of multimedia contents online has been significant and has become increasingly common in many areas of education like medicine for example. The development of the "Who wants to B a lymphocyte?" has been a successful endeavour in immunology education. Additionally to a being a creative and innovative educational tool, the evaluation shows that this game can improve the student's knowledge on complex issues such as ontogeny, differentiation and activation of B cells.

However, despite the encouraging opportunities that the use of multimedia in education has provided, it is important to understand that we should discuss and doubt the issues surrounding the development of educational products because the reality is that there are still few studies on this area.

Thus, if one of the main concerns of the office is to increase the number of multimedia resources, it is also important to develop contents with defined learning objectives, otherwise we will develop products without academic interest and not reusable.

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Changing the Support Model for Students' Hardware

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Keywords

student experience, student hardware, IT support

Abstract

In September 2009 Loughborough University launched a PC Clinic service supporting students' own computer hardware. Employing University students for a small number of hours each week to fit around their study commitments, and working in partnership with a local company co-located within the department, the PC Clinic provides initial diagnosis, and either a fix or referral to the hardware support partner which provides a chargeable repair service. The paper will describe the background to the service introduction, practicalities of setting up the PC Clinic, and lessons learnt.

Background

For the fourth year in succession, Loughborough's students have voted their university experience to be the best in the UK according to the latest student experience poll, published in the Times Higher Education magazine. Service departments, including IT Services, work hard to maintain this reputation, and are constantly seeking ways to improve the experience. The University was one of the first in the UK to provide wired internet to study bedrooms, and more recently has led in providing wireless access in social and learning spaces. There is a very high rate of student ownership of PCs, mostly laptops, and no restriction as to the type of computer that can be connected to the network. During the period 2006 to 2009 it became clear that students were experiencing a range of problems with their own equipment that fell outside the normal support envelope, and that this was affecting both their study and their wider "experience" in terms of their social life. In the Spring of 2009 the IT Services department surveyed students to discover the extent of the problem and to inform the solution that the University should provide or facilitate.

Survey

A web based survey was run during the last few weeks of the academic year 2008–9 and the results supported a significant change to the support model for student owned hardware. There was a need for extra services which could be separately charged, but the level of charges should be kept to a minimum. It also became clear that some existing support arrangements were not well known about, including the "Hall Network Advisers" – students based in hall and employed to assist others having IT problems.

To assess how students would receive the replacement of the Hall Network Advisors by a central clinic, where students could bring their laptops rather than visits being scheduled to their rooms, the following question was asked. "When your computer needs to be looked at, how would you prefer support to be provided?" Responses were as follows:

– HallNet Advisor (i.e. another student living in your Hall whom you can call) 27%
– Laptop clinic where you can bring your computer 56.1%
– No preference/don't know 16.3%.

This gave confidence to change the support model to a clinic for the academic year 2009–10. However free text responses confirmed that it was still important for us to visit Halls for students with desktops (as opposed to laptops) or who would otherwise have difficulty coming to us. (Around 21.2% of student machines were desktops during the year, 19.7% in the sample who responded to the questionnaire).

Preparation for service launch

Recruiting and Training Staff

After discussing our existing HallNet and Network Advisors Guide with members of our Desktop and Network and Security teams, we established common types of problems (software, hardware and networking) and clarified areas of responsibility. The Network team were to support from the network port back, and the PC Clinic would deal with all software and hardware issues, including port replacements. From this, a job description and person specification were written, emphasising reasonably high technical and cross-platform knowledge, combined with high interpersonal skills.

We followed the University recruitment processes to have the posts graded, providing an hourly rate corresponding to the appropriate grade point, and approved for advertising.

Our target group for the post was current University students, and the majority of applications came from this group, both undergraduates and postgraduates. However we were surprised to find applications from outside this group, including recent graduates as yet unemployed, and others associated with the University attracted by the part time post for lifestyle reasons.

We intended to employ between 8–12 casual IT Support Assistants (ITSAs), we received over 250 applications, and interviewed 20 candidates in three batches, one at the start of the summer vacation period, one at the end of the summer vacation and a third after the start of term.

Ideally interviews and appointments would have occurred during the last term of the previous academic year, however we were not ready in time, as we also created a new role to lead the PC Clinic and the Student Experience. Filling that role and ITSA hiring was therefore completed a week before Fresher arrival.

We organised a day's training for the ITSAs covering:

- what IT Services provides to students (services, software, network)
- overview of our network structure
- common problems seen on the network (wired and wireless)
- common software problems
- Acceptable Use Policy and associated responsibilities
- overview of our website, including where useful information is stored (inter and intra net)
- Health and Safety requirements.

Commercial partner

The process for recruiting the commercial partner was conducted over the summer vacation period, in accordance with the university's procurement procedures. With the assistance of the University Purchasing Manager a tender was drawn up for provision of the hardware support service. After evaluation of tenders and clarifications, the "contract" was awarded to a small local firm who already provided a similar service (The IT Pit-Stop) from premises in town. As the actual contract for service is between the student and the company, the legal framework used was a "Memorandum of Understanding" between the supplier and the University, laying out the responsibilities and expectations of each. Appointment of the partner was again later in the year than we would have preferred, and they actually commenced shortly after the start of term. It would have been preferable to get them on board sooner, not least because we would have been able market the new service more extensively.

PC Clinic Location and Initial Marketing

We felt it was important to locate the PC Clinic close to the Service Desk and existing computer labs, thereby allowing:
- existing students to find the Clinic easily
- smooth interaction between the Service Desk and the Clinic for username lookups, password resets, printer credits etc.
- a central location within IT Services.

The IT Services departmental meeting room (47m^2) was taken over for the PC Clinic and divided into the PC Clinic and The IT Pit-Stop, providing demarcation for students between the 'free' and 'paid' services.

Time constraints limited our initial marketing, so we focussed primarily on Freshers. We spoke to the Hall Wardens group at their pre-Freshers arrival meeting, explaining what we were doing, and allaying concerns over the removal of the HallNet Advisors. For the students themselves, we had an ITSA in each Hall to greet arrivals, advertise the clinic, and hand out flyers advertising services. The existence of the new service was also highlighted at induction sessions for new students.

Service in operation, and lessons learnt

Initial Workload

We set opening hours for the service as 1130 am to 530 pm Monday to Friday based on our experience of support hours used by students, intending to revisit this after a month's service. The initial demand for the service was very high, with at least 30 visits each day to the Clinic during the first couple of weeks (Figure 1). As expected these visits consisted mainly of HallNet queries: how do I connect, how do I browse the web, and how do I access email?

Although busy and crowded in the Clinic (we hadn't planned for students arriving with friends in tow), our resolution of software and network problems was between 95 and 100%, and hardware problems were fixed within agreed SLAs by the IT Pit-Stop. All of this helped with word of mouth advertising; moreover the high workload of Freshers Week meant all ITSAs were heavily involved, creating an excellent team building environment.

The systems we had in place worked well, with 98% of our HallNet users successfully registered and connected within 2–3 days of arrival. As students settled in and began exploring other IT services, the types of cases changed (Figure 1). Initially dominated by HallNet connections, we saw an increasing number of wireless configurations, followed, perhaps inevitably, by an increase in virus and hardware problems.

We had provided guidelines to the ITSAs that the service would act as a triage service allowing 10–15 minutes per computer, although this was never rigidly enforced. As the service developed, we relaxed the guidelines and encouraged the ITSAs to do more diagnostic work, including booking machines in for The IT Pit-Stop with a detailed problem description.

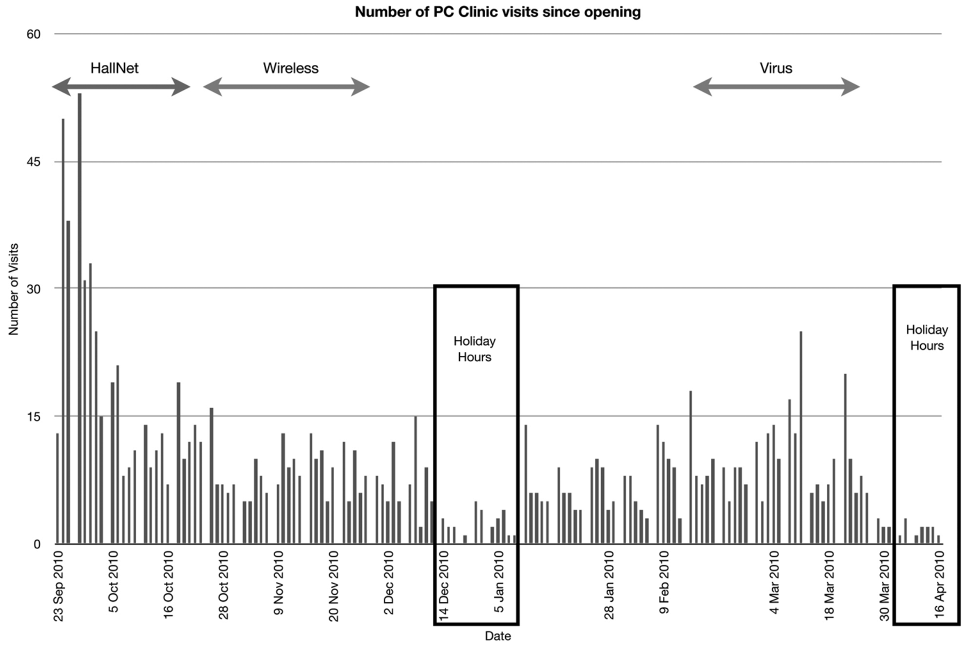

Figure 1. PC Clinic visits over time, including holiday periods and brief call type analysis

PC Clinic Workload Monitoring

We record the following information from each PC Clinic visit: Operating System, PC/Mac, Student in halls/private residence/Staff member, an email address and a description of the problem. We have five common problem types to speed up recording: HallNet connection; wireless connection; wireless printing; HallNet printing; and virus infection, these account for 61% of Clinic visits (Figure 2).

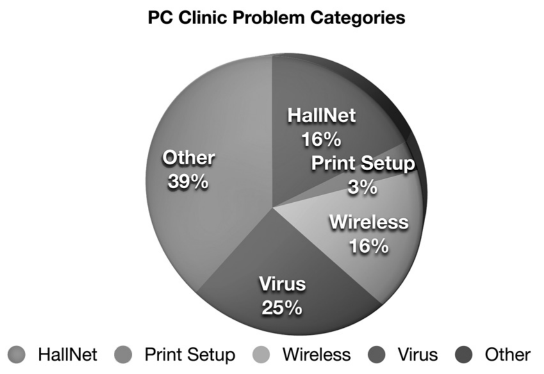

Figure 2. Proportion of call types in the PC Clinic: note that the two print categories have been combined

Capturing the email address allows us to send a survey link assessing the service. Although the response rate is low (13%), replies indicate that our most successful advertising is by word of mouth (45%) and email (32%). The PC Clinic service appears to be valued by students, and enhances their Student Experience, for example:

- *Very Helpful and honest people because they are not after your money*
- *Such a relief to have an extensive free consultation and fixing of simple things before actually deciding to charge you for a major job. unlike most other places.*
- *This is a really good service but I only found out about it in my third year. I think more awareness needs to be made of it because it is really helpful and can save people money!*

We queried students' use of antivirus software (low-medium) and data backups (low) giving us two areas to focus resources on, particularly for next year's Freshers. Our recent move to Google for student email dovetails well with data storage requirements for students.

PC Clinic visits have remained reasonably constant at 10–20 per day (Figure 1 does not include hardware failures that go directly to the paid IT Pit-Stop service), and as our reporting became more sophisticated we've been able to focus resources on fixing developing problems. For example, during a recent virus outbreak (Figure 1), discussions with our Networks team and Clinic staff isolated how the virus was being transmitted, allowing background network checks and communications to the students. We also noticed a number of problems with one of our pre-packaged for download software applications, allowing us to improve instructions and limit the number of installation options available.

Staffing the PC Clinic

Staffing the PC Clinic with students has allowed us greater flexibility, although we've needed to be aware of their University workloads. Our emphasis on social interaction with Clinic visitors means the team is able to clearly explain issues to the Clinic visitors.

We've been extraordinarily fortunate being able to employ staff who, in addition to social skills, were also quite technically able. But our view has always been that technical skills can be taught quickly, social skills can't.

Using students has its own unique problems, workloads can creep up, and staffing the Clinic with one person leaves us susceptible to illness. The fragmented nature of student life, study and coursework means replacements are unlikely to be available at short notice. One unexpected problem for Clinic timetabling has been the University's scheduling of tutorials and block taught courses. Timings for these are often unknown by the students until the week of the course, causing scheduling problems for both them and us. Inclusion of some non students in the team has eased this problem.

Organising ITSA team meetings has also proven difficult. The ITSAs' coursework often prevents full team meetings, meaning most communication needs to be by email.

The recession created an environment where hiring new staff within the department was difficult, so the flexible employment contract of the ITSAs meant they have been assisting with email migrations, staffing the Service Desk, and providing networking support. Again this has created timetabling issues for staffing the PC Clinic, but we've been clear with other teams that the student's personal study and PC Clinic staffing comes first.

Additional Resources / Self-Help

A combination of the survey, Clinic comments, and the ITSAs, provide us with an extensive focus group for the student perspective of our services. One consistent comment was that our website was difficult to navigate, and the information "too detailed". We are currently working on this, dividing our Student pages into HallNet and 'Additional Services' while focusing information on the salient points.

The ITSAs suggested setting up a Facebook site, which we did, although it hasn't been extensively used. But what it has allowed is advertising the PC Clinic on the individual halls' Facebook pages. Integration of the PC Clinic into our VLE should prove more successful, once some technical issues are fixed, allowing interactive forums to encourage student participation, with a less formal layout than the IT Services website.

Budget, Location and Staffing

We initially envisaged having PC Clinic staff fixing problems in halls, including network ports and computers students were unable to bring to the Clinic. This worked well for the first few weeks while we developed the service, but it became apparent that we could not afford to keep that many staff on the budget we were working with. Additionally, although we were aiming to reduce Clinic hours after the first month, the workload remained high, so the only reduction is during University holidays, when the Clinic is open one hour a day.

Figure 3. Artist's impression of the new PC Clinic

Students who don't drop into the Clinic either ring or email the Service Desk, and at that point are encouraged to bring their machine to the Clinic. If this is not possible (for example, a desktop computer rather than a laptop, or a problem that seems to be network related), a member of the Staff and Student PC Service visits them.

The location of the Clinic, next to the Service Desk, is logical, except they are both located on the third floor of a hard-to-find building. The room itself needs repainting and redecorating, and was never designed for its current usage, lacking among other things, permanently lockable cabinets.

Our computer labs are being refreshed and moved to the ground floor of the building, and as part of this project the PC Clinic will be moving. The area has been custom designed, and the intention is to have an open area to stimulate group learning, separate from the labs, with the Clinic at the end providing fixes and advice (Figure 3).

Budget

The move to a more prominent location will necessitate an increase in opening hours and staffing. To cover when students currently use labs, along with responsibility for all student face-to-face support, we will be opening at 10am (currently 1130 am) and closing at 530 pm. For security and the increased number of drop-ins, we will staff the Clinic with two people. During holidays we will reduce opening times to three hours a day, reflecting the fewer numbers of students on campus. We've needed to increase the budget for the PC Clinic, but with our experience and feedback from the current year, we know it's making a positive impact on the Student Experience.

Free vs Paid service

The interaction between the two aspects was intended to be distinct. We initially set up guidelines to describe how we saw the two services working.

Summary

– If Loughborough infrastructure, PC Clinic (ITSA)
– Hardware failure, IT Pit-Stop

ITSA	IT Pit-Stop
HallNet connections	Hardware problems
Wireless connections	Backup/reformat OS
Software installs/patches/antivirus	Unsupported OSs
Hardware diagnosis	Warranty repairs
Book in machines for IT Pit-Stop	OS installs

This has worked reasonably well, although the survey results suggest some students don't recognise the distinction. We are taking steps to clarify this, with the IT Pit-Stop team wearing branded shirts to differentiate them from the PC Clinic. A strong interactive approach has been fostered between the two services, meaning the support process appears seamless.

As part of the relationship with The IT Pit-Stop we hold monthly meetings to assess the service against SLAs, examine marketing opportunities, and develop procedures. These monthly meetings are in addition to brief weekly meetings held between The IT Pit-Stop and PC Clinic managers.

Marketing

As detailed in Section 4, initial marketing of the service was limited to flyers, bags and emails to Hall students during Freshers week, followed by a stall at the Freshers Fair. The PC Clinic was a new service, and as such we doubt we could have dealt with any more visits during the first few weeks; as it was we targeted a third of the student body (around 5000 students). These students would have had access to HallNet advisors in previous years.

Since then, and driven in particular by The IT Pit-Stop, we have explored additional methods of advertising the service to students:
- A stall in the main student catering area, complete with Xbox, to advertise the Clinic and our free antivirus software.
- Targeting IT Support staff within departments, encouraging them to inform students and staff of the service.
- Occasional emails to HallNet users targeting problems seen in the PC Clinic, although we're very conscious of not over-emailing the students.

Other softer marketing methods are being trialled, although it's hard to establish their efficacy. In addition to Facebook and the VLE, we are using a sandwich board outside the building, adverts on the lab desktop, a link on the Student Email landing page, and in an unique approach – guerrilla bike marketing.

We think we've exhausted most avenues for marketing. We've realised that students prefer contact via email, and emails from departments are more likely to be read. Next academic year we will be able to include mention of the service in pre arrival material.

We've recently opened the PC Clinic to Staff personal machines and Alumni. Pickup has been steady, and we've advertised using departmental IT staff and Staff newsletters. Alumni are being targeted through the Alumni email list.

Where now?

How we develop the service is an interesting question. There's a limit to how many students we can target, although capturing first years means within three years the entire student body should be aware of the service. The main untapped area, from the IT Pit-Stop perspective, are Alumni. However we need to be careful to direct Alumni to The IT Pit-Stop, rather than overwhelming Clinic resources.

We see potential in delivering some software applications using virtual technology, although we need to consider how we approach licensing and installation of software (including the virtual client) onto personal machines. We'd also like the Clinic to become more interactive, and our foray into the VLE is an initial step here, eventually leading to Clinic queries being able to be dealt with by Skype/IM etc.

Lessons Learnt

Never underestimate demand for the service

Our initial budget was too low. The budget only allowed us to staff the PC Clinic for six hours a day with one person, preventing the ITSAs going out to Halls and fixing problems. Demand for the service prevented a reduction in term-time opening hours.

Personal skills over technological

One of the major reasons for the success of the PC Clinic has been the ability of the ITSAs to engage with the students. Technological skills can be taught, but the ability to explain what's happening, how it can be fixed, and reassure stressed students, is an invaluable skill and difficult to teach.

Relaxed approach

We had proposed a booking system for the Clinic. It became apparent that students don't want to work this way. Therefore both the Clinic and The IT Pit-Stop need to deal with peaks and troughs in workload. Students appear to be fine queuing, if it's obvious that problems are being fixed.

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Didactic Process Based on the Repository System

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Keywords

competence, learning process, repository, ontological approach

Abstract

The ODL concept and the Bologna Process principles are largely opposed to the traditional way of organising the learning process. In the new conditions, the didactic process requires a new "didactic machine", that extends the tasks settled by Jan Amos Komeński (Komeński, 1956). Elaboration of the learning objectives, the content and its distribution methods should be reorganized and managed in a new way. The key task is not only to divide knowledge into different courses with lectures, exercises and laboratories, but to orient the learning process toward competence as a final product.

Competence, in the educational aspect, is the ability to use theoretical knowledge to solve a practical task and the ability to interpret the results in terms of the used theory. The competence implies some structuring of knowledge that results in a division into theoretical knowl-

edge and procedural knowledge. The problem with maintaining an accurate and up-to-date relationship between the competence and the corresponding knowledge and its division into different types becomes quite complex with the appearance of new high-technologies.

In the domains which are sensitive to technological changes new knowledge continuously changes the existing one or replaces it completely. The problem that arises is how to secure continuous adjustment of the learning process to these changes, how to adapt the content of didactic materials to the rapid changes of knowledge connected to the competences required on the job market. How should the changes in the content be tracked, so that they can be assessed?

The authors propose to use a repository as a basis for creating an information system that would support the competence-based learning process. The repository is a place for storing structured domain knowledge intended for multiple reuse in different contexts. As a storage place it gives the ability to distinguish between theoretical and procedural knowledge and to integrate them into a single competence acquisition chain. Additionally, the ontological approach is used as a computer metaphor of the repository's content.

In the article the authors present the concept of the repository as a learning information environment designed for competence acquisition in ODL conditions, and in particular:

- the concept of representing theoretical content in a repository environment using ontological modelling,
- the theoretical and procedural knowledge integration mechanism in the frames of a specific competence,
- the assumptions of the motivation model as a managing mechanism of the repository functioning.

Orientation of the education process towards competences

The education market is changing. Universities are working in new conditions resulting from the development of the ODL concept, globalisation and appearance of new technologies, and they have a different goal – to meet the market requirements: the standardised qualifications and competences. Considering competences as the main object of supply and demand on the job market finds its reflection in the projects and initiatives aimed at formalising the description of competences, creating competence catalogues and mechanisms for describing competences. In those actions, the concept of competence is connected to the concept of qualification. The current standardisation activities are meant to lead to competences being readable and transferable in the frames of a certain qualification. Among those activities we can distinguish the following:

- Scottish Credit and Qualifications Framework, http://www.sqa.org.uk, competence base published as a catalogue (2007/2008),
- Australian Competency Standard, http://www.dest.gov.au/archive/publications/6220tref.pdf, Australian system of classifying abilities which is the basis for i.a. developing education programs,
- SPO RZL project „Development and popularisation of national vocational qualifications standards", Ministry of Labour and Social Policy (in Polish), http://www.mpips.gov.pl/index.php?gid=502, list of jobs/specialisations for which vocational qualification standards have been developed,

– TENCompetence, http://www.tencompetence.org/, the source of constant support for developing competences of individuals, teams and organisations, through the development of European open-source infrastructure based on services,
– Tuning Project, http://www.tuning.unideusto.org/tuningeu/, harmonisation of educational structures in Europe, methodology allowing analysis of education programs and guaranteeing their comparability through learning outcomes and obtained competences,
– IEEE Reusable Competency Definition, http://www.ieeeltsc.org/working-groups/wg-20Comp/wg20rcdfolder/IEEE_1484.20.1.D8.pdf, a method of formal description of a competence regardless of its application in a given context,
– HR-XML Measurable Competencies, http://www.hr-xml.org, modelling of data from the domain of human resources management.

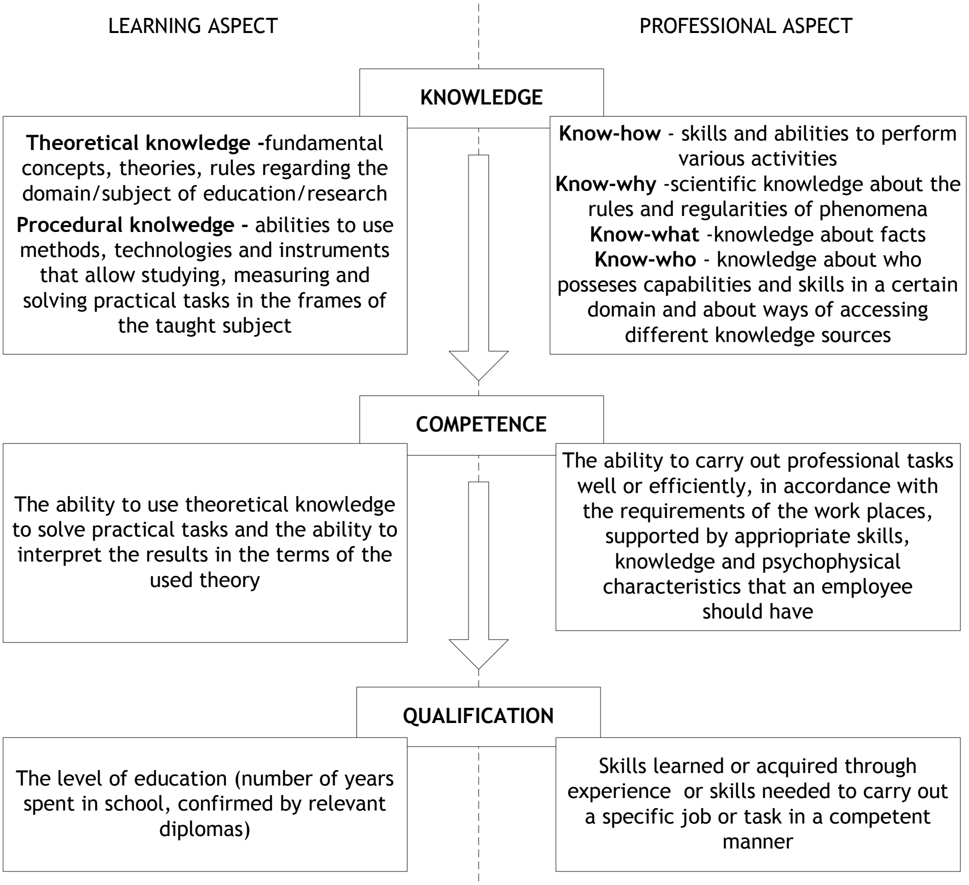

Figure 1. Relations between knowledge, competences and qualifications (on the basis of (Wiśniewski, Pocztowski, 2004), (Tadeusiewicz et al., 2007), (Huang, Yang, 2009))

The concepts of "competence" and "qualification" lie very close to one another. They are both connected to knowledge, but while competence reflects the content and structure of knowledge, qualification presents its description – the meta-knowledge. In the context of education, differentiating between these two concepts is very important. We can evaluate the competence of a graduate basing on his/her grades and ECTS points, while his/her qualification is described in the diploma supplement. Relationships between knowledge, competences and qualifications were shown in (Figure 1).

A university's education offer can be characterised by the set and scope of competences included in the curriculum (education programme). Universities need to compete with each other, and as the competition instrument they use education programme offers, which guarantee the students obtaining appropriate competences. One of the indicators of competitive capability in this situation is the ability of a university to adapt the guaranteed competences to competences required on the job market in the frames of up-to-date qualifications. Making universities directly open to the job market requires a marketing analysis based on comparing competences and qualifications through comparing required and guaranteed competences (Figure 2). A graduate can satisfy an employer's requirements only through the possessed competences. Thus a university graduate needs to be armed not only with formal documents defining his right to obtain a position on the common job market, but also has to be certain of his right to succeed through his competences. This assumption leads to the necessity of organising the learning process in a way directed towards obtaining competences.

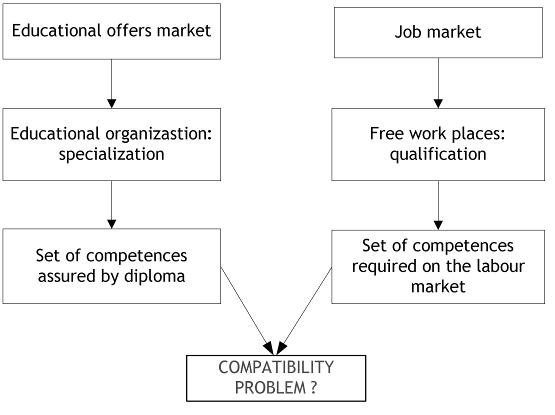

Figure 2. The problem of compatibility of competence description in the context of education and job market

Understanding competence as the final effect of the learning process of a student requires its more detailed definition, appropriately to the educational context. It is essential to define competence by specifying its components as well as processes and means required for its "creation". In other words, for each type of competence as a final product we need to define what components it will be made of and with the use of what technologies it will be created. A competence, in the educational context, consists of an amount of knowledge mastered by the student, which includes: theoretical knowledge, procedural knowledge and a set of abilities to use both types of knowledge for solving practical tasks (Różewski, Ciszczyk, 2009). Theoretical knowledge is a certain amount of fundamental concepts, theories, rules regarding the domain/subject of education/research. Procedural knowledge consists of the abilities to use methods, technologies and instruments that allow studying, measuring and solving practical tasks in the frames of the taught subject. The set of abilities includes: ability to formulate/analyse a task in the terms of the theoretical and procedural knowledge, ability to plan and organise work essential for solving the task, ability to interpret results and draw conclusions.

New didactic machine

Orientation towards competences foresees a new attitude of the student and a change in the teacher's role. These changes require going beyond the borders of a classical didactic machine when organising the education process.

Developing a didactic machine has always been a multi-disciplinary problem, the solving of which requires knowledge of psychology, pedagogy, didactics and at the same time – of the domain of the subject to be taught. Until now, the carrier of this conglomerate of knowledge was the teacher, who's knowledge was partially transformed into the form of didactic materials. Currently, the situation requires to broaden the scope of domains (Figure 3), because the educational organization begins to function in a new technological and economical conditions.

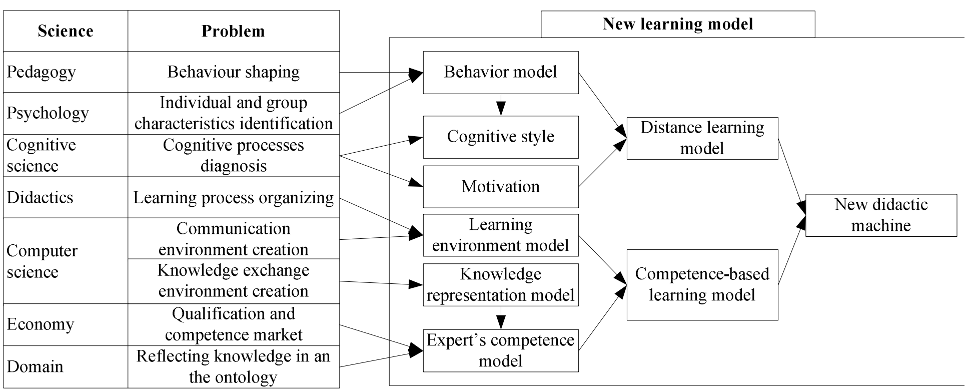

Figure 3. Multidisciplinary character of the learning process realization

The concept of the "didactic machine" can be reflected by a certain abstract thought – a picture explaining the rules of a didactic process when the initiative regarding "student – teacher" cooperation is moved from the teacher to the student. An open learning system and a learning model based on competences are the main components of this machine. The open learning system presents psychological aspects which used to belong to the professional knowledge of the teacher and were hidden knowledge from the point of view of the student. The teacher used this knowledge in order to motivate the student, organise his behaviour, adjust the teaching methods to the student's personal capabilities. Openness of the model does not diminish the importance of these problems. However, a question arises: in what form should the teacher's knowledge be represented and used, how should the teacher share it with the student, if the student is becoming greatly independent?

The learning model based on competences reflects the problems of the new economic position of a university, which requires in to be directly oriented toward the job market, which is asking more often for high-level qualifications from its staff. More questions arise: how to adjust the learning mode and education programmes to the market requirements? How to increase the effectiveness of learning using digital technologies?

Although each of the sciences consisting for the discussed models brings its own input into solving the stated questions, the task presenting itself to the specialists of education is how to integrate all this into a coherent learning system. This is a complex problem that requires a new conception. The proposed metaphor of a didactic machine does not constitute a comprehensive conception of changing the learning system, it does, however, constitute a basis for conducting experiments. The new didactic machine has to, next to traditional issues connected to learning/teaching (defining the learning goals, deciding on the didactic content and methods of its presentation and control), allow formulating the rule for teaching competences in a computer environment, with consideration of the rules of openness of the teaching/learning process.

Repository as a mechanism for supporting the didactic process

The new didactic machine orients the learning process towards competences. Rapid outdating of knowledge, which is the basis of competence, results in a need for finding a mechanism which will allow for adaptation of didactic materials to the needs of competence-based learning and for structuring these materials according to the needs of such a learning style. Creating and using a mechanism supporting the learning process is not aimed at depreciating the value of textbooks or scripts, it meets the new requirements regarding education and considers the new roles of the teacher and the student. The role of the teacher is to cooperate with the students and to direct their creative and independent learning process. The new attitude of the student changes him into an active participant of the learning process.

Developing the conception of such a mechanism in the frames of a computer environment which can complement the "teacher – student" relation guarantees that the didactic experience will not be lost due to the reasons presented below. It is proposed to use the repository as a new element of the learning process (Figure 4).

The etymology of the term "repository" says that it is a place intended for storage of records and official books, with the ability to use them. Existing repositories can be used for the purpose of the learning process as a source of outlook shaping, research way development or as a source of didactic materials. Through using the repository, the elements of domain knowledge are shared, mainly in the form of Learning Objects (LOs), which are interpreted as modules of knowledge created as a result of analysing and dividing knowledge into "pieces" (McGreal, 2007). A well-developed repository assures good quality of the learning process. In the evaluation of the universities rankings (e.g. Webometrics Ranking of World Universities (http://webometrics.info)) repositories are becoming the source of new perception regarding the quality of the entire university.

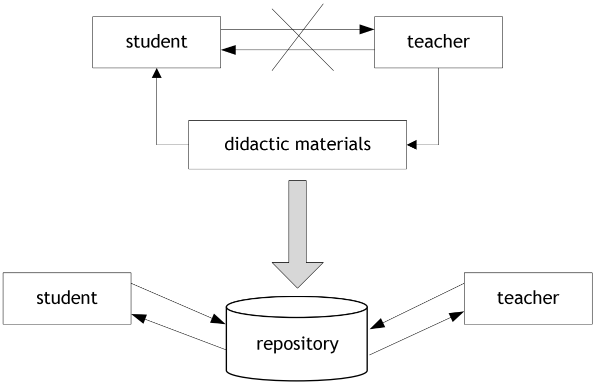

Figure 4. Replacing the traditional "teacher — student — didactic materials" triangle with a "repository" mechanism

Most repositories are created in United States, Great Britain, Germany and Japan (http://opendoar.org). As statistics show, today around 15% of the overall number of repositories are the ones containing didactic materials (in the form of LO). Unfortunately in Poland we still encounter a number of obstacles resulting from the legal, organisational and financial nature of building electronic resources, and the initiative of open access to these resources is not widely applied. We also do not have too many representatives in the most important European digitalisation projects (Bednarek-Michalska).

The conducted analysis of different repositories allows classifying them depending on their content and intended use (Figure 5). There are repositories where the contained materials have a presentation-like character and often include multimedia and audiovisual materials. Nevertheless, the most numerous currently are the repositories shaping the worldview, which present results of scientific research in certain domains or store the achievements of certain organisations. The main resource of these repositories are articles verified by domain-experts.

The third distinguished group consists of repositories designed for education containing the prepared didactic material. The leading repository among them is the MIT OpenCourseWare (MIT OCW), in which the didactic material is organised in the form of courses which can be freely accessed over internet. This repository is supervised by the OCW consortium, which has among its members many international education organisations, e.g. CORE – China Open Resource for Education, Johns Hopkins Bloomberg School of Public Health, Massachusetts Institute of Technology, etc. (MIT OpenCourseWare). Also in Poland initiatives arise for creating repositories with didactic materials. AGH – University of Science and Technology in Cracow is building a repository in the frames of a contest conducted among students and teachers (Notatki w Internecie).

The range of repositories being developed in all the categories develops each day. Each of the existing repositories can be used as a source during realisation of the teaching/learning process. From the didactic point of view, the main interest falls on repositories containing prepared and divided into LO didactic material. The process of obtaining competences while learning requires defining for such repositories the goal, scope and structure of domain knowledge for the needs of a certain educational situation.

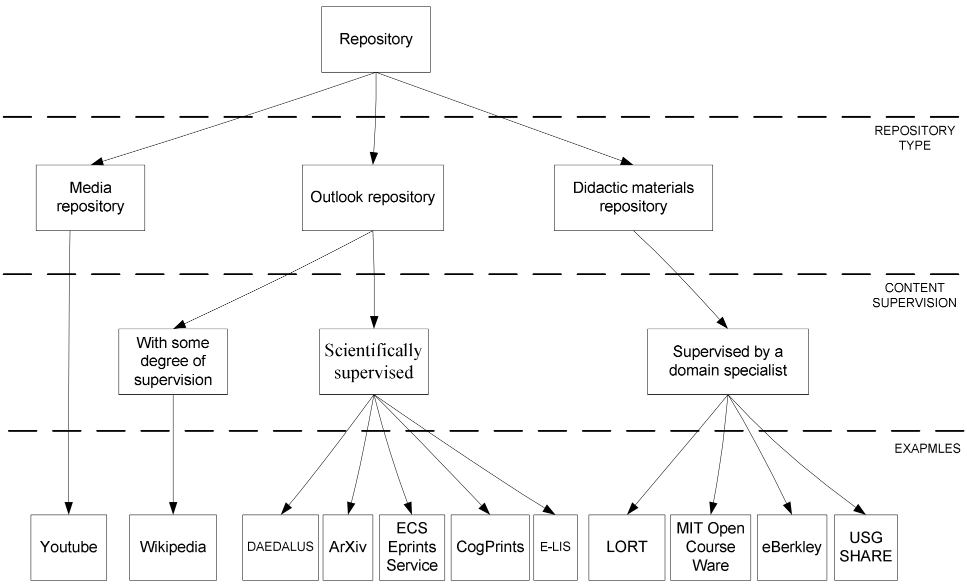

Figure 5. Repository classification (Ciszczyk et al., 2009)

Repository development process management

Working with repositories, the resources of which are didactic materials, requires analysing two main issues:

– management of the repository content,
– management of the repository functioning in the "teacher – student – repository" triangle.

Managing the content of the repository requires using not only the tools for content management based on OWL (Gomez-Perez et al., 2004) but most of all working on the repository content in accordance with the assumptions of competence-based learning.

Management of the repository content

The object of our research is to prepare an appropriate repository structure, which will be the place for storing open resources. A repository cannot be created and then closed. Its structure is determined by competences as a set of appropriate knowledge. The question arises, how to evaluate and expand the scope of knowledge in order for it to be a base for talking about the current and needed on the market competences. Solving this problem requires using ontology as a mechanism for integrating knowledge resources. An ontology can have a different degree of generalization. It can be developed as a schema of theoretical knowledge, but it can also be designed in such a way that allows combining theoretical and procedural knowledge. The border between theoretical and procedural knowledge is symbolic. It depends on the learning subject and the educational situation.

Below a schema was presented of an ontology representing a fragment of knowledge from the course of information systems engineering (Figure 6). The learning subject was included in one integrated structure that is suitable for continuous development. This otology is open and presents the range of concepts integrated in a single subject.

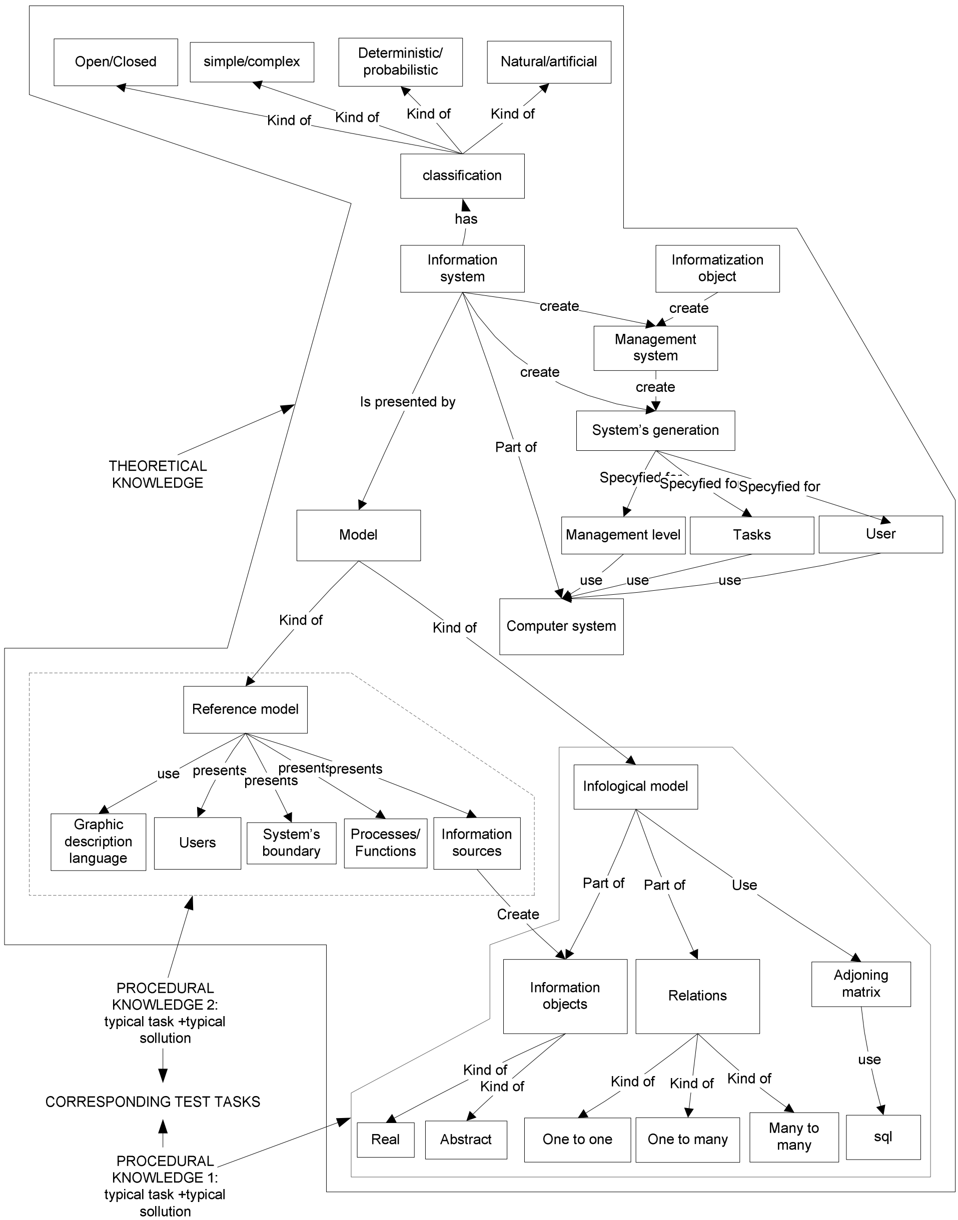

Figure 6. Fragment of ontology with distinguished theoretical and procedural knowledge

The presented ontology is a conceptual model considered in a context of a specified domain. The conceptual schema is a structure intended for integrating domain knowledge, with consideration of the predicted ways of its reception (cognitive styles). It is known that ontology is a method of knowledge representation and that the cognitive style reflects the unique ways in which people perceive the world, which might be contradictory (independent field or dependent field, globalization or detalization, etc.). The presented schema can be considered as a compromise solution because each node of the network can be treated either as the root of the tree or as its leaf, depending on how the knowledge domain is perceived.

The specificity of the network creation approach is considered at two levels:
- At the level of concepts and relations between them – in the form of an ontology – to reflect the semantics of concepts and if the ontology is also hierarchically organized – to visualize the relationship of „parent-child" and identify the theoretical and procedural knowledge.
- At the level of specification of each concept – each node is described using the concept's established specifications. The concept's specification schema (Figure 7) reflects the contents of the conceptual model.

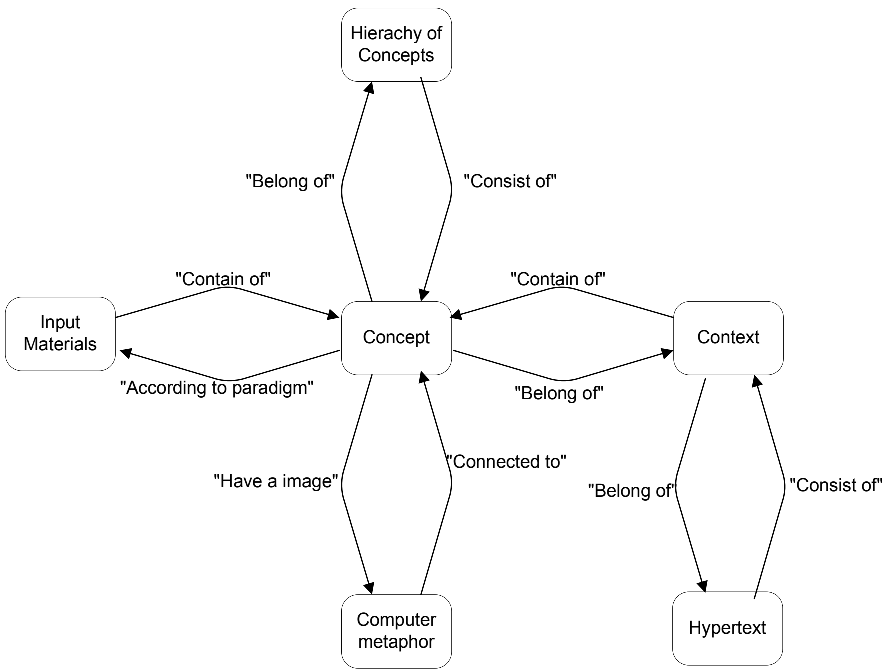

Figure 7. Representation of the concept's specification in the repository environment (Kushtina, Różewski, 2000)

An ontological network integrates knowledge of a given topic. The second level, on the other hand, describes specification of a subject. This allows modifying the content of a repository depending on the learning goals. According to this specification each concept is connected to a context in which it occurs. This context can be different depending on the educational situation. The context consists of the concept's definition and corresponds to a matrix structure of a concept description (completely or partially filled) (Różewski et al., 2008). In the frames of the context, the concept can be connected to other concepts by being defined by them. When the context of one concept contains a reference to another concept, a hyper-text structure is used. The hierarchy of concepts refers to the place of the concept regarding the concepts in its neighbourhood. For each concept input materials should be developed, referring to information sources in the form of a reference list, citations or articles. A computer metaphor is in other words a multimedia representation of the concept. With the use of multimedia solutions a concept can be reflected in the form of a picture, film, schema, what corresponds to different learning styles. The created in such a way surrounding of the concept has an open character and can be changed and developed according to the requirements of the educational situation.

Using an ontology and a mechanism for specifying the concept results in both the teacher and the students maintaining an overall view on the subject.

Management of the repository functioning

Managing the functioning of the repository includes:

- Managing the platform as a technical infrastructure – often for building repositories existing computer platforms are used, e.g. Oracle iLearning [http://ilearning.oracle.com/ilearn/en/learner/jsp/login.jsp], Blackboard [http://www.blackboard.com/], Caroline [http://www.claroline.net/], SABA Learning Enterprise [http://www.saba.com/], Moodle [http://moodle.org/] or Sakai [http://sakaiproject.org/]. Among the used standards for content description we can distinguish AICC, IMS or PENS, but the leading role is played by the SCORM standard (Różewski et al., 2008).
- Managing cooperation – it exceeds the boundaries of the platform and concerns managing the behaviour of the teaching/learning process participants, the basis of which are the rules of motivation.

The first issue is widely discussed in literature (Różewski et al., 2008), (Beatty, Ulasewicz, 2006). Commercial and non-commercial platform solutions are available, content description standards are being created.

For solving the second problem a motivation model is proposed, consisting of appropriate motivation functions of all the learning process participants (Figure 8).

The teacher's motivation function aims at having such an influence on the students' activity that will lead to placing new didactic materials in the repository. Solutions elaborated by students will serve as proofs of a high level of competence acquired by them. The student's motivation function is a result of the adapted self-development strategy. For each subject the student will decide how deeply involved in the learning process he is going to be. This depends on many factors, i.a. on the didactic material contained in the repository, the complexity of tasks, the amount of time the student must dedicate to a task, the potential grade he can be awarded with for solving consecutive tasks.

Formulation of the motivation model can be done in terms of the games theory, as was presented in (Kushtina, 2006). The synergy effect and filling the repository with new content as a result of it requires finding a balance between the teacher's and the student's motivation. However, due to the fact that cooperation between the teacher and the student occurs with a set of time-related, financial and hardware-related constrains, simulation was used as an instrument for verifying the strategy adapted by the teacher regarding a students' group. The experiment based on analysing the queue parameters of the teacher's workplace as well as on defining the forecasted servicing time for all students was described in (Różewski, Ciszczyk, 2009). The simulation experiment allows studying how will the assumptions of a teacher influence realisation of the didactic process. Through the provided time-related parameters the teacher can verify his assumptions and adapt new strategies for group management.

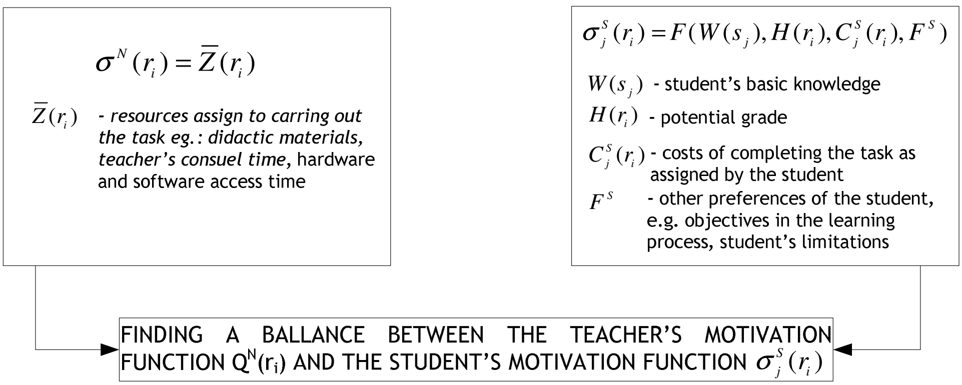

Figure 8. Student's and teacher's motivation functions

Summary

In the article authors presented the concept of competence-based learning, the main mechanism of which is the repository of didactic materials. It was shown that the structure of the repository is defined by competences reflected by a set of relevant knowledge. As the main mechanism for building and controlling this set of knowledge the ontological approach, which constitutes a domain knowledge integration mechanism, was used. Ontology allows not only for representation of the knowledge within a subject, but by defining specification of a concept in the repository environment it enables adjusting didactic materials to different cognitive styles.

The presented approach gives the possibility to analyse the level of coverage of a topic (subject) before and after the learning process, and thanks to the motivation model it allows analysing the work on developing the repository with different groups of students. The ontology's hierarchical structure is a signpost for preparing LO that are to be provided to the students. For the need of isolating a knowledge portion the algorithm presented in (Różewski et al., 2008) can be used.

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E-Learning Development Tendencies in Higher Education and Future Directions

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Keywords

e-Learning, higher education, virtual laboratories, virtual worlds, remote laboratories. mobile learning, emerging technologies

Abstract

Teachers and students in higher education are coming to realize that to become competent practitioners there is need to take advantage of up-to-date digital technologies and learning practices. Learning process requires measurement and evaluation of students behaviour. In the case of e-learning, evidence is sought for improvements resulting from the use of online tools and processes desired to achieve a given set of learning outcomes. In this 21st century, knowledge is fast becoming a powerful engine in life. The visions, innovations, and inventions are the building blocks of developing knowledgeable and sustainable society. E-learning has facilitated the use of a plethora of internet and web-based applications as the method of communication with a distributed audience. Therefore, institutions of higher learning are constantly venturing into new and innovative methods and are radically changing the educational practice making it competitive. This paper examines how emerging technologies and e-learning are being used in education to create a major shift in the educational service paradigm that promises major advantages over the traditional distance learning and face-to-face systems. The authors present developments in distance education and e-learning whilst clarifying the similarities and differences between them. We identify factors affecting development of e-learning systems and examine the implementation of some systems in pervasive distributed computing environments. For everyone everywhere, the present developments in e-learning spells more access for learners, cautionary expansion for universities, and accelerated learning and influences for the future. The future directions is such that the higher educational system of the future and especially in Europe must aim to meet human development needs with e-learning playing some major parts through promotion of access and widening participation in knowledge and skills acquisition. In order to support learning in evolving dynamic environments, several factors must be taken into consideration. These range from policies, strategies, the current education environments and business needs as well as the specific discipline being studied. Since the advent of e-learning and its eventual implementation in higher education, the world of learning for both the advanced nations and emerging economies have witnessed an upsurge in the number and types of students who are now engaged in pursuit of studies at institutions of higher learning. This paper reports on issues relating to expectations of the university of the future and the future of universities.

Introduction

E-Learning has revolutionized the mode of education delivery in further and higher education institutions. A major part of this involves the use of computer-mediated communication (CMC), which can improve communication over face-to-face mode. With CMC there is less distortion of information and a perceived higher level of satisfaction and comfort for the learner. The quality of the relationship between the tutors and students is affected by the medium of communication and the form of information distributed. For many fields of specialization especially where education is based on accuracy and practice, CMC and the internet have great potential for the students. There is a paradigm shift in educational services delivery, this takes cognizance of the fact that there are differences between people in how they seek education information which could depend on age, income and background resulting in the preference for online or offline mode of seeing information, creating a digital divide. Online students for the most part comprise digital natives, who in some cases are younger, have hunger for more education, use the internet for other purposes and spend more time online per week. In most cases, education providers remain a source of information and support for behaviour change. Due to the increasing number of learners accessing websites, the development and provision of information that students need have become more complex. Issues of culture, language, diversity, economy and time requirements all have to be taken into account.

The education and training of competent workforce and researchers of the future must take advantage of modern digital technologies and learning practices (Nattestad et al., 2002). E-learning has provided some inroads into some approaches for ensuring engagement, however, the ability to customize curriculum to accommodate the needs of the sectors and society must be taken into account. Modules and learning objects which are downloadable and reusable have to be considered. For quality assurance, establishment of consortia for peer review and guidance provision is important. Such groups could look at effectiveness of online delivered learning and usefulness globally. Issues of storage and dissemination which will require development of resources (human and capital) are crucial to the deployment of e-learning of the future. There are challenges to which solutions must be sought. Some of these relates to assessment, retention and programme evaluation. In the course of learning, assessment should be used to determine progress. Deeper understanding should be promoted which is measurable and evaluated from students' behavior perspective. This in itself is only evident in the effectiveness, retention and positive transfer of the e-learned knowledge and skills into workplace situation. Obtaining this evidence would require further research which involve obtaining and analysing the elements of the process such as planning, development, the learning outcomes, attitude and knowledge and skills acquisition and transfer.

Emerging Issues

In-house training in industry has always been conducted using the face-to-face (F2F) method. Today there is a shift. The use of network technology has become the trend especially in development and training organisations. This has been dubbed ‚e-learning revolution (Welsh et al., 2003). The authors would like to draw attention to the important factors affecting the adoption and successful implementation of e-learning initiatives. The reasons for use of e-learning and an outline of the advantages and disadvantages stems from the many challenges that face teaching and learning today. With growing emphasis on internationalisation following the introduction of ICT, we find that learning no longer takes place in one single campus. Universities now enter contracts with various other institutions worldwide to enable them to support their growing number of teaching and learning activities. This has resulted in various collaboration described as virtual campus or multi-campus education. This present challenges as it leads to online networks of individuals and learners which may be independent of the institution, sometimes referred to as learning communities or communities of practice. The formation of such informal online communities responds to a need for individual learners to manage their own learning over the boundaries of institutions and institutional systems (van Petegem, Kairamo, 2007). These challenges the closed structure commonly employed by institutions. Social software, Web 2.0 and Web 3.0 are part of this phenomenon. Social software allows links between users and the ownership and control of these links in relation to who is linked and who is not; what sort of information is shared and what is not shared. The context for collaboration and services include Facebook, LinkedIn, Flickr, Slideshare services etc. These social software challenges the boundaries of the closed digital learning environments of institutions.

Education institutions and learners worldwide now have access to resources available on Open Educational Resources (OER), which are teaching, learning and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others. These OER include full courses, course materials, modules, textbooks, streaming videos, tests, software, and other tools, materials or techniques used to support access to knowledge for all. The content may be there but the process for use of these resources are up to the individuals or organisations adopting them to develop and implement.

Supporting Learning in Dynamic Virtual Environments

Implementation of e-learning to date, has involved voluntary engagement on the part of the students. Recent studies involving examination of use of internet from students' perspective in relation to their views on online teaching, tutorials, assessment and possible future applications, have reported a significant increase in voluntary use of the internet and email (Marriott et al., 2004). The study revealed and provided evidence that students value social interaction and the use of internet for learning and developing skills. The future would see the sustained use of VLEs and e-learning to support campus education and for development of new and emerging skills for personal and professional development.

E-Learning and Emerging technologies

People seek to learn through experience. Research has shown that as much as eighty percent of learning takes place outside the formal education system. The lives of people and of societies are becoming complicated and developments become more and more non-linear and non-continuous. The learning environment of a human being consists of a rich variety of different places, spaces and modes. The beginning of the 21st century has shown virtual spaces have become important.

Access to education information is no longer for the select few (Staff and students of any educational institution). Following the integration of systems with accounts provided has in some cases provided access to those who do not belong to any traditional member groups. The use of social networking tools and sites available with free resources will transform teaching and learning into their e-equivalents, almost together into the future.

Organisation of learning

The global financial downturn and glocalisation of universities worldwide continues to affect the way learning is organised in Europe and also throughout most part of the world. The financial crisis continues to affect higher education. The deficits faced by most governments from 2009 may well have an effect on university budgets for the coming years. Thus, e-learning could be used in the next few years to increase the higher education on offer, while maintaining costs and increasing the amount coming from student enrolments. In this kind of context, it may well be that greater efforts are made to rethink the ideas and methods for return on investment (ROI). Likewise, the crisis is going to lead to greater use of free content and technology, and less use of proprietary platforms.

'Glocalisation' is a term that is currently being used to describe the progressive expansion of the large universities, via their campus networks, into other parts of Europe and the rest of the world. There are key benefits to this trend: improved cost efficiency, curricular standardisation, spread of best practices, etc. The local campuses can play a part in adapting training to socio-cultural contexts with specific needs. Thus, university-business partnerships are going to increase as a result of the unstoppable trend of students wanting to organise their own learning and link it to their professional objectives.

Learning production

There are several initiatives seeking to promote and sustain open education and non-traditional sources of learning, including informal learning. The Open Software foundation continues to support making available free software. Courseware for use in further and higher education institutions are now being made available. These initiatives have received funding support from various sources such as JISC in the UK, NSF in the USA etc. Among universities participating in the OER initiatives are the Open University and the Higher Education Academy (ICS) Subject Centre. We note that the open movement, and ideas of sharing and re-use, of materials are going to spread through the university community. This has been the case already, for example, with the use of Moodle in most of Europe's virtual campuses, and the trend is going to grow through the adoption of other learning tools, and social tools in particular. As Stephen Downes points out, unlike in the past, international open-source development communities are now consolidated and mature, which means that it is easier to replace the proprietary applications currently used by universities.

Shifting attention to content creation, this movement represents a change in the way contents will be developed and paid for. Several approaches are being explored. Some of these include content assembly for the simpler programmes and a more homogeneously developed and adapted programmes expressing the views and vision of the teacher. In the case of the former, the course content design has more to do with content assembly than content creation and requires more efficient information architecture and management formulas, standards and metadata models at these institutions. However, for the latter, more thought is given to the process, quality and interactivity for deeper understanding of concepts.

Models of Education

The IT Literacy and level of competence of both tutors and students affects the type of engagement, form of development of instructional materials and students' engagement. One of the main effects of open content has been the notable increase in the amount of educational resources available, whether for free or at a low cost. As the Horizon Report 2010 notes, this has led to a trend in trainers taking on the role of guide, coach or facilitator in a context of overabundance of teaching materials. Students, in turn, no longer need to act as more or less passive receivers and processors of information, instead they need to be able to search for, assess, interpret and summarize this information. We find that students are being positioned to develop a culture of active learning and engagement with the processes and instructional materials using these tools.

Assessment of learning, one of the main points of criticism of the open model, is evolving alongside this, as peer review, reader rating, tagging and retweeting become increasingly common forms of validation (Horizon, 2010). This leads to the need for basic training in ICT skills, especially for faculty and other stakeholders – a need that countries and universities are going to have to respond to in the coming years.

Customizing and expanding the users' web

The rise of Web 2.0, otherwise referred to as the users' web, has only just begun. Many universities have commenced integrating applications, such as blogs, wikis, social tagging, video and photo sharing, etc.. They are aware of the fact that their students are using these Web 2.0 tools and sites to learn informally. In some cases, some universities have even started to test social networks like Facebook as the main educational platform for their courses, like UOC (http://pretoria.uoc.es/wpmu/joyoflearning/facebuoc-project/). Although social learning has been a very popular phenomenon over recent years, its actual and widespread use in higher education is something that one may well finally sere being implemented in the near future.

Learning technologies

E-Learning consist of content, technology and services. In terms of learning technologies, we think about learning management, content management, knowledge management, content distribution, competency management, collaboration, assessment, reporting, localization and workflow. In recent times the many issues affecting the development and deployment of these learning technologies include bandwidth, virtual learning environments and virtual worlds, the advent of mobile learning and gesture-based computing. As has been the case in recent years, bandwidth will continue to increase considerably. The educational implications of this are great. For example, it will aid the use of applications such as videoconferencing or synchronous team working. It must be noted that owing to the trend of majority of students not living at home, especially during the latter years of their study at the universities, for instance in France, UK, Portugal, whilst in their accommodation away from home, they do resort mostly to the use of their PDA, which leads to decreased bandwidth.

Virtual Learning Environments

The transformation of learning management systems into personal learning environments (PLEs) will probably continue to be seen to be the main trend The possibilities of personalising educational experience have to include proposing a work environment that is designed in terms of each student's interests and needs, and in which they take responsibility for this design. There are many initiatives in this area – some of these include the UOC's campus (whose design is based on the Google Gadgets API) or the University of Aveiro's campus (http://campus.ua.sapo.pt/)

Given the fact that many universities are currently forcing their students to use more than one platform or a range of tools so as to be able to offer them different services, the prediction is that in future virtual environments will have to integrate all these different tools, and allow for their use and intercommunication via standards-based interoperability. This will represent a paradigmatic change where we move towards the idea of virtual learning environments as repositories for web-based learning tools. These are tools that can be incorporated into each campus in terms of the desires of users and administrators, and which are able to intercommunicate and offer a global educational experience. We believe the same is going to be the case for social networks like Facebook or Google Wave, which look to offer social functions, email and file sharing within the same tool.

Mobile learning

The number of mobile phone users has now reached 4 billion (Horizon, 2010). It was predicted that 2010 is going to be the year that sees serious experimentation with augmented reality. The European smartphone market has grown exponentially, and developers and users of platforms such as Android or iPhone operating systems are increasing the mobile repositories for augmented reality resources. The spread of mobile web access and the possibilities for context-aware applications, and geographical positioning systems (GPS) in general, offer a wide range of opportunities for exploration. Thus, rather than see mobile devices (and smartphones in particular) as basic tools for virtual courses, they will mainly be used as resources and support for these courses. This is most likely to be true with some limitations in the cases to do with science courses, which will never be delivered satisfactory through PDA. One of the reasons being the size of the screen, which is too small. iPad could have more to offer in future.

The market for videogames based on augmented reality will be of particular interest, especially in terms of user and data networks, which may represent a new way of showing relationships and connections in the 'real world' (Horizon, 2009). The cost of producing serious games is a drawback as many people with various skillsets (Corsortia) are needed for the finished product.

Another type of mobile device, the e-book, has been the protagonist of 2009, thanks to its offering particular comfort and portability when reading teaching materials or any other kind of materials (Horizon, 2010). In 2010 and beyond, these devices are expected to offer more services or see increased use of those tools already in existence, especially internet connectivity, collaboration and tools for taking notes and editing contents. It is not quite clear as yet what success innovative devices such as the iPad will have, which incorporate the typical features offered by netbooks, alongside touch screens and a resolution normally found on a desktop computer.

Virtual worlds and Gesture-based computing

Despite the 'educational disappointment' with immersive environments, and Second Life in particular, a few years ago, new educational uses of tools based on 3D that are starting to come to the fore and are under consideration in many university faculties. The challenges facing development in this area arise from the complexities of the objects used the integration of the various aspects for meaningful use to be made in the context of teaching and learning. This would prove useful as the trend for blended learning develops where there is a drive for seamless transition from one learning activity to another. Such a transition could be one from live group activities to individual exercises or from activities in small groups to activities in a large learning community. The way in which we relate to computers is changing. Models such as those put forward by Apple with its iPhone, based on finger movements, represent a step forward in the development of interfaces that adapt comfortably to typical human gestures (Horizon, 2010). Videogames already show the possibilities available, for example with the Nintendo Wii, which uses common movements in the 'real world' as an interface for gaming. Likewise, educational tools and simulations, in particular, are going to be able to incorporate these possibilities for interaction. There is the problem of the cost of development. Simulations require the participation of specialists in the field of science. We distinguish between two categories of simulations: the ones which derive from research directly andthe ones developed by geeks i.e. scientists with programming skills. The use of collaboration and social networking tools through sharing and exchanges could see progress in this area.

Virtual and Remote Laboratories

On-line laboratories or remote laboratories provide distant access to hands-on experiments and extend to the learners new possibilities of using lab equipment without location and time restrictions. They also help the dissemination of hands-on activity, very relevant in science and technology areas. Nowadays, many universities already have laboratory environments online through using the web. Recently, at IGIP'09 International Conference, in Austria, September 2009, the Ministry of Education, Arts and Culture presented four such environments to promote education – one of them was entitled "Remote and virtual labs". This new tool for teaching/learning purposes is no more a discussion but a reality, and they have been used at the Faculty of Engineering of University of Porto (FEUP), Portugal.

At FEUP, the host institution of one element of this group of authors, a state of readiness has been demonstrated for improving the collaboration between universities and secondary schools by organising learning scenarios ((Restivo, da Silva, 2009), (Carvalho et al., 2009), (Restivo et al., 2008), (dos Santos et al., 2008)) where students have remote access to real laboratory experiments located in different university laboratories. Also, some virtual 3D replicas of some experiments available in each student computer are offered ((Restivo et al., 2007), (Marques et al., 2008)). The main idea is to organise, in the near future, a working network of real and virtual laboratories to facilitate strategic sharing of pedagogical practices and to provide distributed remote access to, in some sense, expensive prototypes as test-beds and for establishing long term collaborative schemes between universities and between schools and universities. This is a first step to bridging the gap between science and applications, theory and practice, and also it will give a strong emphasis on science and pedagogical innovation and an experimental way for good practices dissemination.

Remote and virtual experiments

A remote experiment (which may also be named a remote laboratory) is a real experiment (or a set of experiments) remotely accessed. The user interacts (unless if the experiment is of sensitive type) with the experimental system remotely located, through a user friendly and virtual interface located in an informatics platform – as is the case of a personal computer. Examples of high level of this concept and not available for anyone (although, not using the internet as the communication technology) are the interaction and control of Hubble telescope or the ROV´s (Leitão et al., 2007).

In a virtual experiment the user interaction is restricted to a computer environment based in a developed application supported by a system model. Those types of experiments may be accessed remotely or may be uploaded to the user PC. A real experiment is tied to a real set-up. A virtual one has the inherent freedom and the flexibility coming from its virtual characteristic (Restivo, 2009w), Figure 1. If the virtual experiment is well structured and designed it could be of higher cognitive stage for training purposes. Also, many industries make similar use of the web for supporting their products and services or of virtual systems for training. In terms of university education, the role of experimentation is a key concept, especially in science and technology courses, but even also in medicine! Having the remote experiments ready all the time, the remote laboratory concept also provides a tool to bridge the gap between university research and science teaching at school level.

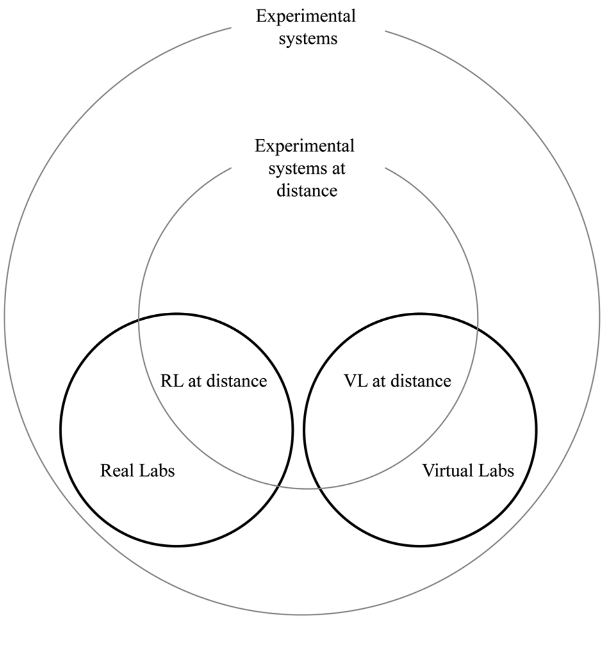

Figure 1. Experimental systems

The system architecture

At present there are some developments aimed at improving the system architecture for better performance as is the case of stability, universality and also at cost systems level, intended to be based on freeware solutions. The most commonly used system architecture is presented in Figure 2. This is the system architecture used at FEUP.

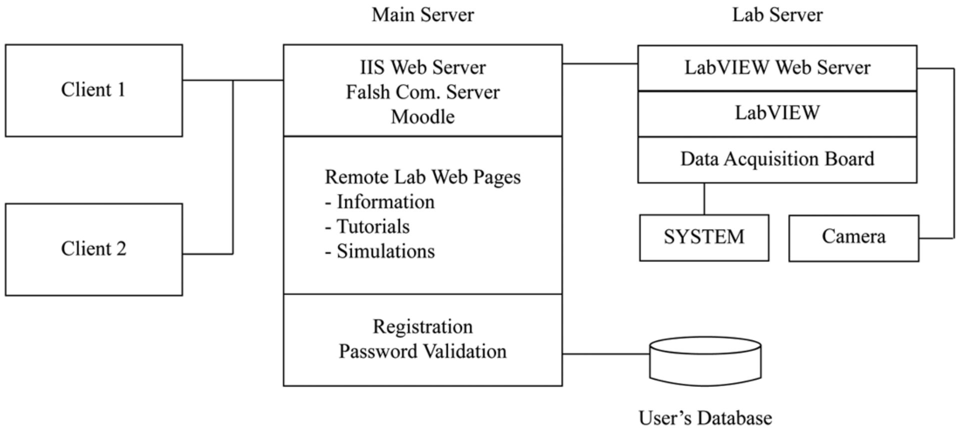

Figure 2. FEUP more common structure for remote labs

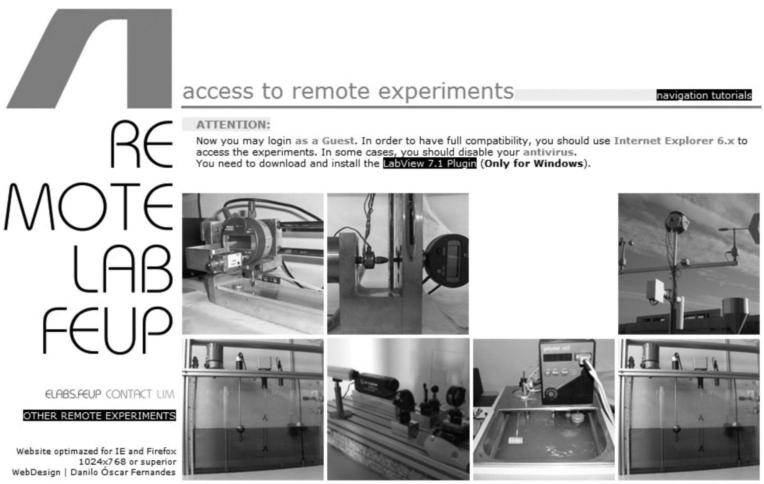

Figure 3. A Remote laboratory web page captured from http://remotelab.fe.up.pt/(elabs.fe.up.pt)

The Microsoft IIS main web server contains all the information on the available experiments (system constraints, short explanation, how to use, videos, simulations, quizzes, booking system and the experiment access) and a database for users' authentication purposes. After user system validation process, the experiment may be scheduled using a PHP interface between the computer user application and the Moodle platform (Restivo et al., 2009j). Some experiments with higher requirements in real video images use Axis, Panasonic and Trendnet IP cameras via an embedded Linux video server. These IP network cameras provide the image directly to the web page of the corresponding experiment. That server runs also the Macromedia Flash Communication Server to control images delivered by webcams used in other experiments with less requirements in video images. Using a dedicated computer for each experiment the software LabVIEW supplies the respective web server. The hardware for communication between the PC and the real experiment is from National Instruments I/O cards. Figure 3 shows the Remote lab web page within the URL: http://elabs.fe.up.pt/.

FEUP is ready to share its online experiments and to collaborate to be able to assess adequacy and get more efficiently the purposes of a global use, either on the complementary labs written contents – tutorial materials adequate to the knowledge stage of the users – or in improving the technology used for better performance of the experiments.

E-Learning in Pervasive Distributed Learning Environments

We have seen the tools used in education from blackboard and chalk, paper and pencil, printed books and photocopies, radio and television, evolve to modern information and communication technologies (ICT). The introduction of ICT into education has resulted in enhanced paradigm of predetermined times, places and ways of learning with the new one of learning anytime, anywhere and anyhow. The integration of more functionality means bridging the gap between the teacher and student space using online technologies. We see the linking of learning resources provided by libraries and VLEs turn into a complete digital learning environment at institutional level to provide integrated access to all resources and activities related to teaching and learning (van Petegem, Kairamo, 2007).

The factors affecting e-learning systems development and implementation, amongst others, include policy of the institutions, the level of IT literacy and the type of curriculum for which the system is intended. Despite the economic crisis which in some countries continues to bite, the learning management systems' market is still continuing to grow. The availability of free OER systems and software has meant increased uptake in their use-learning to promote access and widen participation. The issue remains with the level of IT literacy among learners and access to broadband and associated facilities to access the internet. Some institutions still have a policy that permits restricted adoption of e-learning in some fields of study. With ongoing promotion of digital inclusion agenda in countries like the UK as well as in some European countries it is important that the issues are addressed and the problems resolved.

Trends of Development and Future Directions

The value of information is increasing in higher education. E-Learning has made it possible for students to be able to choose education providers and mode of access to their field of study. Universities and further education establishments could explore investing in shared databases over the internet so that more Information would be available to learners. Students could then choose or be directed to education courses based on their preference. This will give rise to improved access to education and enhance personal and professional life. We see a rise in the demand for education in a bid to achieve the eight millennium development goals (MDGs) of the United Nations. This in turn has resulted in increased education requirements to which technology offers the answer (Uhomoibhi, 2010). Distance learning and e-learning offers tremendous cost savings in reduced travel cost and facility utilization. The multiple purposes of universities have been identified to include preparation of students for the labour market; preparation of students for a life as active citizens in a democratic society; personal development of students, and the development and maintenance of a broad, advanced knowledge base (MSTI, 2005).

The future will see more and more modules developed and made available via Internet and Intranet. Internet will allow access from homes, private offices, libraries, or learning centres. This will remove any space and time boundaries. Video conferencing and interactive videos will be used to extensively enrich the information supplied for instruction and learning. This in turn will provide for more effective education for the learners. Each learner will be able to progress at a pace best suited to the individual or cohort engaged in the education process. The use of discussion groups provides for active learning. The digitization of information and availability of digital libraries all over the world via Internet and Intranet will be commonplace. Older publications dating back to centuries will be available online, providing data and a rich history for understanding current issues and situations for both the students and institutions. The cost benefits for e-learning are positive for many fields of study ((Raju, Abhik, 2000), (Zollo et al., 1999), (Clemmer, 1995)). As different fields of education are integrated, knowledge and information from remote or global database systems will be made available through the internet. Such internationalization of education information via network technology will be seamless and lead to improved and sustainable development, communication, improved living standard and the global economy. Self education could become a common phenomenon and branding of individual or industrial qualifications that meet the needs of specific sectors.

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Business Processes Management and Information Systems: Methodologies Overview and Challenges — a Higher Education Institution's Framework

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Keywords

business processes framework, Higher Education Institutions, Organizational Semiotics, Signs

Abstract

Processes and people are two main factors on organizations. There are many methodologies for management of processes and services such as Business Process Management (BPM) and Software Oriented Architecture (SOA). These methodologies alone do not seem to be able to cover all the specific model of Higher Education Institutions (HEI). A good quality management should then be mindful not only of the defined processes, but also to Organizational Semiotics and the flow of signals. With the help of Semiotic Pentagram Framework (SPF), Dynamic Essential Modelling of Organizations (DEMO), Language Action Perspective (LAP) and the Theory of Organized Activity (TOA) we present a framework adapted to the HEI where, after reviewing the options regarding the

semiotics, we choose to use the Semiotic Pentagram Framework. The various views of the SPF scheme cover larger part of the HEI activities and needs process. To do that, we will use an approach to Strategic and Business Information Systems. Our objective is to apply the framework at one of IPS schools – Superior School of Health (ESS), creating value throughout the flow of information.

Introduction

On developing information system (IS) in public institutions or organizations, there are several challenges to consider. Increasingly the organizations are dependent on IS to support business processes, these are extremely important to business success, to make decisions more quickly and more efficiently that is aligned with the organization's strategy. The organizations are looking to improve their existing processes, or even to automate them. In some countries, government regulations require that business processes be properly documented. These are among the many drivers in the business world today that are making organizations take a closer look at their processes. The first question that arises is that if organizations and institutions have all the same kind of characteristics. In this work we defend that higher education institutions (HEI) nowadays have new specific challenges and characteristics. In the socio-economic Portuguese context Polytechnic Institutes and Universities are centralizing services, decision making processes and IS. It is not unusual to have in this context information and procedures islands lacking a desirable integrated access to information, finding many reasons to capture their business processes in order to obtain top level indicators and competitive advantage in face to other HEI's. In order to understand the HEI business processes we have studied different kinds of approaches to the business processes capture and creation of top-level indicators: the dynamic business processes approaches like Business Process Management (BPM) and Software Oriented Architecture (SOA) and other approaches like Organizational Semiotics, the Semiotic Pentagram Framework – SPF, Dynamic Essential Modelling of Organizations (DEMO), Language Action Perspective (LAP) and the Theory of Organized Activity (TOA). In this paper we present a framework that we have created merging Hoshin Kanri matrix with the alignment between the Strategy and Business Information Systems, BPM, SOA and the SPF Framework and we define methodological aspects in order to validate this framework using one of IPS schools – Superior School of Health (ESS).

Motivation and challenges for HEIs

In the last two decades, computer science revolutionized the communication and the access to the information, opening new challenges to the organization of the work and the business processes related to education and learning in HEI. Computer science opens multiples challenges to the "new school", in the field of the management of the new paradigms of functioning and in the support of new forms of education and in way it generates the new paradigms of learning (Macedo, 2008).

The paradigms of education are in a process of change in the current school as well as learning. The changes in the society and education in the European community demand that the management of the schools is boarded of another form. A school is an organization form where the process of main business is the training/education of individuals. A school in its essence "sells" the acquisition of abilities and generates knowledge – elements basic resources to manage in the schools. Schools not only need to have one politics of knowledge management, but also to access the applications that allow them to manage the knowledge – its main capital.

School was always an important pillar of the communities. School is an active element of the social and academic community establishing bows of communication and contribution with its partners. The technological structures will have to support and to facilitate the management of the activities and business processes, allowing not only the allotment of resources, but also the coordination of the business processes and activities allowing the creation of top level indicators.

HEI are institutions that take on very specific characteristics deriving from its activities, its size, or even its management framework and autonomy that the law provides. With organizational structures unclear, inflexible, and difficult to define and with very weak lines of authority, decision-making processes have been very tightly hemmed in by different collective bodies mostly independent of each other and often with diametrically opposed views on the objectives of institution.

Additionally, at HEI exists high turnover at the top management positions, causing a general failure to promote a sustained process of continuous improvement. Finally, with regard to the core activities of HEIs, including the activities of teaching and learning, are presented with very transverse processes, with multiple actors with responsibilities for decision making, some of them at the same level but with little coordination, with long cycles of achieving and with little consensus about who are the intended recipients / customers (UNIQA/IPS, 2009). HEI have been created the need to adopt quality systems and continuous internal improvement, which are associated with effective processes of decision making so that they have a concrete effect on administrative activities, financial, scientific and educational.

The institutions are being evaluated according to the quality of performance, measuring the degree of compliance of its mission, through performance parameters of action and results. According to A3ES (Agency for evaluation and accreditation), the Portuguese institutions are subject to evaluation and accreditation in order to be entered into the European system of quality assurance in higher education. With the „Bolonha Process" the institutions may be subject to comparisons and rankings mechanisms, and quality performance, very important factors to get a good position.

The Bologna Process enables to compare with another high school and provides the Global recognition.The Bologna Process aims to create a European Higher Education Area by 2010, in which students can choose from a wide and transparent range of high quality courses and benefit from smooth recognition procedures. The Bologna Declaration of June 1999 has put in motion a series of reforms needed to make European Higher Education more compatible and comparable, more competitive and more attractive for Europeans and for students and scholars from other continents. Reform was needed then and reform is still needed today if Europe is to match the performance of the best performing systems in the world, notably the United States and Asia. IS in HEIs need to be well designed and have to provide key performance indicators (KPI) that will be compared among other institutions. One of that KPI are the Bologna Reports that all the courses in HEI need to have visible to everyone, every year.

In this sense, in order to achieve greater internal quality, UNIQUA/IPS (UNIQA/IPS, 2009) proposes the implementation of an IPS performance evaluation model based on a process model approach of HEI resources.

A Higher Education Institution IS: IPS Information Systems

Information systems exist to support the activities of organizations and institutions, its mission, objectives, strategies and business processes. Therefore, by definition, information systems have to be aligned with the business strategy. But that does not always happen, especially because business is dynamic, and change and information systems rarely have the flexibility to accompany these evolutions (Laudon, Laudon, 2007).

Setúbal Polytechnic Institute (IPS), a public institution of higher education, was created in 1979, and includes the Presidency Services, a Welfare Social Service and five Colleges that offer a range of graduate courses in different areas such as Technology, Education, Business Administration and Health Care. The institution has more than 6000 students, 505 teachers and 169 technical and administrative collaborators.

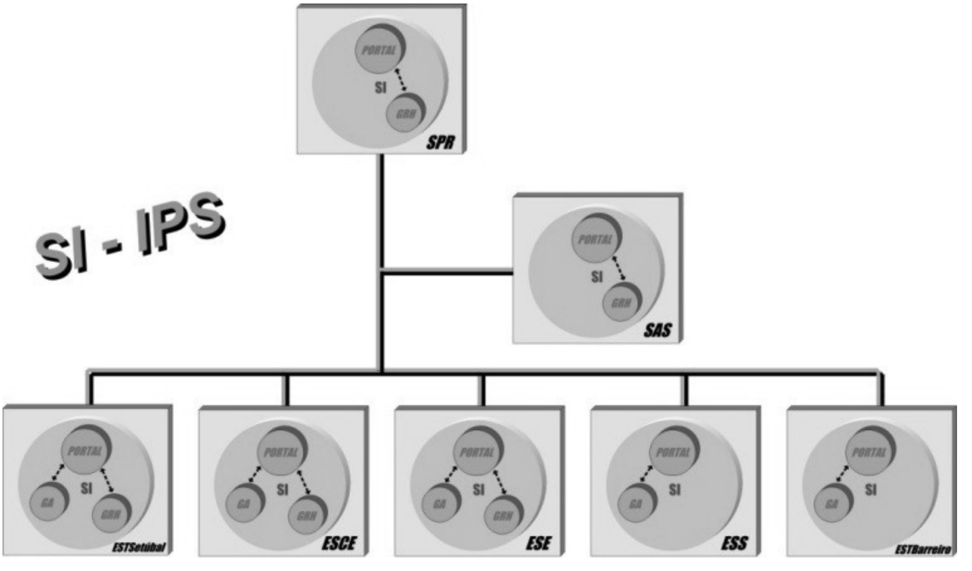

Figure 1. IPS Information System Architecture

Five years ago, IPS evidenced that it was very difficult to gather integrated information from the students as well as from the teachers. IPS and the schools needed to get management indicators and felt that information was spread on small non integrated information systems. All the stakeholders of the education process needed to have access to their information online and it was not possible to obtain that information without a new integrated system. Besides consisting in a central repository and unique access point, a web portal will allow to access information outside institutions facilities.

The students from IPS mainly reside far from the school and many of them work during the day and study at night. It would be a competitive advantage to give them access to lectures, as well as, all important academic data. The idea to develop in house a new system was placed apart, because IPS did not have the sufficient skilled human resources to manage a project with all these requisites in useful time. All the systems with this kind of requisites usually take several years to become in production in a stable way. It was created a team that started to analyze all the available academic information systems all over the country. Two years later the team defined finally that there was only a really stable, solid and tested system that meet the identified requirements to be installed in IPS – SIGARRA.

SIGARRA's system architecture is an integrated Web based information system, a student's management applications (GA) and human resources management application (GRH), its main characteristics are: Information integration, Web interface and Modularity and configurability. As IPS has five schools and two more organic units (Figure 1), all of them used different procedures to the organizational processes. The main idea was to standardize the processes in all the schools. The adopted implementation methodology consisted on the migration of the old systems at each school one by one to minimize the impact in services and increase the team expertise. Beside the lack of standardized procedures another challenge was the fact that the legacy systems didn't have enough documentation, so the migration process needed to be validated several times to assure data consistency. While the migration was in progress, the web portal started being installed and customized (Gonçavles, Sapateiro, 2008).

SIGARRA – Information System for the Aggregate Management of Resources and Academic registers (Ribeiro, David, 2001) which is a stable, robust, widely tested and continuously updated, IS for higher education institutions in use in several Portuguese institutions.

SIGARRA's system architecture is based on a modular integrated web based information system that allows to be configured in specific institutions implementations. The system delivers a portal with a wide spectrum of functionalities ranging from easily obtain lectures schedule from students or professors, to online exams schedule management. The system also provides a workflow engine that supports business processes workflows like helpdesk trouble tickets process, student applications, projects and publications management, among others.

SIGARRA is a really very good IS, but its implementation process and its characteristics determined that the top-level indicators are not easily obtained as well as the business processes are heterogeneous even many of them having the same goals and output information. So, the aggregation of the information in order to help decision making is not as effective as it should, not permitting to make comparisons among schools and services.

Usually top management defines the strategies looking for the results and not to the needs. One way to allow doing this is to review the processes and the "people".

SI-IPS implementation adopted, because of political, financial and organizational factors, was the adaptation of each organic unit to the IS, and this brought a problem – the system was adapted to each organic unit instead of potentiating the harmonization of all the existing processes.

This can be a sign that the organic units do not have clean structured procedures. IPS is betting on improving the quality and in the management of business processes. Question: "the management of organizational processes fits on high school?" The need to implement process management comes from standardization of the processes. It is important to harmonize the processes. It is necessary to create valuable indicators, which allow top management to control the processes. They only can control the processes that have defined or someone defined for them. On IPS exists orientation to results, rather than guidance on process and quality.

People and processes

People in organizations are the most important element, for two specific reasons: they are the suppliers and the customers. But alone they cannot produce a quality service. This is because people cannot know whether the processes that lead to the final result are optimized and have the desired quality. This is where the management of processes appear, one of the most important issues of today's organizations.

Processes, along with people, are of the most difficult to manage in the direction of an organization. And the explanation can be justified in many ways: processes not defined and planned; processes that fail; resources for processing; unclear objectives; lack of process control; motivation of people to implement them; bureaucracy processes.

The functional units of the organizations are beginning to no longer be considered as a discrete set of isolated and well defined borders, and this increases the difficulty of managing the processes. The growing trend to be seen as flexible and interconnected groups of information flows that cross horizontally the units in that group activities, is a reality that is rooted in the movements of reengineering (Hammer, Stanton, 1999) and JIT (Just in Time)(Have et al., 2003), (Coopers, Lybrand, 1990). Organizations come to be seen as a group of incompletely linked groups and for this reason there is great need to manage processes (UNIQUA/IPS, 2009).

Business process drivers can be summarized into three major categories:

- Documentation. Companies need to capture business processes so that others can understand how they work, who is involved, and how activities flow from beginning to end. Typically a business analyst who understands how the processes work models these processes.
- Redesign. Many businesses want to improve their business processes to reduce inefficiencies, drive down costs, and respond faster to customer requests. A process cannot be redesigned before it is understood, so it must first be captured. Redesign can only come after you have properly documented the process. Typically a technical analyst, or perhaps an IT liaison to the business who understands both the business needs, and the I/T systems models these processes.
- Execution. In most cases, the best way to improve the efficiency of a business process is to apply automation to it. If you can reduce or eliminate manual work, the process can be performed faster and at a lower cost. To apply process automation, the business IT staff or a consultant must write code or use a middleware product. It would not be advisable to automate an inefficient process. For this reason, this phase should only occur after you have redesigned the process.

In a organization exists process associated with the mission and the processes on which all activities of the institution relates, however exists other processes and not directly connected with the mission of the institution but have a particular importance in the overall management (Figure 2) and can be defined (Pires, Lourenço, 2010):

Processes that affect all other processes and activities of the institution, including the macro-processes, classified by integrated processes, and take responsibility for organizational convergence, by establishing global forms of action both internally and externally.

Processes focused on supporting the internal structures and processes arising from them, classified by support processes, and without them organization hardly reach their goals.

Figure 2. Global Processes Model (Pires, Lourenço, 2010)

It is important to IPS to restructure and define the procedures to improve quality. At this point is important to talk about two types of management: Quality Management and Process Management (Business Processes and Support Processes).

The processes that we will aboard are the Dynamic Business Processes and several methodologies can be applied in the organization, like BPM (Business Process Management) and SOA (Service-oriented architecture) and with Semiotic approaches is possible to link dependencies of the processes that not suffer any alterations on the organizations, that can be viewed like the skeleton of organization's processes.

Organizational Semiotics can help to see how it behaves throughout the process of information in the organization, helping to validate the flow of information by groups of the organization and deals with organizations such as information systems where information is created, processed, distributed, stored and used. Thus becomes the organization as a system of dependency where the result of a process may depend on another process.

The management processes should be adapted and appropriate to the educational reality, which may have a role in this standard approach as it sees an organization as interconnected and interacting processes by which it achieves the desired objectives. For this is necessary to HEI's clarifying its mission and vision, with emphasis on the ability to provide their recipients / customers products and services recognized by the social, environmental, cultural and economic values (Pires, Lourenço, 2010).

So there is a need for applying something different, because of the specificity of HEI specificities, whereas management methodologies common processes do not fit very well. Interactions are large and actors many with different needs.

A good process management combined with organizational semiotics can improve the quality of how the whole service is provided while improving the definition of all processes and dependencies. So suppliers and customers realize what the procedure is carried out to reach the expected result. These are the processes that make the organization sustainable to offer an educational quality of service allowing continuous monitoring and improvement.

Dynamic business processes approaches

Strategic Planning in the context of Enterprise Architecture

Enterprise architecture refers to both the process and the product of the application of systematic methods. As a complex process, enterprise architecture may use a framework of methods and conceptual tools. An early coining of the term "enterprise architecture" to refer to both the process and product was by Steven Spewak (Spewak, Hill, 1992). This book defined one of the earliest process frameworks for enterprise architecture. One formal definition of the architecture of an enterprise comes from the MIT Center for Information Systems Research: "Enterprise architecture is the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the firm's operating model" (Weill, 2007).

This enterprise architecture has mechanisms to ensure alignment between information systems and the strategic objectives of the organization. The enterprise architecture is a method that involves the application of a set principles and models to understand artefacts essential in organization, namely to understand the business, technology and and how is their evolution over time. Its divide by: the organizational, business, information, applications and technology architectures.

In a brief description, these five architectures are defined by:

– The organizational architecture understand the core aspects of the company, as vision, mission, strategic objectives and the structure of the company (like a organization IPS has a strategic plan);
– The business architecture describes all the activities (processes business) developed by the company to achieve its objectives (ex: teaching/learning; I&D; services and consulting);
– The information architecture describing the structure of qualified information that organization needs to develop the business processes (ex: disciplines, programs; school; IPS);
– The application architecture describes all the necessary applications that support business processes and make use of entities. In this architecture is include de CRUD

matrix (Create, Read, Update, Delete) that describes and analyzes the relations between the activities of the processes and manipulated information in the context of business (ex: information system, student's management applications (GA) and human resources management application (GRH));
- The technological architecture describes the infrastructure of hardware, network and software that supports business needs.

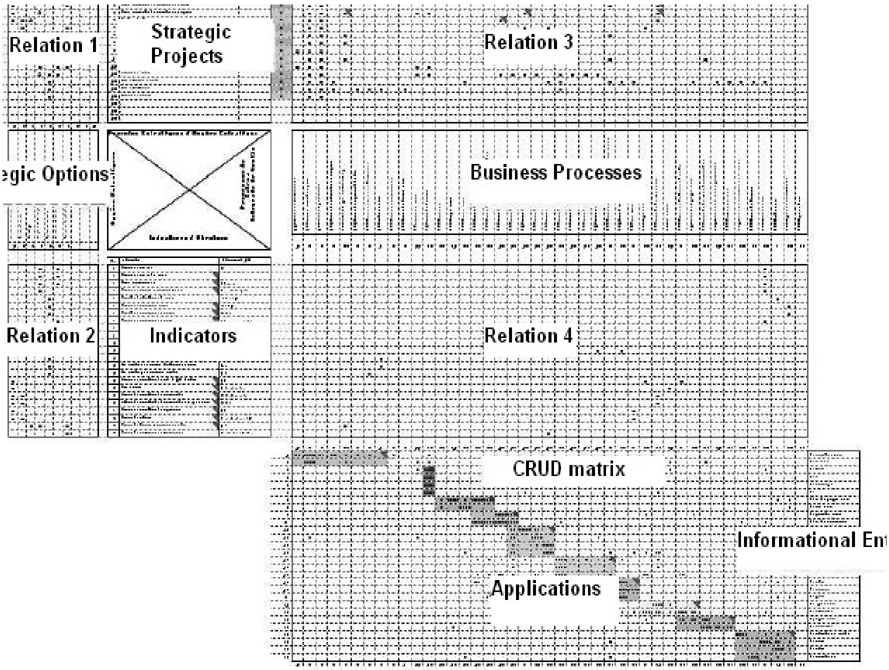

Figure 3. Hoshin Kanri matrix with the alignment between the Strategy and Business Information Systems

In an approach of the reality, the best way to meet this need is adopting the Hoshin Kanri matrix (Jackson, 2006) because it allows doing the representation in a single piece of paper the various interrelationships among the critical factors of company strategy. With this method it can achieve a result positive to show that it is possible to ensure the alignment between the business strategy and technology strategy to help improve performance of the organization.

In the Figure 3 is an example of a final Hoshin Kanri matrix with the alignment between the Strategy and Business Information Systems. Relation 1 is the alignment between strategic projects of the company with its strategic options, the relation 2 shows which the indicators reflect the choices company's strategic, the relation 3 identify business processes that support each of the strategic projects, the relation 4 identify the business processes that will produce each of the indicators of strategic management (information useful in implementing a system of Balanced Scorecard or "Tableaux de Bord") and finally the relation 5 identify the responsible for business process (High et al., 2009).

Management change is a problem with an impact on processes and systems information and with this matrix is possible to have a control change of the alignment between business and information, allowing viewing and understanding the consequences of alignment processes, informational entities and applications. With this the enterprise architecture can help to clarify the role of information systems in business, in a strategic perspective business, especially if it is considered as an alignment tool should be implemented dynamically by the company.

Dynamic business processes and models enable organizations to optimize business performance and rapidly respond to changes in competitive, economic, and market conditions.

By continuously improving key business processes across systems and people with business process management (BPM) and a solid business strategy, businesses can streamline operations, create agile business models, and reduce enterprise costs.

By discovering, documenting, deploying, and optimizing business processes and models, businesses can transform the way they work by:

- Delivering agile business models that rapidly adjust to changing customer expectations and business demands (curriculum design continuously based on market and society needs; using the best pedagogical knowledge; using the best technologies);
- Empowering people to operate in real-time with detailed process visibility, and new insights from sensors and events for smarter decisions and actions (monitoring and becoming available relevant data to the stakeholders, in adequate time, as well as to processes managers/Program managers);
- Flexibly automate and extend business processes to easily find and use the best resources anytime, anywhere (supporting activities and processes in IS).

BPM

Business Process Management (BPM) aims to provide the alignment of business processes with the strategy, with goals and create a value chain for the organization.

The Management of Business Processes uses the best management practices, such as the mapping of processes, modelling, determining the level of maturity, documentation, communication plan, automating the monitoring, establishment of performance indicators and the cycle of continuous improvement. The aim is the continuous improvement of processes to achieve the expected results.

These practices applied help maximize the results and performance of procedures, and so do organizations have better financial performance, competitive advantages, reduce costs, optimize resources, increase customer satisfaction through products, increased employee satisfaction, which leads to services with a superior level of quality.

SOA and BPM

The value proposition of Service Oriented Architecture (SOA) is centred on agile and aligned business and IT design and delivery. The ability to architect the alignment between business and IT is a hallmark of SOA, and is the cornerstone for derived business agility, reduction of cost and risk, as well as improved portfolio management.

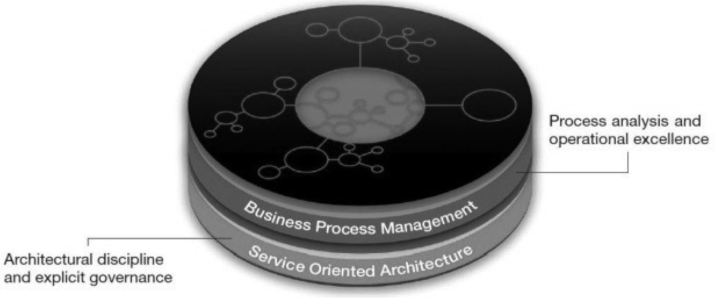

Figure 4. BPM and SOA integration

The notion of business process optimization has been around much longer than SOA. Yet, around the same time that SOA became a mainstream architectural style, the focus in many process optimization communities shifted subtly to one of Business Process Management (BPM). The key distinction for BPM as a discipline is added focus on flexible and dynamic process design as well as process orchestration and automation through IT enablement. This provides the foundation for agile business optimization and IT responsiveness, a particular aspect of business and IT alignment.

While BPM and SOA each have value on their own, they are naturally synergistic, and best when done together for business and IT agility, optimization and alignment. When done together, BPM provides the business context, understanding and metrics, and SOA provides a governed library of well architected service and information building blocks (Figure 4). Both are, in fact, needed in order to dynamically optimize investments, drive operational excellence and manage business risk.

Note that a valuable side effect of doing BPM and SOA together is enhanced collaboration across business and IT boundaries. Communication and collaboration are brought to life through simulations and visual models of process and service orchestrations, as well as through explicit business contracts that govern the horizontal linkage between business units and the realization of end-to-end processes.

SOA can be beneficial to IPS in several ways; the common theme among the primary benefits of SOA is that it provides a metaphorical "view from above" that wasn't possible before—a view that's both higher and broader in perspective. And when combined with BPM, SOA can be even more effective (Serra et al., 2008).

Other approaches

Organisational Semiotics — OS

Organisational Semiotics (OS) seeks to present new and useful ways to understand human information and communication systems from an organisational perspective. According OrgSem (Organisational Semiotics Community, 2010), OS is emergent discipline whose purpose is to study the nature, characteristics, functions and effects of information and communication within organisational contexts. The use of semiotics helps by providing many interesting ideas that can be studied, developed and applied in a business and/or organisational context (Gazendam, Liu, 2005).

Dynamic Essential Modelling of Organizations — DEMO

Dynamic Essential Modelling of Organizations (DEMO) is a cross-disciplinary theory for describing and explaining the action of organisations. An organization is conceived as a (discrete dynamic) system, of which the elements are social individuals or subjects, each of them having the authority to perform particular (objective) actions and a corresponding responsibility to do that in an appropriate and accountable way (Gazendam, Liu, 2005). For the coordination of their actions, the subjects enter into and comply with commitments towards each other. To perform a transaction is needed actions and interaction of the individuals (Figure 5) (Barjis et al., 2001), (Dietz, 1999).

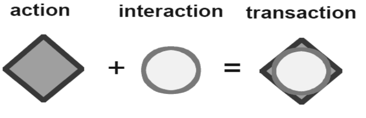

Figure 5. The business transaction concept

DEMO fits in a fairly new and promising perspective on business processes and information systems, called the Language/Action Perspective. The pioneer of the L/A Perspective is undoubtedly Fernando Flores. The L/A Perspective assume that communication is a kind of action in that it creates commitments between the communicating parties.

Language Action Perspective — LAP

The Language/Action Perspective (LAP) introduced in the field of Information Systems by Flores and Ludlow. Organizations have the intrinsic problem of communication between groups is of extreme importance, and according to Fernando Flores communication is exchanging sentences, expressing some proposition with the aim of creating commitment between the parties. This approach, contrasting to traditional views of „data flow", emphasizes how people communicate, what people do while communicating, how language is used to create a common shared reality and how people use communication to coordinate of their activities (Flores, 2010).

Theory of Organized Activity — TOA

Created by Anatol Holt, Theory of Organized Activity (TOA) is based on 'human' activities which occur within every organization or business system. Human action or act is the key element for the structuring and planning of all activity processes. Its dependence is based strictly on the human element, where computers and information technology is just a supporting tool. For the modelling of these dependencies is the language used Diplan (Cordeiro, Filipe, 2003).

Semiotic Pentagram Framework — SPF

Focusing on the human factor, the Semiotic Pentagram Framework (Figure 6) is an alternative sign model with four different views of the sign: Interpretational, Relational, Communicational, Physical and Work (Cordeiro, Filipe, 2003). The Interpretational View is interested in a passive interpretation of signs where the sign already exist and its possible creation is not the emphasis of the analysis, the Physical View emphasis is on a material view of the signs with less attention to any source of meaning from the signs being carried, the Relational View is concerned with all kinds of relations between signs where they distinguish here between formal relations and informal relations, the Communicational View is one of the most important view because the concern here is to communicate, so signs are studied from their use within a communication perspective, and the Work View that is a study on the relation between signs and the common activities or work practices (Cordeiro, Filipe, 2003).

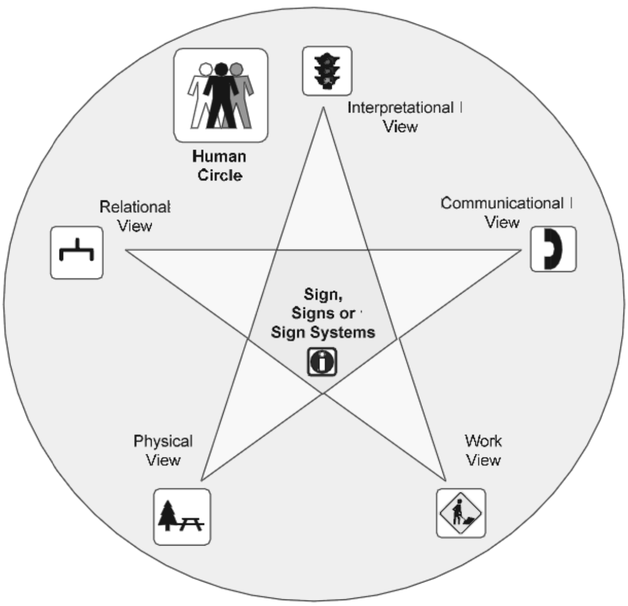

Figure 6. The Semiotic Pentagram Framework

The Business Processes Framework For HEIs (BPFHEIs)

We propose a framework, named Business Processes Framework for HEIs (Figure 7), with three objectives: improve quality of processes; build a process portfolio and create procedures documentation. It is very important to view how whole phases work together, in

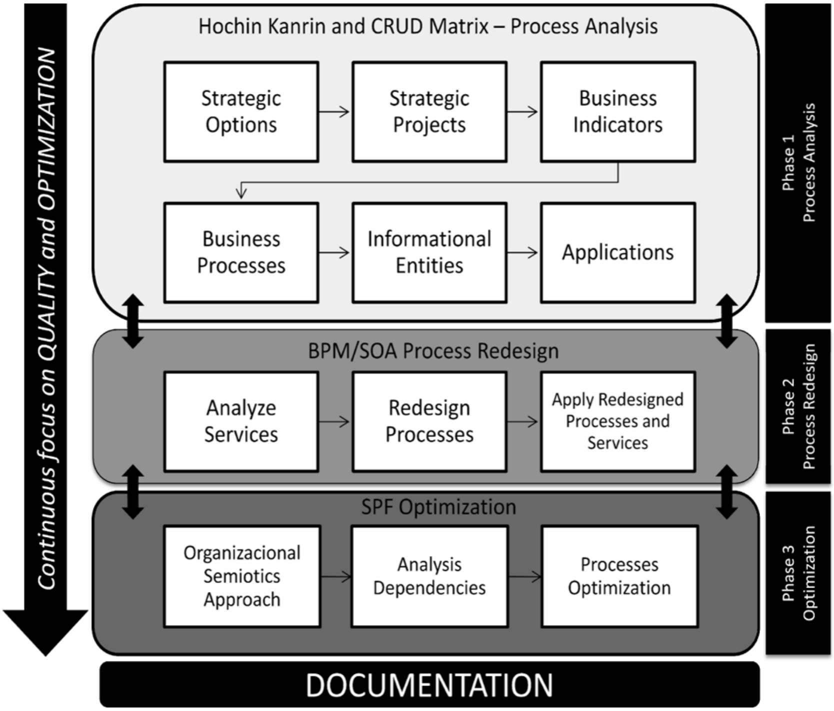

Figure 7. The Business Processes Framework for HEIs

Phase 1

- Define the strategic options and strategic projects
- Identified the top-level indicators that allow monitoring development of strategic goals
- Describe the business processes
- Identification of informational entities
- Identify the applications (with CRUD matrix)
- Create a survey to map the existing processes, with the matrix Hochin Kanri and CRUD Matrix.

Phase 2

- Analyze services supported by SOA (Service Oriented Architecture)
- Re-design the processes with tools like BPMS (Business Process Management Suite)
- Apply Redesigned Processes and services

Phase 3

- Use Organisational Semiotics - SPF approach to relate human and technology factors
- Analyze the dependencies
- Processes Optimization
- Create a survey that allows evaluating the optimization and increasing quality of processes.

Figure 8. Three main phases of Framework

order to create an educational framework that allows a better process management. With process portfolio we want to create a document with all procedures of HEI that can be useful to control and optimize it. BPMS allow us to evaluate and analyse, in a simulated environment, if the services and processes are well defined, removing the cost and complexity of the implementation of the model. Obtaining a simulation of how it works, thus achieving optimal even before approaching the real environment of the organization. This methodology is intended to be more agile and adaptable to HEI, and the requirements delegated. There is a continued focus on optimizing that seeks to increase the quality of all processes in any of three levels: meta-processes, processes or sub-processes.

Conclusions And Future Work

In the educational context processes optimization and quality enhancement can lead to changes that our framework intends to become milder with a wider range of areas within the HEI. The approach using enterprise architecture, SOA and BPM manages processes, but only with the help of semiotics, using the SPF, can we really validate how information moves within the organization, and the responses of the various views that can help us in further analysis. We present a framework that enables the optimization of processes and the approach to the institutional strategy, giving a good set of very useful business indicators to help decision making in HEI. The application of the framework may ensure business processes management optimization and quality towards the success of HEI information systems.

Thus, because of the specific nature of the organic unit, it is our objective to apply BPFHEIs at ESS. This choice was due to school size is small, with few procedures and therefore we expect to be a good organization to apply this framework at the beginning, making the ESS a case study, being the next step to apply the framework in other IPS organic units.

A Process Management appropriately adapted and adjusted to reality, has a key role, since this is help to achieve their objectives and this framework is one more added value to the IPS, to implement an internal quality and brings to the institution a competitive advantage in the rigorous educational "market".

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E-governance & E-administration

Using Microsoft Analysis Service to Analyze Graduates' Performances and Working Conditions

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Keywords

data warehouse, analysis services, AlmaLaurea, quality assessment

Abstract

Since 1994 several Italian Universities have been gathering invaluable information about their graduates. They founded a Consortium, AlmaLaurea, which had the mission to collect data in a central database, submit surveys about working and studying conditions after graduation. Presently 60 Universities (representing 70% of Italian students) joined AlmaLaurea Consortium.

Every year AlmaLaurea releases a detailed report about the Italian graduates' profile and their working conditions. The report consists of a qualitative analysis together

with a detailed quantitative datasheet. Measurements and statistics can be evaluated from a bird-view perspective aggregating together the records of all the universities to the deeper granularity (e.g. comparing male and female performance and condition for each single course of study). AlmaLaurea represents one of the fundamental sources of information about the Italian University outlook.

AlmaLaurea has been collecting a large amount of information during its activity. Beside the main graduate's database and related survey results, we can find other precious sources: the activity of companies on the CV database, the job offer posting and the job application sent back by graduates. Using all these information, we are able to estimate the preferences companies use to select curricula, the characteristics of the degrees owned by graduates selected from the database, the most attractive degree, the professional figures mainly required by companies, etc.

As a consequence you can answer to a lot of questions about the labour market related to University graduates. You can estimate how companies behaves as a function of their dimension, theirs field of activity, their location. The number of questions is virtually infinite.

In order to answer to those questions, we should be able to retrieve and analyse data in a smart way. Therefore we need to:

- organize all these information in a structured and well documented data warehouse;
- introduce the right tools to query and analyse them.

This work is the natural follow-up to the paper presented during the last EUNIS conference in Santiago de Compostela (Leone et al., 2009). There we addressed the first issue, introducing a list of all available data sources and starting the building of the data warehouse. It was necessary to face issues of different kind: technical, organizational and even legal, like the respect of the regulation about privacy. Here we present the further work. How the structure of the data warehouse is growing and evolving according to Kimball theories (see Figure 1). Moreover we are experimenting analysis tools, like Microsoft Analysis service, to query and analyze the data.

We will describe the logical structure of the database, the nature and the content of the fact tables and the dimensions. How these concepts have been mapped into the Microsoft Analysis Service model. To better understand the potentiality of the instrument we are designing the report structures together with people working on quality assessment and statistical observatories inside the 60 partner Universities.

Introduction — AlmaLaurea

AlmaLaurea was founded in 1994 on the initiative of the Statistical Observatory of the University of Bologna in order to provide innovative services to graduates, companies and universities. Today AlmaLaurea is a Inter-University Consortium of 60 Italian Universities (the overall number of public and private Italian Universities is about 80) supported by the Ministry of Education, University and Research. Every year about 180.000 new graduates' records (75% of Italian graduates) are added to the database. Presently the database collects 1,540,000 graduates' records and 1,370,000 is the number of CVs available to the employers.

AlmaLaurea was set up with the aim of building a National statistical observatory of the University and its relationships with the enterprise world. AlmaLaurea, putting businesses and graduates in contact, became a reference point within the university system for the subjects involved (scholars, operators, etc.) in university education, employment and the development of young people in general.

Figure 1. Universities in AlmaLaurea (2009)

Every year AlmaLaurea publishes two analyses on Italian graduates:

– **Annual Graduate Profile Report.**
  The Report examines all the graduates of the year, considering their characteristics and performances in the light of a multitude of variables including age at graduation, continuity of studies and attendance, parents' education, social background, study abroad, apprenticeships or internships, foreign languages and IT skills, etc. (AlmaLaurea, 2010-1).
– **Annual Report on the Occupational Conditions of Graduates.**
  The Report provides in-depth information about the employment conditions of young graduates at one, three, and five years from completion of studies, the prospects of the labour market and the relationships between university studies and employment opportunities (AlmaLaurea 2010-1).

Overview of available Data Sources

The central data warehouse of AlmaLaurea contains information originating from different data sources and subjects. The main source is the relational database of AlmaLaurea, which manages and helps personnel in the process of verifying, validating and cleaning data, which come from two entities:

- The **universities** taking part in the Consortium which -besides population data regarding the graduate community- send data concerning the title achieved, the university career, the thesis which has been carried out and previous educational qualifications (including the high school diploma).
- The **graduate** community which, through the filling in of a detailed on-line questionnaire, provide data pertinent to linguistic and computer related expertise, possible working experience during studies and type of employment which is seeked. Besides this, they provide an accurate assessment of the university experience which has been carried out.

The annual reports are made available, with different levels of details, to universities, to the Ministry of university, to the press and to all the visitors of the AlmaLaurea website.

Over the years the number of reports produced and of variables analyzed has grown considerably, in order to satisfy the demands of very different subjects requiring statistics with very different levels of granularity. The reports allow simple, but highly detailed comparisons among universities, faculties, disciplinary areas and, at the finest detail, the specific course of study. Data can be compared also along the time.

After that the aforementioned data have been checked and cleaned (Leone et al., 2008) all the collected information is made anonymous and integrated into the warehouse.

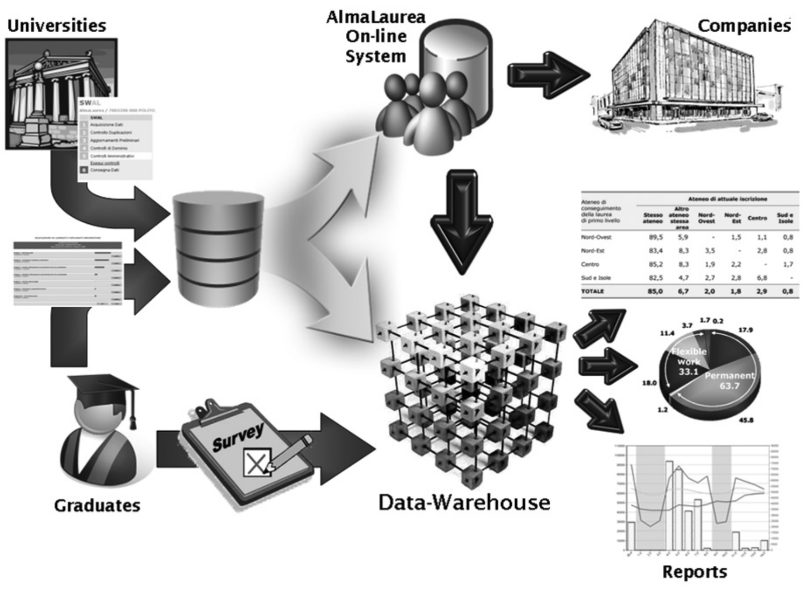


Figure 2. Schematic Data Flow in the AlmaLaurea Data Warehouse

A very well identified subset of the available information is used to build a rich and structured curriculum vitae. Graduates have also the opportunity to publish their CVs on-line in the AlmaLaurea website to favour their access to the labour market. In fact, companies can search and browse the online database. Graduates can modify their CVs, adding information about post-graduation training courses and work experiences.

The analysis of the efficiency of the University system is enriched by data provided by various interviews regarding the employment and studying conditions after graduation. The surveys are conducted in a systematic way in the years following the degree completion (Camelli et al., 2008). These interviews are conducted through CAWI (Computer Aided Web Interview) and CATI (Computer Aided Telephone Interview) methodologies.

Also information derived from activities related to the on-line CV done by companies and graduates themselves are conveyed in the DW. We can mention data originating from the distribution of CVs to companies, from the publishing of work offers on the noticeboard of the website and from the spontaneous application of graduates to these offers.

To give an idea of the number of the different analyzable combinations one can consider that the cube of the analysis of the graduates of the solar year of 2009 from 52 different universities taking part in the consortium (about 190.000 graduates) consists of 13 dimensions and, if all significant aggregations were calculated, one would have more than 6.000.000, each of which would count more than 100 calculated members.

The same kind of analysis and report is done yearly to analyze the employment condition of graduates one, three and five years on after graduation. The acquisition of the data necessary to this kind of analysis is done through CAWI and CATI surveys.

Also in this case reports having different levels of granularity – up to the level of the single degree courses-are produced. The possibility to supply significant statistics with a very fine level of granularity is guaranteed by the high number of graduates that we try to contact for the survey and also by the fact that the answer rate is always over 70% , with a maximum of 95% for the cohorts that are the most willing to answer.

In addition to these data-marts, which can also be consulted publicly, there are another ones which are currently available only to the internal researchers. As for the reports – which are still being elaborated and validated – they will be available to the universities which will apply for them through an extranet system. Through these reports it will be possible to analyse several factors related to the quality of the human capital produced by universities, such as:

- The sectors which are mostly required by companies in a given period.
- The possibility to be selected on the basis of the age/ age at graduation.
- The importance of factors such as foreign languages skills and diplomas certifying them.
- The characteristics of the CVs which are the most read by companies and their dependence from factors such as: the company economical sector, the main office and the dimension of the company.

Data collection process

The data warehouse collects data from several and heterogeneous sources. Some data are collected by structured questionnaires filled online by the users themselves (CAWI – Computer Aided Web Interview) or by an interviewer (CATI – Computer Aided Telephone Interview). Other data are collected by relational databases, where the activities of the different users are recorded: search parameters used by the employers when browsing and searching the CV database, the CVs that have been selected and downloaded by employers. Other data are collected directly by the Universities, such as the characteristics of all the degrees.

Table 1. Data source categories

Type	Quality/ Reliability	Transfor-mation	Source	Formats
Interviews	Very high	None	Local	Relational data
Administrative Data	High	Cleaning, Trans-coding	Remote, heterogeneous	XML
Enterprise information system	Medium	Cleaning, trans-coding	Local/Remote	Relational data, XML
Log data	low	Filtering	Local/Remote	Relational data, text files, XML
Mailing Data	Medium	Cleaning, Trans-coding	Remote	Text/cvs data files

This is the list of the different types of data, grouped by type:
– Interviews.
– Administrative data. Collected from Universities. Extracted from several and different University Information systems.
– Enterprise information system. Data extracted from relational databases.
– Log data. Other data about user activities recorded into system and application logs.

Each category of data is characterized by different quality and reliability, that ETL procedures have to take into account. Moreover we have to deal with different data formats and transferring procedures.

Data Warehouse implementation

The data warehouse implementation is still in progress. We are building the inventory of all the potentially useful data sources and related metadata. The acquisition of a new data source is performed following different steps. At the end of the process a semi-automated procedure allow for periodical import and update of new data.

Table 2. Data source list (partial)

Source	Type	Description	Update Frequency
1	2	3	4
Employment Conditions	interview	CAWI and CATI interviews about graduate employment and studying conditions	yearly

1	2	3	4
Graduates' profile	interview	CAWI interviews about the university experience	Yearly
Graduates' administrative data	Administrative Data		quarterly
Purchased CVs	Enterprise information system		Daily
Job Offers published	Enterprise information system	Job Offers published by Employers in our bulletin board	Daily
CV's sent by graduates to Job offers	Enterprise Information System	CV's sent by graduates in response to a Job Offers	Daily
Placement Dpt. Activities	Enterprise Information System	Employers contacts, sold CVs and subscriptions, turnover, etc	Daily
Graduates Activities	Log Data	Access and Update of CVs, Search of postgraduate courses	Daily
Mass Mailing Activities	Mailing Data	Sent Messages, Number of recipients, Number of reads, of clicks etc	Daily

ETL modules

Extract, transform and load is the first process that you need to execute in order to use data in a data-warehouse environment. This process consists, mainly, of three phases:
– Extracting data from external data sources (file, relational databases, web-services etc).
– Transforming them to fit operational needs (including quality levels).
– Loading them into the final target (data-warehouse).

As shown in the table above, we deal with data sources that are so different in terms of quality of data that we need to project different ETL procedures for each kind of data-sources. The standard process of an ETL process is:
– Cycle initiation (preparation of staging environment)
– Extract data from original sources into bulk load tables
– Validate the data and make some preliminary upgrade on data
– Load Into the Staging Tables
– Transform (clean, apply business rules, check for data integrity, create aggregates or disaggregates)
– Audit reports on compliance with business rules or, in case of failure, on errors
– Publish the data to the final tables
– Archive bulk loaded data
– Clean up the staging environment

Example 1: Loading of Web Sites Log data

To manage our website we use four different web server load balanced by twos, one couple uses Apache and hosts PHP and PERL applications while the second couple uses IIS and hosts ASP.NET applications. Every machine has its own web log and, consequently, we need to join all the files together in order to analyze them. After that we have to bulk load the information cleaning the dirty ones, to classify the new pages and to group them into visits. Finally the data are loaded into the final relational tables designed using the star-schema.

- Truncate of the Staging Environment
- Data are extracted from log files and loaded into bulk load tables
- Data are splitted into fields. Incomplete lines are deleted. Fields that exist only in one web-log format are deleted from bulk tables. All records that are not relative to page request (i.e. JavaScript files, css file, images, etc) are deleted. The same thing happens to records that have not a 200 (OK) status code.
- Data are loaded into the staging tables
- Some transformations are made on data in order to uniform their format (i.e. date/time format, URI format, etc). After that, data are sorted in order to isolate unique visits on website and staging dimensional tables are populated. During this step data

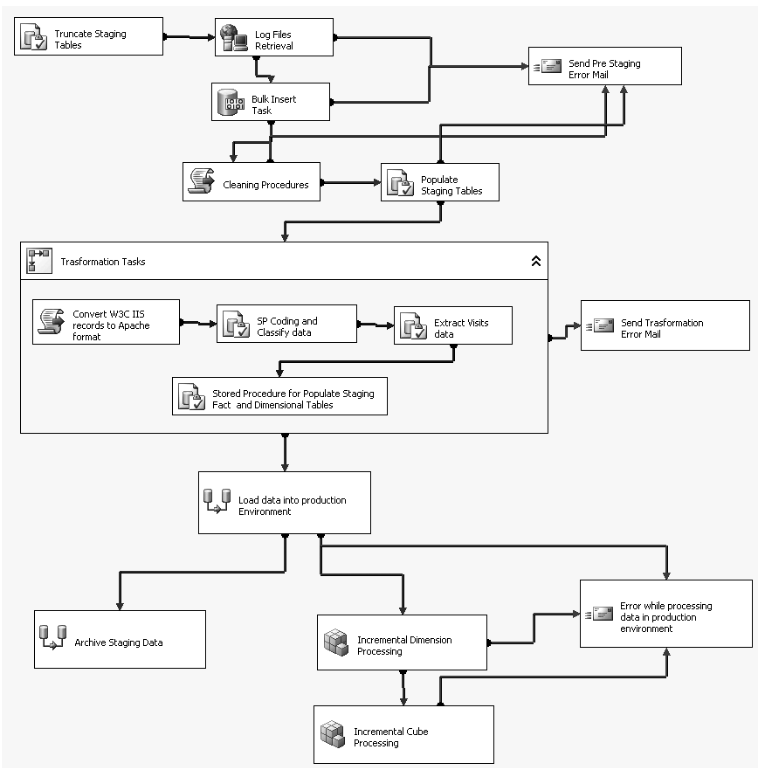


Figure 3. ETL diagram for the web traffic data mart

are coded in order to populate the fact tables and the dimensional ones. New Pages are classified following a set of rules.
– Using a web-application staff users could verify the previous activities and modify page, host or user agent classification.
– Data are loaded into the final dimensional and fact tables
– The data contained into the staging tables are archived
– The staging environment is cleaned

All these steps are made using a Sql Server Integration Services package.

Core data warehouse structure

Figure 4 represents a portion of the data warehouse showing different fact tables, their dimensions and relationships. The main goal of this project is the integration of all the data marts around the main fact/dimension table: the graduates table. Each activity around the AlmaLaurea systems can be referred to a set of graduate records (table Graduates): interview on Employment Conditions (table Employment Conditions), CVs search and download by employers (table Purchased CV).

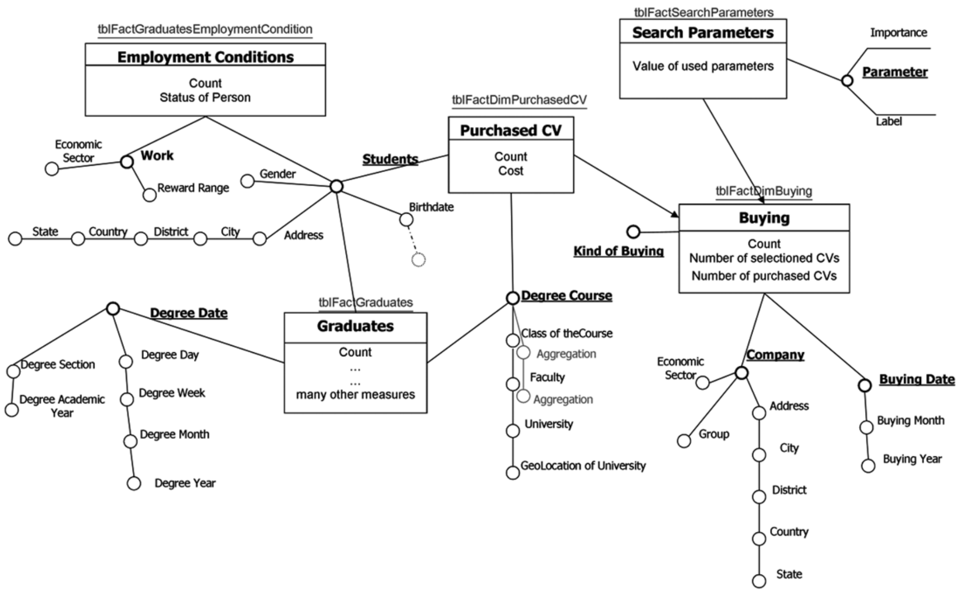


Figure 4. Schematic representation of Fact Tables, Dimensions and Hierarchies

Metadata

An essential component of a data warehouse is the metadata and tools to manage and retrieve them. Ralph Kimball describes metadata as the DNA of the data warehouse as metadata defines the elements of the data warehouse and how they work together. According to Kimball, metadata can be divided into 2 similar categories: Technical metadata and Business metadata. Technical metadata correspond to internal metadata, business metadata to external metadata.

Business metadata stores business definitions of the data; it contains high-level definitions of all fields present in the data warehouse, information about cubes, aggregates, datamarts and so on.

Business metadata is mainly addressed to and used by the data warehouse users, report authors (for ad-hoc querying), cubes creators, data managers, testers, analysts.

Typically, the following information needs to be provided to describe business metadata:

- DW Table Name
- DW Column Name
- Business Name – short and descriptive header information
- Definition – extended description with brief overview of the business rules for the field
- Field Type – a flag may indicate whether a given field stores the key or a discrete value, whether is active or not, or what data type is it. The content of that field (or fields) may vary upon business needs.

Technical metadata is a representation of the ETL process. It stores data mapping and transformations from source systems to the data warehouse and is mostly used by data-warehouse developers, specialists and ETL modelers. The most important pieces of information which you must provide to describe technical metadata are source and target databases, source and target tables, source and target columns and data transformations.

In our system we store all the business metadata into a meta-database. The meta-database contains structured information about each table, fields, and related dimensions.

Metadata also collect management information and the history of all the updates to the data stored into the warehouse.

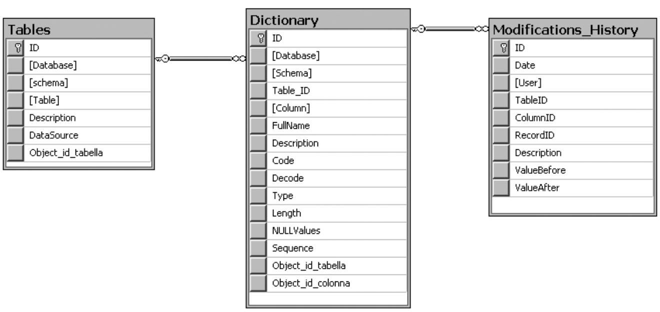


Figure 5. Metadata core diagram

Information about the ETL process, technical metadata, are not programmatically stored yet. They could be pulled out analyzing the structure of the SISS Package

Analysis and Reporting tools

Analysis tools permit to make inquiry on the aggregate data (cubes) built by the system. Typically the analysis features of a system lean on OLAP (On-Line Analytical Processing) technology. OLAP is essentially an approach to decision process that focus on information's dimensional analysis and helps to sole no-structured problems. It uses aggregate data and dimensions because OLAP is oriented to business users and business is made of dimensions rather that of tables. For this reason every business user is able to use an OLAP tool after understanding the concepts of dimensions and hierarchy.

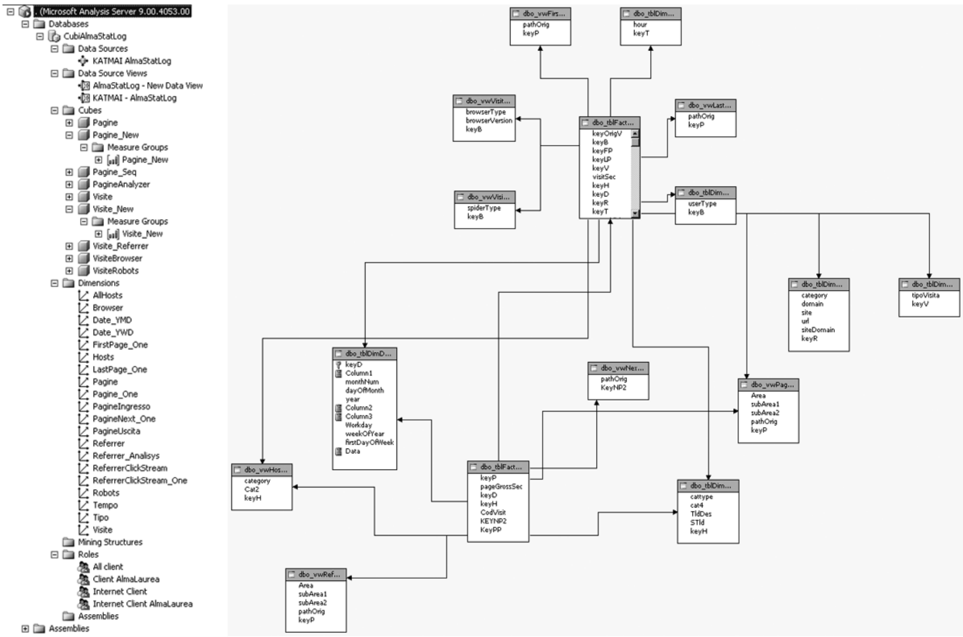
Our solution exploit Microsoft Analysis Services 2005 as OLAP Engine and Microsoft Reporting Services 2008 as tools to explore data. In order to build and deploy projects we use Microsoft Business Intelligence Studio a product that run into Microsoft Visual Studio environment.

First of all you have to build a new "data view" that is a representation of relational tables involved into the project together with relations, primary and foreign keys between tables. Starting from the data view you could easily build dimensions and hierarchies inside them. You can also define different translations for attribute's names: in that way data could be explored in different languages. After creating the dimensions, you can create the cubes. The steps that you have to follow to create a cube into Microsoft Business Intelligence Studio are:

– Select the "data view" involved in the cube
– Select the fact table and the OLAP dimensions. The attributes of the fact tables must be foreign keys toward the dimensional tables connected to selected OLAP
– Create the measures that you want to calculate, the measures group and any calculate attribute
– Create Cube partitions. Partitions enable you to distribute a measure group into discrete segments on a single server or across multiple servers, and to optimize storage and query performance.
– Choose storage settings. Depending on the version of Analysis Service that you are using you could chose between MOLAP (Pure, Scheduled, Automatic, Medium Latency and Low Latency), HOLAP and ROLAP. The main difference between them is:
– MOLAP (Multidimensional OLAP) data is stored in a multidimensional cube. The storage is not in the relational database, but in proprietary formats. Advantages: it could perform complex calculations and exploring data (slicing and dicing operations) have excellent performance
– ROLAP (Relational OLAP) data remains stored into the original relational database and manipulated to give the appearance of traditional OLAP's slicing and dicing functionality. Every operation relies on generating SQL statements to query the relational database. Advantages: you could handle huge size of data without using other disk space. Disadvantages: responsiveness could be poor (slow query performance) and you cannot perform complex calculations because SQL statements do not fit all needs
– HOLAP (Hybrid OLAP) attempt to combine the advantages of MOLAP and ROLAP. For summary-type information, HOLAP leverages cube technology for faster performance. When detail information is needed, HOLAP can "drill through" from the cube into the underlying relational data.
– Defining any data mining model

– Define any measures translations
– Define security policy (Roles)
– Process the cube in order to test it

When you have finished to build all the dimensions and cubes you could deploy the project to the Analysis Service Engine.



a b

Figure 6. Exploring Analysis Services Objects (a). DataView for Web Log Data Cube (b)

Sample one: delay in degree completion times study

The example report of Figure 7 presents the *delay in degree completion times study* (*delay_index*) for different disciplinary areas. This index is given by the formula:

$$delay\_index = (duration - legal\_duration)/legal\ duration$$

where *duration* is the duration of studies and *legal_duration* is the prescribed duration defined for that particular course of study. We must remind that in Italy the real duration of a course of studies is often higher than the prescribed duration. For example, in 2008, just 40% of the student graduated within prescribed degree completion time.

The example shows how this figure changes with respect to the field of study and parents' educational qualification. The report has been improved by associating different colours to different value ranges.

Profilo - Indice di Ritardo

Gruppo disciplinare - Titoli dei genitori

	Titoli dei genitori													
Gruppo Statistico	Solo uno dei due con diploma superiore		Solo uno dei due con laurea		Titoli inferiori o nessun titolo		Tutti e due con diploma superiore		Tutti e due con Laurea		Undefined		Totale	
agrario	0.40	708	0.41	482	0.53	1034	0.40	699	0.31	278	0.72	317	0.46	3518
architettura	0.47	1772	0.42	1524	0.61	2086	0.45	2019	0.36	1037	0.81	865	0.51	9303
chimico-farmaceutico	0.35	891	0.39	841	0.49	1267	0.34	1047	0.32	545	0.55	375	0.40	4966
economico-statistico	0.41	4918	0.38	3342	0.54	6396	0.38	5267	0.30	1926	0.79	2052	0.46	23901
educazione fisica	0.33	531	0.31	292	0.33	556	0.30	581	0.33	101	0.30	483	0.32	2544
geo-biologico	0.35	1755	0.32	1289	0.48	1977	0.33	2017	0.30	785	0.53	976	0.39	8799
giuridico	0.67	2233	0.56	2439	0.86	3106	0.63	2827	0.41	1713	1.04	3110	0.73	15428
ingegneria	0.45	4086	0.40	3615	0.60	4382	0.43	4929	0.34	2387	0.74	960	0.47	20359
insegnamento	0.46	1992	0.44	765	0.53	3602	0.42	1510	0.49	250	0.54	1763	0.49	9882
letterario	0.52	3193	0.47	2853	0.72	3796	0.48	3887	0.39	1821	0.81	2737	0.57	18287
linguistico	0.40	2205	0.38	1315	0.59	2556	0.38	2311	0.32	739	0.80	1058	0.48	10184
medico	0.16	3467	0.21	2278	0.18	5617	0.18	3064	0.15	1594	0.27	3258	0.19	19278
politico-sociale	0.38	4872	0.38	3421	0.43	6824	0.36	5435	0.33	1901	0.50	2951	0.40	25404
psicologico	0.34	2129	0.29	1423	0.43	2711	0.30	2330	0.27	826	0.46	586	0.35	10005
scientifico	0.46	1049	0.44	870	0.62	1243	0.40	1206	0.27	631	0.63	502	0.47	5501
Totale	**0.41**	**35801**	**0.39**	**26749**	**0.52**	**47153**	**0.39**	**39129**	**0.32**	**16534**	**0.65**	**21993**	**0.45**	**187359**

Figure 7. Course duration delay index as a function of field of study and parents' educational qualification (2008 graduates, all the Universities)

Analysing the report we can immediately see that the medical sector has better performances (lower values for this index), and the result can be very easily explained reminding that the courses of study in this area require an admission examination. In Italy most of the courses of study are open and do not require any examination.

Profilo - Indice di Ritardo

Gruppo disciplinare - Titoli dei genitori

	Titoli dei genitori													
Gruppo Statistico	Solo uno dei due con diploma superiore		Solo uno dei due con laurea		Titoli inferiori o nessun titolo		Tutti e due con diploma superiore		Tutti e due con Laurea		Undefined		Totale	
agrario	0.21	94	0.26	67	0.53	87	0.37	90	0.32	49	0.85	32	0.38	419
architettura	0.31	58	0.38	41	0.38	67	0.30	58	0.41	34	0.63	8	0.36	266
chimico-farmaceutico	0.28	63	0.33	102	0.47	95	0.31	81	0.35	68	0.43	19	0.36	428
economico-statistico	0.35	454	0.31	382	0.39	500	0.30	489	0.22	221	0.85	155	0.36	2201
educazione fisica	0.37	47	0.24	32	0.38	47	0.31	52	0.08	12	0.55	39	0.36	229
geo-biologico	0.22	119	0.25	131	0.31	96	0.22	165	0.23	74	0.43	54	0.26	639
giuridico	0.66	163	0.48	225	0.80	173	0.59	231	0.34	177	0.98	161	0.63	1130
ingegneria	0.39	372	0.35	370	0.51	364	0.40	459	0.34	287	0.97	31	0.41	1883
insegnamento	0.30	199	0.49	102	0.38	307	0.31	174	0.51	40	0.54	90	0.38	912
letterario	0.46	424	0.40	459	0.56	394	0.40	492	0.40	293	0.75	627	0.51	2689
linguistico	0.31	169	0.28	125	0.50	163	0.30	177	0.27	89	0.76	54	0.37	777
medico	0.17	195	0.16	168	0.20	242	0.17	186	0.17	136	0.24	112	0.18	1039
politico-sociale	0.30	442	0.26	422	0.47	429	0.30	511	0.26	294	0.51	170	0.34	2268
psicologico	0.12	116	0.19	73	0.28	117	0.15	102	0.13	36	0.66	8	0.19	452
scientifico	0.35	106	0.46	113	0.53	132	0.29	131	0.33	80	0.62	28	0.41	590
Totale	**0.34**	**3021**	**0.33**	**2812**	**0.45**	**3213**	**0.33**	**3398**	**0.30**	**1890**	**0.69**	**1588**	**0.39**	**15922**

Figure 8. Course duration delay index as a function of field of study and parents' educational qualification (2008 graduates, Bologna University)

We can also observe the influence of the parent's educational qualification: better results for higher qualification. The index grows from a minimum of 0.32 when both parents are graduated (a delay of 1 year in a course that have a prescribed duration of 3 years) to 0.52 when parents have lower educational qualification or no educational qualification.

Reporting services automatically define a panel where the user can select the subset of data for the report. The panel shows all the variables that are defined as parameters in the queries instanced in the report.

For example, we can analyze the same report limiting data to the graduates of the University of Bologna (see Figure 8). The qualitative behaviour remains the same, but the overall delay index is lower than the national one.

Sample two: relationship between field of study and company type

Figure 9 shows the number of CVs (2008 graduates, University of Bologna) downloaded by companies during 2008. Data are presented by field of study on the rows and company type on the columns. Rows can be drilled down from Faculty level to course of study.

This report is generated combining the fact table of the downloaded CVs and the fact table of graduation (that has the role of a dimension table in this report).

Numero CV Acquistati 5/3/2010 1:25:55 PM

			Tipo Azienda											
Facoltà	Classe di Laurea	Corso di Laurea	Assicurazioni	Associazioni	Azienda Sconosciuta o di Sistema	Aziende	Banche/Finanziarie	Enti	Enti di formazione	Istituto Superiore	Liberi professionisti	Ricerca personale	Università	Total
⊞ Agraria		Totale	14	2	20	192		9	869			70	263	1439
⊞ Architettura		Totale			14	96		35	86					231
⊞ Chimica industriale		Totale	1	1		114		15	5			3		139
⊞ Conservazione dei beni culturali		Totale	12	2		12	10		74			32	38	180
⊟ Economia - sede di Bologna	⊞ finanza (19/S)	Totale	10	19	4	73	84	6	202			166	31	595
	⊞ scienze dell'economia (64/S)	Totale	29	3	7	189	167	5	626		1	381	69	1477
	⊟ scienze dell'economia e della gestione aziendale (17)	economia aziendale	33 1.07 %	8 0.26 %	4 0.13 %	139 4.51 %	259 8.40 %	24 0.78 %	1179 38.24 %	6 0.19 %	0.00 %	1379 44.73 %	52 1.69 %	3083 100.00 %
		economia e commercio - BOLOGNA	57 15.57 %	2 0.55 %	0.00 %	13 3.55 %	32 8.74 %	1 0.27 %	94 25.68 %	0.00 %	0.00 %	167 45.63 %	0.00 %	366 100.00 %
		economia e gestione delle imprese	3 0.84 %	1 0.28 %	1 0.28 %	24 6.72 %	67 18.77 %	0.00 %	198 55.46 %	0.00 %	0.00 %	47 13.17 %	16 4.48 %	357 100.00 %
		economia e management dei servizi turist ...	11 20.37 %	0.00 %	0.00 %	1 1.85 %	3 5.56 %	0.00 %	28 51.85 %	2 3.70 %	0.00 %	7 12.96 %	2 3.70 %	54 100.00 %
		economia e marketing	42 2.67 %	1 0.06 %	4 0.25 %	99 6.29 %	134 8.52 %	12 0.76 %	888 56.45 %	1 0.06 %	0.00 %	361 22.95 %	31 1.97 %	1573 100.00 %
		economia e professione	13 1.37 %	3 0.32 %	1 0.11 %	61 6.41 %	83 8.73 %	5 0.53 %	402 42.27 %	2 0.21 %	0.00 %	366 38.49 %	15 1.58 %	951 100.00 %
		Totale	159	15	10	337	578	42	2789	11		2327	116	6384
	⊞ scienze economiche (28)	Totale	39	1	7	91	156	21	916			655	56	1942
	⊞ scienze economiche per l'ambiente e la cultura (83/S)	Totale	12	1		25	24	1	263			48	5	379

Figure 9. Companies activity on the CV database by field of study and company type

Technical details

The project is still in progress. While the implementation of the data warehouse and ETL procedures is still in progress, the reporting layer is still under analysis.

Microsoft analysis and reporting tools are an hypothesis that we are still evaluating. At the time of writing of this paper we are still working on data mart design, while the reporting layer is running on development machines with limited resources. We are planning to deploy a first test architecture by the end of year 2010, with a basic set of data mart and access to AlmaLaurea University members.

Conclusions

We presented a case study regarding the use of Microsoft Analysis Service and Microsoft Reporting Service to analyse and present the data contained in the AlmaLaurea Data Warehouse. The data warehouse implementation is still in progress and we are trying different software solutions to build the presentation layer.

Microsoft tools promise to be the best choice combining simplicity, flexibility and compatibility with the technical infrastructure and the application environment of AlmaLaurea.

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Identity Federation Beyond National Borders: Connecting the SIR Service to the STORK Infrastructure

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Keywords

STORK, SIR, cross-border, federation, digital identity, interoperability

Abstract

Federated identity is a key topic in any organization nowadays. It has evolved from an in-campus test technology to nation-wide production services in only a few years, thanks to the growing user community, the standardization of protocols and the effort on establishing trust links between service and identity providers.

In Spain, RedIRIS (the Spanish National Research and Education Network) operates an identity federation called SIR. With the aim of broadening the services available for the community, RedIRIS is exploring the links with international initiatives, such as STORK. The STORK project (Secure idenTity acrOss boRders linKed) establishes a legal, organizational and technological platform, which will enable EU citizens to access e-government services by presenting their actual eID. The 29 participants from 14 countries in the consortium have defined and are implementing common specifications for mutual recognition of national electronic identities; in order to test these specifications, the project will deploy a platform on which different pilots will demonstrate the usefulness and viability

of delivering cross-border electronic services in Europe. One of these pilots is called 'Student Mobility', that will enable students to get access to online administrative services offered by a particular University using their national eID card of origin.

This paper shows the design and implementation of the interconnection between the SIR federation and the Spanish national authentication service from STORK, fruit of the collaboration between CRUE (Spanish Conference of University Rectors), Universitat Jaume I de Castellón, RedIRIS and Indra.

Background

The implementation of the Student Mobility pilot is not built from scratch, but relies on preexisting infrastructures that ease the integration for university services. Here we will analyze the Spanish academic federation SIR and the STORK infrastructure.

The SIR Service

SIR (Servicio de Identidad de RedIRIS) provides a single entry point to digital identity services for the Spanish academic community. It acts like a hub, connecting the local infrastructures to a central point of information exchange, and offers compatibility with several protocols on both IdP and SP sides: SAML1.1, SAML2, Shibboleth 1.3/2.x, eduGAIN and openID.

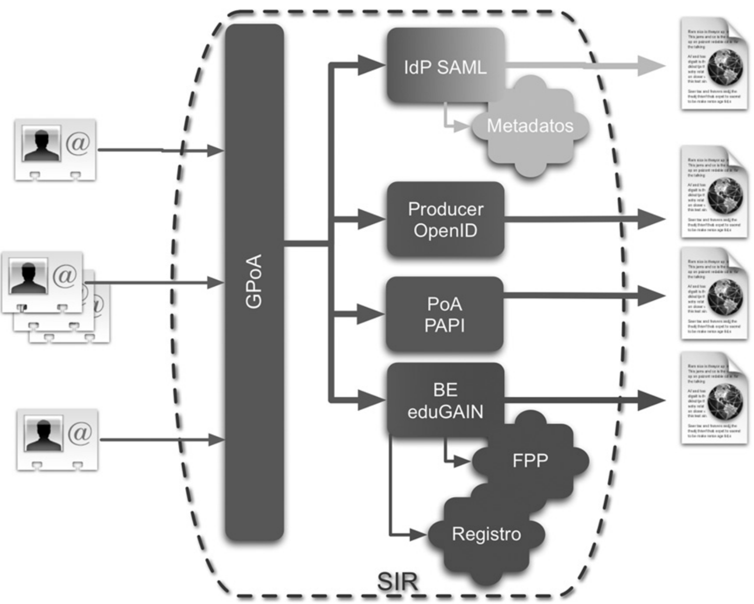

Figure 1. Technical view of the SIR service

With SIR, universities acting as Identity Providers (IdPs) have to deploy their connection to SIR only once; Service Providers (SPs) are made available to them seamlessly when they join the federation (of course, there should be some kind of agreement or contract between IdP and SP). RedIRIS takes care of enabling the appropriate connector for the SP and aggregating the metadata for the participants.

Universities can also act as SPs, offering their services to the federation: this is the case of University of Cordoba, which offers a dropbox-like service to the community; and of University Jaume I of Castellón, that has enabled federated access to their mediatheque. Following this model, Spanish members of the STORK pilot on Student Mobility will offer e-administration services to STORK users.

Joining SIR provides a range of benefits for both Service and Identity Providers:

– Access to a consolidated federation, with 54 IdPs and 118 SPs (as of April 2010)
– Seamless integration with the federation, thanks to the multiprotocol nature of SIR
– Support and advising for institutions affiliated to RedIRIS
– Centralized management of metadata and attribute mappings (on demand)
– Privacy preservation on both ends
– Independence of authentication mechanisms and LoAs (Levels of Assurance)
– Ad-hoc Discovery Service: when accessing a SP, users see a restricted list of IdPs (those who have an agreement with the SP)

The STORK project

The STORK project aims to establish an European eID Interoperability Platform that will allow European citizens to use their national eID to establish new e-relations across borders. The project will test cross-border user authentication by means of five pilot projects that will use existing government services in EU Member States. In time, the number of cross- border services available to European users will increase as more service providers become connected to the platform.

Thus in the future, citizens should be able to start a company, get their tax refund, or obtain their university papers without physical presence; all they will need to access these services is to enter their personal data using a national eID, and the STORK platform will obtain the required guarantee (authentication) from their government.

Most EU countries have already deployed national electronic citizen cards; citizens are becoming accustomed to them and are beginning to enjoy the benefits they offer. Other countries have opted for simpler solutions based on user ID and password, sometimes complemented with other identification mechanisms.

The goal of the project is not to replace any existing national infrastructure, but rather to take what is already available and to connect all the various authentication methods with transparency, in such a way that any of these methods will allow users to present their certified personal data to foreign administrations.

The Student Mobility pilot is intended to facilitate students' mobility across Europe. It will enable foreign students to get access to online administrative services offered by Universities using their national eID of origin for authentication and transfer of identity attributes. In Spain, these services include the enrolment for Erasmus students and registration of foreign students. In order to use them, a student will follow these steps:

- The student will access, for example, the registration page at Universitat Jaume I de Castellón.
- The student will be shown a country list, and will choose his/her country (in this example, Estonia).
- The student will be redirected to the university country's PEPS (PanEuropean Proxy Service, the national STORK entry point); in this case, it will be the Spanish PEPS.
- The student will be redirected to the Estonian PEPS transparently.
- The student will authenticate by means of his/her credentials, and will give consent to the issuing and transfer of data.
- Then, he/she will be redirected back to the Spanish PEPS, which will forward him/her to the university's registration page.
- The registration page will check if the authentication has been successful, and act accordingly (by recording the user's data into the application, or asking him/her to enter the data manually).

Challenges

Seven Spanish universities are part of the student mobility pilot of STORK. Therefore, in order to implement the pilot, some online services of these universities should be connected to the STORK infrastructure. Bearing in mind that most of them are already connected to the SIR service, it looks reasonable to implement only one connection between SIR and STORK.

Generally, connecting to SIR requires exchanging metadata documents and maybe a protocol adaptation; but in the case of STORK there are some more challenges:

- Protocol: STORK has defined an extension of SAML2 (SAML2-STORK), which isn't supported in the SIR federation.
- Deployment: The SAML2-STORK engine has been developed in Java, while the SIR federation is based on PHP.
- Attributes: Most Spanish institutions follow the iris-* and schac schemas to represent users and attributes in their directories, thus needing an adaptation to the specifications of STORK.

To implement this, and after studying the two infrastructures, the most reasonable solution was to deploy a new protocol adaptor inside SIR, as an addition to the current ones. This connector would have the ability to generate SAML2-STORK requests and receive SAML2-STORK responses, solving the protocol issue.

The next question is: how to implement this connector? Instead of writing a new connector from scratch for SAML2-STORK, it seemed reasonable to make use of the library being developed by the STORK consortium, therefore avoiding the re-implementation in PHP and providing a better maintenance of the interconnection, as any change in the SAML2-STORK profile will be reflected in the library.

This library is written in Java, thus creating the second challenge mentioned earlier as it needs to be used by a PHP class. The solution to this was to develop a simple web service, that can be instantiated by a PHP connector in SIR, and which will query the SAML2-STORK engine to create requests and validate responses.

Finally, there was the issue of attribute mappings: while STORK defines a set of attributes that can be used within their infrastructure, most Spanish universities follow the iris-* and schac schemas. It was decided that each university will make their choice, by doing the mapping locally, or asking SIR to do it for them.

Architecture

A high level picture of the architecture is depicted in Figure 2, with special emphasis in the interconnection components (the SIR-STORK box)

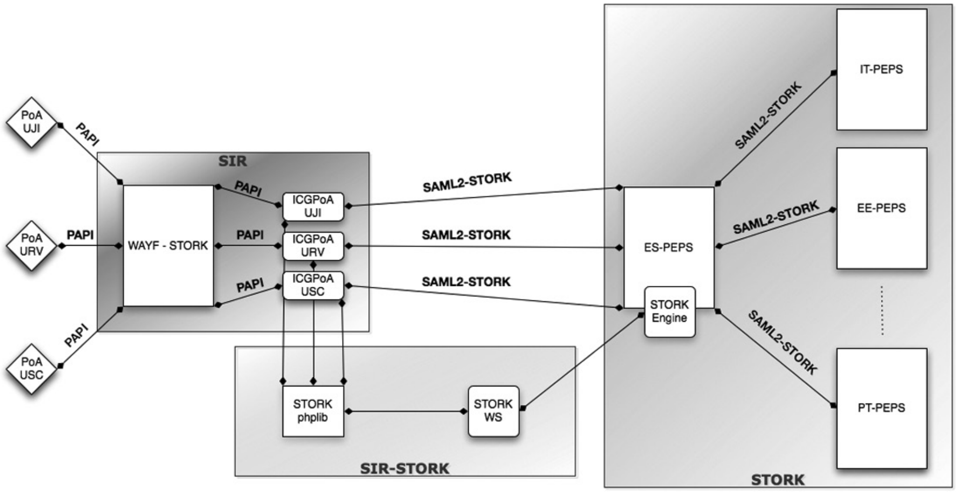

Figure 2. SIR-STORK interconnection architecture

To explain all the components, we will follow the same use case explained in the end of section 2.

– *The student will access, for example, the registration page at Universitat Jaume I de Castellón (UJI)*

  The service is protected by some kind of federation software (Service Provider software). In the PAPI protocol, which is the one being used to internally connect to SIR, this software is called PoA (Point of Access). So the PoA will redirect the user to SIR using the PAPI protocol.

  The image also shows other Spanish universities, to have a complete view of the architecture.

– *The student will be shown a country list, and will choose his/her country (in this example, Estonia)*

  The PEPS expects a destination country code in the request, so this decision must be taken before the request is created. Instead of including a country list in each service at each university, it has been decided to have a single list (WAYF-STORK) and deploy it inside SIR.

- *The student will be redirected to the university country's PEPS (PanEuropean Proxy Service, the national STORK entry point); in this case, it will be the Spanish PEPS*

  This is the core operation. The WAYF forwards the PAPI request to a very simple protocol connector between PAPI and SAML2-STORK, called ICGPoA (InterConnection Group-wide PoA); each university will have an ICGPoA, to have enough flexibility in what relates to attributes (which attributes each university expects, and with which mappings, can be defined here).

  The ICGPoA (PHP based) receives the PAPI request; then, it will call the STORK-phplib library, that has the objects and methods to provide STORK-SAML2 requests to the ICGPoA, and will use a web service to connect to the STORK Engine (Java based), who actually creates the request. After this request is made available to the ICGPoA, it will redirect the user to the Spanish PEPS, with the appropriate parameters defined in the SAML2-STORK specification and posting the request with it
- *The student will be redirected to the Estonian PEPS*

  The Spanish PEPS (ES-PEPS) receives the requests, checks for the destination country and redirects the user to the corresponding PEPS. This process is transparent to the user
- *The student will authenticate by means of his/her credentials, and will give consent to the issuing and transfer of data*

  Either wit username/password, software certificate, smartcard-based certificate or any other approved means, the user will authenticate and give his/her consent to the issuing of personal data
- *Then, he/she will be redirected back to the Spanish PEPS, which will forward him/her to the university's registration page*

  This is the other important operation in this flow: the ICGPoA receives a SAML2-STORK response, which is validated against the STORK Engine by means of the STORKphplib and the web service. A PHP object is made available to the ICGPoA, which can now adapt the response to the PAPI protocol as well as the attribute mapping (if necessary). The user is redirected back to the university.
- *The registration page will check if the authentication has been successful, and act accordingly (by recording the user's data into the application, or asking him/her to enter the data manually)*

  The PoA at UJI receives the PAPI response, and provides the result of the operation and the attributes to the registration page.

In the picture, the components (except the PoAs at each university) are separated in 3 big blocks: one for the SIR service components (developed by RedIRIS), another for the STORK project components (developed by the STORK consortium) and the last one that are particular to the interconnection between them (developed by Indra). It is worth noting that, while the Student Mobility pilot is in its early stages, the SIR service that is being used lives in parallel to the production one. In the near future, the WAYF for STORK will be integrated with the production WAYF for SIR (that currently includes IdPs from the Spanish academic community); also, the ICGPoAs will be merged in one and will be available as a new connector in the SIR production service (see Figure 1).

Conclusions

The main conclusion we can take out at this moment is that the pilot is up and running. We have made tests of accessing services at Universitat Jaume I authenticating with Spanish and Portuguese eIDs, with good results. The interconnection infrastructure has proven to be stable, easy to maintain and providing a good user experience.

One of the main goals behind this work was to provide the university administrators with a simple way to integrate their services with STORK. We think that this has been achieved, as the administrators will continue to work in the way they know (in this case, by connecting their applications to the SIR service) and moving the complexity of the interconnection to a central point. For instance, any improvement in the STORK specifications will be applied in the component called STORK Engine, and will automatically be available for all the services in the pilot without a single line of code or change of configuration at the universities.

The next step is to test services in the other Spanish universities that joined the STORK pilot, a work that will help us to improve the infrastructure, documentation and experience. If a university wants to offer a service through STORK, the only thing they need to do is install a PoA that protects the service. As of today, all the universities in the pilot are already in SIR, therefore making unnecessary any other deployments or bureaucratic processes. They know the technology, and are familiar with it and with SIR.

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RBAC in Production, Easy and Flexible

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Keywords

RBAC, capability, business-role, IT-role, workflow

Executive summary

University of Turku (UTU) has implemented hierarchical role based access control solution with Sun Microsystems Identity Manager. The solution, UTU-IdM, has been in production since November 2009. UTU-IdM has improved university's user access management in many ways including automation of user account creation and access control.

With hierarchical RBAC, UTU has been able to implement flexible workflows that support the requirements for access control coming from different it-solutions and rules set by the university rules of finance and the guiding principle of the university.

Background

The University of Turku started the project of renewing user access management solution in autumn 2007. The goal of the project was to replace the in house build solution with commercial product that would implement hierarchical role based access management. Drivers for the project ware upcoming merger with Turku School of Economics, legacy product that was used so far, the need to improve information security among other reasons such as cost savings.

The project included careful planning and role mining before the public European procurement was made. A year of requirements gathering was needed before the request for proposal was ready to be published (TED-publication 115766-2008).

Technical environment

UTU-IdM technical environment consists of IdM software, internal database, source databases, target directories and on board applications.

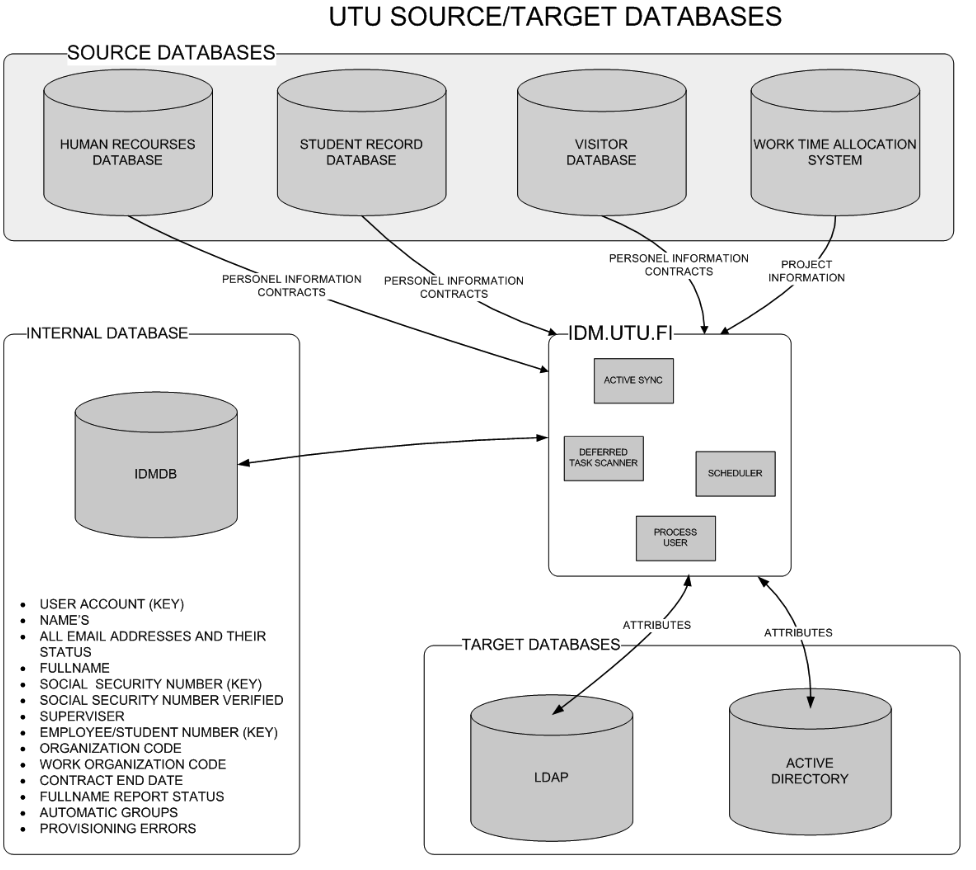

Figure 1.

Source databases

UTU-IdM source databases hold information of students, employees, visitors and projects. The source databases define the main roles, described later in this paper, and identities for the users of the University of Turku. Figure 1 below describes the source, target and internal databases of the UTU-IdM.

Student record database

Student record database provides personal information of the students and their study rights at the university. Personal information is used to create the identities for the students and study right information is translated in to contracts, which are described later in this paper. The duration of the contract defines the length of time the user account is active. Students may have several overlapping study rights effective at same time. Information coming from the student record database is read into the UTU-IdM every morning. Based on the information the new user accounts are provisioned automatically to the state that they are ready to be activated. After activation the final roles are calculated and the students are placed into the correct organizational unit of the university.

Human resources database

Human resources database provides personal information of the employees, their contracts at the university. Personal information is used to create the identity of the employees and contract information is used to place the employees to the correct organizational unit. In addition to the personal and contract information the human resources database provides information of the employees manager, organization role (unit manager, department manager, etc) and possible information of leave of absence which might effect on the user's access rights.

Visitor database

Visitor database holds information of the visitors who need to be able use the it-resources of the university. Visitor database is implemented as an internal resource of the UTU-IdM and it is administrated via the UTU-IdM. Within the database UTU-IdM holds personal information of the visitor and information regarding the visitor contract/s the visitor has. Visitor contract information always includes information of the manager assigned to the visitor. The manager assigned to a visitor needs to be an employee of the university. The visitors are placed into the organizational unit of the visitor's manager. A visitor may have several overlapping visitor contracts effective at the same time.

Work time allocation system

The Work time allocation system provides information of the projects established by the financial department. The project information contains the project number and name, the project manager and project members. The information will later be used to provide specific resources for the project's use. Such resources could be network disks, automatic email groups etc… The concept of project will be added to UTU-IdM during the summer of 2010.

UTU-IdM internal database

The internal database of UTU-IdM consists of the internal database itself and copies of the source databases which provide personal and contract information of the users. The internal database holds only necessary information of the users, so that UTU-IdM can retrieve the rest of the information from source and target databases when needed eq. when the user's information is opened from the UTU-IdM. The Figure 1 below describes the contents of UTU-IdM database. Figure 2 describes the contents of the UTU-IdM internal database instance.

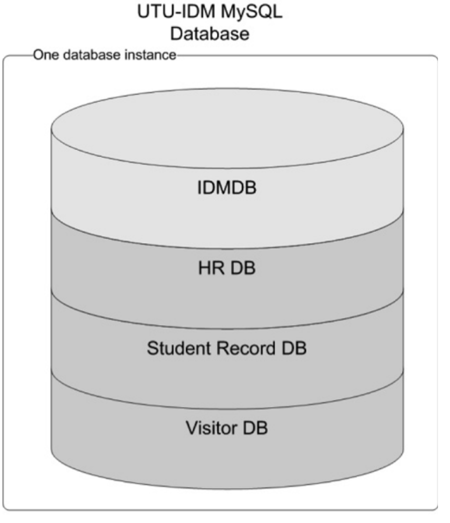

Figure 2.

Target directories

The user information is provisioned as attributes into Sun Directory Server (LDAP) and domain controllers (Microsoft Active Directory). These directories provide the need login information for most of the university's production it-resources. UTU uses LDAP for login into web based applications, email and federated services of HAKA- and KALMAR-federations. In addition the LDAP holds information of the email and posix groups. Active directory is mainly used for login into the micro computer network of the university.

Provisioning users

The process of provisioning new users get's it's impulse from a source database which holds information of a new user. Figure 3 below shows the different steps that are performed by the UTU-IdM while it provisions a new user.

UTU implementation of RBAC

UTU has implemented hierarchical RBAC in to UTU-IdM. Business roles may contain several it-roles which bring in the access rights to the resources and controls if the user account should be active or disabled. A special implementation of a business role is the main

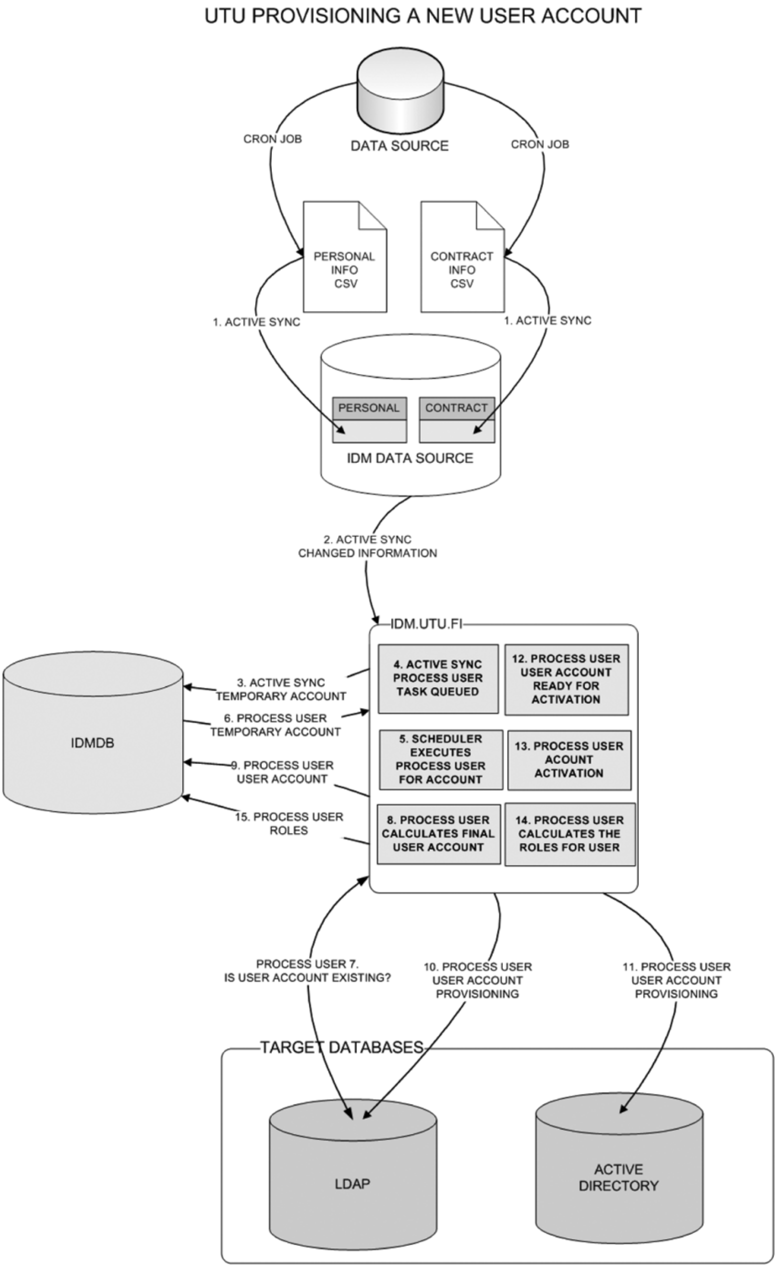

Figure 3.

role which gives generic access rights to employees, students and visitors. Other business or it-roles can be tied to a organizational level which gives simplicity to the role model since there is only need for one department manager role as an example even if UTU has close to a hundred departments in the university organization.

Main role

UTU-implementation of RBAC contains a concept of a main role (type of a business role). Every identity within the system is based on a main role that user gets when his/her user account is generated. Every user has at least one main role but is not limited to one. Current main roles are:
- Employee
- Student
- Visitor

The source of the role is one of the source databases: human resources, student records or visitor database. Out of these source databases the UTU-IdM get's the personal information for each user. In case user is present in more than one of the source databases the solution compares the personal data of a user in the order databases are listed above. As an example if a person is both active employee and student his/her personal information coming from student record database is over written with the information coming from HR-database. Figure 4 below describes the main roles of UTU-IdM.

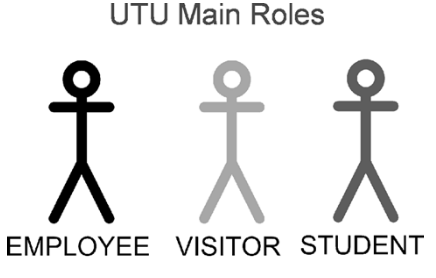

Figure 4.

Business role

Business role is used to group it-roles together and/or to give access to a capability targeted to organizational level to users who have the role. Main role is a business role with special characteristics.

All business roles have common characteristics which control the behavior and effect of the business role:
- May contain other roles
- Capabilities assigned to IT
- Limited to a select group of main roles
- Request able, automatic or assigned
- When request able have workflow connected to IT
- Have specified assigner or approver roles assigned to IT

Capability

Capabilities are used to give special rights for roles. Capabilities can be tied to a organizational level so that the actions that user can do with his/her capabilities can only be targeted to objects belonging to a specific organizational level and below it.

With capabilities a role might have the right to activate user accounts, view other user's information, assign roles to users or approve roles etc.

Contract

Each main role is based on one or more contracts received from the source databases. Once a new person is found from the source database the UTU-IdM pre-provisions the new user. Once the user's contract becomes active his/her account can be activated and the required roles calculated.

A contract always contains the following attributes:

- Start date
- End date
- Organizational unit for the user

Every user may have one or more contracts coming from one or more source databases. Once user's last contract is terminated the user account will be closed. User has only one user account which is created when the first contract of the user is activated.

IT-role

With IT-roles UTU-IdM controls access rights to resources it has control over and gives administrative rights to users. Administrative rights can be such as create a new user account, assign/remove roles from users, reset passwords and active user accounts.

Resource

A resource can be defined as an on board application or access right within UTU-IdM. There are resources that are common to all users (main roles). Examples of these are:

- Email
- Microcomputer network
- Intranet
- Unix

Some resources are specific to a set of predefined users. Examples of these are:

- Access to graphical material of the university
- Automatic email groups
- Student Record database administration
- Access to electronic library material

A user right or access to a resource is managed by it-roles of UTU-IdM. It-role specific to a resource may contain resource attributes which will then actually create the access right to the resource. As an example the UTU-LDAP-Mail it-role provisions the required LDAP-attributes to create the email account for the user.

A resource connected to UTU-IdM needs to be owned by someone belonging to UTU organization.

UTU-organization and roles

UTU has four level organizations: UTU, faculty, department and unit. Faculty level contains seven faculties, special unit organization and university administration according to the Figure 5 below.

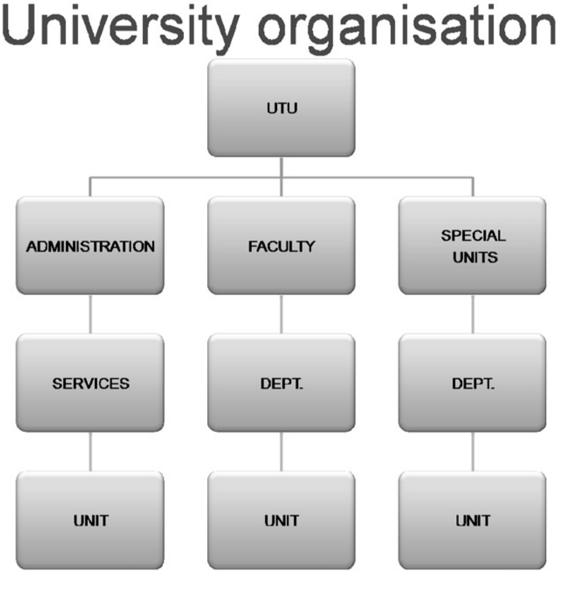

Figure 5.

Every person is placed to the unit level within the university organization according to his/her contract received from the source databases. Figure 6 below describes how different roles are tied to a organizational level of the University of Turku.

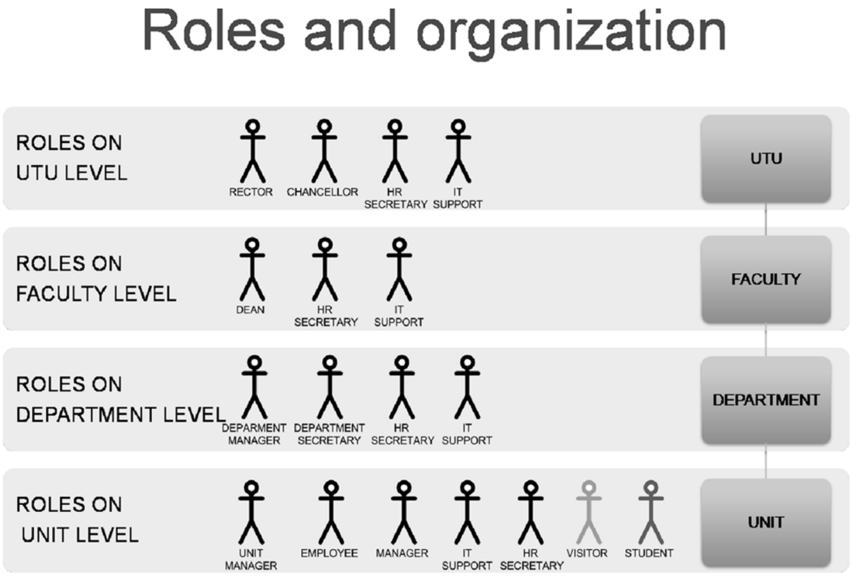

Figure 6.

One user account several roles

A user can have several main and business roles tied to his/her user account at the same time. As an example a person can be an employee, visitor and/or student at the same time. Figure 7 below shows how one user account can be have different roles active at the same time.

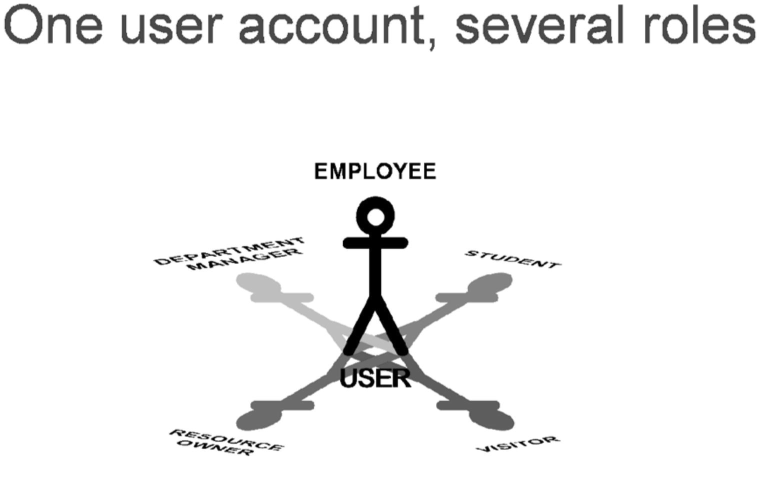

Figure 7.

All of the users roles are tied to his/her contract and to the organizational unit of the contract itself. Figure 8 below describes how the roles above can be tied to different organizations.

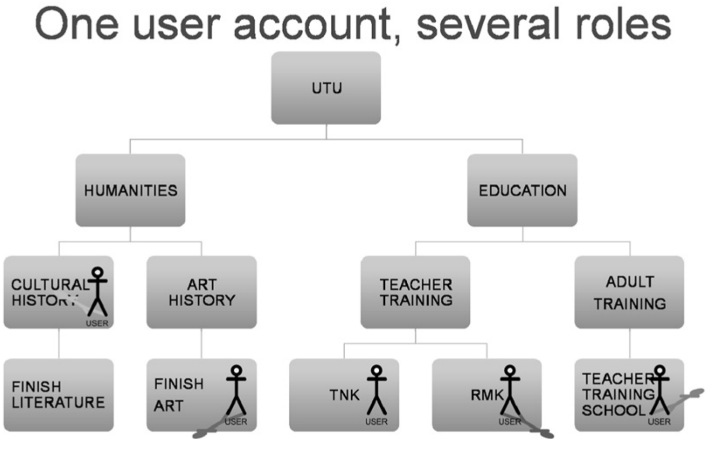

Figure 8.

Workflow

If a role is defined to be request able it has a workflow connected to it. The workflow used when a role is requested can be defined within the role itself. The role contains information which roles can request for it.

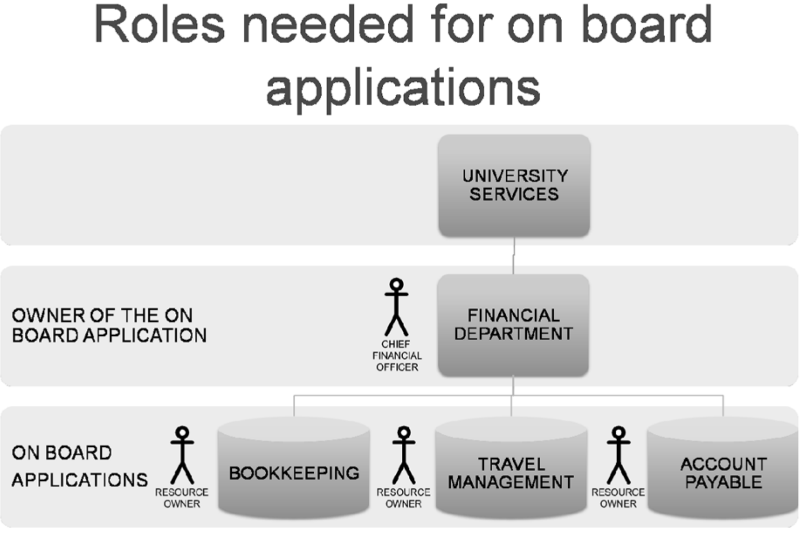

Figure 9.

UTU has defined that a request able role can be received automatically after it is requested or with one or two level approval process. The first or second level approver can be any role that has approver capability with in it and is selected to be the approver within the role.

Figure 9 below shows the roles needed for defining who has the resource owner role for the on board applications of the financial department. The chief financial officer owns the responsibility and delegates his/her responsibility to the employees of the financial department.

Figure 10 below shows an example workflow related to financial applications. According to the university rule for financial the department manager approves the user rights for e.g. travel management system and resource owner belonging to the financial department is responsible for the second level approval.

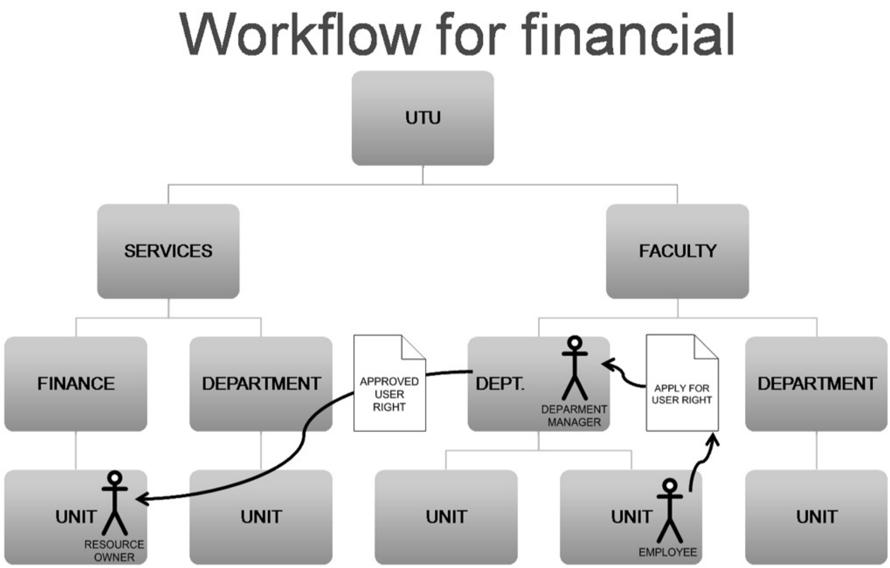

Figure 10.

Directly assigned roles

Roles can be assigned to a user. Assigned role may be so that they have effect only to a part of the organization. IT-support in UTU is organized to central and local IT-support. Central IT-support can manage all of the user rights of the organization. Some parts of the organization have also their own local IT-support teams. The local IT-support may only manage the users belonging below to the organizational level they have management rights to. UTU-IdM administrator defines who is the IT-support manager. The rights to manage users at different levels of the organization are given by the IT-support manger. Figure 11 below gives an example of roles need for centralized and local IT-support.

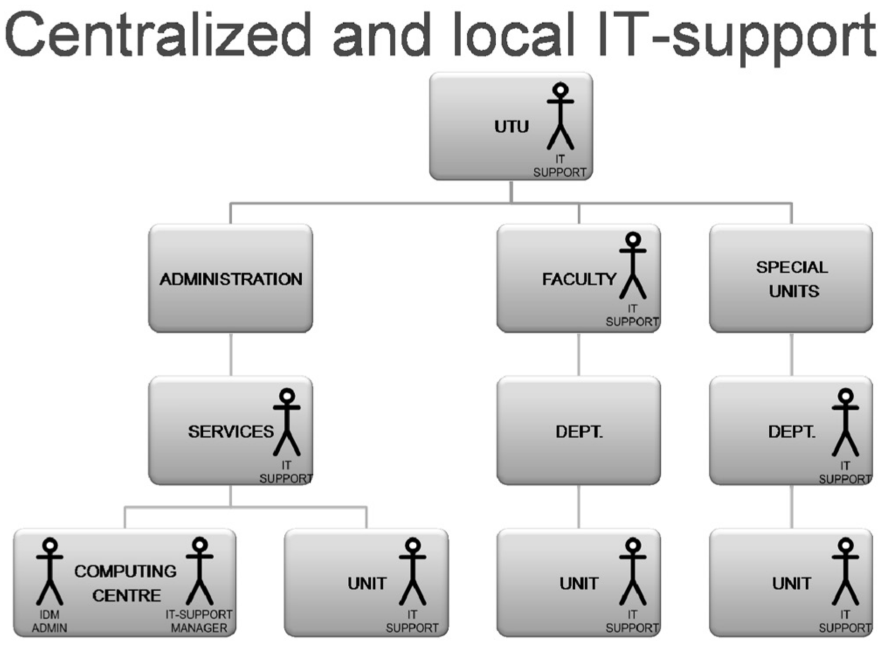

Figure 11.

Further development

The University of Turku has started a project called UTU-SSO to bring in Web Single Sign on features and into UTU-IdM to move from IdM-solution to IAM-solution. In addition more on board applications will be part of the solution during year 2010.

Conclusions

With careful planning, an implementation of RBAC with commercial products, can be cost effective and provide huge improvement to the management of user and access rights for all of the user related to the university of Turku. With commercial products it is possible to outsource the development of IdM or IAM solution. University of Turku has only kept the design of the solution in house, the implementation has been done by the vendor.

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Innovation, University Research and Information Infrastructure — Making Sound Investments in Information Infrastructure

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Keywords

innovation, university research, information infrastructure

Abstract

Innovation determines the prosperity of nations. By equipping people with the skills to innovate, to embrace new and better ways of doing things, business and industry thrives, productivity increases and the nation benefits from a more prosperous and educated workforce. Collaborating and making connections are now integral to the innovation process, as information and ideas may come from anyone, anywhere, making innovation more pervasive, more open. Universities are key agents of a nation's innovation capability, as primary creators and disseminators of new knowledge, through research and teaching. They play a key role in the preservation and diffusion of knowledge through publishing, presentations, consultancies and the like. Increasingly nations seek to not only strengthen the key agencies of innovation, but also the links between them.

"Innovation is built on stocks of knowledge and capability, and the information flows of innovation capital around these." (Cutler, 2008; p.18). If universities are the heart of the innovation system then information infrastructure is the lifeblood. It is through information infrastructure that knowledge is created, manipulated, interpreted, disseminated and preserved: through its libraries, information repositories, communication and collaboration tools, advanced computers, networks and its information specialists. This is recognized in many national and regional innovation strategies as agencies of government invest not only in their universities, but in a range of facilities.

But are we investing in the right ways in the right places if we wish to drive innovation through investment in information infrastructure? What is best done at a local university level? What is best done at a regional level? What is best done at a national level? What is

best done through international collaboration? The global information landscape is rapidly evolving. Innovation, by definition, means change is a constant. Yet this does not absolve us, as university information professionals, from ensuring that our universities invest wisely in developing their information infrastructure, that they exploit regional, national and international opportunities in the most effective and efficient ways.

We must begin by understanding the vision and motivation of three of the key agents of innovation: the researcher, the university and the national government. When mapped against research information infrastructure services it is possible to determine a level of research information infrastructure service that any researcher should expect, that every university should deliver. These services are "pre-competitive" from a university perspective. They underpin the vision and motivations of the nation, the university and the researcher, driving competitive advantage for the nation as a whole, not privileging any university specifically. These are best delivered through national investment and national or international collaboration, in the most cost effective manner. There is a complex middle ground, where the inter-dependent motivations of the agents and the tensions between the short and long term make decision-making complex. Lastly there are services which provide distinct competitive advantage to a university. It is these that will yield the greatest investment benefit in the medium term. This paper seeks to assist universities to make informed investment decisions in their own information infrastructure and provide some observations on the ways in which universities may wish to shape regional or national information infrastructure policy.

Introduction

This paper seeks to provide a framework to assist universities in making sound investments in research information infrastructure in an increasingly complex global knowledge economy. Whilst this paper is written from an Australian perspective, it is clear that in today's globalised world many of the drivers and challenges are common across the world's developed and developing nations – hence the strategies adopted by nations, and universities, are becoming increasingly similar. To develop a university investment framework it is necessary to understand the vision, motivations and strategies of the key agents who drive investment in research information infrastructure. For the purposes of this paper the key focus will be on the nation, the researcher and the university. This paper begins with a summary of the vision, motivation and strategies of these key agents. From this the implications for the development of research information infrastructure are teased out, providing the necessary foundation for the development of a university research information infrastructure investment framework.

A matter of definition

The term "research information infrastructure" within this paper is used in the broadest sense. Whilst much has been written about 'e-research' and 'cyberinfrastucture' the reality is that all research now requires the use of information and communication technologies- it is simply a matter of degree. "Research information infrastructure" within the paper refers to the information professionals, scholarly information, tools and technologies which underpin the research endeavor. Of existing definitions (of which there are many) it most closely resembles that of Borgman – "encompassing the nation's networks, computers, software, information resources, developers, and producers".

Background

The act of research and innovation is a human activity, relying upon individual creativity and imagination, building upon existing knowledge. "Innovation is built on stocks of knowledge and capability, and the information flows of innovation capital around these" (Cutler, 2008; p.18). If universities are the heart of the innovation system then information infrastructure is the lifeblood. We now live in a time where information and communication technologies have fundamentally re-shaped the ways in which knowledge is created, shared and preserved. Networks and associated technologies enable everyone to create, collaborate, access and share knowledge. The boundaries between nations, between organizations, between disciplines, between people have become permeable, increasing complexity whilst creating new opportunities and challenges. This world has been characterized as a global knowledge economy.

The innovation imperative

Innovation theory, and our understanding of the role that universities play in driving regional and national innovation, has evolved over the last twenty years. National prosperity in a knowledge economy rests upon the ability of a nation to apply existing knowledge and to innovate to build economic and social prosperity. By equipping people with the skills to innovate, to embrace new and better ways of doing things, business and industry thrives, productivity increases and the nation benefits from a more prosperous and educated workforce. Collaborating and making connections are now integral to the innovation process, as information and ideas may come from anyone, anywhere, making innovation more pervasive, more open. Many nations are responding to the innovation imperative through significant investment in universities, research and national information infrastructure. Australia has followed this trend, with the Federal Minister for Innovation, Industry, Science and Research commissioning the Cutler review in 2008 to examine the way in which Australia's national innovation system was positioned in a globally competitive Internet-enabled Word (Cutler, 2008). This led to the implementation of a Government innovation strategy, Powering Ideas, in 2009 (Powering Ideas, 2010), a policy framework which seeks "to create a better Australia – a fairer, richer, healthier and greener Australia that can meet the challenges and grasp the opportunities of the twenty-first century….Our aim is to make innovation a way of life" (p.1).

The place of universities

"An internationally competitive economy begins with an internationally competitive innovation system – and that begins with internationally competitive universities" (Powering Ideas, 2010; p.32). Universities, as primary creators and disseminators of new knowledge, understandably feature heavily in the national innovation strategy. Within Australia most public research is done by universities. Universities play an important role as repositories of existing knowledge, together with a nation's research agencies, libraries and cultural institutions, and are hubs for the generation and exchange of new knowledge. Whilst networks are making more information accessible, facilitating collaboration, enabling anyone to contribute to knowledge creation, universities remain at the heart of a nation's innovation capability. Within the Cutler review there was recognition that innovation increasingly relies on distributed inter-organisational networks rather than innovation within an organisation. Universities form part of multi-faceted social or information channels or mechanisms through which information, knowledge and other resources are shared or co-produced- a much richer picture of university engagement than that of the traditional university concept of knowledge transfer (Perkmann, Walsh, 2007). It is this richness that also creates complexity, creating new opportunities and new challenges for universities.

The place of information infrastructure

A nation's information infrastructure is central to its innovation system: from high speed networks, advanced computing and collaboration tools through to capturing research data for reuse, and making government data and national collections held by libraries, museums and other agencies more accessible. Not only do researchers and innovators require the tools to undertake their work, they require access to past knowledge upon which their creativity is founded. Australia creates 2% of the world's knowledge with 1.3% of the world's R&D expenditure (Cutler, 2008; p.20). Within this context national productivity growth will require the capability to adopt and adapt the 98 percent of new knowledge generated by the rest of the world. This highlights the need for a high level of interaction between knowledge providers and knowledge users. The role of the information professional will be critical to the broader innovation agenda. The importance of information infrastructure, in its broadest sense, had already been recognized through the National Collaborative Research Information Strategy which led to the release of a Strategic Roadmap for Australian Research Infrastructure, issued in August 2008. Powering Ideas served to reframe, reinvigorate and increase investment in national research information infrastructure policy and strategy.

Managing in complexity — the multiplicity of agents and priorities

"The networked information economy has not decreased the total capital intensity of information production, storage, processing, and communication, but it has decentralized its ownership." (Benkler, 2008; p.52). Knowledge can now be created, disseminated, shared and preserved (or lost) by everyone. Even if we confine ourselves to university research and its place in national innovation we have a myriad of agents: individual researchers; research centres or groups, which may span organizational or national boundaries; the university; the region; the state; the nation. Overlaying these are other informal or formal groups, such as discipline-based scholarly academies, which may be global in reach. Each of these agents brings their own priorities and motivations to the task of driving research and innovation. Yet to achieve success in a networked global knowledge economy each must work in concert, must avoid competitive behavior which works against achieving shared aspirations for an improved future. Achieving the national innovation agenda requires not just a strengthening of the parts, but a strengthening of the links between those parts (Powering Ideas, 2010; p.1).

This paper focuses on the researcher, the university and the national government (referred to as "the nation"). The following section outlines the vision, motivations and strategies of each of these agents, drawing out the implications from a research information infrastructure perspective.

The researcher

The noble vision of a researcher is to create new knowledge, but in order to keep doing so they must build their research profile to ensure tenure and promotion, and build their reputation to attract research funding and research partners. From a researcher's perspective whilst their focus is clearly on the immediacy of their research they also have an interest in maximizing their research impact through publication and citation impact. As the research environment has become more complex, as the reliance on information and communication technologies has increased across all disciplines, and as a variety of scholarly publishing options have evolved each providing differing impact value, researchers are increasingly valuing the role that information professionals, with disciplinary knowledge, can play as part of their research team. Work undertaken by the author at the University of Melbourne (O'Brien et al., 2008) confirmed this, as has a recent study by Intersect (2009) across four Australian universities which found that academics are seeking expertise in data management, data analysis and IT support.

Very few of the respondents to the Intersect study were aware of the national and state agencies which have been established to advance research information infrastructure, with only 3–4% indicating they used services provided by any of these bodies. The reality is that they care little about where, or how, the scholarly information, systems or infrastructure are delivered to support their research. Their primary motivation is that such services are responsive, easy to use and cheap, or "free", so that they might focus their resources (time and money) on their actual research.

In summary, it is proposed that researchers are motivated to:

- Increase their research impact
- Build their research profile
- Maximize the resources (time, effort, money) available for the actual research

Minimize the resources (time, effort, money) they must devote to providing the research information infrastructure required to undertake the research.

The research university

The vision of a university is to create new knowledge, influenced by national imperatives to seek solutions to the economic, social and environmental challenges of the 21st C. To do so they must continue to attract good researchers, strong research partners and research funding. From a research university's perspective there is an incentive to maximize the value of the university's research outcomes for both the short and long term. Whilst a university's research strengths and priorities will determine where they invest in the immediate term, universities are long lived institutions – they seek to protect their right to research the most theoretical and intractable uncertainties of knowledge, not simply those that have immediate practical application or that might be set as national priorities (Boulton, Lucas, 2008). Universities constantly balance the tension between delivering immediate value to their nation, as measured through research rankings or commercialization of research, with their vision of creating new knowledge for future generations unhindered by the immediate political imperative. Many will seek to foster research and innovation across all their disciplines, hence university information strategies and policies need to support the research base broadly, as well as the areas highlighted as current strategic priorities.

The university's commitment to the long term also impacts on how they consider the management and accessibility of scholarly outputs. The university will be motivated to maximize its overall research impact through publication, but this will, or should, be tempered by a desire to not only increase citation impact and journal ranking but to maximize true impact of research through open dissemination, maximizing access for all, and in protecting scholarly output for future generations of scholars.

From a research information infrastructure perspective the university will seek to maximize the value of its investments, targeting investment where it will add the most value in the short and long term. Universities now realize they must collaborate to compete. There is a strong incentive to lobby for government funding of research information infrastructure collectively, and to compete for government and other funding individually.

In summary, it is proposed that universities, from a research perspective, are motivated to:

- Increase their overall research impact, using rewards and incentives to maximize research output and impact
- Boost their research ranking (prestige) to attract more research funding, good researchers and strong research partners
- Maximize the resources (time, effort, money) invested in driving competitive advantage
- Minimize the resources (time, effort, money) they must devote to providing "pre-competitive" infrastructure.

The Nation

At a national level the vision is to make the future better than the past, to make the nation more productive and more competitive, to address the economic, social and environmental challenges of the 21st century, to improve their nation's position on relevant international rakings such as those of the OECD. Governments, in their desire to build national competitiveness through research and innovation, seek to implement policies and strategies to maximize the value of their investment in university research to increase the economic and social prosperity of the nation. In a globally connected world nations must help their universities to be more competitive, and be more attractive collaboration partners. At a fundamental level they must ensure that appropriate national information infrastructure is in place, through a combination of government investment and stimulation of the private sector investment (see for ex ample (King, Kraemer, 1995), (Andreotta, 1995)).

Within Australia a Strategic Roadmap for Australian Research Infrastructure was issued in August 2008, at the same time that the Cutler Review was released. This Roadmap established a framework for investment in national research infrastructure, focusing on collaboration tools, a national approach to data services, high performance computing, high performance networks and access and authentication frameworks. It was the focus on a national innovation strategy that reinvigorated the national government's interest, resulting in significant further investment in research information infrastructure. More than A$3.1 billion has been allocated to the Australian national innovation agenda with more than a third of the funding targeted to build improved research information infrastructure. Strategies include more than a doubling of funding for the indirect costs of research flowing directly to universities over the next four years. This will provide Australian universities with the ability to increase their investment in research information infrastructure, should they choose to do so. An investment of A$1.1 billion has been made in the Super Science Initiative to "stimulate economic activity, supporting new jobs and building the platform for high-skill, high-wage careers in the future" http://www.innovation.gov.au/Section/AboutDIISR/FactSheets/Pages/SuperScienceInitiativeFactSheet.aspx(Australian Government, 2010), of which $900 million will be directed toward cutting edge research infrastructure. A further A$312 million targets e-research infrastructure:

- $97 million for data storage and collaboration tools through the Australian Research Collaboration Service (ARCS)
- A$48 million to establish a national research data commons through the Australian National Data Service (ANDS)
- A$130 million for national high performance computing initiatives and
- A$37 million for enhancement to the Australian research and education network.

It is also in the national interest to maximize the value of government investments in publicly funded research through policy, by requiring open access to the scholarly outputs from the research: both the published outcomes of the research and the data which underpins the research. Within Australia the major public research granting bodies now require adherence to the Australian Code for the Responsible Conduct of Research (Australian Code, 2007) which requires proper management and retention of research materials and data for use by other researchers, subject to any ethical, privacy of confidentiality considerations.

In summary, it is proposed that the nation, from a research perspective, is motivated to:

- Maximize the impact of publicly funded research to make the nation more productive and competitive
- Boost the nation's ability to attract good researchers, and strong national and international research partners
- Build national competitive advantage through investment in appropriate research information infrastructure
- Drive effective use of public funds by research universities.

Bringing it all together

Creating a strong innovation system requires not just strong agents, but strong links between the agents. The actions of the agents are inter-dependant and, ideally, mutually reinforcing. Research information infrastructure plays a major role in both domains. Lynch (2008, p. 78) posed the question "How does the campus cyberinfrastructure challenge differ from the national cyberinfrastructure challenge, recognizing that investments in these areas should be not just complementary but mutually reinforcing?" He highlights the need for local investment if a university is to be able to fully benefit from national investments. Borgman (Borgman, 2007, p. 252) noted that "The situation calls for ways to balance the local needs of individual scholars, students, and teams with the global requirements of a distributed, multidisciplinary, multilingual, multipurpose e-Infrastructure." The complexity of the current environment should not be under-estimated. Universities have the potential to play a critical role in balancing these tensions, strengthening the links between the agents of innovation for mutual gain. The visions and motivations of the key agents have much in common, and it is these shared senses of purpose which will provide the best foundation for developing investment strategies that are acceptable, and valuable, to the multiple stakeholders. These aspirations must not be lost in the immediacy of daily demands – tactical behaviours must not be at the expense of the longer term strategic vision.

Towards a university investment strategy

Within Australian universities, with more than a doubling of funding for the indirect costs of research flowing directly to universities over the next four years, it is timely to ask if we are investing in the right ways in the right places to drive research and innovation through investment in information infrastructure. As university information professionals we have an obligation to ensure that our universities invest wisely. We have an obligation to our researchers to ensure they are provided with the best possible research information infrastructure services. We have an obligation to contribute to, and exploit, regional, national and international opportunities in the most effective and efficient ways. Universities have a privileged position, with a unique opportunity to strengthen the national innovation system not only through their own actions, but through forging and strengthening the links between key agents within the innovation system.

By mapping the vision and motivation of three of the key agents of innovation: the researcher, the university and the national government, against the range of research information infrastructure services, a university investment framework can be formed.

Pre-competitive research information infrastructure

There is a level of research information infrastructure service that any researcher should expect, that every university should deliver. It is these services that I would describe as "pre-competitive" from a university perspective. They underpin the vision and motivations of the nation, the university and the researcher, potentially driving competitive advantage for the nation as a whole. These are the services which are best delivered through national investment, or national or international collaboration, in the most cost effective manner.

Questions to be asked are:

- Does this service advance the vision and motivations of the university and the nation?
- Does this service provide my institution with a greater competitive advantage if advanced at a national level rather than individually?

If the answer to these questions is 'yes' then influencing government policy and investment strategy, or seeking out collaborating partners, should be the preferred strategy. Examples of this would include high capacity information networks, national identity and access systems and data storage. National competitive advantage is derived from such networks, but from a university's perspective, unless this is an area of research for the particular university, their networks must simply keep pace. Large investments in expensive "landmark" research infrastructure, such as a synchrotron or peak computing facilities would also meet these criteria. Even as increased performance and lower costs make it possible to derive more compute capability at a local level, whether within a university or a research group, with the growth of cloud-based services and increasing interest in driving green IT solutions it is becoming more difficult to justify the benefit of local investment in advanced research information infrastructure.

National identity and access systems are necessary pre-competitive infrastructure, enabling the nation's researchers to become part of the global research community. Universities must invest adequately to participate in such initiatives and encourage national collaboration and investment.

Data storage infrastructure, providing that appropriate security and access measures can be met, provides no competitive advantage to a university. This may be an obvious candidate for national investment, as is occurring within Australia, though it may increasingly make sense to source this internationally through the Internet cloud.

The complex middle ground

Some components of research information infrastructure services blend pre-competitive and competitive advantage in a complex fashion. This is where the tension of long term vision competes with immediate competitive advantage for attention. Where Marginson (Marginson, 2009) urges that we "recognize, understand and factor into our organizational systems the post-capitalist production of knowledge goods, which is the primary zone where we make our future."

Questions to be asked are:

- Does this service advance the vision and motivations of the researcher, the university and the nation?
- Does this service provide my institution with a greater competitive advantage if advanced at a national level?
- Does this service provide my institution with a greater competitive advantage if advanced at an institutional level?
- Does this service provide our individual researchers with greater competitive advantage?

If the answer to these questions is 'yes' then a more complex investment response is required.

Included within this domain are the scholarly publications, research data and associated tools, created by our researchers. Access to the world's scholarly information, which provides the foundation for the development of new knowledge, is arguably pre-competitive. Everyone benefits. Collaboration and investment at a national (or even international level, such as SCOAP3) ensures the best outcome for a university and the nation. Houghton and Sheehan (Houghton, Sheenan, 2006) analysed the literature and quantified the potentially measurable impacts of enhanced access to research findings, for researchers, government and the wider community. These benefits included more timely access to both accelerate collaborative research, adoption and commercialization; a greater opportunity to inform professional practice; the potential to create more informed citizens and consumers with implications for better use of health care, social benefits and education, and potentially improved productivity. Their modeling showed significant economic benefit from open access to publicly funded research, with, for example, an estimated 5% increase in access and efficiency in Germany worth USD 3 billion. Yet peer-reviewed prestige publication is still the route to academic success, and improved university and national research rankings. Publishing in the "right way", which may exclude opportunities for open access publishing, can significantly increase research impact as measured through citation and journal ranking, increasing a university's competitive advantage.

Scholarly output now includes not only the published works but the research data, tools and techniques associated with the research. An unknown amount of this research data will have value for the future as an important part of scholarly output. Whilst researchers are motivated to have ready access to the data, tools and techniques they have previously used for their own benefit, there are strong disincentives for researchers to engage with long-term data management, including concerns of loss of competitive advantage. Universities serve to benefit in a range of ways (see the following section). Again there will be an inevitable tension between maximizing institutional value whilst contributing to the global store of knowledge. This is an area where the researcher, the university and the nation all have the potential to gain competitive advantage if a more coordinated approach is taken, but where the best investment model is still unclear.

Government policy and investment in services which encourage open access to the outcomes of publicly funded research make good sense. But the researcher and the university are also motivated to increase their research impact and prestige. Whether to influence and support government policy, whether to invest locally, becomes a matter of balancing tactical short term advantage for the university with longer term strategic advantage for both the university and the nation. Within Australia policy has been established to encourage open access to scholarly outputs. The government has provided policy incentives and investment to establish university-based digital repositories. Currently significant investment is being made in the development of a national research data fabric and the tools and data storage infrastructure to support this. This is an area of evolving policy, an area that will provide great opportunities, and many challenges, requiring all the agents to work in concert to achieve the best shared outcomes.

Ensuring senior university executive awareness of, and engagement in, national (and international) research information infrastructure opportunities will be critical if the most effective investment decisions are to be taken in the complex middle ground.

Driving a university's competitive advantage

As the services move closer to the actual researcher more competitive advantage can be derived from targeted investment. Where the answer to the following questions is 'yes' there is a distinct competitive advantage to be gained for the university.

- Does this service advance the vision and motivations of the researcher, the university?
- Does this service provide my institution with a greater competitive advantage if advanced at an institutional level?
- Does this service provide our individual researchers with greater competitive advantage?

Where the bulk of research income comes through competitive grant funding for specific projects, and where government funding of the indirect costs of research is allocated out to researchers and research groups on an 'as earned' basis (as in many Australian universities), there is limited incentive for researchers to minimize duplication of services and infrastructure, particularly if they feel they must relinquish control. The researchers putting forward a research proposal may not know what infrastructure service options exist, nor how best to maximize the impact of their research (see for example the earlier studies mentioned). It is unlikely that they will understand how best to manage their research data if it is to provide long term value to the scholars of the future. It is pointless to assume that this will be resolved through researcher training. Researchers are not motivated to understand the evolving national research information infrastructure framework, nor to become experts in information/IT, nor is it a good use of their time and expertise. They may, across some disciplines, have an understanding of the landmark facilities available to them, though this should not be assumed. A university has the potential to derive competitive advantage by including information professionals at the inception stage of the research proposal, and as required throughout the research itself (though this latter work may be best covered by the research grant funding). This will ensure that the research maximizes use of existing university, state or national services and infrastructure (a university motivator) whilst minimizing the resources the researcher must put into providing research infrastructure (a researcher motivator) and driving more effective use of public funds (a national motivator). For the university it provides a distinct competitive advantage in many ways: producing more effective research, making the outputs of its research available for current and future scholars, attracting research partners and scholars and ultimately enhancing the university's research profile.

Whilst research data management forms part of the complex middle ground, there is real competitive advantage for a university through investment in this area. Existing research data can be re-mined and re-used, research algorithms, tools and techniques can be easily shared, large data sets can be visualised to render complex findings in useable ways. With appropriate stewardship research data has the potential to significantly increase research impact, provide competitive advantage to the university and the researcher by increasing their profiles, and attracting research partners and new researchers. Universities are one of the enduring features of the research landscape and hence arguably a logical home for long term commitment to data stewardship. One of the policy problems with data curation and preservation is that the costs persist long after the project ends. Yet universities have invested significant sums of money (through government funding) in building and sustaining library collections for future generations of scholars. They have done so based on a belief that the library plays a key role in supporting their research and learning through preserving and making accessible scholarly output. Borgman (Borgman, 2008) suggests that research data may become the new 'special collections' for libraries.

Lynch (Lynch, 2008) sees the biggest challenge for universities as the design and staffing of organizations that will work with academics to access local, national and global cyberinfrastructure services, assisting faculty to manage their data, prepare for handoff for curation and aiding them in data reuse, mining, computation. By providing such services the university has the opportunity to gain real competitive advantage in both the short and long term.

Whilst open access publishing forms part of the complex middle ground, universities can gain real competitive advantage by making targeted investment in this area. In a complex evolving scholarly information environment it is neither reasonable, nor sensible, to expect researchers to necessarily know how best to maximize their research impact through publishing, nor to understand how best to balance the benefits of open access publishing with decisions about increasing impact though publishing in highly ranked journals. Real competitive advantage can be gained by a university establishing a publishing advisory service to assist researchers to maximize their research impast (O'Brien, 2010).

The new environment rewards researchers who profile themselves and their work most effectively. Researchers seek to build their research impact and profile, universities seek to build their research impact and ranking, and nations seek to maximize their research investment and build national competitiveness. They all stand to benefit from sophisticated systems to link information about university research strengths, researchers, their grants, their publications. There is merit in national policy and investment in this area, but universities and individual researchers, who hold most of the data, will be motivated to promote themselves and their work. Whilst this may be a candidate for the middle ground, in the short term it is likely that the greatest competitive advantage will flow to those universities who promote their research and researchers. Ideally this should occur within a framework that works for the nation and also for the individual researcher.

Conclusion

Innovation, by definition, means change is a constant. Universities have a privileged position within a nation's innovation system, with a unique opportunity to strengthen the nation, not only through their own actions, but through forging and strengthening the links between key agents within the innovation system – building the bridge between researchers, university and national priorities. To achieve success in a networked global knowledge economy each of these agents must work in concert, ideally avoiding competitive behavior which works against achieving shared aspirations for an improved future. These issues are self evident when we consider the research information infrastructure required to drive competitive advantage. By better understanding the vision and motivation of three key agents of innovation it is possible to work toward an appropriate university investment strategy. There is a level of research information infrastructure service that any researcher should expect, that every university should deliver. These services are "pre-competitive" from a university perspective. They underpin the vision and motivations of nation, the university and the researcher, driving competitive advantage for the nation as a whole, not privileging any university specifically. These are best delivered through national investment and national or international collaboration, in the most cost effective manner. There is a complex middle ground, where collaboration and negotiation, coupled with investment at all levels, will provide the ultimate solution. Yet there are some services which provide distinct competitive advantage to a university. It is these that will yield the greatest investment benefit in the medium term.

This paper reflects the context from a time-bounded Australian perspective, a time when policy and technology are rapidly evolving. It is clear that many nations are following broadly similar strategies as we each grapple with increasingly shared challenges and opportunities. As university information professionals it will be our role to assist our universities, and our nations, to make informed investment decisions. This paper has sought to provide some insight into the complexities, challenges and opportunities of the global knowledge economy of which we all play a part.

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AlineaTIC v2: New Features for ICT Governance and ICT Management at Universities

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ICT Governance, ICT Alignment, ICT Management, ISO 38500, ICT performance metrics

Abstract

In (Vicens et al., 2009), we have shown that AlineaTIC should help the board and the ICT staff to align ICT projects with University objectives and ICT budget. The strength of using AlineaTIC resides on monitoring this ICT alignment by explicitly showing (among other features) the current ICT projects and their corresponding ICT principles, strategies, tactics and programs, who made the ICT decisions about project budget, project deadline, milestones, architecture, infrastructure, etc., and also alerting when the implementation of the ICT programs and projects does not implement the strategic principles and objectives defined by the University board.

In this new version of the tool of government ICT, which we call AlineaTIC v2, we have added new features to help datacenters management based on indicators of progress of projects and the services operation to maintain the QoS. Thus AlineaTIC now has a new

module that includes management indicators, for instance, the ICT staff turnover (to measure the efficiency of the management of each area), or even the evolution of the number of incidents according to their importance and their average time to fix them. This new module in will help for CIOs at universities, requiring a continuous monitoring of activities leading to the success of the initiatives raised by the board.

The ICT governance conceptual model that we followed for the development of AlineaTIC is based on ISO / IEC 38500 and AS8015 standards, although we have freely adapted it for building a simple and useful tool for the communication between the CIO and other ICT staff, as well as for the communication between the CIO and the board. On one hand, we first developed, the ICT governance module for helping CIOs to communicate their alignment with board and ICT projects conformance with board goals. On the other hand, we are now presenting in this paper, the ICT management module which helps CIOs to keep track an extensive performance ICT metrics on project development and ICT operations. We believe that these two modules are close related trough the conceptual model of ICT governance standards. Thus, we have separated ICT governance issues from ICT management metrics in different menus, even though they are together in AlineaTIC, to give to CIOs an integrated tool to take decisions about their day-to-day work.

Introduction

Govern ICT in the universities, it is not easy, because many external factors, for example, pressure from business units / services, and internal, for example to determine the value of ICT or clarify the role of the CIO and the rest of the ICT staff. Governing ICT has several layers; we may establish three different kinds of tasks:

- ICT Operations, which deals with the continuity and competence of the ICT infrastructure of the organization. Once business projects (even they are belonging to infrastructure or architecture) are implemented and services deployed, they have to be maintained.
- ICT Administration, which aims to achieve credibility in the design and management the architecture of the ICT organization. This includes the ICT personnel management.
- ICT Governance, which aims to achieve the commitment and the evidence that ICT is a strategic element that provides added value to the company. It includes the establishment of a system of governance mechanisms that seek compliance with local and corporate objectives in the context of processes business and ICT projects. It requires also a conceptual model to engage ICT operations and ICT administration to ensure the performance and conformance of ICT products and services.

The most important objective of the ICT Governance is the alignment between business and ICT. The key question for the University board is whether ICT spending by their organization is in harmony with its strategic objectives (purpose, current strategy and business goals), creating business value. Since, more than half of all capital spending by businesses worldwide goes to ICT, most boards remain skeptical about whether their ICT investments are paying off, yet. They are frustrated with their ICT staff, and they respond by putting pressure on ICT costs. According to ICT researchers (Hunter, 2009), the issue is not cost – it's communication. AlineaTIC v2 improves the communication among the University board and ICT staff through this CIO governance tool. Universities that can communicate effectively about the value of ICT are able to create more value from ICT. When CIOs make IT's performance and decisions transparent, everyone — from seasoned technology experts to non technical employees – can better understand their roles in using and managing ICT. This state of harmony is known as alignment, and is characterized by complex, multifaceted and it never achieved completely.

After clarifying the three layers we mentioned above and the corresponding roles, the institution may go to the standard certification of management and / or government with greater guarantees of success. However, the alignment of ICT with the strategic objectives, like any other asset of the organization, is crucial to the success of ICT programs. This document aims to show an implementation of a simple software tool, AlineaTIC, which can help to improve the communication between the University authorities (board) and ICT management through the CIO leadership. AlineaTIC does not prevent the adoption of any standard of management of ICT, on the contrary, it allows a leisurely adoption, overwhelming the symptoms of poor communication and implementing the standards selected by the organization at a later stage of maturity. AlineaTIC v2 has been improved to help CIOs not only in the third layer (Governance) but also in the first one (Operations) related through performance indicators and measurements.

In short, ICT staff need to be aligned to produce value, so that support appropriate to the organization to provide its service on time with the right functionality and expected benefits, and produce infrastructure and services that enable the organization to grow with the introduction in new markets, increasing customer retention and driving strategies competitive. They will be assigned explicit responsibilities in the organization for each assessment and establish value measures between business and ICT. This would mean, for example, designing a balanced scorecard of ICT to include these measures, developed under the supervision and approval of all administrative levels of the organization. AlineaTIC helps CIOs to align goals and projects and to manage performance indicators of projects and operations coming from the administration of projects and operations management layers.

The CIOs should identify which are the ICT metrics they need and how they can relate the scorecard of the institution. They are also responsible for verifying that the risks associated with ICT projects are controlled by ICT staff and that their budgets are realistic. Specifically, CIOs are responsible for integrating ICT budgets in the global financial plan organization. The CIO must manage budgets and investment in ICT and provide a performance monitoring system in the remaining executives and managers. The evaluation system should include objectives and indicators linking direct with business objectives and therefore the organization's overall. However, another key aspect of risk management is to ensure continuity of operations to ensure the performance of the organization and retain its ability to achieve its objectives short term. For this, ICT management can utilize the continuity of business, identifying potential accidents that threaten the organization and develop and implement viable strategies for continuity. AlineaTIC v2 serves to communicate performance and conformance values coming from ICT administration and ICT operations in order to keep ICT production continuously improving.

Another aspect of ICT governance to be considered is the management of ICT resources through investment and the optimal use of them. Organizations must meet various requirements for quality and safety, both for the information, and their assets, so as to obtain a proper balance in the use of available resources. To fulfill this responsibility and to achieve board expectations, the CIO should use adequate system of internal control that supports business processes and determine the way in which each control activity satisfies the information requirements and may impact on ICT resources. AlineaTIC v2 integrates all the necessary information to keep an eye on indicators that ICT staff and infrastructure meet these requirements.

The Governance of ICT, like most other managerial, strongly associated to management with executive management in a cooperative manner. However, due to the complexity and specialization of ICT, CIO must rely heavily on lower levels of the organization (ICT staff) to obtain the necessary information for making assessments and decisions. To achieve effective governance of ICT, the lower levels need to apply the same principles as the CIO for setting goals, giving and receiving instructions and to provide and evaluate performance measures. In summary, the practices with the Governance of ICT need to be implemented at all levels of the University. AlineaTIC v2 helps to communicate the alignment of board goals with ICT projects and the performance and conformance of ICT operations which should be managed by ICT staff.

The paper is as follows: in section 3 we will remind the ICT governance, distinguishing what is governance and what is management through a conceptual model provided by ISO and AS standards. In the next section will recall what the key decisions on ICT and how we can register their responsibility. Section 5 will propose a set of ICT performance metrics and goals for managing ICT. In section 6 we will review the implementation mechanisms of ICT governance and why we integrate ICT performance metrics in our tool. Finally, in section 7, we will overview the features of our software tool. The paper ends with our findings that show the problems that remain open and the future work to be done on AlineaTIC v2.

ICT Governance

The governance of ICT is to specify the decision rights and accountability framework to produce the desired behavior in the use of ICT at the organization (Weill, 2004).

Also the governance has identified ICT as the responsibility of executives and senior management, and consists of leadership, organizational structures and processes that ensure that ICT supports and extends the company objectives and strategies of the organization (ITGI, 2003). There are other ICT governance definitions, but all converge on the rights and decisions about ICT at the institution.

After all, the definition of ICT governance comes from the general definition of governance. Thus, the ICT governance at Universities should not be very different of governing other assets, such as financial, personnel, intellectual property, students, administration, etc. However, the everyday work at many Universities seems to be quite different. It seems natural that the CIO to continuously justify each minor management decision, which is not true in other governance assets. This not happens with other traditional assets at University, where is almost impossible to think about this continuous justification of simple projects, tactic goals, department strategy, etc. that CIO typically suffers.

Therefore, one of the basic mistakes in an organization (not only at the board but also in ICT staff) is to confuse the governance with the management (administration) of ICT business assets, because their frontiers may be somewhat diluted (England, 2008). In previous section, we have depicted three different layers for governing ICT, where these differences were clarified. These differences between the governance and management, in the case of ICT, do not want to define the exclusive role of the CIO versus the role of technical staff; on the contrary, ICT governance is carried out in several structures of the organization, sometimes not joining the CIO. Similarly, managers and ICT technical staff must belong to ICT governance structures, as we shall see later. Indeed, this error has been widely promoted by some governance ICT standards, which include management mechanisms (Van Bon, 2008). It is not the nature of this article on the debate about standards, but we may conclude that COBIT (ITGI, 2007) and ITIL (Taylor, 2007) are currently regarded management frameworks with some governance features. Both standards contain parts that refer to the governance, explicitly or implicitly, as a subset within the management exploitation of ICT systems. The same applies to the standard ISO / IEC 20000 (ISO-1 ISO-2, 2005) which is also a management framework for the exploitation of ICT.

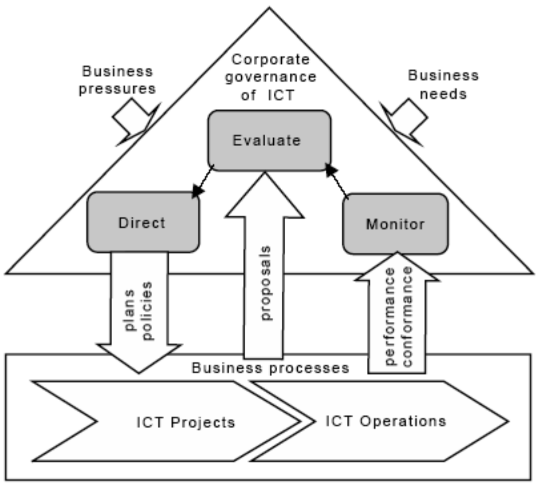

Figure 1. Model for corporate governance of ICT in AS8015 and ISO 38500

We may conclude that there was only one standard of ICT governance until 2005, the Australian Standard AS8015 (SAI, 2005), on which the ISO / IEC 38500 (ISO-3, 2008) is based. In figure 1, the conceptual model for governance and its relation with management is depicted. ICT managers and staff should guarantee the development of ICT business, infrastructure and architecture projects and their corresponding operations to maintain QoS of business processes. These projects should be directed from the strategic plan and policies coming from the board, in which the CIO must be included to improve communication with business and ICT staff. Thus, business units and ICT units must work together to propose new projects (including infrastructure and architecture ones) that CIO and other governance structures should evaluate to be included in the tactic goals that implement the strategic plan. To close the virtuous cycle, once the projects become a reality and they serve to operate business, infrastructure or architecture processes, IT staff should measure their performance and conformance. CIO must monitor these values in order to have more information to consider new proposals coming from lower levels again. AlineaTIC v2 is implemented taking into account this virtuous cycle and to provide enough information to align plans with ICT projects and to keep an eye on performances metrics coming from ICT operations and projects.

AlineaTIC tries to improve the communication between the CIO and the rest of the board and between the CIO and their ICT management staff, implementing simple way to understand the roles and responsibilities governing the ICT assets at Universities. The model proposed by the tool AlineaTIC, considers only a minimal part of ICT governance that, it could be summarized to answer the following questions:

- What are the IT principles and strategic and tactic goals coming from the board?
- Who should (organization structure) make the decisions of implementing new ICT projects?
- What is the project portfolio and where are the standard forms to evaluate it?
- How will these decisions be tracked?
- What are the performance metrics and their values coming from ICT operations?

The answer to all these questions corresponds to the scope of each organization, but AlineaTIC keeps the information necessary to answer them. AlineaTIC v2, presented in Section 7, aims to articulate a standard tool to respond to follow up the decisions of ICT governance, i.e. AlineaTIC attempts keep information to make decisions.

ICT Governance decisions

According to (Weill, 2004), the five types of decisions to be taken by the government of ICT are as follows:

- ICT principles: that is to clarify the role of ICT business.
- ICT architecture: that tries to define the requirements of integration and standardization.
- ICT Infrastructure: determining shared services and allowed.
- Need for business applications: specifying the business needs to acquire or develop them internally.
- Investment and prioritization of ICT: to select which initiatives are funded and how much is spent on them.

These types of decisions are informed / made by government structures (individuals, committees, commissions, interest groups...) which establishes the University for such purposes.

Among the types of decisions, the ICT principles are crucial to align organizational goals, the company policy (understood as designed to achieve a specific behavior of the organization) and the Information Technology and Communications. ICT principles should be few but well-articulated, and typically is a set of sentences related high level of abstraction about how to use ICT in the business of the company. Once ICT principles are constructed, they become the lexicon of management and can be discussed, debated, supported, developed, etc.

The architecture relies on the integration from a technological perspective; it comprises the standardization of the corporate data, providing a single definition and a unique set of characteristics that are caught with an item. In turn, the key to the integration of processes is the discipline, adherence to a single way to make things consistent. Standardization of data and processes are the defining features of the ICT architecture in business. The elections on standardizing data, processes and technology, strongly influenced the design of the ICT architecture. The distinction between infrastructure and applications, allows companies to promote the economies of scale without sacrificing the flexibility needed to respond to change. Architectures are often expressed through modular components that tend to be viewed as services for business units.

ICT infrastructure is the foundation of technical and human capacity planned ICT, available for all parts of the company as a shared service and reliable, used by multiple applications. In some Universities, the infrastructure may exceed 50% of total investment in ICT.

Integrated ICT infrastructure combines all the capabilities of the company to drive the business. It is believed that an integrated infrastructure is a set (catalog) of services, with each one connecting the external world of customers, suppliers, users, etc. For example, one can distinguish the following sets of channels (web, e-mail, and mobile applications), security (firewalls, redundancy), communications (networks, intranet), data management (databases, middleware) systems (servers, operating systems, etc.). The infrastructure should also include other services such as training management and staff training, technical standardization, innovation, planning, etc.

Universities, as other organizations, collect more valuable success of ICT by focusing its investments in strategic priorities, distinguishing between "must have it" and "would be nice to have it." Therefore, ICT investment decisions leading to the problem of spending money accurately and to reconcile the different needs in the organization.

The latter two types of ICT decisions, application requirements and investments, are the most controversial and divisive at organizations even they are aligned with principles.

ICT Performance Metrics

The University board must use ICT operations to obtain value for the institution. In order to ensure this value, CIO has to keep an eye on (Fernandez, 2009):

- ICT manager and staff have implemented practices and processes required to maximize the value of ICT to the business.
- ICT investments are made based upon a balance between risks and benefits and those budgets are adequate.
- ICT projects arrive on time and within budget.
- ICT staff improves reputation, product leadership and the appearance of profitability
- ICT provides customer confidence and gain competitive time periods to bring a product or service to market

Additionally, IT managers and the rest of the IT staff also must measure performance by defining and inspecting along with the executive measures to verify that targets are compliance and to measure performance, so as to remove contingencies. Thus, they have to ensure the success of ICT operations and ICT project development. If we again look at figure 1, we will realize that these activities are concentrated in the bottom of the drawing and are the responsibility of the ICT manager or director, which in turn depends on the CIO.

Unfortunately, ICT staff has also to manage also information and systems risks, and mitigate their costs. So that, a proactive risk management can create competitive advantage and must be included among the institution's operations. CIOs also have to know some metrics about risk management in order to evaluate proposals.

ICT staff should ensure that management has put processes, technology and trust in places right to security of the information. Thus, transactions are reliable services are usable and can appropriately resist attacks and recover from fault.

CIOs should monitor use of ICT resources needed to achieve the objectives and ensure that there is a proper balance in ICT investments to provide growth to the University. As shown in Figure 1, CIOs need to monitor the performance of the ICT staff; through the proper metrics and ICT staff should provide a simple and efficient way to understand these metrics. These measures help the CIO to decide whether the infrastructure and architecture that has implemented the ICT staff responds to business initiatives and to ensure the operation in terms of value, not in technical terms (which is the responsibility of the ICT staff).

Goals for ICT Management

The mission of ICT staff is to provide an information processing capability that benefits the business. In order to fulfill this mission ICT must provide the following services, while managing costs and prioritizing requests to optimize value:

– Operate and support the infrastructure required to process, store, secure, and communicate information.
– Operate and support the business applications that process information.
– Provide technology consulting, training, and planning services.
– Employ, train, and deploy staff required to provide these services.
– Plan, develop/purchase, test, and implement new infrastructure or software to fix problems or provide enhanced information processing capabilities to the business.

In (Spanos, 2009) we found the data elements for measuring ICT performance by related categories. Some of the metrics represent averages while others are reported in the form of a graph. By reporting these metrics on a regular basis (monthly is the minimum recommended reporting period), trends can be observed across the reporting periods. In many cases the trends are more important than the actual value. ICT staff has to capture most of these indicators to monitor its own operation and be transparent so that the CIO has sufficient information for making decisions with the rest of the board.

Spanos proposes one hundred data elements, which is more than a typical CIO would review. The ICT staff should be tracking and managing to these metrics. The highlighted metrics should be reviewed by a CIO on a regular basis. The following general tactic objectives have been identified for all ICT organizations. The recommended metrics are organized according to the supported objectives. Some of the metrics are described in general terms and must be interpreted by each organization. The intent of the metrics is more important then the specific terminology used to describe the metric itself. Thus, the metrics that the CIO should watch are classified into these categories:

- Availability of existing Processing Capabilities
- Utilization of Available Staff Resources Efficiently
- Timely Response to Business Requests for New Features or Services
- Successful implementation of system changes
- Management of the cost of delivering ICT services and optimization of their value

ICT director and ther rest of the ICT staff are devoted to guarantee these main objectives and CIO should have to know their metrics in order to align the current operations with future plans.

Implementing ICT Governance and ICT Performance Metrics together

There are three different types of governance arrangements for the deployment of ICT (Vicens et al., 2009):

- Structures of decision-making roles: they are responsible for ICT decisions through committees, executive teams, managers, commissions, etc.
- Process alignment: they are formal processes to ensure that daily behaviors are consistent with ICT policies and provide input for decisions.
- Communications: they are adverts, channels, and educational efforts to disseminate the principles of governance, ICT policies and decisions taken.

The decision-making structures are the first step in designing the governance of ICT, but the governance is not only making effective decisions. Alignment processes are management techniques to ensure that ICT will involve the entire organization on the effective use of it. The alignment need to bring everybody on board, while providing information (input) for making decisions as to disseminate the results (output) of the decisions. To align business objectives and ICT, communication is used to disseminate the decisions and processes related to behavior occurring in the company.

It is not the purpose of this document, nor how they should be conformed the structures or committees, nor the manner in which decisions are communicated. In fact, the two mechanisms are more natural implementation of all the bureaucratic processes in any University. The simplest of ICT governance is to appoint committees to inform / communicate decisions. However, the difficulty remains on tracking the processes of formal alignment between ICT and the principles that really make ICT projects happen through these decisions.

In the next section we present a simple tool, namely AlineaTIC v2, which can be used to implement a monitoring and follow up decisions about ICT governance. In particular, AlineaTIC served to monitor and communicate those decisions that are more confrontational and less technical: the project portfolio and investment portfolio related to the principles and the strategy of the organization (Weill, 2004) and now AlineaTIC v2 adds new features that we are going to overview in next section.

Implementing AlineaTIC v2

The five types of decisions: principles, architecture, infrastructure, application needs and investment needs can not be isolated from each other. If the ICT governance is well designed, decisions reinforce one to another ensuring that business goals. Each of the five decisions requires individual attention but nothing can be done in isolation.

The same may be applied for ICT governance mechanisms (structures, communication and alignment), they are not operating in isolation because their impact depends on the interactions between them. In the particular design of the ICT governance of a University must take into account some features:

- Choose the three types of mechanisms: decision structures, alignment and communication.
- Limit the number of decision-making structures: avoid contradictions and disconnections.
- Provide members of overlap between structures.
- Implement mechanisms at multiple levels within the organization.
- Clarify responsibilities, goals and metrics.

AlineaTIC provides the way to explicitly declare the process of alignment, the governing structures (and their members) and communicates the decisions that they made. Additionally, AlineaTIC provide the communication of the objectives (strategic and tactic) guided by ICT principles and the corresponding projects that deploy them grouped by programs.

An approach to the governance distributes the ICT decision-making process on those people best positioned to understand the requirements and their implications. AlineaTIC partially formalizes the processes of governance to ensure communication and feedback from these key decisions.

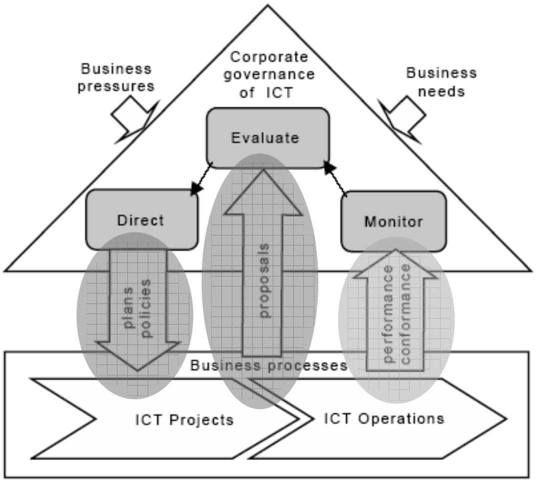

Figure 2. Model for corporate governance of ICT and AlineaTIC v2 modules

AlineaTIC also has a management module that enables ICT to track a large number of indicators made with tactical aims of the organization. This new functionality will allow us to see the timed evolution of certain metrics, and to receive alerts when values of the ranges set out in the application configuration. In figure 2, we may see how AlineTIC governance modules helped to communicate plans and policies and align them with proposals (green areas). In AlineaTIC v2, we add a management module which helps to communicate performance and conformance metrics of ICT projects and operations (blue area).

AlineaTIC Governance Module

AlineaTIC allows defining ICT principles, ICT strategic goals, ICT tactical objectives and programs. All these elements can be aligned to link projects with them. It also allows both the principles, objectives and projects as may be linked to the decisions made by organizational structures. Thus, AlineaTIC preserves the relationship between governance decisions and ICT strategy.

In addition, AlineaTIC also incorporates a simple browser of project management. That is, incorporating data on the project status every time the user performs a follow-up, the budget associated with each of these projects, etc.

Specifically AlineaTIC can:

- Assign members to various governance structures (e.g., the CTO in an architectural committee)
- Align projects with objectives and principles
- Assign projects to programs
- Create the meeting minutes of decisions taken in each session about a project, program, objective, etc., so that a record of documents of each decision and who is on charge of it (for example, the diagram of the architecture at a committee cited above).
- Store all project documentation generated in the meetings, the decisions related to principles, objectives, projects and budgets.
- Show alerts highlighting projects without a budget or in a state of near completion.
- Show alarms when there are inconsistent data, for example, budgets are not linked to any decision, objectives not aligned with a principle, projects not aligned with tactical objectives etc.

Alineatic Management Module

The AlineaTIC management module allows you to collect a series of metrics related to tactical and operations objectives. Thus, it is possible to track the status of all applications and infrastructure. Specifically this module adds to the original version of AlineaTIC:

- Collecting values on many metrics of management (disk utilization, incidents, service response times, etc).
- Showing all sorts of graphics on these indicators to visualize both the current state of infrastructure and applications as the evolution over time of these indicators.
- Setting up a warning panel to be alerted when certain parameters are out of the range of preset values.

Design

AlineaTIC has been implemented as J2EE Web application architecture. It has been divided into several layers separating presentation, business logic and data. This suggests these layers can be distributed across multiple servers so that they can be integrated with other applications, such as human resources database (structure membership) or web page news (University communications). AlineaTIC v2 application language is Spanish even there would be an English version in next releases. Therefore, the examples shown in next figures are in Spanish even we depict the functionality of them.

Examples

Figure 3 shows two graphs generated from information stored on incidents. On the left you can see the evolution of the number of incidents (classified by severity) over time. The graph on the right you can see a comparative number of incidents according to priority.

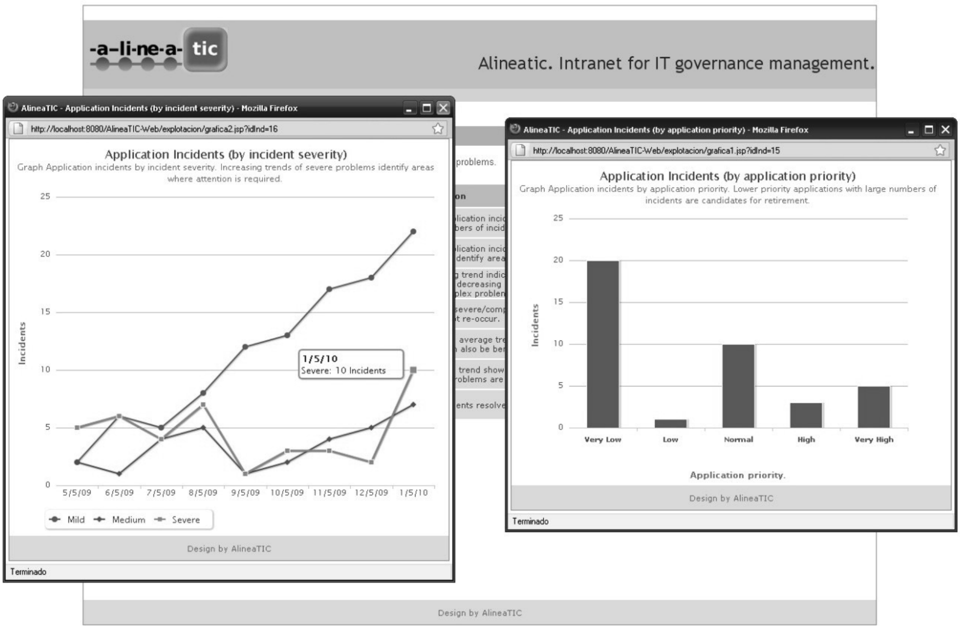

Figure 3. Showing incidents and problem priorities

Figure 4 shows a screen where values of a set of metrics of the applications of the organization are filled. Downtime per application priority and Response time are shown, respectively.

Application Availability

Metric	Restriction	Value
% Downtime (by application priority)	Maximum % of downtime on applications of **very low** priority that should not be exceeded (value between 0 and 100).	17.5
	Maximum % of downtime on applications of **low** priority that should not be exceeded (value between 0 and 100).	15
	Maximum % of downtime on applications of **normal** priority that should not be exceeded (value between 0 and 100).	12.5
	Maximum % of downtime on applications of **High** priority that should not be exceeded (value between 0 and 100).	10
	Maximum % of downtime on applications of **Very High** priority that should not be exceeded (value between 0 and 100).	7.5
Max Peak Downtime (by Application Priority)	Maximum peak downtime on applications of **very low** priority that should not be exceeded.	20
	Maximum peak downtime on applications of **low** priority that should not be exceeded.	17.5
	Maximum peak downtime on applications of **normal** priority that should not be exceeded.	15
	Maximum peak downtime on applications of **High** priority that should not be exceeded.	12.5
	Maximum peak downtime on applications of **Very High** priority that should not be exceeded.	10

Application Utilization & Performance

Metric	Restriction	Value
Average Application Response Time	Maximum of average application response time on applications of **very low** priority that should not be exceeded.	15
	Maximum of average application response time on applications of **low** priority that should not be exceeded.	12.5
	Maximum of average application response time on applications of **normal** priority that should not be exceeded.	10
	Maximum of average application response time on applications of **High** priority that should not be exceeded.	7.5
	Maximum of average application response time on applications of **Very High** priority that should not be exceeded.	5
Average Number of Users/Day	Maximum variation of average number of users on applications of **very low** priority that should not be exceeded (value between 1 and 2, the decimal part indicates the percentage).	1.25
	Maximum variation of average number of users on applications of **low** priority that should not be exceeded (value between 1 and 2, the decimal part indicates the percentage).	1.20
	Maximum variation of average number of users on applications of **normal** priority that should not be exceeded (value between 1 and 2, the decimal part indicates the percentage).	1.15
	Maximum variation of average number of users on applications of **High** priority that should not be exceeded (value between 1 and 2, the decimal part indicates the percentage).	1.10
	Maximum variation of average number of users on applications of **Very High** priority that should not be exceeded (value between 1 and 2, the decimal part indicates the percentage).	1.05

Figure 4. Availability and Performance Metrics

In Figure 5 two graphs that provide information on the resolution of incidents. On the left you can see the evolution of resolution time for incidents according to severity. On the right you can see a comparison of the number of incidents as well as their severity.

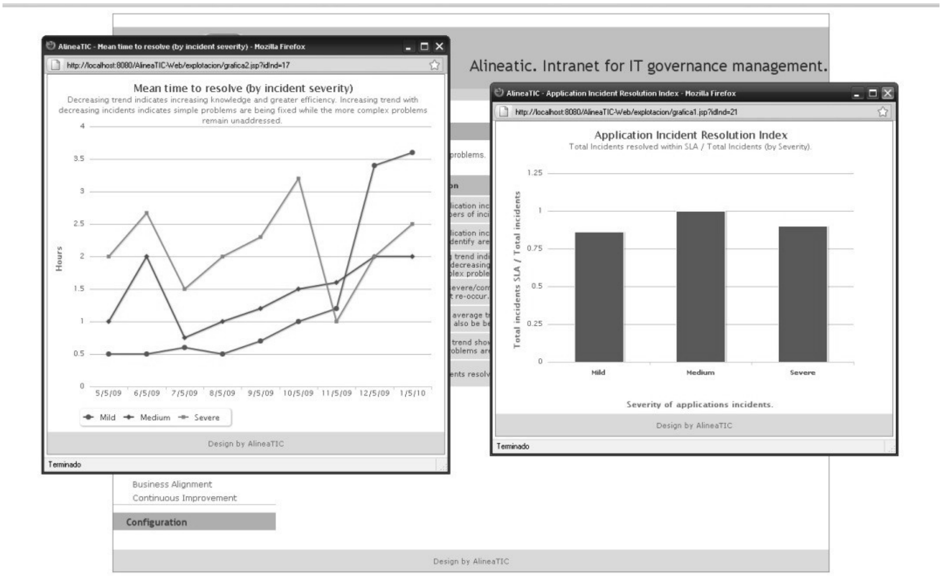

Figure 5. Time to resolve and severity of incidents

Figure 6 shows the evolution of turnover for ICT staff, so that they can identify areas in which management is performed worst.

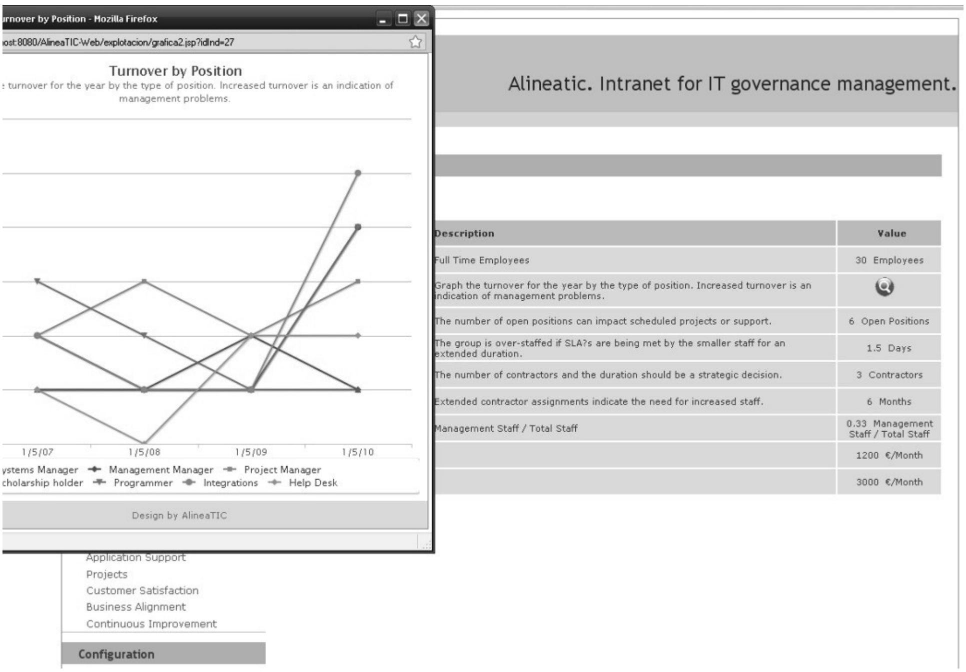

Figure 6. Turnover of ICT personnel

Conclusions and future work

In this paper, we have presented the necessity of having tools for communicate ICT value at Universities in order to improve ICT governance and ICT management, together. The shortcomings in the communication are due, mainly, because of the activities of governance and improper management are overlapped or are misunderstood. This introduction to ICT governance and ICT management was included in order to better understand the design of AlineaTIC v2.The main contribution of this paper, in addition to a few sections summarize the basics of governance of ICT, is to present the implementation of a simple tool, namely AlineaTIC v2, which can be integrated with other University ICT databases to manage the information about the University organization, particularly its implementation of ISO 38500 standard. The AlineaTIC v2 design does not suggest, even remotely, to replace the implementation of any of the standards that are emerging now for the ICT governance (and ICT management), but it may be a first approach to the implementation of ICT project alignment and the conformance and performance of operations. Thus facilitating the passage of a non-governance situation, to one oriented to the principles and objectives of the organization, explicitly. Such monitoring is done in the most troubled ICT governance issue: prioritization of investment in ICT projects, according to sound principles with the strategic objectives of the Board and implementing tactical objectives of the technology staff.

Future features to include in AlineaTIC v2 would be:

– Improving the historical data of previous governance decisions
– Defining new Import/Export modules for project management and personnel applications
– Improving the document database
– Customizing the language of the tool automatically

AlineaTIC v2 is going to prove its utility at University of the Balearic Islands during its test and validation phases. The first public version of AlineaTIC will be released in Fall 2010.

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Student Management Information System for Polish Universities at its Tenth Anniversary

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Keywords

student management information system, USOS, student life cycle

Introduction

Development of the *University Study-Oriented System* (USOS, http://usos.edu.pl/) began in 1999 under the Tempus Phare Joint European Project (UM_JEP-14461-1999). The system is owned by *University Centre for Informatization* (MUCI, http://muci.edu.pl) – the unit created by the Conference of Rectors of Polish Universities in 2002. Nowadays over forty percent of students of Polish public higher education institutions use this system and its associated applications. The main task carried out by USOS is administrative support of the teaching and learning process, which begins with the recruitment and ends with a presentation of diplomas and assistance in launching students careers. In this article we summarize ten years of system development and deployment and present our experience gathered in the specific environment of higher education. For this purpose, we use the results of the survey, which was carried out at participating universities in the beginning of the year 2010. The main aim of the survey was to show system position at institutions and what effort should be put to deploy the system.

Functionality of USOS and associated applications

A ten-year history of the development and use of the system allowed us to to fulfill expectations reported by higher education institutions of various profiles. Selected elements of the system — the most innovative — were also presented at EUNIS conferences by its developers. In 2007 the system got EUNIS Elite Award for excellence in implementing information systems for higher education (http://www.eunis.org/activities/b_practices/award/MUCI.pdf).

The main functional parts of USOS are the following:

– **USOS-Admin** (First deployed in 2000) — an interface of management system for handling most aspects of university education like students and teachers personal data, study programs, plans and requirements, course of study, degree certificates (all processes support ECTS credit system and diploma supplements), student financials (scholarships and fees), teaching lessons, survey and reporting.
– **USOSweb** (First deployed in 2003) – the first web-based student and academic-centered user interface with the large number of services. It provides many electronic operations and procedures performed by academic teachers and students concerning documentation of the study, for example presentation of students' results and achievements, filling in questionnaires on the teaching process, participating in the elections, communicating with other participants of groups and their teachers. However, the main use is course registration which supports individual education plans and multiple methods of registration for classes. It can be called the virtual deanery.
– **Admission/Internet Registration of Candidates** (First deployed in 2002) — supports the admission process with self-service functionality and gives full information about status of the qualification for registered candidates. Administration, measurement and analyzing recruiting effectiveness becomes very easy.
– **Central Registry for Results of Maturity Examinations** (Deployed in 2006, https://krem.uw.edu.pl) – allows universities which signed an agreement with the University of Warsaw to get candidates' data essential for the recruitment process (of course this is done with the agreement of the candidates).
– **Course and Diploma Catalog** (First deployed in 2006) – systems which are fully compliant with requirements of the Bologna Declaration. The first of them as an electronic brochure contains essential information about the university, programs of study offered by the university, recruitment, and practical information for students. The next one is used for the following purposes: management of data on graduate thesis, information about the topics, authors, maintainer of the data units, search and view thesis, carrying out the process of review and evaluate thesis authorized by a person and storing electronic versions of written reviews.
– **Mobility** (First deployed in 2007) — three applications which cover main aspects of student and staff mobility:
  • outgoing mobility of students and academic teachers within the EU projects ranging from recruiting, arrangements with coordinators (Learning Agreement) and returns with the Transcripts of Records. After two years of collaboration with partners from Italy (CINECA), now we are able to exchange electronically structured data by calling web-services (http://usos.edu.pl/Mobility/). The Mobility Project gathers consortia of European universities (e.g. MUCI, SIGMA, HIS, Ladok, etc.), individual universities and companies,
  • arrivals of foreign students involve registration which includes choice of courses offered by the university (integration with Course Catalog), upload of necessary copies of documents and supports the process of qualification,

  - central registry of domestic exchange under the program "MOST" (deployed in 2010, https://most.uka.uw.edu.pl/). In this program (similar to original EU SOCRATES) participate most Polish universities.
- **Career Office** (Deploy 2008, https://biurokarier.edu.pl/) — covers conducted by colleges and universities the promotion and guidance for students. This tool gathers data from many universities (of course, only those students who agree to share their data) and uses the advantages of USOS (e.g., reliable data on students' acquired skills and achievements). Therefore, CVs of students presented in this system are more valuable for the employers than those available in typical employment agencies. System allows employers to submit bids for practices and jobs, review the data and contact with students and alumnus.
- **Statistics** (deployment in progress) – the management information system which uses solutions available in the Business Intelligence Applications. This system gathers information from USOS and Admission primarily dedicated to the management staff that provides the knowledge obtained on the basis of data collected from many volumes (originating from many sources). This knowledge is presented in various cross-sections, to help in the process of decision-making.

All USOS web-based applications are available with full functionality in English language version. Locally operated university applications can use CAS to authenticate their users.

USOS in numbers

The USOS is used by 27 public higher education institutions, which constitutes 20 percent of the universities in this category and 40 percent of their students (see Table 1). With consortium MUCI is associated more HEI, some of them actually begin to deploy the system.

Table 1. USOS and Educational Market in Poland

Categories of HEI		Participation in educational market	Participation in handling students
Deploying USOS	Quantity		
public	27 from 131	20,61%	40,00%
non-public	3 from 325	0,92%	0,74%

In particular, eight of 12 largest Polish universities (over 30 thousand students each) belong to this group (see Figure 1). Figure 2 illustrates the types and numbers of universities participating in the project.

Furthermore, universities deploying USOS are distinguished by their high quality education. For example three of them took three first places and further two were in the top ten in the Ranking of Higher Education Institutions published in 2009 year by magazines Rzeczpospolita (http://www.rp.pl) and Perspektywy.pl.

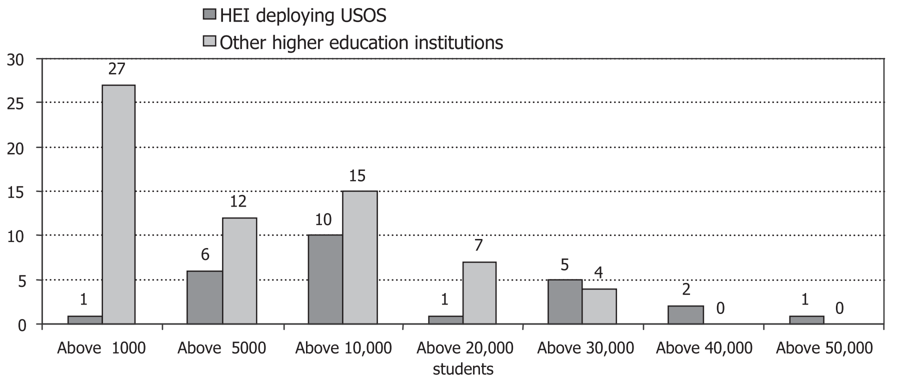

Figure 1. Higher education institutions by number of students in Poland

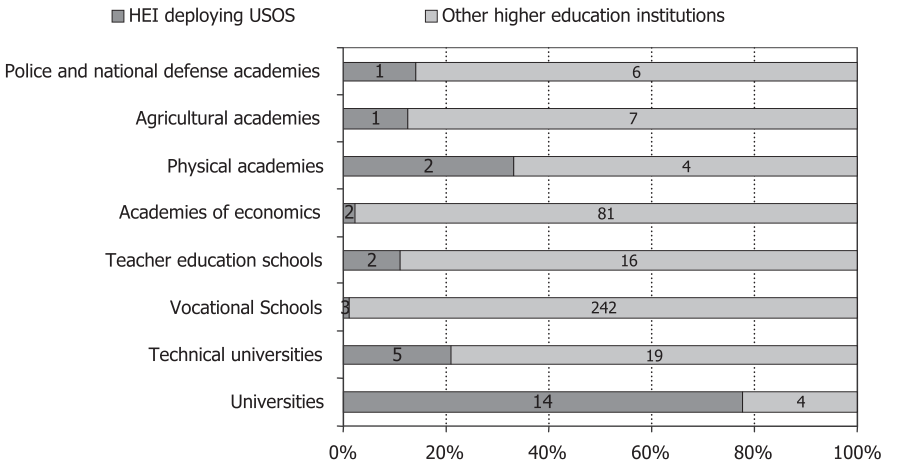

Figure 2. Types of higher education institutions in Poland

The system is developed by the experienced programmers, IT graduates with good knowledge of specificity of the higher education. It therefore offers effective solutions and can compete with commercial products available on the education market. Table 2 contains selected figures describing the project. Data has been gathered during the survey mentioned in the introduction.

Institutions participating in the project can, according to their needs, free to choose and use the associated applications. Figures 3 and 4 illustrate associated applications (local and domestic) which are used by higher education institutions.

Higher education institutions have a wide variety of IT applications which support their activities. It is necessary to exchange data among these systems. Table 3 shows how many universities carried out a process of integration and what methods were used. This task becomes the main objectives of the future development of the system.

Table 2. Selected figures describing the USOS project

Total number of	Quantity
applications associated with USOS/installations	8 / 65
servers for main databases and associated applications	79
defined fields of study/courses	5702 / 528087
developers/people deploying the system	from 5 to 10 / 89
people in team deploying the system – minumum – maximum	 2 at 7 HEI 7 at 4 HEI
users from HEI's administration/academics/students per one developer per one deploying system	3693 / 26798 / 497185 369 / 2679 / 49718 41 / 301 / 5586

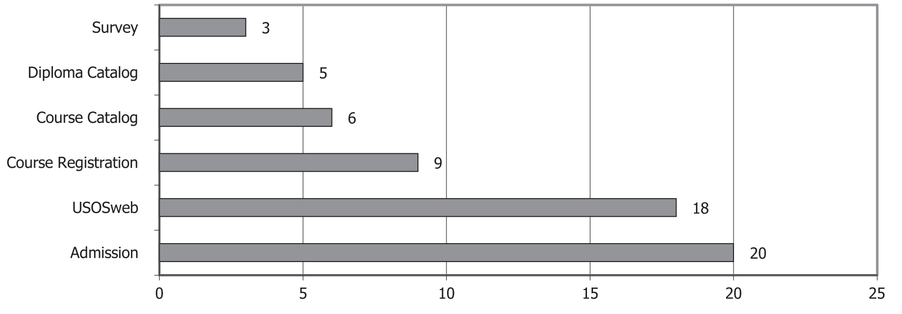

Figure 3. Quantity of most popular applications associated with USOS installed on HEI

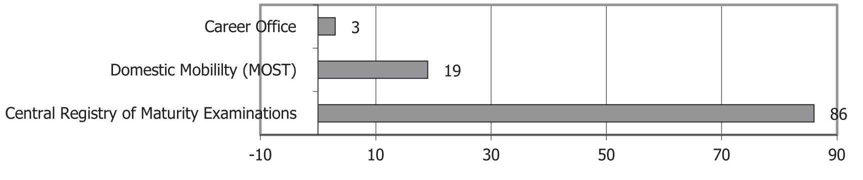

Figure 4. Quantity of HEI benefiting from the central applications

Table 3. Main systems integrated with USOS and methods of integration

Category of system	Number of HEI	Methods used
Human Resource Management	6	CSV files own scripts table views special applications
Financial Accounting and Management Information	4	
Library Management	6	
Student Mail Accounts	10	

Partnership and exchange of experience — base of USOS development

Business model of USOS development is quite different from other systems available on the educational market. First, the owner of the system is a non-profit organization. The base license fee and annual fees are very low. All the collected funds are spent on the application development. Furthermore:

- expectations of the universities determine the main directions of development of the system, all this occurs through discussion leading to consensus, partnership allows to create the flexible solutions,
- software development principles and methods are similar to those used in open-source society,
- source code is available on request for project participants, local changes and often developed own modules can be incorporated into the official version of the system,
- prototype versions of selected modules are developed by graduate students, which allows them to gain the first experience, provides good recommendations, accelerates implementation of new expected features at lower cost, furthermore, it involves academics in development of the system,
- developers have support of scientific staff, who are developing new algorithms and solutions, for example applying artificial intelligence to the registration of classes,
- people deploying the system get assistance and support of colleagues from other universities in solving technical and organizational problems, they can participate in many newsgroups, created to exchange of experiences, reporting demands and shortcomings.

People and their best practices

During production of every module of the system developers use the well known best practices of software engineering, such as preparation of specification of requirements, technical and user's guide, CVS repository for every element of the system, the complete database schema as hypertext for authorized users. But more interesting are other activities, for example:

- any element of the system (starting from assumptions, requirements, design and code) is reviewed by the leader of the project and the development team,
- every new module before transferring to the production use, passes two-level additional testing: first on sample database and second at university which is an author and implements a prototype,
- system installation package also contains a reference sample database with the latest structure and full but anonymous data, it can be used for testing and training,
- sample scripts for data migration from old university databases are available on demand,
- the status of tasks is described by the project leader on a daily basis,
- access to bugtracker and testing tool (https://bugzilla.usos.edu.pl/) is given not only to the developers of the system, but also to the representatives of major users; it is also used to suggest new ideas, exchange views and gather support for new projects,

– free training courses and workshops are offered to cooperating universities; on not only about USOS and its subsystems, but also on other solutions used in universities, for example LDAP,
– documentation describing an implementation of the system is constantly updated, it contains not only a specification of the system, but also all aspects of implementation (for example schedule of all activities, conducting training, legal acts, etc.) which helps in successful implementation of the system,
– each institution carries one additional activities to support local users of the system (see Table 4).

Table 4. Examples of methods of supporting users

Method	Quantity of HEI
prepare its own dedicated documentation	15
access to local web pages	18
run discussion lists	6
formal help-desk	All

Developers and user representatives are a harmonious team, which meets 1–2 times a year to present achievements and make plans for the next period (last but not lest to play bowling together).

Benefits and challenges

Decade of development of USOS and their associated applications helps us to:
– standardize and document processes carried out in higher education and influence them through changes in national law (e.g., Regulation of the Minister of Science and Higher Education for the documentation of the study),
– change the university administration, making it more effective and efficient (e.g., uniform and clear division of responsibilities),
– improve management of human resources, educational buildings and rooms (e.g., planning teaching, filling classrooms),
– improve communication among teachers and students (e.g., modules U-Mail, Exam); maximize value of teachers with functions (e.g., Erasmus Coordinator, Catalog Editor, Course Coordinator),
– make deploying and maintaining IT more efficient with lower cost.

After this time we have obtained the possibility of using solutions to exchange data with other institutions:
– admission using data collected in Central Registry for Results of Maturity Examinations,

– domestic and international cooperation and student mobility,
– applications gathering data from many HEI's in one system (a system to support duties of a university Career Office and monitoring professional careers of graduates).

There are new challenges:
– developing better tools for data mining and visualization,
– provide better services for students, faculty, and staff — more self-service functionality with 24x7 system access,
– better integration and data exchange with other university information systems (see Table 3),
– it is also time to rethink earlier technology decisions – parts of the systems will be rewritten using new technology platform.

Summary

After ten years of development, USOS is a mature system with a strong position on the market of management information systems for higher education in Poland. The number of installations in Polish HEI's is substantial and grows steadily.

Acknowledgements

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Design and Implementation Details of the Public Andalusian Universities Identity Federation CONFIA

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Keywords

CONFIA, AUPA, Identity Federation, SAML, Hub and Spoke, eduPerson, SCHAC, irisPerson, LMS

Abstract

The Andalusian Virtual Campus is a project of the ten public Andalusian universities with the goal to share a part of their course offer between themselves. This initial scenario motivated the definitive implementation of the Andalusian Public Universities Identity Federation, called CONFÍA, interconnecting effectively all needed Learning Management Systems and Identity Management Systems.

The chosen technical topology follows the hub & spoke model successfully implemented by the Danish University Federation WAYF.dk. The SAML 2 standard is used to connect Identity and Service Providers, although other standards could easily be supported for connecting other service providers. Standard attributes usage, based on eduPerson, SCHAC and irisPerson has been agreed on and other normative rules have been established.

All used software is open source. Advanced features include: automatic metadata distribution; attribute release consent; RDBMS SQL, SOAP and LDAP sources for additional attributes; SAML assertion encryption; single logout support for hub & spoke model; attribute validation module implemented at the hub; attribute filtering and generation at the hub; attribute value filtering at the hub; metadata editor web interface; IdP and SP monitoring; certificate validation based on CRLs and OCSP. An Attribute Release Policy editor is under way.

At the SP side, connectors have been built or updated for Moodle, Blackboard/WebCT and ILIAS4, w**h**ich support on-the-fly user provisioning and course enrollment, Single Sign-On and Single Logout. To leverage administration procedures, IdPs send course entitlements gathered via queries to Student Information Systems, which enables near to real-time user provisioning and deprovisioning.

The central infrastructure of CONFIA includes: a metadata editor and distributor with periodic metadata gathering and validation, certificate validation and IdP and SP monitoring; a homeless IdP; the hub, which acts as discovery service, central attribute release consent application provider, data processor and protocol bridge; a test moodle SP. All components are available in the development, testing and production environments.

This contribution explains some of the design decisions and implementation details used for CONFIA and the Andalusian Virtual Campus as its first application.

CONFIA: a succesful project in Andalusian Universities

Since the beginning of the Bologna process, collaboration between universities is one of its main goals. Among its requirements, one of the more important is to ensure the exchange of students and inter-university services, which must be conducted in a safe and transparent way to final user.

Among the projects run from the Andalusian Association of Public Universities (AUPA), lies the so-called Andalusia Virtual Campus (CAV). This project allows any student at any of the 10 public universities of AUPA to complete their studies with courses offered by any of the other 10 universities. Thus, in a completely virtual way, students have access to virtual learning platforms (LMS) of those universities where they have enrolled some courses.

Among the main difficulties during the first three academic periods of this project, we can show the complexity of administrative and authentication procedures students and administrative staff had to perform. All participant universities had to exchange student identity, course, course member and infrastructure information. In this way, each LMS had to use a local authentication policy and the responsible organization had to send LMS authentication credentials to all students of other universities. Thus, a student needed different credentials (different identity) for each of the LMS's where they had enrolled in a course, and any modification was limited by very strict time periods.

In the academic year 2009–10, AUPA decided to solve these problems. This was the initial reason to define and implement the first identity federation among the 10 universities of Andalusia (CONFIA). The first of its services has been the Andalusian Virtual Campus (CAV). CONFIA allows students to retain their original identity, and in addition, access the target LMS's course section whenever the student information system is up to date, performing on-the fly user provisioning and course enrollment.

Figure 1. Andalusian Virtual Campus (CAV) Project

The potential number of students who participate in this initiative is 9,000 from around 230,000 total students in Andalusia and they are potential future users of new federated services that are already planned within CONFIA.

Main Pillars of the project

Any successful project must reside in robust pillars that support it. And each of them are as important as the others. We believe that CONFIA, as an Identity Federation between the Andalusian universities, has three essential ones:

- **Political Agreement.** It´s essential that the governments of the entities involved are convinced of the benefits of the project and be an active stakeholder during the planning. CONFIA was born to support the political agreement for cooperation among the 10 universities of Andalusia. As a result of this collaboration, CONFIA has established the basis of trust, identity transfer and ease of use that Andalusian Virtual Campus (CAV) required.
- **Successful Reference Model**. The technological basis should be based on a model already used and successful, with clear references. CONFIA has based its architectural model and its implementation on WAYF.dk (the Danish identity federation), using local criteria for our federation. Specifically, the hub & spoke model that centralizes common functionality (discovery, informed consent and data filtering) into a single logical node.
- **Interoperability Standards**. The use of open standard protocols for data exchange ensures interoperability among the 10 universities and future collaboration agreements at European level. CONFIA uses SAML 2, X509, LDAP, SOAP, REST and so on.

On the other hand, there are other important factors from which CONFIA gained its benefits: all used software components are open source, it's a trustful system (certificate validation, SAML Assertion encryption, automatic metadata distribution) and it's easy to use. To make the deployment more agile, horizontal and agile communication tools were used, mainly mailing lists and instant messaging, which will be supplemented in the future with federated help desk services.

Design decisions

General requirements

Before starting the description of the components used in the design and development of CONFIA, we will summarize the basic concepts of Identity Federation. We know that identity is a strategic element in all types of organizations, because it´s the basis to access both, services and institutional information. For this reason, the mechanisms to manage authentication and authorization have become an important task.

The following figure illustrates the components of an identity federation. There are two different end-points: the home institution that provides digital identities for users and the remote institution that provides services. Data is exchanged by a set of agreed protocols on the federation infrastructure. All elements: IdP, SP, central elements, will be detailed in the following paragraphs.

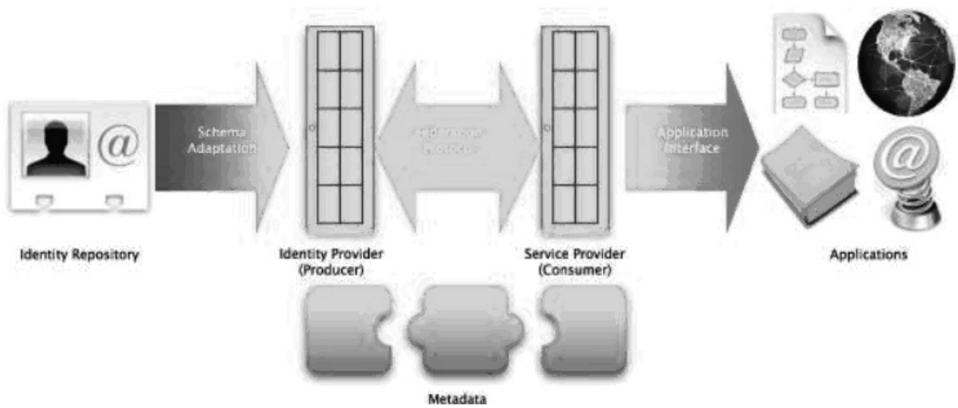

Figure 2. Identity Federation Components

As discussed above, CONFIA is standards based and open source, which increases the level of security and trust due to transparency

CONFIAs technology is based on SAML 2.0, following the recommendations by SAML 2.0. Profile Interoperability. On the other hand, currently only the Web Browser SSO profile is used, http-redirect binding to request authentication and http-post for SAML2 assertion responses. No specific software was imposed to use in any of the infrastructure elements, such as IdPs and SPs. However, the open-source software „simpleSAMLphp" was recommended because of the following benefits:

- It´s lightweight.
- It's PHP and gains all the benefits of the popularity of the language.
- It´s easy to install. You only need to create a folder on an apache 2 with PHP ≥ 5.1.6 installation (≥ 5.2 recommended)
- It's easy to integrate, maintain and develop.
- It has very good documentation on-line.
- It´s scalable (for instance, it uses memcached to share session information between several nodes).
- It's modular.
- It's multi-protocol, enabling alternatives such as OpenID, Shib13, A-Select, WS-Fed, etc.
- It's easy to write new attribute filters.
- It generates metadata on-the-fly for IdPs y SPs.
- It´s Open Source.
- It's widely used: FEIDE, WAYF.dk, SWAMI, and so on.

And finally, as interaction model, we mention briefly the centralized Hub & Spoke model that has been chosen, which combines the advantages of distributed and centralized models, and where a central element performs the functions of discovery, protocol adaption, entity validation and data filtering, lowering the barrier for new federation members to be connected.

Identity Provider (IdP)

IdPs are the most critical components of an Identity Federation. They must authenticate users and provide for them a minimum set of attributes. It's the federation's policy, which specifies exactly what attributes are required and which are optional. For the first use case of CONFIA (Campus Andaluz Virtual) a standard set of optional attributes has been defined and agreed upon to cover the requirements for account provisioning and course enrollment for students at the target LMSs.

The basic elements and design recommendations for IdPs that CONFIA has used, are:

- Elaboration of a standard set of attributes during an early stage of the project. This was essential to ensure that the 10 universities involved could adapt and validate their identity management systems in accordance to the required attributes. All these requirements were written down in the Attributes Specification Document, available for all institutions. In this sense, eduPerson, irisPerson and SCHAC schemes were agreed upon.
- Integration compatibility with all existing authentication systems of the member institutions and clear separation from IdP layer. Methods of access include: PAPI, OpenSSO, LDAP authentication, OID and so on.
- A new module (Attribute Collector) was created to ease the collection of user attributes required for each service from heterogeneous data sources. This module, developed in PHP, implements, among other methods, RDBMS SQL, SOAP, LDAP and is easily expandable to any other data source.

- Explicit user attribute release consent. In the hub & spoke model, as discussed above, this is implemented at the central node.
- Provision of needed attributes in order to enroll students in the courses of the target LMSs, which are compiled from Student Information Systems at each university to ensure real time and up to date information provisioning.
- All code development is done as Open Source.
- Easiness for setting up filters to send attributes (php code).

Service Provider (SP)

As mentioned above, the first federated service in CONFIA has been the common Studies Offer to students from different universities as well as on-the-fly enrollments of LMS courses. A real-time synchronization between the local Student Information Systems and remote LMSs has been achieved, which only depends on the individualized managements in integrated institutions. In particular, it´d be enough a student makes their enrollments in subjects in their home university, which are taught at the target university, to access, minutes later, to the destination course in the LMS.

The most important characteristics used in the design of the different connectors are the following:

- A particular connector has been made for the three different LMS platforms available in 10 universities: Moodle, Blackboard/WebCT and ILIAS4. This code has been made in collaboration with the community and ensuring wider independence to the LMS for future upgrades.
- The provision of student and enrollment in courses at the LMS, are made on-the-fly, minimizing the old administrative procedures.
- Single Sign-On and Single Logout have been implemented, which affects both, the IdP where the user authenticated and all of the SPs where she initiated a session.
- All developments are done as Open Source.
- Access control depends on received attributes in SAML assertions: user roles, enrolments, account status and so on.
- Ability to easily set up filters to process attributes (PHP code).

Central Infrastructure and Hub & Spoke Model

CONFIA's configuration is based on the Hub & Spoke model, which has already been used as a successful case in other federations such as the Danish WAYF.dk. This model gains the advantages of the distributed model, in which each IdP and SP can communicate with each other and the centralized model, in which one IdP acts as front-end for several authentication sources.

In the the Hub & Spoke model:

- A central node exists, where common discovery functions, attribute release consent and data filtering is performed.
- Authentication is done in the IdP spoke.
- The complete set of IdPs and SPs is only visible to the central node and therefore, they only require the metadata from the central node.

– The original authentication domain is provided as attribute, so that the SP can do any decisions based on it.
– A simplified setup and maintenance.

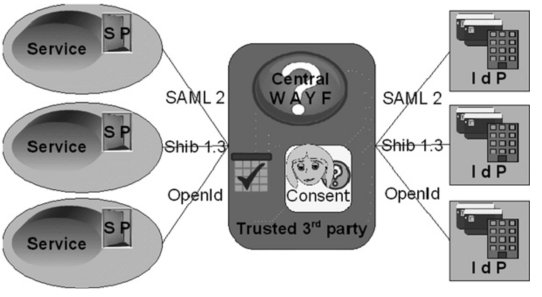

Figure 3. Hub & Spoke model

Technically, when the binding SAML2 http-redirect Web SSO profile is chosen, the following sequence of calls to access a SP is produced: when a user's browser is directed to an SP's URL without a valid session, it is redirected to the central node which presents an IdP selection screen. Then, the user is redirected to the IdP for authentication, which returns user data to the central node. In this node is where the defined attribute release policy is applied and where the informed consent screen is shown. Finally, the user is returned to the SPs assertion consumer service which validates the SAML message, extracts the user data and gives the control to the requested Service. If the user is authorized, decision done by the Service, the user gains access.

In addition to components already mentioned in a federation (IdPs, SPs and central node), CONFIA has adopted a set of additional services that facilitate its administration and make it safer and more reliable. These ones are:
– Metadata automatic distributed procedures, which simplifies administrative work.
– An attribute validation and filtering service where values offered by IdPs are verified, before these are included in the federation (JANUS).
– Monitoring tools for IdPs and SPs.
– Trust model based on automatic certificate validation (CRLs and OCSP) and encrypted assertions.
– A test (moodle) SP server to test and a development environment.
– A discovering service in the central node.
– A central attribute release policy and an attribute release policy editor.

Other advantages

– The success of this Project has been achieved thanks to an strategic plan and financial support in order to resolve a key problem of a key application (CAV) of the Andalusian universities.
– A strong collaboration with the community work has been done: WAYF.dk, simpleSAMLphp, ILIAS, moodle, JANUS.

- Adding new services (IdPs and SPs) has been simplified, thanks to a centralized model.
- A technical committee composed of widely experimented staff from universities has been a critical factor for successful execution of the project.
- Finally, collaboration from a highly qualified company in all phases of the project has also been critical for the success.

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eLabs — Platform for Online Laboratory Management

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Keywords

workflow, organizational management, online laboratory management

Abstract

We observe, today, an unprecedented development of information technologies in various organizational, social and economic fields. The Web is the main driver of this evolution from a simple display system of linked pages to a powerful platform for information and communication, having the interaction, the dynamism and multimedia resources their main features.

At the organizational level, the Web has introduced several improvements, turning the business processes more effective and centered on users. The deployment of portals to support management and communication in organizations was the first step in the integration of information technologies in several fields of organizations.

One of the most relevant technologies to support business process management is workflow, representing the most significant solution for process automation and information management inside an organization. According to Hales (1997) workflow is a proactive management system that manages the workflow among the participants (users or other systems), according to predefined procedures that define the tasks.

This article discusses the development of a platform for online laboratory management based on workflow technologies, with the main goals to improve communication, cooperation and integrated management of resources, promoting greater efficiency in laboratory management.

The eLabs platform is been used in Instituto Politécnico de Bragança for laboratory management, integrating the management of internal and external services, equipment, resources and tasks. The results obtained demonstrate an improvement in the efficiency of resources management and the enhancement of quality of services realized inside the institution and to the community.

Introduction

Information systems had their evolution from the age of data processing to the information age, where the information and knowledge are the main drivers of evolution in our societies. At organizational level, the management systems are often associated with the workflow systems, cooperative work and groupware, because they permit to extract knowledge from various systems within an enterprise or institution. Communication and knowledge are naturally associated with the human experience and social contexts, and managing it with efficiency means that is necessary paying attention to persons, cultures, organizational structures and technologies, in terms of its sharing and use.

The main types of collaboration systems in organizations are workflow and groupware systems, having the purpose to establish a relationship between people and processes, enhancing process management and communication. The integration of these systems in an organization, have several implications in respect to the natural resistance that people presents when is necessary to change habits.

The adoption of workflow systems in higher education institutions to support management has some resistance, because the necessity change the internal procedures and the difficult to harmonize the different processes is a great challenge.

The integration of workflow systems in laboratory management is the main topic of this paper, presenting a bottom up approach that started in one laboratory and was progressively expanded to other laboratories in different areas.

Workflow technologies

Workflow systems had an important role in organizational management integrating information technologies to decision support in processes of an organization. With the implementation of these systems, the information can be used to produce organizational knowledge implementing good practices and promoting the sense of responsibility in each part of the process by all the collaborators.

Chiavenato (1995) refers that: „the process of adapting and updating technologies have profound internal modifications, in relation to material aspects such as machinery, equipment and facilities". The main purpose of collaborative systems is to allow responding to routine questions and flow the transactions across the organization.

The main characteristics of workflow systems are (Sarmento, 2002):

- Having the capacity to distribute tasks between participants;
- Have the ability to store rules (work plans, priorities, referrals, authorizations, security and the role of actors);
- Automate business processes and document management;
- Generates the flow of work between participants, documents, information and tasks;
- Coordinates information resources, users and tasks based on information.

According to the author, the success of an organization depends on the ability to communicate and cooperate in teams, emerging working groups and even in virtual organizations. It means that to perform a task or job team members don't need to be in the same geographic location or at the same time, when using appropriate tools for communication and collaboration.

The basic characteristics of a workflow system was proposed by Moro (1998), divided into three functional areas: design and implementation of processes, services and activities, control of execution time and changing process and the interaction of individuals with the information technology, tools and applications (Figure 1).

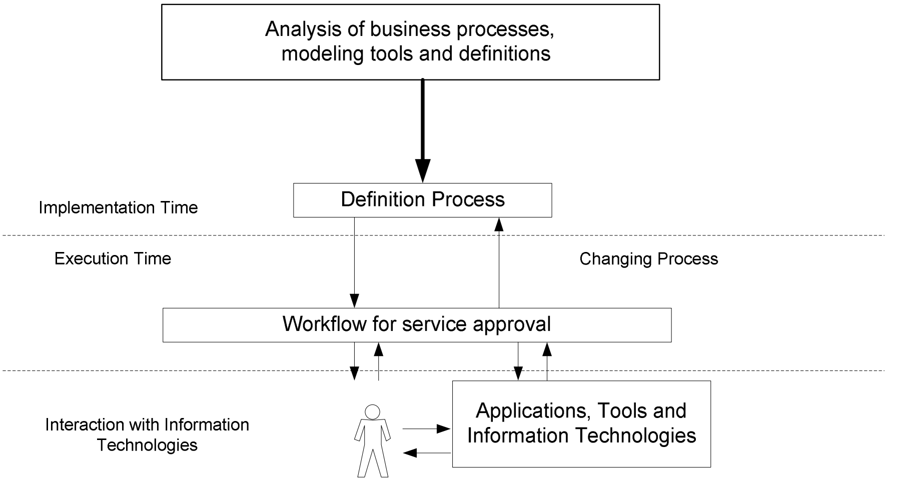

Figure 1. Workflow process implementation

Workflow systems bring several advantages to organizations, at environmental level, with the reduction of paper, and increases the sharing of information and its access without the limitation of space and time. Moore (2002) highlights the main advantages of workflow systems:

- Reduction of production time;
- Increased productivity and reduced costs;

– Improved customer service;
– Increased ability to rapidly change business processes;
– Reduction of errors;
– Reduced time spent on administrative tasks, which frees resources for other tasks increasing productivity.

According to Jablonski (1996) workflow systems can be defined in three different areas: consulting, industrial and academic. In this paper we discuss the academic field, more specifically the laboratory management, where workflow can support processes and tasks management, facilitating the requisition of equipment, inventory management and the improvement of services.

These characteristics were explored in order to add to the eLabs platform the ability to support different tasks related to laboratory management. The development of eLabs platform was based on workflow technologies to support communication, cooperation, integrated resources management and to promote the efficiency of processes.

eLabs platform

The eLabs platform has an interface that integrates the management of several laboratories in different areas and associated with different departments of an institution of higher education. The general architecture of the platform eLabs has three user profiles: the supervisor, laboratory staff and end user. eLabs has two main parts: the frontoffice portal, allowing access to end users (students, faculty management services, staff or clients) and the backoffice witch is available to the eLabs supervisors and laboratory staff.

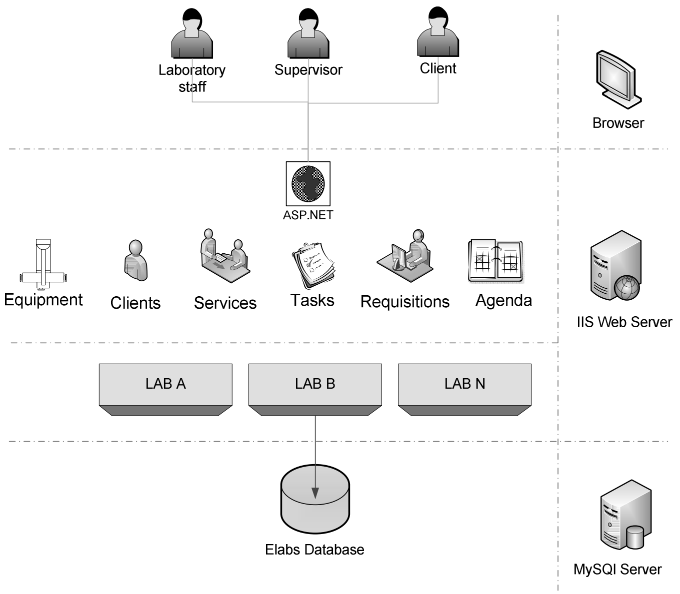

Figure 2. eLabs architecture

The backoffice has the feature of management of equipment, including supplies and stocks, clients, users, services, tasks, requisitions and agenda. On the frontoffice clients, including external enterprises, students and lecturers, have access to online services and equipment requisition (Figure 2).

Each user profile has different roles in the system. The laboratory staff is the administrator of the laboratory that is affiliate managing equipments, clients, providers, services, tasks and requisitions. The supervisor has a read only view of the information and can view all the information related to the laboratory that is affiliated. The end users have access to services and equipment requisition, and can follow all the workflow of each process that request.

eLabs presents an intuitive design based on tableless structure (Figure 3) and is compatible with most common browsers. All formatting is based on CSS and XHTML standards and the architecture is based on tree layers supported by ASP.NET and AJAX.NET(Asynchronous JavaScript and XML).

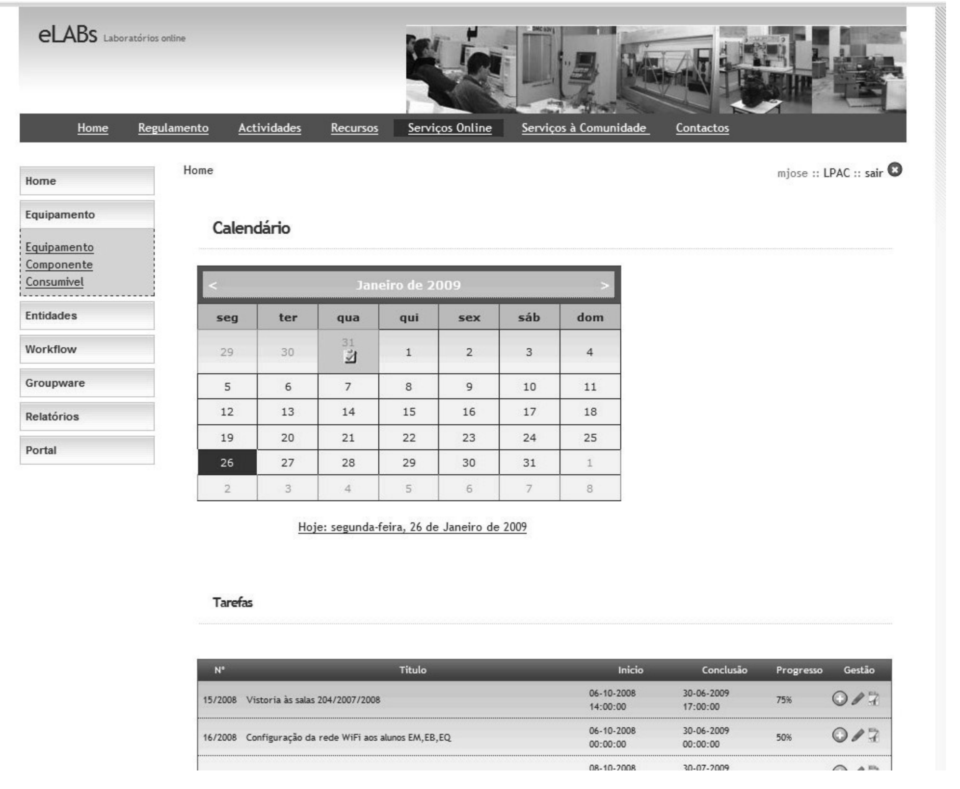

Figure 3. eLabs interface

The today screen shows all the tasks and services that each laboratory has in execution, informing the staff and supervisors when a task or service is delayed by email and in the eLabs platform.

The platform also contains a public area with a number of information including general information about each laboratory, services policy, resources and contacts.

Results and conclusions

Workflow systems are very powerful tools for organizational management. It facilitates the sharing of information, coordination of tasks, processes flow management, services and activities.

Elabs platform is based on workflow technologies to support laboratory management, with the aim to promote a greater efficiency in resource management. The implementation of a common service management framework for all the laboratories represents an improvement in the time to respond to services requests and in its quality, because all the data is now electronic with advantages in their access and management.

The platform is been used by eight laboratories in School of technology and Management of Instituto Politécnico de Bragança, in the areas of mechanical engineering and chemistry. The average of monthly accesses is near 50, the number of tasks per month is 31 and the numbers of requested services per month are 16, which it is a good indicator because there are only six laboratory staff members.

The adoption of eLabs in the laboratories of Instituto Politécnico de Bragança represents an improvement in the efficiency of laboratory management, supporting the management of services, tasks, equipment, stocks and documents. The launch of the platform eLabs also contributes to increase the activity of technology transfer, since it allows a higher efficiency in the support of research projects and facilitating the management and the development.

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Students' Mobility: STORK Project Deployment

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Keywords

STORK, cross-border, digital identity, authentication, interoperability, mobility

Abstract

Providing e-services on a federated environment requires a hard and trustable authentication scheme, traditional methods such as username and password have become obsolete as far as there is no centralized database to check against, furthermore, additional data associated with the actor who is being authenticated can be required for the process. Identity

management solves this by providing strong authentication and attribute management capabilities.

This paper describes STORK's Students mobility pilot, including project planning, definition of the common specification layer, technologies that implement the interoperability layer and tasks oriented towards the integration, testing and tuning of the authentication mechanisms of Universitat Jaume I into STORK's common interoperability layer.

In addition, it considers the results and benefits expected during the running and monitoring of the real life pilot that is taking place within June 2010 and May 2011.

Background

Secure idenTity acrOss boRders linKed (STORK) is 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 problem. This project brought together in its first phase 14 countries and 29 consortium partners mixing public and private sector organizations. Five new member states have incorporated to the STORK consortium in a second phase.

University Jaume I is leading the student mobility pilot on behalf of "Conferencia de Rectores de Universidades Españolas" (CRUE) which will allow students to perform some formalities through a web portal despite of their location.

Student mobility pilot, covered in this paper, is one of the five projects deployed in order to test a common interoperability layer built within the Large Scale STORK Pilot. The other projects are:

- Cross border Authentication for Electronic Services.
  - The objective of this pilot is to prove that existing national services can interoperate across borders. It will enable existing national online services in one or more participating Member States to connect to existing national electronic identity services in other participating Member States. The online services that are part of this pilot are the national portals of Austria, Estonia, Germany, Portugal and the Limosa service, which enables compliance for the right to work in Belgium.
- SaferChat.
  - The SaferChat pilot will demonstrate a more secure social networking environment, where venues for collaboration and communication are tailored to students aged 14–18 and their educators.
  - The Safer Internet Nodes in Austria and Iceland are actively involved, with their respective Youth Panels playing important roles as focus groups involved in testing and piloting. Furthermore, several schools are already participating in the SaferChat project and are involved in the pre-pilot preparations and tests. A widely-spread and accepted open source e-learning framework (Moodle) that provides many features in order to fulfill the requirements for this pilot, such as resource sharing or chat modules has been selected as the demonstrative application for chat rooms and school projects. A special connector and plug-in for connecting this e-learning framework to STORK has already been developed and is being tested, while a chat room module has also been adapted. The e-learning application has been deployed in a test environment, bringing this pilot closer to its effective launch.

- eDelivery.
  - This pilot will enrich selected eDelivery portals of Slovenia, Estonia and Austria with STORK authentication components. As a result, citizens from other Member States will be able to login, register and pick-up deliveries at these eDelivery portals by using their own domestic eID tokens.
  - Public authorities of one Member State will be able to send documents to recipients in another Member State using their domestic eDelivery system. This cross-border eDelivery framework is going to be piloted between Austria and Slovenia. This pilot will start testing at the beginning of June 2010. Currently, the pilot is deploying and testing the developed technical components in connection with the existing national infrastructure of STORK's partners.
- Change of Address.
  - The Change of Address Service enables citizens to electronically change/update their addresses in the participating Member states.
  - The challenge is ensuring the service obeys the requirements of each Member State's local law and internal processes while at the same time allowing for EU-wide interoperability. Once updated in other Member States, the change of address can be communicated to several entities of the citizen's choice. All participating Member States recently agreed upon the chosen format for the Address Declaration, in order to allow automatic and/or manual processing. Currently, the participating Member States are in the final stages of development for all the necessary services, with the test phase shortly following.

STORK Project deployment: students mobility pilot

The student mobility pilot aims to solve some of the current mobility problems. The idea behind this is to provide a common framework in order to interoperate among different entities. This framework will be provided by the STORK project, allowing universities to use it in order to get identity proofs. When a student wants to apply for an e-service offered by a university different from his or her own, this university will get the student's authentication data and will send them to the STORK backbone to get an identity proof. The participant universities will provide e-services to students from abroad facilitating cross-border mobility a pan-European higher education environment. The pilot is focused on students moving to a foreign European University, with the 'Erasmus' registration procedure having been selected as the main application for the pilot

Technology overview

Providing e-services to authenticated users over a corporate controlled intranet is solved by Single Sign On Systems where the authentication procedure is centralized and the control over it remains on the organization but when the set of users that can access to these e-services comes from external sources the organization has no control, the authentication procedure must be delegated to the organization who has this control, that is named Identity Federation and one of the basis upon the STORK project is constructed. The main idea behind Identity Federation is to delegate the authentication procedure against the involved party who has control over the validation of the authentication data. This party is commonly known as Identity Provider and could offer an Identity proof – That is a yes/no answer to the question, is the user authenticated? – or in addition, an authenticated attribute set could also be offered by the identity provider. For example, the address of a person, the telephone or the date of birth will be possible attributes.

In order to get these identity proofs and the attributes, an open XML based standard is used, SAML. The authenticated data is signed using the XML Signature specification so authenticity and integrity are assured.

From the STORK point of view, we can find the next components that compose the full Identity Federation infrastructure:

– E-service

  It is the service delivered to the end-user and where he or she wants to get authenticated in order to get some benefits.

– S-PEPS

  When an organization wants to authenticate an external end-user, it must know where the request must to be addressed, this mapping is stored in the S-PEPS (Source Pan-European Proxy Service) that will be the part involved into user's redirection towards C-PEPS.

– C-PEPS

  Once the authentication is sent to the C-PEPS (Colleague Pan-European Proxy) this component will redirect the request to the final IDP.

– IDP

  The IDP authenticates the user and gives an identity proof as a response.

Regarding STORK, each country is named Member State and has a PEPS used for interaction between them.

Students mobility as a paradigm of pan-European interoperability

The STORK framework will encapsulate the procedure to have the students' identity checked against the country or university of origin and to get it back to the university of destination, which will be able to decide whether the e-service should be provided or not. From the student's point of view, the whole procedure can be performed from its origin country or university. Authentication is not the only goal of the pilot, as the STORK infrastructure also provides authenticated attributes, and thus, some extra data can be used with full guarantee by eService providers.

That will allow systems from different universities to interact to each other without any access or implementation restrictions that is the classic definition of interoperability. The interoperability could be achieved in two formal classifications:

– Syntactic Interoperability

  That is the systems exchange information with a predefined data structure, communication protocols, etc. In case of STORK Syntactic Interoperability is achieved by using an XML based standard (SAML) to interchange the authentication data over a common transport layer (HTTPS).

– Semantic Interoperability

  Semantic Interoperability is referred to the ability of interpret the information interchanged in an automated form. For example, in a scenario where a consumer university wants to know if a foreign student has a bachelor's degree, the identity provider could offer such attribute that will be automatically interpreted by the consumer university system allowing the student to perform the required procedure.

For this interaction, four universities from different European countries (Italy, Austria, Portugal and Spain) are directly involved in the pilot together with the Estonian institution in charge of providing services for registration and access to higher education. However the participation is open for any university willing to join the project. In Spain, there are at least seven universities which are going to benefit from the pilot through CRUE and RedIRIS.

Use cases under test

The project started on June 2008 defining the scope of the pilots and it is scheduled to go live during June of the present year (2010). As a result, a limited set of common use cases were selected in order to be implemented by any participant university. These use cases are:

– Erasmus enrolment and pre-enrolment procedures: an Erasmus student will be able to get enroled or pre-enroled from his origin country through the STORK infrastructure.
– Foreign students/citizens registration to specific courses: some universities allow citizens and students, with no further requirements than checking their identity, to access specific courses. Pre-enrolment to these courses is also included in the pilot.
– Access to on-line services through SSO mechanisms: in addition to the enrolment or pre-enrolment procedures, universities participating in the pilot offer some services focused in the student relationship with the institution. The access to the e-services provided by the universities is also considered within the use cases.

Regarding the use cases, there are some challenges to overcome when doing them automatically and in a cross border way. The first problem to solve is the administrative procedure, universities have their admission procedures very well defined and the new procedure must fit totally the administrative requirements. Each university has its own admission procedure and, thus, they must evaluate if the new procedure meets their own rules.

Secondly, the identity must be checked in a secure and trustable way, the identity providers must perform correctly and the information given must assure its authenticity and integrity. The attributes related to this identity are also really important as far as they will be the only data used into the used e-service.

During the first phase, universities will only be attribute consumers, requesting the attributes needed to the citizen's origin countries through the S-PEPS – C-PEPS – IDP interaction, but the STORK infrastructure also consider to interact with universities turning them into an attribute providers, thus in the first phase only some set of attributes could be interchanged, see Table 1, but in a second phase a wider set of attributes could be consumed by universities, i.e. imagine that an Austrian citizen, a student from Graz University of Technology wants to get enrolled into a master's degree course at University Jaume I in Spain, the University Jaume I must know that the incoming student has finished a bachelors degree first and this could be an attribute that will be asked by University Jaume I, using the STORK infrastructure, to the Graz University.

Table 1. Attributes offered by each country IDP

Austria	Estonia	Italy	Portugal	Spain
Last name First name Date of birth A unique sectorial ID	Last name First name Date of birth National ID number Gender	Last name First name Date of birth Place of birth Address Fiscal code Sex	Full name Date of birth National Id number	ID Given name Surname Family name Gender Date of birth Nationality Canonical Residence Address Text Residence Address email Address Age Is Age Over

A Working Test Example (fonoteca@uji.es)

The Student Mobility pilot is in its testing phase, at University Jaume I, a very early integration is done with the "fonoteca" service, a service that allow students to listen to a wide set of music stored at University servers. This test is a prototype and is only delivered to the service developers in order to test the SIR (Identity Service from RedIRIS, the Spanish academic and research network) that connect the university to STORK, the process is shown at Figure 1.

The first step is the user request for an e-service application, in the fonoteca test case, this is done in the main page that can be seen in the Figure 2.

When the user request access to the service, he or she is redirected to an authentication page where he or she can choose whether to authenticate using the local SSO or an external provider as shown in Figure 3.

Once the user has chosen the external authentication method, a page is displayed by the SIR in order to alloy him or her to choose its origin country, Figure 4 illustrate this process.

When the student select its origin country, he is finally redirected through STORK to its identity provider in order to perform the authentication, in this example a Portuguese authentication has been chosen as the Figure 5 shows.

And finally the user is redirected through the STORK back to the e-service provider who receives the authentication data and attributes. An important remark, from a privacy point of view, here is that the user always has to give permission over the authentication and the attributes that will be transferred in a transparent way, thus he will always know the information that is going to be transferred about him or her.

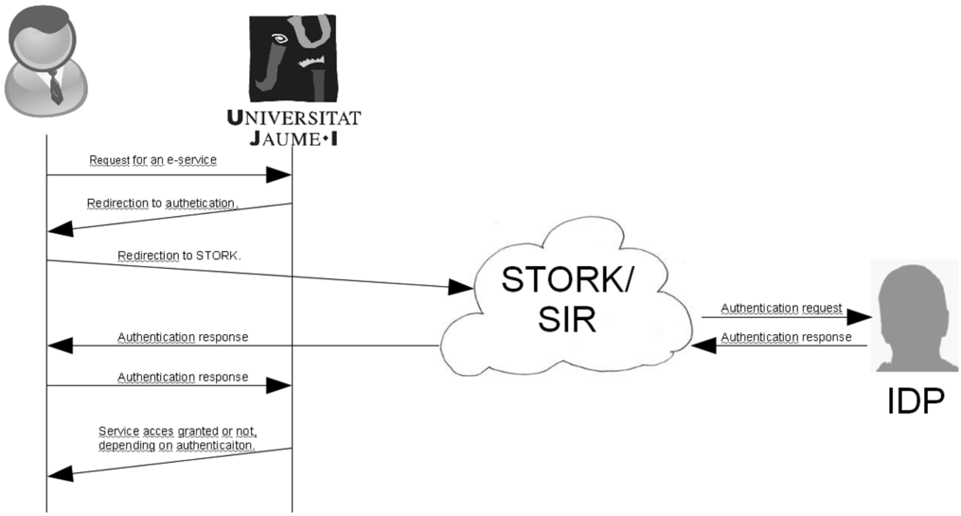

Figure 1. User authentication for an e-service

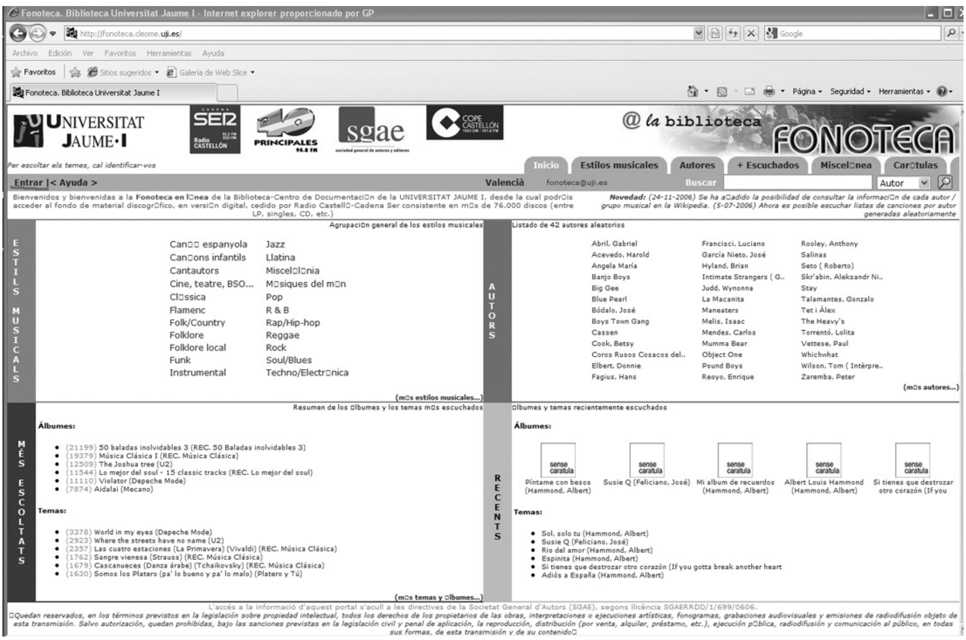

Figure 2. E-service page

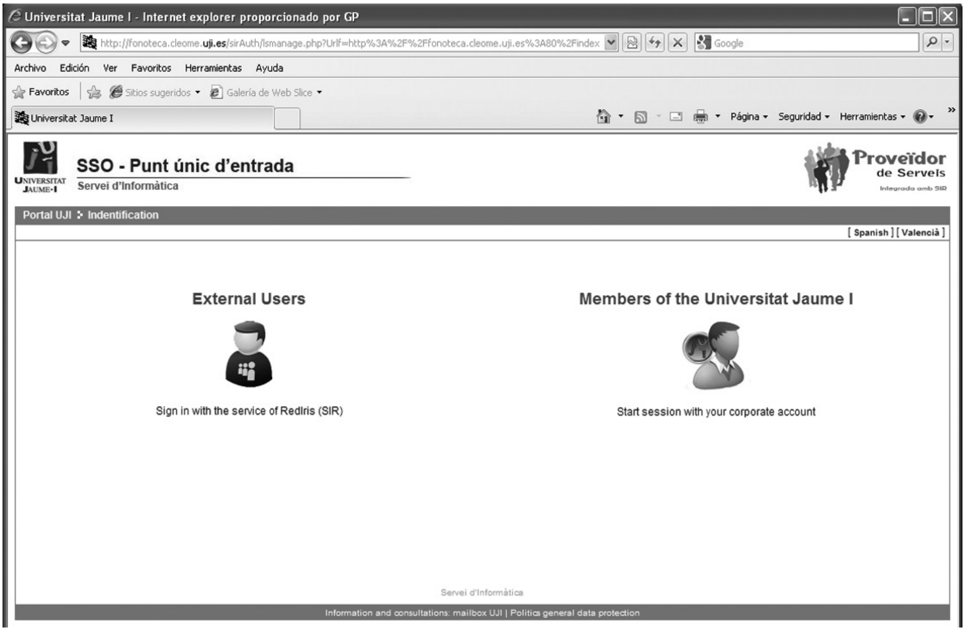

Figure 3. Authentication method

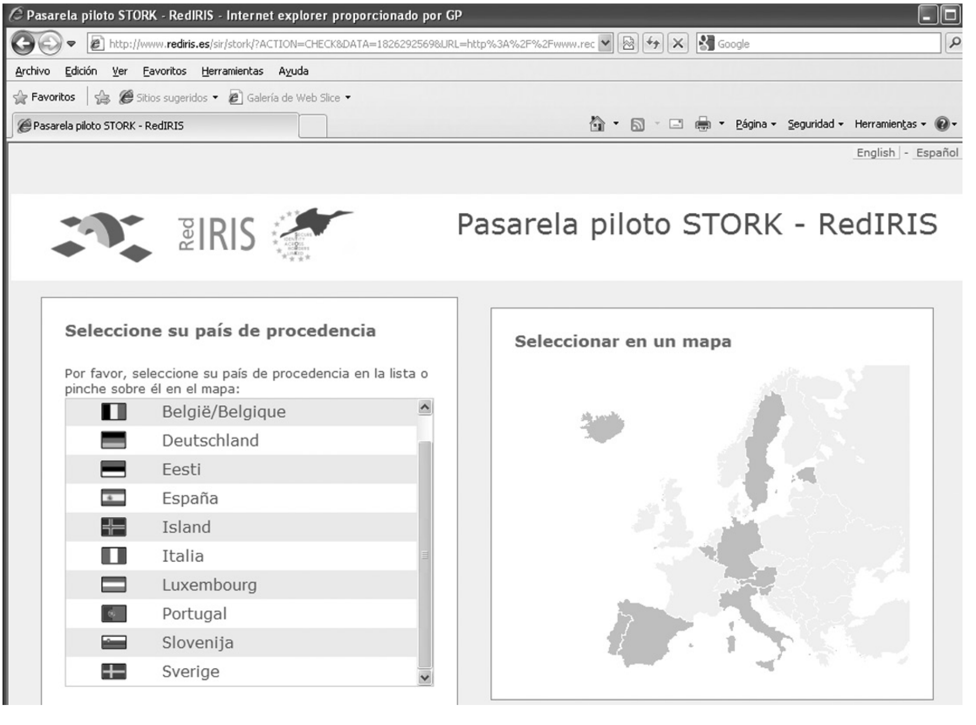

Figure 4. Country of origin selector

Figure 5. Authentication and attribute selection

Extension and future

The infrastructure will not be limited to the use cases mentioned in point 5. Any university is free to adapt STORK to other services depending on the internal organization, the degree of integration of authentication procedures and the attributes available.

Any university of Europe is encouraged to integrate to the STORK infrastructure, their first step should be to adapt its own SSO system to be able to delegate the authentication to a national PEPS, an interesting model is the Spanish SIR where a connector component hides the particularities of the national PEPS, or any other IDP, offering to any university an easy and feasible way to use any identity provider that is registered in the SIR service.

In the future universities could be also attribute providers so the interchange of authenticated data will not be limited to an authentication and personal data but data about the degrees coursed, academic records, prizes, grants, etc. could be offered by a origin university with the student consent eliminating formalities on the destination university being able to perform any procedure from its origin country. This will contribute to the European Higher Education Area within the context of Bologna process promoting mobility and homogenization of procedures between European universities.

Risks

As any other project, this pilot is not free of any risk, the main problem we are facing thinking on the deployment is not to find the sufficient amount of Erasmus students participating in the project. The student not only has to be an Erasmus student but he or she has to own an enabled eID from its origin country that it is enabled on STORK. That can reduce a lot our target group of participants.

Another risk the pilot is facing relates to the maintenance of the deployed components, a big infrastructure has been created and a lot of resources has been assigned to develop the specific member state and universities infrastructures, all these components will have to be maintained and more resources coming from the European Commission will be necessary in order to evolve and maintain the project.

Students engagement

Student's mobility pilot is especially interesting to test the whole STORK project due to the specific targeted group of users. The group of users that can access to the services is previously determined, because they are students, and it is relatively easy to contact to them and encourage them to participate through special programs.

Furthermore, a set of actions will be performed in order to engage the students, the most notable ones are the organization of workshops where users will receive a gift and a certificate to assist, also the students that have shown interest to study in a foreign university could receive a brochure where the stork advantages will be explained and some articles will be sent to the press media in order to spread the pilot awareness within the student community.

Conclusions

We can conclude that the Student's Mobility Pilot is a key pilot regarding the testing of the whole STORK infrastructure because of its targeted set of users.

Also, the deployment of this pilot will, in the nearer future, eliminate formalities within the university engagement procedures allowing students to apply from a specific service from anywhere just having his or her enabled eID. Also the evolution of the project relies on the continuous adoption of eIDs by the European countries provoking a growth in the potential user set.

Finally the infrastructure will be a key factor regarding the interoperability between the different public administrations and European companies that could take profit of the authentication procedures in order to offer their services to a wider set of users.

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IT Governance — How We are Making it Work at Nottingham Trent University

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Keywords

IT Governance

Abstract

Nottingham Trent University, like many institutions, has been reviewing IT risks and opportunities. A reorganisation enabled the setting up of a small IT Governance team to introduce appropriate identification and management of controls to ensure that activities across the Information Systems department are correctly governed. Each of the identified areas has been tackled systematically to arrive at a solution which works for our organisation. In doing so we have identified what works and what does not and how our culture has changed as a result of the work undertaken.

Background

Nottingham Trent University is a so-called 'new' University having been created out of the former Nottingham Polytechnic in 1992. The components of the Polytechnic which were brought together in 1970 can be traced back to 1843 with the opening of the Nottingham Government School of Design. Today the university is a vibrant modern university based on three campuses, with approximately 25,000 registered students and 2,800 members of staff.

Business systems were being moved to electronic format in the late 1970s and the University has been through a number of support structures for IT, with the current Information Systems and Web Development teams being created at the end of 2004. Bringing staff together in one department and in the main co-located, has allowed university and IT managers to identify both strengths and weaknesses and the balancing of risks and opportunities of the then IT provision, and to move to address issues.

This balancing of risks and opportunities is the major drive for the introduction of IT Governance at Nottingham Trent University. One significant risk identified is associated with the University culture, identified as 'Academic Freedom', which has translated into a perception that IT staff can 'do what they like'. This has essentially arisen from poor management – consequently IT Governance has been introduced to bring in systems of control, without quenching initiative and enthusiasm.

Governance Models

Our first approach was to use the National Computer Centre best practice guide (NCC, 2005) to identify the issues we should be tackling to create an IT governance model:

- Creating a business case for IT Governance
- Performance Measurement
- Implementation roadmap
- Communication Strategy and Culture
- Capability Maturity and Assessment
- Risk Management
- Supplier Governance
- IT and Internal Audit working together and using COBIT
- Information Security Governance
- Legal and Regulatory aspects of IT Governance
- Architecture Governance
- Managing the IT Investment.

Our conclusion, given the amount of work identified, was to pick off the areas perceived to be low hanging fruit and to use these to start to promote change, and to help us address an appropriate model for IT Governance within the University.

Looking at COBIT (ISACA website, 2010) we rapidly decided that this was not the model for us. Essentially we felt a need for something simple which we could adopt easily and let it grow. If it morphed towards COBIT then so be it, but for us it was not a place to start from.

Rather a small group proposed a simple hierarchical structure:

Where we are using the 'pillars of activity' to represent the working areas of the department – operational; development; projects; etc.

The working group proposed that by establishing the work of the department on a grounding of best practice this should ensure we were operating in the correct space with appropriate monitoring being used to identify if the work was appropriately aligned to the business need.

Shortly after reaching this conclusion, the work reviewing IT Governance in the UK Higher Education sector funded by the Joint Information Systems Committee was published (JISC, 2007) which seemed to reach similar conclusions (but with a better picture):

<table>
<tr><td colspan="5">Business Strategy alignment</td></tr>
<tr><td colspan="5">IT Governance – Critical Success Factors – IS objectives</td></tr>
<tr><td colspan="5">Balanced Scorecard</td></tr>
<tr><td>Pillars of activity</td><td>Pillars of activity</td><td>Pillars of activity</td><td>Pillars of activity</td><td>Pillars of activity</td></tr>
<tr><td colspan="5">External Benchmarks; Good Practice (ITIL, ISO, PRINCE2, etc.)</td></tr>
<tr><td colspan="5">IS Values</td></tr>
<tr><td colspan="5">Monitor – Key Performance Indicators</td></tr>
<tr><td colspan="5">Audit – External assessment</td></tr>
</table>

Figure 1. Proposed IT Governance structure

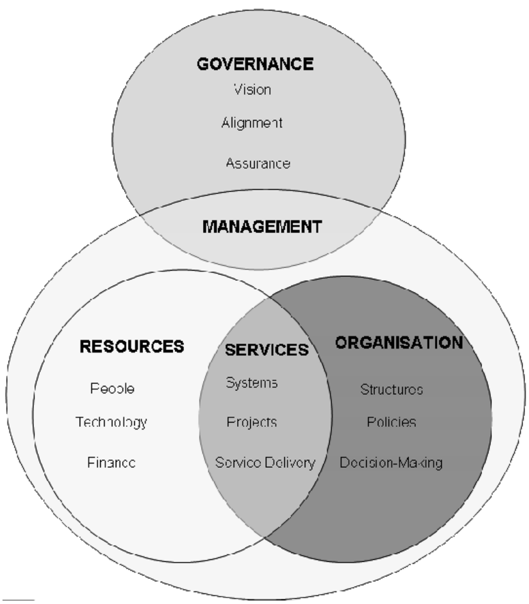

Figure 2. JISC IT Governance structure

For us, what was particularly helpful was the supporting material, including a toolkit and questionnaire which have enabled us to identify where we are along the process, and what still needs to be done.

Latterly we have also been looking at the overlap between the JISC model and the ISO standard 'Corporate governance of information technology' (BSI, 2008) and in particular the 6 principles:

– Principle 1: Responsibility
  Individuals and groups within the organization understand and accept their responsibilities in respect of both supply of, and demand for IT. Those with responsibility for actions also have the authority to perform those actions.

- Principle 2: Strategy
  The organization's business strategy takes into account the current and future capabilities of IT; the strategic plans for IT satisfy the current and ongoing needs of the organization's business strategy.
- Principle 3: Acquisition
  IT acquisitions are made for valid reasons, on the basis of appropriate and ongoing analysis, with clear and transparent decision making. There is appropriate balance between benefits, opportunities, costs, and risks, in both the short term and the long term.
- Principle 4: Performance
  IT is fit for purpose in supporting the organization, providing the services, levels of service and service quality required to meet current and future business requirements.
- Principle 5: Conformance
  IT complies with all mandatory legislation and regulations. Policies and practices are clearly defined, implemented and enforced.
- Principle 6: Human Behaviour
  IT policies, practices and decisions demonstrate respect for Human Behaviour, including the current and evolving needs of all the 'people in the process'.

This will enable us to further refine our model and to ensure that we keep moving forwards.

Low hanging fruit

Using the NCC list (see section 3) we rapidly concluded that the most appropriate areas to address were those where we felt that 'quick wins' were possible and so we agreed to address the following topics first:
- Risk and audit
- Finance
- Information Security
- Legal issues.

A review of the department following the appointment of a new Director in Information Systems led to a review of capability followed by a two year programme to develop shortcomings. In Governance terms this added the following areas to the work programme:
- Capability Maturity and Assessment
- Performance Measurement
- Architecture Governance
- Supplier Governance
- Culture
- Leadership and Management.

Subsequently we have formalized the whole approach to IT Governance by writing a strategy for taking issues forward and identifying the work needed. The work list from the first version of the IT Strategy is included in Appendix 10.1, the capability model we are aligning to is in Appendix 10.2.

A more recent minor departmental reorganisation further extended the reach of IT Governance when the following areas were moved into the IT Governance team:

– Software Licensing
– Asset Management
– Change
– Test and QA.

The IT Governance strategy has recently been reviewed and updated – we continue to identify areas for development, for example we have identified we need to develop a formal communications strategy both within Information Systems and for our outward messages across the University.

How have we tackled each area?

Risk and audit

The first thing we realised was that whilst risk was everybody's business; it was also nobody's business. Consequently while risks were being managed informally, there was neither departmental risk register, nor high level view for the IS Management Team. We have tackled this by collating risks into three areas:

– Department wide (so called high level risks the Director need to be aware of)
– Operational risks
– Project risks.

High Level risks are reviewed by the Information Systems Management Team at a formal risk and audit meeting, looking for minimisation of gross risks and formal sign off of minimised risks to a 'risks accepted' register. Operation risks are also reviewed monthly by operational managers. This register has needed some work as these staff are often less interested in formalising risks, documentation or review! Essentially a high degree of involvement by the IT Governance team has been required, in training, in identifying and categorizing risks, identifying appropriate mitigation and ongoing management. Project risks exist as generic risks across all projects, managed by the head of the Project Office and as individual project risks managed by project boards. For projects we use the RAIDs formula (Risks, Assumptions, Issues and Dependencies).

Audit actions, for us, are those as a result of investigations into IS activity by internal audit. For practical purposes these are managed as issues in the risk register and reviewed at the monthly managers' meeting. Formal audit closure takes place and both audits and the work done are reviewed by the University's Board of Governors. The most significant involvement has been to encourage managers to be honest about their capability to respond to request from auditors, not to be over ambitious and to agree practical timescales for implementing improvements.

Finance

Traditionally finance had been managed centrally; i.e. there was one budget for the whole department. This meant that departmental managers had neither authority nor responsibility for making purchases. This has been resolved by identifying appropriate budget managers and devolving budgets. For governance purposes, expenditure is tracked monthly and significant deviations from budget need to be explained/resolved. These are reviewed locally but also at a monthly management meeting which also tracks overall progress. Governance is also involved at budget setting to ensure that budgets are realistic and within wider budget setting constraints.

Information Security

Information Security has been in the hands of a dedicated member of staff for some six years. This ensures that we have the correct skills to manage and maintain security and also to conduct investigations. Our weakness is providing cover for holidays and sickness, though we have made plans to address this should budget become available. For governance purposes this role was moved into the IT governance team when this was formalised.

Legal issues

Identifying that the legal aspects of IT management and governance were resolved correctly was achieved by a simple discussion between the IT Governance team and the University's Legal Services team. As well as establishing an ongoing dialogue, we have established formal processes to ensure issues are resolved in a formal way; notably requests for information under the Data Protection and Freedom of Information acts.

Capability Maturity and Assessment

This was an activity promoted by the then new IS director where we undertook a maturity model self assessment against 8 areas:

- Leadership and Management
- Communications
- People
- Client
- Organisation
- Process
- Architecture
- Finance.

The criteria for each of the maturity levels are described in Appendix 10.2. In practical terms for IT Governance this enabled a number of areas to be addressed as part of a wider programme. One particular success has been the workstream leader for the People stream effectively becoming a surrogate member of the IT Governance team and ensuring that appropriate processes are in place for managing our staff and ensuring their voice is heard.

Performance Measurement

Establishing appropriate performance measures has been something that we have not found easy to do, though we are not sure why. After about 12 months of prevarication the Capability Improvement Plan project manager finally established Key Performance Indicators for each of the project areas, though until we appointed one person to be responsible for collecting the data reporting was patchy. Having someone who no longer accepts 'the data is not ready' as an answer means we now have regular monthly reporting. Having this data also names and shames poor performance, and has meant that scores have been improving!

Architecture Governance

We have addressed managing the University's IT architecture by creating a small group which we call the Design Authority. This consists of four staff with systems management; network design, business management and system testing skills. They have created a model architecture to which we are aspiring, and new work has to be approved by them before it can proceed.

Supplier Governance

We have tackled our relationship with our suppliers in two ways, Firstly we have simply created a list of who they are, what their details are and what we purchase from them. This will generate further work to seek to consolidate suppliers and to better manage the relationship we have with them. We have also tendered for a strategic partnership for the supply of our key activities – servers; storage, network, desktop computers, printers and AV equipment – and this has led to the development of a significant arrangement where we have call on added value services; access to specialist and preferential pricing; enabling us to develop activities which improve the service received by members of staff and students.

Culture

We had identified a problem with low morale (which curiously did not affect staff turnover) and have been looking to improve this in a number of ways. Most importantly we have been using a survey from the Health and Safety Executive to measure morale and thus have something more objective to identify issues and change over time. Practical activities have been an all staff morale team to highlight and seek to resolve issues; better communication; a team newsletter; encouraging managers to have 1 to 1 meeting and team meetings to improve team bonding; informal coffee and lunch sessions, etc.

Leadership and Management

Our aim was essentially to improve management skills and manager confidence. We have had a year of in-house training in areas of management practice with practical activities for managers and team leaders to use with their teams. This has been followed up with a mangers forum where we are staring to encourage managers to talk with each other and raise areas of common interest and concern.

IS values

Whilst this might seem a trivial issue, we have agreed and are promoting the values we hold as a team. Doing this has helped with the change of culture, so that as we start to value each other we start to become a team, and then start valuing the work we do, and thus start to assess how what we do impacts on the business of the University, and thus embrace the reasons behind why we conduct IT Governance.

Software Licensing

Essentially our aim is to ensure that all software is licensed correctly, but also to ensure best value by minimising the number of software titles and making use of bulk discounts. We have implemented this with a small team who process requests for new licenses, and are working thorough a long backlog of previous ways of recording purchases.

Asset Management

Inventory management has essentially a stand alone manual activity. We are in process of implement a Configuration Management Database (CMDB) which will enable improved management but will also link request for service through our Service Desk and enable maintenance of device configuration on a regular basis rather than ad hoc.

Change

From a position where essentially Change took place in a completely unregulated way, we have created a small team who have implemented a Change Management Process based on best practice from the ITIL toolkit. This process has been integrated into our Service Desk tool and so Change is now captured and managed in a way that is well understood and which the whole department has bought in to. Our next move is to ensure that as well as reporting change, better assessment of what is being proposed takes place.

Test and QA

We have also introduced a small team who are responsible for managing system testing and Quality Assurance. So far we have been creating processes – convincing developers that independent testing is worthwhile is, so far, an uphill struggle!

Standards and Best Practice

Apart from ISO 38500, we have identified a number of other areas of best practice which we have used to improve IT Governance:

- PRINCE2 – We have adopted PRINCE2 as a standard for our project management. By doing so this has enabled formal project management to start taking place. A number of templates have been written to ensure that project managers follow a similar format and also that documentation, project plans, risk management, budgets etc. are comprehensive and complete.
- ITIL – We have agreed to adopt ITIL as our standard for service management. Implementation has been slower than we had planned, possible because we have been trying to run before we can walk. Implementation of new service desk software to underpin ITIL processes has also been more complex than we had been led to believe. So far we have implemented Incident Management; Problem Management and Change Management with the Asset and Configuration module (CMDB) on the way.
- Investors in People – Investors in People (IiP) is a less than obvious standard to be thinking of in relation to IT governance. IiP is a standard for identifying that we have implemented appropriate people management through our capability improvement plan. We believe that having a workforce that is valued and feels themselves part of a highly skilled and well motivated team and managed correctly is a sound building block for establishing the processes and procedures that expect them to behave in appropriate ways.

What do we think we need to underpin all this?

There are a number of key attributes that we believe are needed to enable IT Governance to be a success:

- Establishing a culture where people start thinking that governance is important and start asking themselves what would the IT Governance team make of what I am doing/proposing to do
- Strong support for the IS Director and Senior managers – At NTU the IT Governance team is viewed as the conscience of the IS Director; he knows he will get nagged!
- Having a Governance team who have the ability to find out what is going on – having someone who can get people to talk to them about what is really happening; what staff are really thinking; what mad ideas managers are proposing; etc.
- Be prepared to ask questions and expect answers.

Conclusion

Introducing IT Governance at Nottingham Trent University has been an interesting journey. Winning management hearts and minds was relatively easy; getting the support from the rest of the staff has been about showing them the value of what we are seeking to change and explaining why we are doing it. At some point there has been a cross over where they come and ask, rather than have to be encouraged to join in. At that point we felt that we were winning and have been encouraged to carry on.

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Appendices

Extract from the Nottingham Trent University IT Governance Strategy — the work we agreed needing to be undertaken:

What's being done via the Capability Improvement Project

CIP1 Information Management Strategy integrated into IS life [Overall objective]
CIP2 Business Relationship management [Client L2]
CIP3 RADAR process [Process L1]
CIP4 Improved dialogue between IS and stakeholders [Communications L2]
CIP5 Ongoing development of IS risk programme [Leadership L3]
CIP6 Balanced Scorecard (right KPIs) [Client L2]
CIP7 People section of IS capability plan implemented including succession planning; talent management [People L1, L2]
CIP8 Development of IS architecture [Architecture L1, L2]
CIP9 Supplier partnerships [Finance L2]
CIP10 Ongoing development of IT standards; implemented (imposed?) [Architecture L2]
CIP11 Design authority in action [Architecture L1, L2]
CIP12 3 year budget planning tied to strategy [Finance L2]
CIP13 Supplier partnerships [Finance L2]
CIP14 Budget management; improved reporting by budget holders rather than just management accounts [Finance L1]
CIP15 Review of suppliers used; improved supplier management [Finance L2]

CIP16 Implement ability to provide full service costs for discreet services [Finance L2]
CIP16 Implement ability to provide full service costs for discreet services [Finance L2]
CIP17 Ongoing review the services IS is offering and how these will be supplied (Roles and Responsibilities); tweak reorganisation of teams as appropriate [Organisation L2]
CIP18 Implement effective leadership and management structure [Leadership L2, Organisation L2]
CIP19 Project Process and procedures; standard paperwork [Process L1]
CIP21 Architecture development [Architecture L1, L2]
CIP22 Project management methodologies and Tools [Process L1]
CIP23 Further staff training as required in PRINCE2 [Process L1]

What else needs to happen?

ITG1 Development, approval by SMT and promulgation of an IT strategy [IS Director]
ITG2 Development, approval by IS MANAGEMENT TEAM and promulgation of individual strategies for IS departments [IS managers]
ITG3 Information Management Strategy kept up to date [IS Director, IS managers]
ITG4 IS strategies update timeline agreed [IS Director]
ITG5 IS strategies kept up to date [IS managers]
ITG6 External validation of IS strategy alignment by SMT [IS Director]
ITG7 Annual IT audit programme [IT Governance]
ITG8 Communication of improving alignment via IS publications – IS monthly report for stakeholders; TeamTalk for IS staff [IS Director]
ITG9 Additional (Key) Performance Indicators [IS Management Team]
ITG10 Consider external review of IS [IS Director]
ITG11 Promote appropriate IS training through TDU (improve planning of the training programme partnership?) [IS Director, Business Relationship Managers]
ITG12 IS involvement in student IS induction planning? [Business Relationship Managers]
ITG13 IIP accreditation [IT Governance]
ITG14 Long term budgeting [IS Director, Head of Technology Services, IT Governance]
ITG15 Capacity planning and ongoing monitoring [IS managers]
ITG16 Disaster Recovery/Business Continuity planning [Head of Technology Services, Technology managers, ITSCM project]
ITG17 Ongoing security programme [Matt]
ITG18 Technology refresh via the Strategic Partnership programme [IS Director, Head of Technology Services]
ITG19 Consider IS involvement in NEUPG [IS Director]
ITG20 Maximise benefits from Strategic Partners [IS Director, Head of Technology Services, IT Governance]
ITG21 Implement service reviews [IS Director]
ITG22 Policies and procedures agreed; documented and published in central place [IT Governance]
ITG23 Document management systems [Portals project, IT Governance]
ITG24 Improved communications channels [IS Director]

ITG25 Regular staff reminders of their responsibilities to DPA; FOI, etc. [IT Security manager]
ITG26 Completion of Service Continuity project; embedding in KTLO procedures [Head of Technology Services]
ITG27 Ongoing ISMG activities [IS Director]
ITG28 Development of a standard Business Case template [Head of Portfolio and Project Office]
ITG29 Service reviews [IS Director, Head of Technology Services]
ITG30 Development of existing systems to comply [Head of Technology Services, Infrastructure Manager]
ITG31 Single sign-on [Head of Technology Services, Infrastructure manager]
ITG32 Implementation of RAIDs activity in structured way across projects [Head of Portfolio and Project Office]
ITG33 Implementation of ITIL [Head of Technology Services, ITSCM project]
ITG34 ISO20000 accreditation [Head of Technology Services]
ITG35 Liaison with LLR for student feedback [Head of Technology Services]
ITG36 Service Level Agreements [IS Director, Head of Technology Services]
ITG37 Adopt IS values [IS Management Team]
ITG38 On going development of the Risk Assurance matrix with managers to proposing controls and assurance [IT Governance]
ITG39 Completion of audit actions [IS managers]
ITG40 Identification of additional reporting indicators; production of a Balanced Scorecard [IS management team]
ITG41 Consolidation of budgets for 2009/10; profiling [Budget holders]
ITG42 Ongoing assessment of lessons learned [IS Director]

Capability Maturity Levels

	Leadership	**Communications**
	1	2
Level 1	• Shared vision and purpose accepted by team • Understanding of the individual team • Evidence of a clear leadership style • Understanding own leadership strengths / weaknesses	• Basic internal communications • Egg timer meetings • 6 weekly briefings • Monthly Reports • Publish successes in Weekly Update and Grapevine
Level 2	• Clear understanding of the talent • Local interpretation of shared purpose and vision • Leadership development plan in place • Commercially led decisions and actions • Clear performance expectations • Reward good performance and deal swiftly with non performance	• We understand the University / It understands Us • Internal PR/Internal measurement • Improved push/pull balance • No surprises • Research and improve tools and methods • Conduct surveys

	1	2
Level 3	• Demonstrate commercial risk management • Dynamic energetic presence • Counselling skills • Positively enhancing purpose and vision • Demonstrate an adaptive leadership style	• External PR activity/case studies • Look at competition • Knowledge management • Formalise communications with clients • 360 client feedback • Communities of Practice – "Front Foot"
Level 4	• Significant impact outside own area of responsibility • Clear understanding of our function's capability and value to the organisation • Demonstrably improving the University's capability • Getting 10% more than teams thought they could deliver • Creative collaboration	• Sought after brand • Brand identity • Corporate portal • Exceed client expectation • Market awareness • Guest speaker competencies
Level 5	• Highly sought after leaders, both internally and externally • Influence the University's direction	• Externally marketed service offers • Buy-in expertise • Launch events • Sponsorship • Serious involvement
	People	**Client**
Level 1	• Performance Management of task and behaviours • All working well in each location • We understand Today's culture • No HR issues remain from the past • Framework implemented	• Desire to satisfy clients in general terms
Level 2	• Cross campus ethos • Right people in right jobs • Clear career paths for every discipline • Supportive, honest and open environment • Managers recognise value of individual • Delivery culture	• IS Business Relationship Managers • Remove complacency • Be viewed as Enabler, rather than Barrier • Build relationships • Demonstrate flexibility
Level 3	• Individuals understand their contribution • Change culture • Cross functional ethos • Self-owned career development • Vision and Values understood and bought into by leadership population	• Clients think we are Top Dogs • Consistently invited to Hallowed Rooms • Proficient and mature contract ethos • Fully mature estimating/reporting models • Defined service style

	1	2
Level 4	• Vision and Values understood by everyone and bought into by everyone • Staff Balanced Scorecard • Active and robust succession planning • Commercially focused culture	• Business plans to generate income • Our service style is desired by our clients • Defined brand ethos but no logo • Marketing strategy • Acquire marketing skills • Market our capability
Level 5	• Secondments to other organizations / teams because they want us • Others see us as experts in our fields • Professional consultants sought after elsewhere • All our people are highly marketable	• We are sought after by our clients • Perceived as a Professional Services organisation • Track record in marketplace • Recognised as industry experts • Strong brand
	Organisation	**Process**
Level 1	• Today's model understood by all in IS • High level cooperation across 3 campuses	• Link processes with best practise framework • Project prioritisation/planning process • Development process established/published • Development centre established
Level 2	• Defined operational model • Development organisation implemented • Support organisation implemented • Quality assurance / governance of key processes in place • Right office environment in all 3 campuses	• Document systems • Mature development methodology • Process for change control and configuration management • Efficient testing model • Process for estimating, cost control • IT support • Professional resource management
Level 3	• Matrix management of staff • Organised by activity, not function • Efficiency of activities constantly measured • Complete delivery capability optimised • No passengers • Right size and shape	• Internal college / function processes linked • Benchmarking within sector • Sophisticated project reporting • Stakeholder, resource and relationship management • Establish development tools
Level 4	• Sales/commercial management skills in place • Partnerships with complementary organisations • Defined IS services, capable of being sold • Flexible resources working in virtual teams	• Recognised best practice • Estimating models to support fixed price bids • Develop methodology to compete externally

	1	2
Level 5	• Recognised in NTU and HE sector • Core team, supplemented by external companies • Important contributor to bottom line	• Benchmarked globally • Leaders in Business Change Management
	Architecture	**Finance**
Level 1	• IM Strategy underway	• Understand our budgets • Reactive cost tracking • Accurate time and materials tracking • Clients understand our costs
Level 2	• IM Strategic Architecture defined • Adherence to external standards • Architecture stack concept understood and accepted • Link with NTU Strategic Plan aligned	• Proactive cost management and forecasting • Understand costs and activities that drive cost • Robust estimation and full cost tracking • Manipulate/Flex our budgets to get things done
Level 3	• IM Strategic Implementation 50% complete • Unified Communications complete/stable • Clients "Buy-in" • Demonstrable benefits • 3 year rolling plan in place • Enforced governance of change	• Financial intelligence and commercial thinking • Personal billing/understand individual and team contribution to bottom line (in £s) • Cost reductions providing extra money for investment • Fixed price capability based on track record
Level 4	• Low cost, stable, proven architecture fit for purpose • Rationalised application stack • Benchmarking process in place • Proven as flexible and adaptable • Component based	• 3 year financial plan in place to fund strategy • Help up as a model for University financing of IS
Level 5	• One architecture – no competitor can match • Differentiation between historic silos long gone • Supports NTU in exploiting opportunities • Mature processes in place • "This is the way that IS works"	• Shared Risk/Reward • Could be floated off as a business

E-learning Task Force Session

Evaluation of Web 2.0 Tools in the e-Learning Context: Case Studies Related to Pedagogy and Usability

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Keywords

e-learning, hybrid courses, Web 2.0 tools, pedagogy, case study, usability

Abstract

The potential uses of Web 2.0 tools are investigated in case studies of several hybrid academic courses with an emphasis on their usability and potential for improvement of pedagogy (creativity, collaboration, peer-to-peer learning, etc.). More than 35 different Web 2.0 tools were included in courses in the 2009/2010 academic year and for 20 of them

a detailed usability survey was performed. Conclusions are made regarding the choice of Web 2.0 tools for academic education, the integration of artifacts produced by the students in wiki, blog, online community tools, e-portfolio, or Moodle LMS. These activities were performed as part of the EduWeb2.0 project and are discussed from the aspects of technology, pedagogy, innovation, and usefulness.

Introduction

E-learning 2.0 (Downes, 2005) is a recently introduced concept that aims to integrate some of the newer trends in teaching and learning with the use of Web 2.0 tools (wikies, blogs, social bookmarking tools, online community tools etc.). Educational use of Web 2.0 tools is often placed in the context of pedagogical approaches like student-centeredness, learner autonomy, community of practice, learning community, collaborative learning, etc. (for instance, see: Gonzalez and St. Louis, 2008). The use of Web 2.0 tools is not limited to the social effects of learning, but can also support higher-order thinking according to the Bloom's taxonomy (Burns, 2009). Constructivism is the most popular paradigm associated with *E-learning 2.0*, and some other related and innovative conceptualizations include *social learning 2.0, micro learning, nano-learning, University 2.0, Curriculum 2.*0, and *Pedagogy 2.0* (McLoughlin, Lee, 2008b). One of the potential positive effects of the introduction of social software like wikies and blogs in online learning is a pressure on educators to reconceptualize their view of teaching and learning (McLoughlin, Lee, 2008a).

Redecker et al. (2009) have summarized some of the contributions of the use of Web 2.0 tools in the areas of technological, organizational and pedagogical innovation, but they also emphasize the challenges inherent in E-learning 2.0: digital divide (regarding internet access, digital skills and advanced digital competence); problems that are encountered by students with special needs and disabilities; new pedagogical skills needed by educators; copyright issues; concerns regarding preservation of privacy and unwanted advertising/spamming; uncertainties regarding the reliability of user-produced content and preservation of data in case of external service providers. Even though there are numerous models for integrating Web 2.0 tools in higher education, it must be noted that such innovation in e-learning can have both advantages and disadvantages (Grosseck, 2009). A recent case study of the use of multiple Web 2.0 tools in the creation of personal learning environments (PLE) has indicated that such activities can be time-consuming, distractive and confusing to students, and that the use of Web 2.0 tools could suffer from technology and adoption problems (Torres Kompen et al., 2009). The adoption problems associated with Web 2.0 tools in education are related not only to students, but also to university teachers, even though some educators expect that their use could improve learning outcomes, interaction with peers and satisfaction with the course (Ajjana, Hartshorne, 2008). Finally, there are not many studies in literature on potential technical problems and usability of Web 2.0 tools even though evidence exists that some of their developers may be disregarding good design practices (Pilgrim, 2008).

To address some of the above mentioned issues an e-learning project was conceptualized that would test the applicability and usability of various Web 2.0 tools in a hybrid academic educational environment. The project entitled *EduWeb2.0* was started in 2009 with the main intention to test a large number of Web 2.0 tools in concrete courses at the university level.

The EduWeb2.0 project background

The *EduWeb2.0* project is a one-year project funded by the Ministry of Science, Education and Sports of the Republic of Croatia that is conducted at the Faculty of Organization and Informatics, University of Zagreb. In some way it is an extension of the *Engwiki* project that was presented at the EUNIS 2008 conference (Kovacic et al., 2008). However, in the *Engwiki* project only a wiki system was used to develop and implement more than 25 online activities (e-tivities) in teaching English as a foreign language, while the idea of the *EduWeb2.0* project was to test up to 50 different Web 2.0 tools (and present the experience with their use through brief case studies) rather than develop various e-tivities for their application in a specific course.

Previous experience with the use of Web 2.0 tools in the hybrid course "Psychology and the Internet"

The main idea for the use of different Web 2.0 tools in one university course dates back to the 2005/2006 academic year and the hybrid university course "Psychology and the Internet" which combined classroom teaching with a traditional (E-learning 1.0) online course and the use of wiki, blog and the social boomarking tool *Delicious*. The use of a wiki system and a blog in this hybrid course enabled various educational outcomes that justified the effort invested in the use of novel technology (Bubas, Kermek, 2007). For instance, since the students were co-creators of the course content, the effects related to the use of a wiki to develop an online glossary and support course related activities resulted in the development of vocabulary and concepts, peer-to-peer learning, personal web publishing, collaboration, orientation toward public interest, greater sense of responsibility and increased feeling of empowerment. Similarly, for many students the use of a blog tool provided a greater potential for expression of their creativity, online interaction through comments of blog posts, feeling of social presence, peer-to-peer learning, enriched learning experience, greater motivation for learning, storytelling, web publishing, and potential for self-reflection (comparable to the use of an e-portfolio). However, some problems were evident regarding the use of the wiki and blog tools. First, it presupposed the need for technical support and a web server to install a wiki and blog tool. Second, a reasonable level of instruction was needed for students to be able to effectively create wiki pages, whereas the blog tool required even more training owing to a more complicated user interface that was not intuitive for students. Also, the blog tool worked very slowly after a large number of photographs were uploaded and when the local computer network would slow down. The wiki and blog tool required maintenance by a system administrator. Finally, the blog tool proved to be inadequate and was not used in other courses. In the evaluation of the elements of the hybrid course the wiki tool was evaluated as highly as traditional lecturing, the Web CT component of the course and the special e-course on online communication and psychology of internet users. However, the blog tool was rated less favorably by the students in relation to other components of the hybrid course. There was no misuse of the wiki and blog in form of inappropriate content, except in one case when a student placed links to photographs of bikini models on several wiki pages. As a consequence, one student was asked to monitor the newly created and edited wiki pages, which solved the problem. It must be noted that the access to the wiki at that time was without login or other restrictions.

Previous experiences with the use of a wiki system in several courses

The wiki tool was used in the course "Organizational Communication" in 2005/2006 and 2006/2007 academic years. The students created a glossary related to the course content and posted their written assignments on wiki pages. They found the wiki easy to use but did not develop much interest in this technology. There were no instances of misuse of the wiki even though no login was required for creating and editing of wiki pages. However, there were several instances of plagiarism when students copied theoretical content that they found on the web on the wiki pages of their assignments. In one case a student scanned a textbook with optical character recognition (OCR) software and placed the content on the wiki page of his assignment.

The wiki tool was also used in the course "Customer Relationship Management" (CRM). The wiki was particularly convenient for organizational activities like reservation of assignment topics, scheduling student presentations and alike. In this course the wiki was predominantly used for project activity. In the academic year 2007/2008 the students of the CRM course had to develop a wiki site with the theoretical content related to the topic of university CRM whereas in the 2008/2009 academic year they developed another wiki site devoted to the topic of a CRM of a SME (concretely, a printing company). These projects enabled the students to work on their own potentially practical solutions and engage in a type of learning that is associated with cognitivist and constructivist pedagogical approaches. However, a new wiki system had to be installed for each of the two academic years. No instances of misuse of the wiki system were observed even though there was no login and there was open access to the wiki systems. At the end of 2007/2008 academic year the spambots started to insert external links in wiki pages (including talk/discussion pages), probably to improve search engine rankings of commercial websites. This meant that the wiki engines used in previously mentioned courses needed to be upgraded and that a login had to be enabled as a requirement for the creation and editing of wiki pages.

The *Engwiki* project started in the academic year 2006/2007 and by the academic year 2009/2010 more than 25 online pedagogical activities (e-tivities) had been designed and evaluated that used the wiki system for teaching English as a foreign language (EFL). This project proved that online pedagogical activities with a wiki system could effectively supplement traditional EFL teaching and that some types of e-tivities are more suitable for the online environment than others. Also, the designed e-tivities were found to be useful to other foreign language teachers who were interested in computer-aided language teaching. Some of the results of the EngWiki project were reported at the EUNIS 2008 conference (Kovacic et al., 2008) and information on this project can be found on the project website.

The results of the *EduWeb2.0* project

The main results of the EduWeb2.0 project can be derived from the use of various Web 2.0 tools in several hybrid academic courses:

- In the course "Computer-Mediated Communication" several groups of students performed assignments in up to 18 different Web 2.0 tools and presented their artifacts in a blog tool, online community tool Ning, and e-portfolio tool Mahara.

- In the course "Data Structures" a comprehensive usability evaluation was performed of 20 Web 2.0 tools and novel forms of peer-to-peer learning of course content were investigated.
- In the course "Business English" several Web 2.0 tools were used for visualization of selected topics from English grammar and collaborative learning.

The use of multiple Web 2.0 tools in the hybrid course "Computer-Mediated Communication"

The hybrid course "Computer-Mediated Communication" started in the 2008/2009 academic year with a group of 18 students of Information Systems at the Faculty of Organization and Informatics, University of Zagreb. The teacher was Goran Bubas (with assistance from Tihomir Orehovacki, Igor Balaban and Tonimir Kisasondi). This hybrid course was delivered through traditional classroom lecturing and several online components. First, all of the lectures (MS PowerPoint slides and articles in MS Word) were placed in a Moodle learning management system (LMS), which served as a depository of the learning content. This hybrid university course also had a separate non-moderated e-learning course named "On-line communication" with 6 chapters and 34 subchapters on various topics including online communication technology and communication skills, computer literacy, motivation for Internet use, Internet addiction, use of the Internet for finding information and learning, as well as security and privacy related behavior of Internet users. During their participation in the "Computer-Mediated Communication" course the students maintained a wiki glossary related to the course content and used a blog tool to keep a diary of their online activities in computer lab sessions. During their excercises in a computer lab the students learned about various Web 2.0 tools that can be used for the following purposes: social bookmarking (Delicious), mind-mapping (bubbl.us), block-diagrams (Gliffy), online comic-strip creation (Bubblr), online surveys (JotForm), collaborative writing and document sharing (Google docs), online presentations / video podcasting (Slidestory, Veotag), online notes taking (Notemesh), online learning objects (Nanolearning). With most of those tools the students had to perform simple activities and create online content that was related to the theoretical topics of the course. Our most important experiences with the use of various Web 2.0 tools in the academic year 2008/2009 were both positive and negative:

- The wiki tool *MediaWiki* that was placed on the college server proved to very reliable, easy to use and good for organizational activities (reservation of assignments, scheduling of student presentations, etc.). Also, the wiki glossary was used to create links to explanations of concepts that were used in the text of the projects which students placed in their blog.
- The blog tool *WordPress* required more technical skill than the wiki, but enabled the students to create visually effective online content. The students had to use the blog tool to write an online "diary" of weekly course related activities and create their final project (theoretical text / report / essay).
- The social bookmarking tool *Delicious* proved intuitive and easy to use but the students did not show much interest in using the tool for creating their online collections of links and they only used it to complete an obligatory course assignment.

– The mind-mapping tool *bubbl.us* was quick to learn (5–10 minutes) and enabled very effective visualizations of the theoretical content. However, there were some problems with user registration and saving the created mind maps.
– The block-diagram tool *Gliffy* was not very intuitive and it required more time (10–15 minutes) to learn the basic functionalities. It was very good for creation of process diagrams related to the course content (use of various online communication tools) and description of online communication skills.
– The online comic-strip creation tool *Bubblr* had a poor image search function and it sometimes took students a lot of time to find useful *Flickr* photos this tool utilized. The comic-strips were used in computer lab exercises to illustrate online communication skills and different course related topics.
– The tool for the creation of online surveys *JotForm* was intuitive and quick to learn (5–10 minutes). It has a very good user guide and is practical for short online survey forms. It was used by the students to create surveys related to behavior of Internet users.
– The creation of online presentations (with audio) from photos or PowerPoint slides was performed with a tool named *Slidestory* that required a local installation of free software. This means that a login with the administrator account is needed for each computer installation, which is not convenient when college computer labs are used. Also, for unknown reasons, some students were not able to upload/synchronize their audio files with photos/slides. The Slidestory tool needed more computer skill than any of the previously mentioned tools. The related tool for tagging of video files *Veotag* was both intuitive and easy to learn. However, this is a commercial tool with free basic service for 30 days.
– The collaborative online note-taking tool *Notemesh* was used before a midterm exam with an instruction to students to create and share notes related to the exam content. To be able to create notes and collaborate, the students needed to register a course for notes sharing in Notemash and ensure separate registration for each participant. Most of them did not develop much interest in this voluntary online activity and the use of this tool was abandoned in the next academic year.
– In one online activity the students were asked to use a tool for the creation of learning objects (brief e-learning lectures) named *Nanolearning*. The Nanolearning tool manifested basic reliability problems that resulted in data loss and therefore caused frustration for both the students and the teacher. This outcome illustrates what can happen when a Web 2.0 tool is used in class without serious prior testing/evaluation.

The artifacts that the students produced with Web 2.0 tools were visible to all the other students who were enlisted in the course "Computer-Mediated Communication" since all of them had to keep an online diary with a blog tool *WordPress*. Each time a student created some Web 2.0 artifact in class or as a homework assignment, they had to place a link to the artifact (or embed it) in their blog post with a title that consisted of the date of the classroom lecture or the exercise in the computer lab.

For their final online activity the students had to create a theoretical text (i.e. report/essay) on a specific topic in 1–3 blog posts (this was their "project"). The written reports/essays were related to course topics and in their blog posts the students had to create artifacts with different Web 2.0 tools that supplemented and illustrated the text of their "project”. For instance, such a “project” on the topic of online games could include a mind-map (bubbl.us) of a typology of online games, a block-diagram (Gliffy) of a specific strategy for an online game player, a comic-strip (Bubblr) of some online gaming issue, an online survey (JotForm) for other students about participation in online games, an online presentation (Slidestory) about several online games, a collection of links to related online resources in a social bookmarking tool (Delicious), photos and links to YouTube videos on online gaming. Finally, the students were asked to place links in the text of their “project” to explanations of concepts they found in the wiki glossary of the course (i.e. if the term “Internet addiction” appeared in their text they had to link it to the wiki page that some other student had created to explain this concept). As presented in Figure 1, the student-produced content of their “projects” was used in the final oral exam of the course “Computer-Mediated Communication” and the students had to learn the theoretical content of up to three “projects” of their choice that were created by other students of this course.

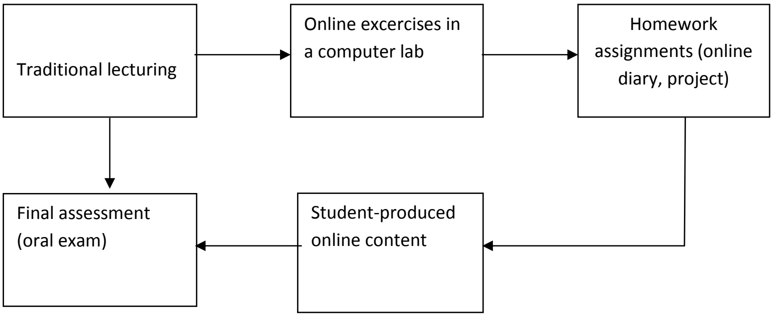

Figure 1. The procedure for the use of Web 2.0 tools in the course “Computer-Mediated Communication”

We tested the possibility to use Web 2.0 tools with two groups of full-time students of Information Systems study in the academic years 2008/2009 and 2009/2010 and found that they adopted the Web 2.0 tools and the online activities that they had to perform with them. However, some of the less computer-skilled part-time students had difficulty with using too many tools in one course. Online activities for such groups of students were therefore limited to several tools that were easy to learn. Our overall experience was that after a 10–15 minute demonstration of using a specific Web 2.0 tool almost all the students were able to use it effectively to perform an online learning activity. However, most online learning activities with Web 2.0 tools could not be successfully completed within a one-hour practice session in a computer laboratory and the students often had to finish their assignments at home.

In the academic year 2009/2010 the following new types of Web 2.0 tools were included in computer laboratory exercises for full-time students of the academic course “Computer-Mediated Communication”: online notes taking (*Helipad, SpringNote*), mash-ups (*iGoogle*, *myYahoo, Pageflakes*), and user interface design (*MockFlow, Mockingbird*). The collaborative online notes taking tool *Notemesh* and the tool for creating learning objects *Nanolearning* were no longer used in the 2009/2010 academic year. The teachers were Goran Bubas and Ana Coric.

If the wiki (*MediaWiki*) and blog (*WordPress*) tool as well as *Google Docs* are counted, in the academic year 2009/2010 the students of the "Computer-Mediated Communication" course had an opportunity to learn about 18 different Web 2.0 tools during one semester (i.e. 15 weeks of teaching). Were the requirements for students too great and what are the possible positive outcomes of their effort? Our experience indicated that computer literate students of Information Systems were able to manage such tasks and that despite their slight initial resistance, by the end of the semester they had learned about diverse Web 2.0 tools and were satisfied with the skills that they developed.

According to literature, the use of Web 2.0 tools can help in the development of new literacies, support collaboration, and engage students through different modes of expression (Crook et al., 2008). Also, the educational use of various Web 2.0 tools can support diverse learning outcomes, increase student involvement and responsibility, create greater self-awareness, help them develop digital and social competencies, and facilitate the use of Web 2.0 content created by students as a learning resource for other students (Grey at al., 2010). Web 2.0 technologies can be used to support shared knowledge-building, enhance student learning and improve their learning experience (Cooke, 2008). Accordingly, the greatest positive effects from the students' perspective that we noticed in two consecutive academic years of teaching the hybrid course "Computer-Mediated Communication" were related to their discovering of new online tools, development of novel Internet skills, greater potential for creativity and self-expression, and a different way of learning. Some of those effects are illustrated in the results of student evaluation survey in Figure 2 and Figure 3.

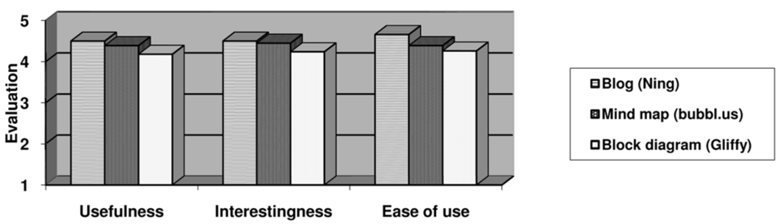

Figure 2. Results of student evaluation of a blog tool (a component of *Ning*), mindmap (bubbl.us), and block diagram tool (Gliffy) regarding usefulness, interestingness, and ease of use (scale: 1 = very poor, 5 = very good; N=38; part-time students)

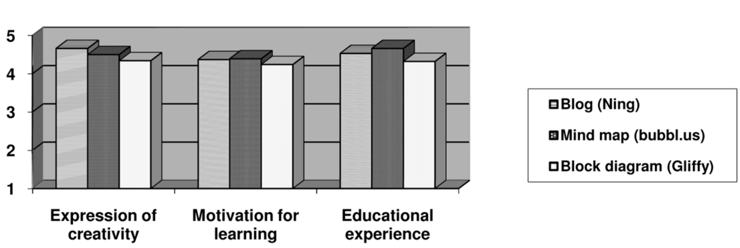

Figure 3. Results of student evaluation of a blog tool (a component of *Ning*), mind-maping (bubbl.us), and block-diagram tool (Gliffy) regarding their potential to express personal creativity, positive influence on motivation for learning, and enrichment of educational experience (scale: 1 = very poor, 5 = very good; N=38; part time students)

To evaluate the effects of the use of Web 2.0 tools on education we performed a survey with questions about their usefulness, interestingness and usability, as well as those related to pedagogical effects like concept acquisition, expression of creativity, collaborative learning, positive impact on motivation and enrichment of educational experience. The results of student evaluation in Figure 2 indicate that we have made a good choice of the following Web 2.0 tools that were used in our courses: *Ning* social networking site (in fact the students evaluated a *blog tool* that was a component of *Ning*), a tool for online creation of mind maps (*bubbl.us*), and a tool for creation of block diagrams (*Gliffy*). All of these tools received an average rating above 4.0 on the scale ranging from 1 (very poor) to 5 (very good). The evaluators were two groups of part-time students of Business Informatics (total N=38) who attended a course "Computer-Mediated Communication". It can be concluded that the students found these tools useful, interesting and easy to use, with a potential for positive educational outcomes. In Figure 3 the results of evaluation of pedagogical effects of the use of Web 2.0 tools are presented. Again we found that the Web 2.0 tools were highly evaluated regarding (a) their potential to enable students to express their creativity, (b) positive influence of the use of those tools on increasing their motivation for learning, and (c) enrichment of students' educational experience. It must be noted that the students who had performed this evaluation were familiar with online learning since they were regular users of the Moodle LMS and that most of the courses they had attended were supported by at least some content in the Moodle system (e.g. course information, PowerPoint slides of lectures, etc.). Still, the novel experience with Web 2.0 tools may have positively influenced their evaluations.

The evaluation of Web 2.0 tools that was performed during the 2008/2009 and 2009/2010 academic years with several study groups of students of the course "Computer-Mediated Communication" provides an example of the way such tools and pedagogical innovations could be implemented. Our conclusion is that Web 2.0 tools should first be tested on small groups of students in combination with concrete pedagogical activities which the students perform with such tools. It must be noted that we found some of those tools highly problematic regarding their reliability (*Nanolearning*) or that they were unattractive to students (*Notemesh*).

Usability study of Web 2.0 tools in the hybrid course "Data Structures"

The evaluation of Web 2.0 tools that was performed during the academic course "Data Structures" was more oriented toward a usability study. This usability study was performed by Tihomir Orehovacki with some guidance from Goran Bubas. During the course "Data Structures" in the winter semester of the academic year 2009/2010 students were given assignments which involved using diverse Web 2.0 tools to illustrate the content of the course and provide other students with instructions on how to better understand the course content. A detailed breakdown of the course content was presented to students in a wiki system. The students had to perform specific assignments that covered the most important topics of the course. For example, to complete an assignment related to the explanation of an algorithm that executes an operation of "walking" through a hierarchical tree data structure with a set of linked nodes a student with initials T.O. had to perform the following tasks: (1) use an online notes taking tool *Zoho Notebook* to present the theoretical content; (2) create a mind map with *Mind 42* that consisted of a visualized analysis of the problem; (3) depict the algorithm process with a block diagram tool *Mindomo*; (4) use a videopodcasting tool *Stupeflix* to present the program code of a solution with a synchronized audio recording of its narrative explanation; (5) post the programming solution in an online collaborative programming service *Bytemycode* for other students to view, analyze and comment; (6) place the artifacts created by Web 2.0 tools or links to their location on the web on their wiki page together with comments on the performed activities.

All the students who enrolled in the course had to perform four assignments during the semester and use different Web 2.0 tools for each assignment. In that way four Web 2.0 tools of each type were used and later evaluated by various subgroups of students. Finally, at the end of the semester the students responded to the items of a survey for usability evaluation of the following Web 2.0 tools:

– Online notes taking (iNetWord, Helipad, Google Docs, Zoho Notebook).
– Mind mapping (Mind 42, Mindomo, Mindmeister, Wise Mapping).
– Block diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw).
– Online presentations / video podcasting (Masher, Slidesix, Stupeflix, Yodio).
– Collaborative programming / SNS (Posteet, Github, Bytemycode, Pastebin).

The comprehensive survey that was designed by Tihomir Orehovacki for the evaluation of the usability of Web 2.0 tools consisted of items designed to measure the constructs like navigability, ease of use, understandability, reliability, error prevention etc. The idea of this study was to create a detailed usability survey for the evaluation of Web 2.0 tools that can be used in academic education and also to identify the Web 2.0 tools with highest usability in each of the previous categories, as well as potential usability problems of selected tools. However, in our study we also found that in the academic environment some categories of Web 2.0 tools manifested greater usability problems than others, as presented in Table 1. According to the evaluation that was performed by the students, the fewest usability problems were experienced with mind-mapping and block diagram tools, whereas the greatest amount of problems occurred while using video podcasting tools.

The newly created student survey for usability evaluation of Web 2.0 tools consisted of items that were, among others, related to the following attributes: *Navigability, Ease of Use, Mental/Physical effort, Understandability, Learnability, Usefulness, Efficiency, System quality, Customizability, Controllability, Availability, Accessibility, Reliability/Stability, Recoverability,* etc. (for a more detailed overview of potential usability attributes for evaluation of Web 2.0 tools see: Orehovacki, 2010). At the end of the winter semester of the academic year 2009/2010 the students gave their responses concerning the items of the survey to evaluate those Web 2.0 tools that they had used in the course "Data Structures". Therefore, the feedback about the usability of Web 2.0 tools was provided by those who actually created the online content by using the evaluated tools (i.e. performed the assignments related to various course topics).

The results of the evaluation of the worst performing video podcasting tool Masher in comparison to the best performing video podcasting tool SlideSix are presented in Figure 4. As many as 39.6% of the students who used Masher responded with "Disagree" or "Totally disagree" to the survey item *"Navigability – User can quickly and easily locate on a web tool all that is needed for performing a desired activity."* In comparison, only 16% of students who used SlideSix responded in the same way to that survey item, which indicates a considerably better performance of SlideSix regarding "Navigability" as a usability attribute.

Table 1. Results of student evaluation of different categories of Web 2.0 tools (the percentages refer to the number of students whose evaluation indicated a potential problem with a specific tools; the numbers of students who performed the evaluation differed for each tool and the percentages are in fact average evaluations — for various groups N=158—171)

Usability attribute	Categories of Web 2.0 tools				
	Online notes taking	Block dia-grams	Mind ma-ping	Video podca-sting	Collabora-tive pro-gramming
Navigability – User can quickly and easily locate all that is needed for performing a desired activity on a web tool	20%	13%	7%	26%	19%
Ease of use – Only minimal effort is needed for performing of various activities with the web tool and control of the results	19%	17%	8%	30%	15%
Understandability – User can immediately notice the operations (options) that are provided by the web tool	17%	12%	5%	20%	17%
Reliability – There are no errors in the performance of the web tool (or they appear very rarely) and there are no interruptions while working with the web tool	19%	15%	10%	28%	11%

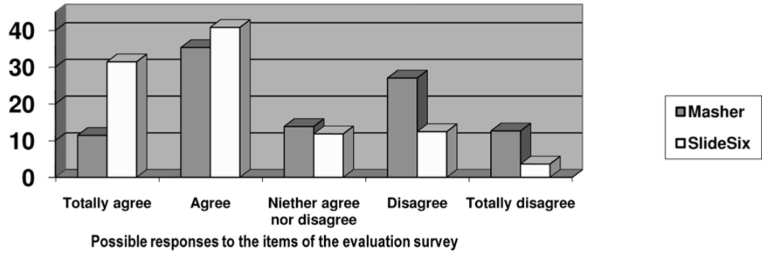

Figure 4. Results of student evaluation of video podcasting tools Masher (N=167) and SlideSix (N=169) regarding *navigability* as a usability attribute

The other usability attribute that can be used for evaluation of Masher and SlideSix is *reliability*. In case of the video podcasting tool Masher as many as 37.2% of students responded with "Disagree" or "Totally disagree" to the survey item *"Reliability – There are no errors in the performance of the web tool (or they appear very rarely) and there are no interruptions while working with the web tool."* On the other hand, a much lower percentage of students (21,3%) responded the same way when they evaluated reliability as an attribute of SlideSix. The student responses that are presented in Figure 5 indicate that both tools manifest reliability problems, but that the SlideSix tool should be preferred for the educational purpose.

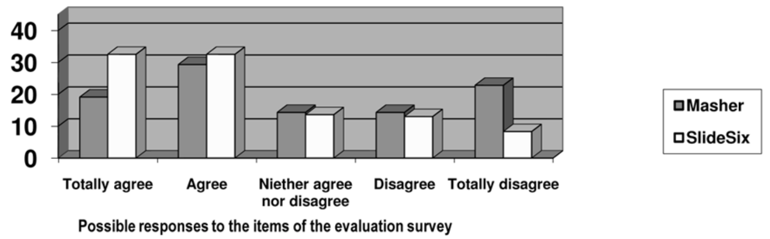

Figure 5. Results of student evaluation of video podcasting tools Masher (N=167) and SlideSix (N=169) regarding *reliability* as a usability attribute

In our study we have tested four Web 2.0 video podcasting tools (Masher, SlideSix, Stupeflix, Yodio). According to the results of student evaluation of the selected usability attributes (Navigability, Ease of Use, Understandability, and Reliability), the *SlideSix* tool is probably the best choice. The Web 2.0 tools from other categories (online notes taking, block-diagrams, mind-maping) underwent the same kind of usability evaluation in concrete educational settings (i.e. with the use of an evaluation survey by the students who performed online activities/assignments). In the case of the mind-mapping tools (Mind 42, Mindomo, Mindmeister, Wise Mapping) we found that all of them received rather favorable evaluation. Among them, the *Mindomo* tool was the easiest to use and most understandable, and also received the highest average evaluation of efficiency and user satisfaction (with Mindmeister taking the second place). In the category of block-diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw), the Web 2.0 tool *Gliffy* received the highest, and the Project Draw tool the least favorable ratings regarding usability attributes. Finally, in the category of online notes-taking tools (iNetWord, Helipad, Google Docs, Zoho Notebook) the *Google Docs* tool considerably outperformed other tools regarding almost all the evaluated usability attributes.

As a conclusion to the usability evaluations that we have performed with the help of the students in the course "Data Structures" the following quotation from Niall Sclater (2008) seems appropriate: "Offering products with widely differing user interfaces that have not been checked for accessibility and usability may be inadvisable". As a result of this study we can recommend the following tools for use in the academic educational environment: Mindomo (mind-mapping), Gliffy (block-diagram/flowchart), Google Docs (online notes taking), and SlideSix (video podcasting). Also, the authors of the presented usability study are not familiar with any similar use of Web 2.0 tools in a course related to computer programming and the pedagogical aspects of using such tools to illustrate and explain the important topics of the course and facilitate peer-to-peer learning are perhaps another significant contribution.

Visualization of grammar in collaborative second language learning

As an addition to the *Engwiki* project, in the winter semester of the 2009/2010 academic year we developed a concept of collaborative language learning with online activities related to the visualization of the English grammar with the use of various Web 2.0 tools. Specifically, for mind-mapping we used *Mindmeister* and *bubbl.us*, whereas for

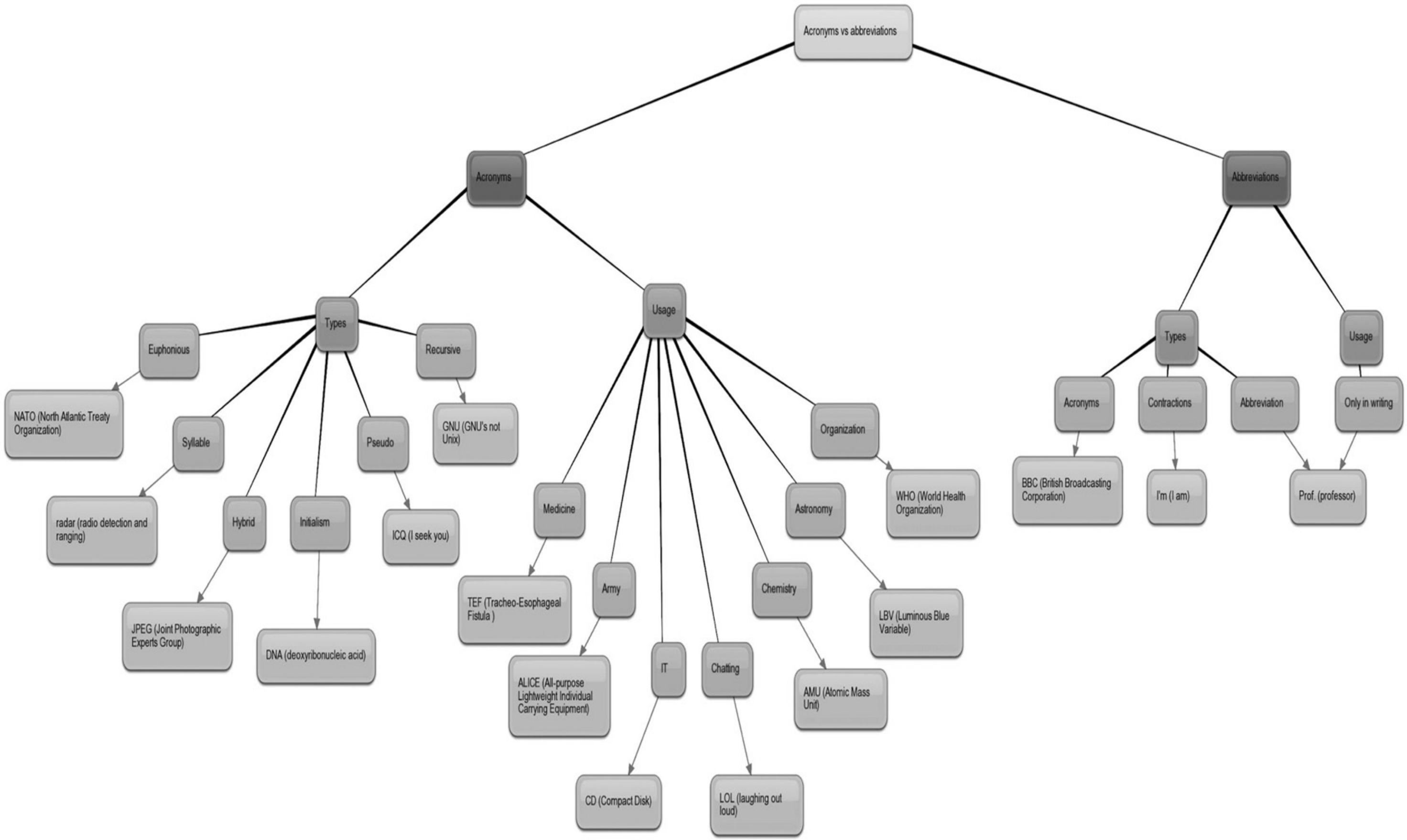

Figure 6. Example of the use of a Web 2.0 tool *bubbl.us* to create a mind-map which visualizes the difference between acronyms and abbreviations in the English language (created by students Igor R. and Nikola P.)

block-diagrams *Gliffy* was used; for video podcasting and video tagging the *SlideSix* and *Veotag* tools were chosen, while *Bubblr* was used for online comic strip creation from Flickr photos. In the previous stages of the Engwiki project that was led by Andreja Kovacic (see Kovacic et al., 2008) only a wiki was used to develop, implement and evaluate various online learning activities. In this further stage of development of the use of Web 2.0 tools for teaching English as a foreign language (EFL) conducted by Andreja Kovacic (with the assistance of Ana Coric and Goran Bubas) the students were required to use Web 2.0 tools to create collaborative learning material for other students concerning various course related topics. They were primarily grammar-oriented and included acronyms vs. abbreviations, prefixes and suffixes, making plural, countable vs. uncountable nouns, the English tense system, noun phrases and multiple compounds,

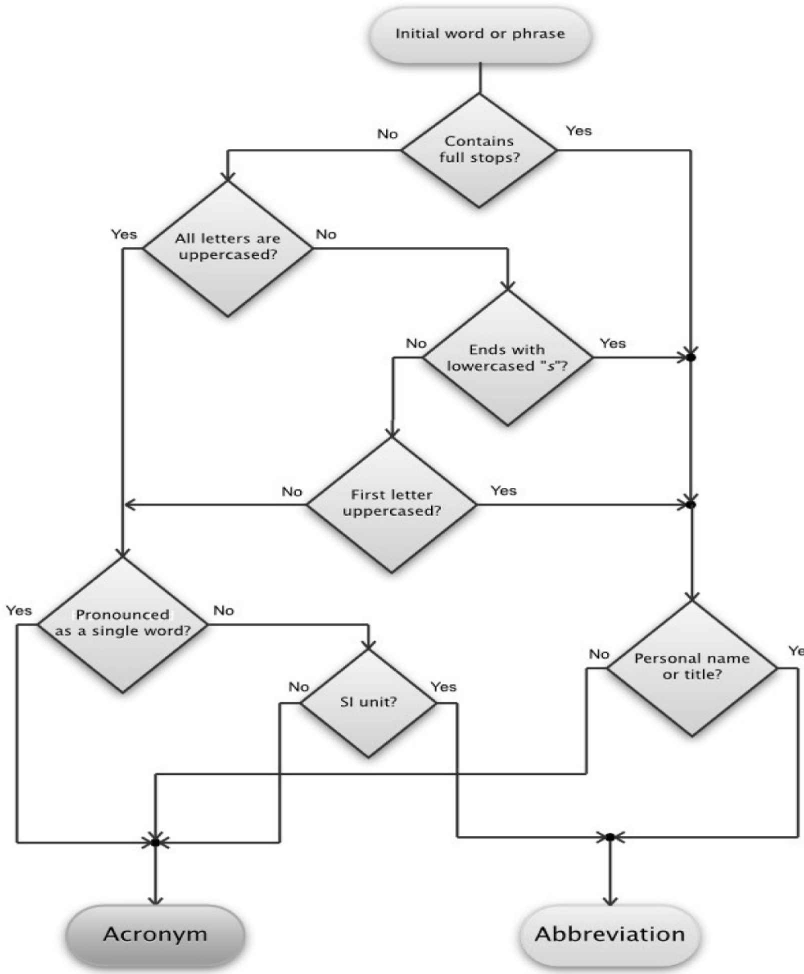

Figure 7. An example of the use of a Web 2.0 tool *Gliffy* to create a block-diagram which depicts the “algorithm” for deciding whether a lexical item is an acronym or abbreviation (created by student Josip L.)

when to use the passive, etc. In the case of the *acronyms vs. abbreviations* topic two pairs of students who worked on this assignment used the mind-mapping tools *bubbl.us* and *Mindomo* to accompany the theoretical content of this part of the English grammar by providing its visual structure and examples; one student used a block diagram tool *Gliffy* to present an "algorithm" on how to decide whether a lexical item is an acronym or an abbreviation; two students used an online cartoon strip tool Bubblr to create a funny illustration of a situation in class about learning acronyms/abbreviations; finally, two students used a video tagging tool Veotag to annotate a video recording of a speech about the use of robots in future warfare, i.e. create "tags" or "jumps" (links) to the parts of the speech where acronyms and abbreviations are mentioned. The example of a mind-map on the difference between acronyms and abbreviations is presented in Figure 6 and the "algorithm" for deciding whether a lexical item is an acronym or an abbreviation is depicted in Figure 7.

The visualization of the English grammar in online collaborative second language learning will continue in the academic year 2010/2011 and is perhaps the first use of Web 2.0 tools for such a purpose. The explanation of the use of Web 2.0 tools for grammar related online activities is available on the Engwiki website (http://e.foi.hr/engwiki/index.php/Grammar_Web_2.0), as well as the list of the grammar topics to be covered in students' assignments in 2009 and 2010, with a selection of completed students' articles (http://e.foi.hr/engwiki/index.php/Grammar_e-tivities).

Integration of students' assignments in wiki, blog, online social community tool Ning, e-portfolio, and Moodle LMS

One of the potential problems of using Web 2.0 tools for students' assignments is the integration of the work that they produce in a single virtual space so that it can be used for collaborative learning by other students. Perhaps the easiest way to solve this problem is to use a *wiki* in which the teacher places organizational pages (with the description of online activities, topics of assignments that the students can volunteer to perform, links to Web 2.0 tools etc.). Similarly, a wiki can be used by the students to create articles in form of wiki pages with theoretical text, photographs and other illustrations, links to YouTube video, as well as the content that they produce with Web 2.0 tools (mind-maps, block-diagrams, video podcasts, online cartoon strips, etc.). Furthermore, a wiki is a good choice for creating online glossaries and large structured projects. We have used the wiki (MediaWiki) to present students' work with Web 2.0 tools in the courses "Data Structures" and "English Language I".

In the course "Computer-Mediated Communication" in the academic years 2008/2009 and 2009/2010 we successfully used a *blog tool* (WorldPress) in which students documented their learning of various Web 2.0 tools in form of a diary of their weekly course related activities. Students also integrated the final results of their use of various Web 2.0 tools on their blogs in form of a "project" on a specific topic (e.g. online communication skills, internet addiction, online gaming, etc.) that consisted of a theoretical text description, photos and YouTube videos. This project presentation included links to artifacts created with Web 2.0 tools like mind-maps, block-diagrams, online surveys, online comic strips, tagged video or slides with narration etc. The use of the blog tool provided more possibility and motivation for creative expression of students. Finally, at the end of semester best students' projects were placed in the Moodle system alongside with the theoretical content provided by the teachers of the course.

For two groups of part-time students of the course "Computer-Mediated Communication" in the summer semester of 2009/2010 academic year we used an online community tool *Ning* instead of a wiki or a blog. The Ning tool is a platform that supports personal profile pages, forum, chat, events management, a blog tool, upload and sharing of images and video files, etc. We asked the students of both study groups to use Ning to keep a blog (online diary) of their course related activities and to place in their blog the Web 2.0 artifacts that they had created (or the links to those artifacts). It must be noted that the Ning tool received very favorable ratings by both groups of students as well as the blog tool in Ning. One of the students' verbal comments on the use of Ning was that it is an excellent tool for members of small study groups to get to know each other, collaborate and support each other in course assignments. We recommend Ning or a similar tool for study groups of 15–40 students. It must be noted that most of our official course related learning content was in Moodle LMS and that Ning was used for communication and collaboration activities, as well as for sharing of the learning content discovered or created by the students themselves.

For a very large group of 190 students of the course "Social Aspects of Computer-Mediated Communication" we decided to use a *wiki tool* in a Moodle LMS. In one assignment the students of that course chose and reserved assignment topics by using the wiki tool and also created wiki articles (separate wiki pages) displaying the results of their assignments in form of essays or professional papers. In another home assignment teams of students chose from among Web 2.0 tools listed in 45 categories and created wiki pages with their descriptions of more than 65 tools that they found interesting for themselves and their colleagues. Although the wiki tool in Moodle had a greater potential for visual presentation since it used a WYSIWYG editor and its content is not open to public viewing, the MediaWiki somehow appeared to be more appealing to the students (and their teacher).

It is our conclusion that the use of more than one Web 2.0 tool in a hybrid university course needs an integration tool like wiki, blog, Ning, e-portfolio, or Moodle. We recommend an experimental use of such integration tools until the teacher(s) find what is optimal for a specific group of students (small/large, full-time or part-time, more or less computer literate, etc.) and the course topic.

Conclusion

The *EduWeb2.0* project that was funded by the Ministry of Science, Education and Sports of the Republic of Croatia, had the following main goals:

- Select and evaluate 20 different Web 2.0 tools in the academic environment by using those tools in hybrid university courses and performing usability evaluation.
- Present the results of the evaluation of Web 2.0 tools on the project web site as well as case studies of their use in academic courses.
- Perform workshops and presentations for the promotion of the use of Web 2.0 tools in teaching at the academic level.

Because of a considerable setback (partly caused by the fact that 35+ tools were evaluated instead of 20 and because it was decided that the project website would be in English instead of Croatian) all of project web pages were not finished in June 2010 as planned. The project wiki is placed on the web site http://e.foi.hr/iProjekt/index.php/Main_Page

The **technology part** of the *EduWeb2.0* project included the application of the following types of Web 2.0 tools in several university courses by the end of the summer semester of the 2009/2010 academic year and the testing of usability of many of those tools with an extensive survey:

– Online notes taking (iNetWord, Helipad, Google Docs, Springnote, Zoho Notebook).
– Mind-mapping (bubbl.us, Mind 42, Mindomo, Minmeister, Wise Mapping).
– Block-diagrams (Draw Anywhere, Gliffy, Lucid Chart, Project Draw).
– Online presentations / video podcasting (Masher, Slidesix, Slidestory, Stupeflix, Veotag, Yodio).
– Audio podcasting (Podomatic, Woices).
– Collaborative programming / SNS (Posteet, Github, Bytemycode, Pastebin).
– Online comic strip creation (Bubblr).
– Mashups (iGoogle, My Yahoo!, Pageflakes)
– Mockups / user-interface design (MockFlow, Mockingbird).
– Social bookmarking (Delicious).
– Online surveys (JotForm).
– Social networking (Ning, SocialGO), etc.

The **pedagogy part** of the *EduWeb2.0* project included the previously mentioned Web 2.0 tools and some other social networking tools that were implemented in hybrid courses and tested regarding their usefulness for the design of online learning activities in hybrid university courses: wiki (MediaWiki), blog (WordPress), e-portfolio (Mahara). In the 2009/2010 academic year more than 35 Web 2.0 tools were tested on different groups of students of the following university courses: "Computer-Mediated Communication", "Data Structures" and "English Language 1". The intention of the teachers was to use with each group of students several tools that complement each other regarding the pedagogical goals and content of a course in order to facilitate knowledge production and collaborative (peer-to-peer) learning. Once the Web 2.0 tools were tested in concrete courses their usefulness (benefits for learning) was evaluated by the students who implemented them in various learning activities. It was also planned that the teachers present their experiences with the Web 2.0 tools and provide scenarios for their application. Finally, together with the presentation of each of the specific Web 2.0 tools, their brief case study and the results of usability analysis, the potentially applicable online pedagogical activities (e-tivities) would be suggested on the *EduWeb2.0* project wiki pages.

The **innovation aspects** of the *EduWeb2.*0 project include the implementation of several complementary Web 2.0 tools to design and enhance the learning experiences of students and develop their skills in using novel web-based open source (free) technology and services. We found that standard Web 2.0 tools like wiki and blog can be combined with social bookmarking, mind-maps, block-diagrams, comic strip creation, online presentations with audio recordings, online surveys, mashups, etc. Also, the creation of attractive online content in wikies and blogs for peer-to-peer learning by individuals and student teams was greatly supported by the use of more than one Web 2.0 tool. Furthermore, our recommendations to other teachers will include the results of our usability tests so that they can avoid using the Web 2.0 tools which may cause them technical problems in implementation of online learning activities and scenarios.

Usefulness and benefits of the innovation of the *EduWeb2.0* project are related to the combination of case studies of the use of numerous Web 2.0 tools in concrete university courses, usability evaluation, and suggested e-learning activities for specific Web 2.0 tools. The project aims to resolve some of the disadvantages and adoption problems associated with the use of Web 2.0 tools in e-learning that were mentioned in the introduction of this paper. A series of workshops for academic teachers is planed in 2010. It must be noted that a usability procedure for the evaluation of Web 2.0 tools in educational settings is being developed that will include not only surveys but also expert evaluations and task-related procedures for more reliable Web 2.0 tools. The project will briefly address some privacy and security issues regarding the use of Web 2.0 tools and related technology (both on the client and server side), as well as accessibility of Web 2.0 tools. Finally, a wiki-based *EduWeb2.0* project website in English (and Croatian) language, together with presentations at international e-learning conferences, will help disseminate the results of our project.

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Become Professional at the University of Applied Sciences

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Keywords

curriculum, e-Learning, e-Learning Platform, eLearning Pedagogy, ICT supported teaching methods, employment opportunity

Abstract

Changing working life keeps bringing challenges to vocational higher education. Vocational skill requirements and job descriptions change all the time in the globalizing world. Vocational education has to be on the pulse of time, preferably ahead of it, when educating professionals for working life. At Vaasa University of Applied Sciences we take the needs of working life in the region into account by reforming our curricula.

The starting point of the reform is to produce competences required in working life for the students. The students need, in addition to skills in their own field, ICT skills, co-operational skills, readiness for international operations, entrepreneurship, project work, product development and innovative and development work. Regional characteristics are also taken into account; in the multicultural and export-oriented Vaasa region international skills are in the key role, not only in export companies but also in social services and health care.

In information society, the institutes of higher education are faced with the requirement for a new operational culture; flexibility especially is the key word. Information and communication technology facilitate the availability of education and support the learning process. An eLearning environment is a learning platform based on the www and the Internet and it consists of texts, hypertext, multimedia, possibilities for interaction (mail, chat, and forum) and other supportive services.

Curriculum

The curriculum is the most important tool in education, teaching and learning. The curriculum expresses the competences the student will have after the education but also the competences the student will receive during each academic year and each semester (Karjalainen, Alha, Jaakkola, Lapinlampi, 2003; p. 1). The curriculum is the starting point for the detailed implementation of the education.

There are several structural models for a curriculum. The traditional curriculum is divided into disciplines and is made of subjects e.g. languages, mathematics, physics, nursing, etc. In such a curriculum the student has to integrate the different subjects to make a whole. Vaasa University of Applied Sciences has chosen so called subject-integrated curriculum which is built up of working -life related competences so that general subject and professional subjects are combined into a whole, based on the competences needed in working life (e.g. language skills needed in foreign trade, marketing, mathematics and business skills).

Common core themes/competence entities are planned, implemented and assessed by teacher teams in which case all teachers involved know the contents, implementation and assessment well. Overlapping can be avoided and the work load of the student can be ne evened up. Another objective is to use diversity of methods and tools in the implementation, as in working life, e.g. projects, utilization of ICT and the Internet, problem-based learning, group work, etc.

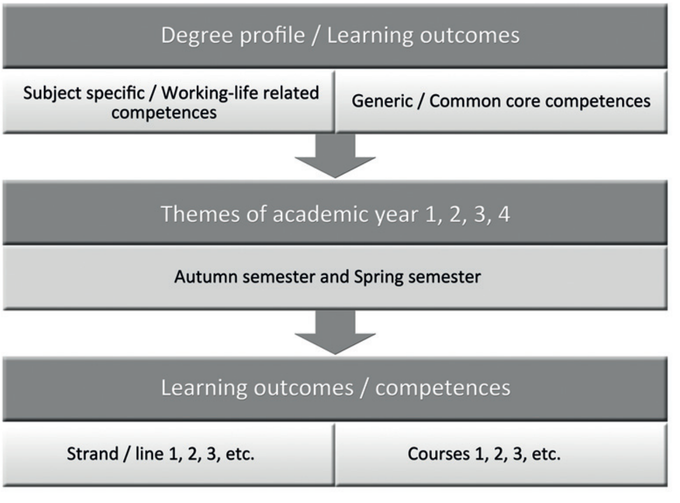

Figure 1. Structure of the Curriculum

eLearning Platform

The usability of an eLearning platform can be considered from two aspects: (1) from a pedagogical aspect and (2) from a technical aspect. It is important that the platform is easy to use and natural to get used to. The platform should provide useful pedagogical concepts to keep learners motivated and also be visually attractive. Furthermore, the platform should provide usable components and work tools that help you create your lesson structure, add content and build online tests, communicate with others, track users history and progress, conduct surveys, assign projects and assessments.

Vaasa University of Applied Sciences has chosen Moodle as its eLearning platform. Moodle is an Open Source platform and has proved to be a flexible and useful solution which answers to the teaching/learning challenges that we face. The eLearning environment develops reciprocity and cooperation among students and helps them to keep close contact with the instructors. Through the platform it is possible to respect diverse talents and ways of learning and to give students personal feedback.

eLearning pedagogy and ICT supported teaching methods

The types of eLearning can be divided into 1) contact teaching supported by e-learning 2) multimedia instruction on the web and 3) self-study on the web. The interaction is emphasized in the contact teaching supported by eLearning and in multimedia instruction. The interaction takes place between the teacher and the learner, among the learners or between the learner and the material. The interaction channels can be e.g. e-mail, discussion forums, audio and video conferences, chat groups, text messages, group work, games and simulations. (Kalliala, 2002; p. 10.)

In eLearning pedagogy it is important to take into account the special nature of the learning environment. The teacher's support and guidance is equally important. In didactic solutions it should be carefully considered what is taught and how. The learning concept as well as the teaching concept influences the design of the learning environment and the progress of the study and learning process. Student orientation, socio-constructivist learning concept as well as social and cognitive interaction (connectivism) feature good eLearning pedagogy. The teacher's task is to actively guide the student's learning and process of construction of information. (Net Pedagogy Portal, 2008).

The learning process includes the start, orientation to the learning material, completing the learning tasks, reflection and assessment. Critical reflection and individual and collective reflection are especially important for deep learning. The function of the eLearning material is to activate the student and support the learning process. The criteria for a good eLearning course are 1) interaction /co-operation, 2) audiovisual material, 3) high quality eLearning pedagogy and 4) reflection and objective assessment (Net Pedagogy Portal, 2008).

A pedagogical strategy is a strategy on the implementation of education, jointly agreed in the educational organization. It is a mental model in the teacher's mind, which manifests itself in the instruction and of which the students are also aware. Efficient eLearning in the Internet environment involves connectivism. According to the theory of constructivism, interaction has a great significance for learning; the access to information is not enough. Because the media on Internet in itself connects to a network using external resources, it enables the access to people, ideas and information behind it in quite another way as the ordinary instruction in the classroom. Connectivism is a fairly young theory among learning theories, supported by eLearning researchers. It has brought up a new model of knowledge which is taking its place in learning-related computers, software and organizations. The objective is to establish contacts with sources of information and thus create a usable model of information required in learning in the information society (Net Pedagogy Portal, 2008).

The principles of good practice (Net Pedagogy Portal, 2008):

- Frequent communication between the educational organization and the students adds students' satisfaction and motivation and reduces isolation.
- Simultaneous and unsynchronized communication used to distribute programs and deepen the environment also enables group activities and group projects.
- The students can use the Internet to discuss and debate the contents, to understand the contents and to apply it in other contexts. Interaction can be facilitated by doing it on the Internet.
- The Internet provides for many possibilities to make the guidance material more interesting and fascinating, e.g. colorful examples and photos make text-based contents more interesting or inbuilt checkpoints to follow the progress together with instant feedback encourage the learners to study the contents that they have not understood.
- Participation in group discussion or group activity not only gives time for the assignment but also gives the group members an opportunity to help each other to clarify and combine information.

One aspect of learner centered learning is giving the learners responsibility of their own learning. Giving the learners more control and responsibility of their own learning is one method for teachers to meet high expectations. The Internet is one possibility for the learners to study in a way that serves their abilities best and adapts to their learning style. Audio and video can be used for auditive and visual learners. The tactile/kinesthetic learners can also benefit from the interaction with the computer.

A timely feedback is an important component of efficient learning. On the Internet the teacher can encourage to give feedback as one of the forms of communication on the Internet.

Employment opportunity

Our objective at Vaasa University of Applied Sciences is to educate experts for working life and to give good readiness for further education and readiness for lifelong learning. Through student feedback and feedback from working life we can further elaborate our curricula and studying at Vaasa University of Applied Sciences.

Practical training in the region's multilingual organizations within Health Care and Social Services as well as in the school's modern premises prepares the students for working life. During the practical training period the students familiarize with the working procedures and tasks in their own field of specialization. The training period increases the students' professional skills and motivation. During the training period the students become acquainted with the activities, culture, work and social life of the organization. The training period will emphasize internationalization, entrepreneurship and professionalism. Jobstep.net is employment and information service for graduate students (http://www2.jobstep.net/).

Summary

As the age groups are getting smaller on part of the young people, we also have to focus on adult education. Changing working life creates demands on updating education and re-education. Our aim is to arrange the adult education so that studying is also possible alongside the work or from distance. This requires ICT supported teaching methods and for this purpose Vaasa University of Applied Sciences has Moodle and ConnectPro learning platforms and the student portal. E-mail and text message service is used a lot in communications. The electronic media enable not only the communication, but also distance learning; discussions and lectures can be online, as well as the students' assignments.

Vaasa University of Applied Sciences prides itself on modern and well-equipped facilities. Technobothnia, the technology research centre, provides the students with an excellent platform to participate in projects introducing the latest technology. Numerous local and international companies and organizations offer the students an authentic training environment.

The Web Community User is a Future Employee. The world we are living in will be surrounded by a large number of heterogeneous computing and communication infrastructures and smart devices that will co-operate with each other to enhance the entertainment services and user productivity. The Social Media is a modern way to have contact with each other.

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INFRASTRUCTURE & SYSTEMS

The University of Porto Open Repository: The Role of the Information System

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Keywords

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Abstract

The creation and the dissemination of knowledge are nuclear to the mission of universities. As John Newman anticipated in his work "The Idea of a University"[1] *Knowledge is capable of being its own end*.

We all know and experiment the influence of the new information and communication technologies (ICT) in our daily work and in the way we live in society. These technologies are having a tremendous impact on production and diffusion of knowledge. The open access movement for scholarly communication bears on the possibilities of Internet technologies, and institutional repositories on the Web are seen as new ways to support that primary constituent of the universities' mission. In this work we will present the institutional repository of the University of Porto (U.PORTO) from its creation to the present moment, emphasizing its goals and the key factors that influenced most the adhesion of the academic community to self-archiving, allowing that from November 2007, when the repository was created, to present days the number of publications regis-

[1] http://www.newmanreader.org/works/idea/discourse5.html.

tered increased by an order of magnitude, the University of Porto now being the higher education institution in Portugal that offers more open access full text publications, over 11.000 documents. To achieve these results, the connection between the U.PORTO Information System, SIGARRA, to the DSPACE platform, that supports the University repository was decisive, and we will address its implications as well as the main directions for future developments.

The University Of Porto

The University of Porto (U.PORTO)[2], the origins of which date back to the 18th century-was created on 22 March 1911, by decree of the Provisional Government of the Republic[3]. Nearly 100 years later, when the institution is approaching its one hundredth birthday, the legal system of the University of Porto was changed by Decree-Law 96/2009, of 27 April: from a public institution it is now a public foundation with legal personality under private law, according to the Legal System Applicable to the Higher Education Institutions[4], the statutes of which are published in the Official Gazette, 2nd Series, no. 93, of 14 May 2009, establishing its statutory, pedagogical, scientific, cultural, administrative, financial, heritage and disciplinary autonomy.

Formed by 14 Faculties, a Business School[5], 69 research units, 31 of which have been classified as Excellent or Very Good by a panel of international experts that are part of the evaluation process of research units in Portugal, about 30 Libraries and 12 Museums, the U.PORTO provides an exceptional variety of courses, covering all levels of higher education and all major areas of knowledge. There are over 670 training programmes – such as undergraduate degrees, masters and PhDs that are adapted to the Bologna process, and continuous training and specialization courses.

The U.PORTO is gradually becoming a national and international reference for both the qualification level of its students and the production and dissemination of knowledge. Internationalization is part of its objectives. The number of foreign students has increased significantly over the last few years. The current number of students under mobility programmes represents 8.3% of the total number of students at the University.

With a university population of about 30,000 students, 2,280 teachers and researchers (1,895.8 FTE (Full Time Equivalent) – 75% PhDs) and 1,689 non-teaching staff (1,685.3 FT), the University of Porto assumes itself clearly as a Research University, and has established as target for its 100th anniversary (2011) to rank among the top 100 higher education European institutions.

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[2] Cf. http://www.up.pt.

[3] Cf. http://sigarra.up.pt/up_uk/WEB_BASE.GERA_PAGINA?p_pagina=122251.

[4] Decree / Ministry of the Interior. Directorate General for Secondary, Higher and Special Education.Creation of the universities of Lisbon and Porto. [5] Law 62/2007, of 10 September.

[5] http://www.egp-upbs.up.pt/.

Research at the U.PORTO

One of the missions of U.PORTO is the creation of cultural, artistic and scientific knowledge, the promotion of economic and social value of that knowledge and the active participation in the advancement of the community in which it is established. Taking into account the last 10 years, the teaching and research staff at the U.PORTO was responsible for more than 1/5 of the scientific articles indexed in the *ISI Web of Science*, making it the biggest producer of Science in Portugal.

Between 2003 and 2008, the U.PORTO contributed with 20.9% of the total national scientific production, with an average annual variation rate of 16%. In 2009, the analysis carried out (but not yet completed) shows that the ratio between document and FTE PhD is of at least 1.5.

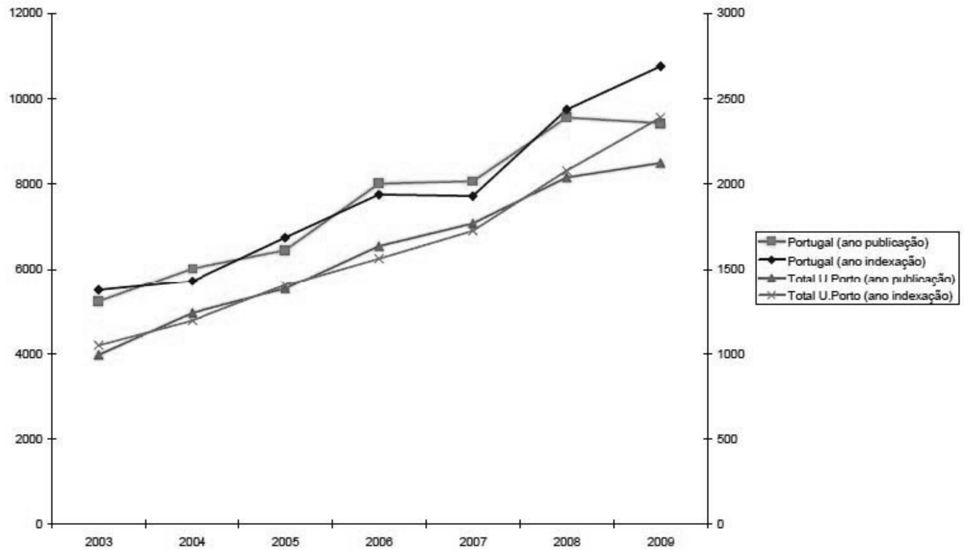

Figure 1. Growth in the number of ISI-WoS documents — Portugal and U.PORTO — 2003—2009 (year of publication *versus* year of indexation)

There are several factors that contribute to the growth of scientific production. First of all, we have to mention that the target to place the U.PORTO among the top 100 European higher education institutions mobilized the academic community significantly. Nonetheless, other factors have also contributed to these results, such as the conditions set up to facilitate applications to funding programmes, through the creation of an Office at the University Rectorate dedicated to the Promotion of Funding of RD&I activities, merit recognition for scientific production at some faculties by awarding scientific excellence prizes and incentives, and the stricter rules applicable to the public notices announcing top teaching positions, for instance the case of applications for associate professors and full professors.

There is also a number of specific actions regarding the dissemination of scientific production at the University, in particular the recommendations made to the authors to register and enable the availability of all publications developed in the scope of their teaching and research activities, if possible with the full text version, through the University's information system (SIGARRA)[6]; suggestions to use, whenever possible, the "*SPARC Author Adendum*"[7] in contracts signed with publishers, so that they can preserve the self-archive rights of their works in institutional open repositories, and advice to present their affiliation in authorial documents properly. Lastly, the facilities provided by SIGARRA and its link to the U.PORTO Repository have helped to facilitate and stimulate the registration and publication of the intellectual works produced by the academic community, which then become accessible, in an open and unrestricted way, to those who wish to consult them, in Portugal and abroad.

The SIGARRA information system

The U.PORTO is a vast and complex organizational macro-system with an exponential growth of information produced in the course of its activities, in terms of academic, scientific, technical, cultural and administrative information.

The management of this systemic universe has relied on SIGARRA – Information System for the Aggregated Management of Resources and Academic Records – an integrated information system, developed to facilitate production, circulation, storage, access and the dissemination of relevant information of the U.PORTO, to favour internal cooperation and cooperation with external academic communities and companies, as well as to contribute to the cohesion of the community itself, encouraging good practices and compliance with procedures[8]. The SIGARRA system, used to manage information at the U.PORTO, interacts with other applications and systems within the University, such as library and e-learning management systems, academic and financial management systems.

The SIGARRA project is based on a successful information system model developed by the Faculty of Engineering of the University of Porto since 1996, entitled SiFEUP[9]. The success of the project, associated to a much needed intranet, made it the favourite choice for the global management of the U.PORTO. Indeed, the SIGARRA project was implemented in a transversal way within the University from 2003 on, aiming to play a crucial role in facilitating decision making processes and in the promotion of organizational quality. At the end of 2004, twelve faculties were already using the system, and at the moment the SIGARRA is used by the 14 U.PORTO faculties, as well as the Rectorate and Social Services and some research and development entities.

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[6] Azevedo, Ana, Ribeiro, David, Gabriel, Ribeiro, Lígia M., & Santos, J.C. Marques dos (1997). Developing an Information System at the Engineering Faculty of Porto University. Proceedings of the EUNIS 97 -European Cooperation in Higher Education Information Systems, 282–287. https://www.fe.up.pt/si/publs_pesquisa.FormView?P_ID=8835; http://hdl.handle.net/10216/606 (accessed February 11, 2010).

[7] http://www.arl.org/sparc/author/addendum.shtml.

[8] Cunha, António, David, Gabriel, Machado, Manuel, Ribeiro, Lígia M., & Silva, Filipe (2004). Upgrading an Academic IS From a Prototype to a Product. IT Innovation in a Changing World. EUNIS 2004. http://hdl.handle.net/10216/200 (accessed February 11, 2010). David, Gabriel, & Ribeiro, Lígia M. (2001). Impact of the Information System on the PedagogicalProcess. The Changing Universities: The Role of Technology. EUNIS 2001.http://hdl.handle.net/10216/465 (accessed February 11, 2010).

[9] http://www.fe.up.pt/si/web_page.inicial.

The implementation of the information system covers the entire U.PORTO and has contributed significantly to strengthening the standardization of administrative processes and procedures. At the present moment, SIGARRA is an essential instrument for its regulation and monitoring, and the Organic Units are thus able to share the same procedures. Furthermore, there has been a significant reduction of burocracy and a qualitative improvement in administrative modernization and transparency. In fact, SIGARRA is used widely by the University of Porto and has an aggregating instrument – the SIGARRA of the U.PORTO – which collects and processes information from all other bodies.

The publications module

One of the modules offered by SIGARRA, since its early development stage, is the publications module. This module, which has been upgraded over time, allows the authors to register all their published works. An author just needs to register a publication and the bibliographical record becomes available to the other co-authors diminishing thus the effort involved. Publications are classified as books, conference proceedings, articles in international and national journals, book chapters, articles in international and national conference proceedings, theses, technical reports and pedagogical publications. Abstracts and full texts may be registered also. Besides being available for the authors, bibliographies may thus be automatically produced per department or course, or even organized according to other criteria.

When an author registers a publication, it can choose to associate to it the respective full text version. In this case, the author defines the levels of access of the document: restricted to the author (and to juries, for example), accessible within the institution, or public. If the record includes the full text version of the document, and if the author chooses to make it accessible to the public, then the publication is transferred automatically to the Open Repository. The connection between SIGARRA and DSPACE, the technological support platform of the U.PORTO Repository[10], guarantees that the publications entered by the academic community through the publications module are transferred immediately from the SIGARRA to the Open Repository[11]. The intention was that direct access to the repository was not granted so that the academic community register scientific productions through the SIGARRA. As SIGARRA is also connected with the integrated Library management system, ALEPH, of Ex-Libris – in use at the U.PORTO –, the descriptive meta-data of the publications is also transferred to ALEPH which allows professionals to intervene in the verification process of records created and in validating the meta-data entered by the information producers.

The information recorded in the publications module is retrieved to produce the Curriculum Vitae of the author and its Activity Report, available in SIGARRA. In fact, the Curriculum Vitae and Activity Report are both part of the same instrument that collects information from various sources from within the SIGARRA, such as biographical data, professional status, academic qualifications, posts, teaching work schedules, publications,

[10] http://repositorio.up.pt/.

[11] http://repositorio-aberto.up.pt/. Currently, the development of a module to support the evaluation of teachers is in progress, which also makes reference to the publications module.

projects, supervision of theses and dissertations, further to other information that can be added by the author. All items, either from other modules or the registered locally in this instrument, can be made visible or concealed, rated in terms of relevance and can be commented. The difference between the Curricula and the Activity Reports facilities lies in how items are presented and the fact that Activity Reports are related to a year-period.

The bibliography of each author is available in its personal institutional page in the SIGARRA and can likewise be retrieved for the production of other semi-automated reports within the system.

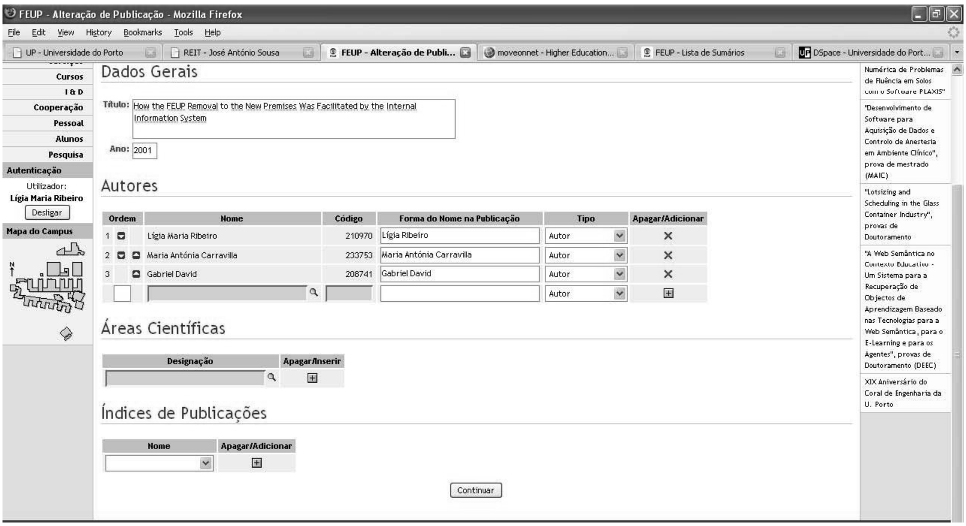

Figure 2. SIGARRA form for the registration of Publications

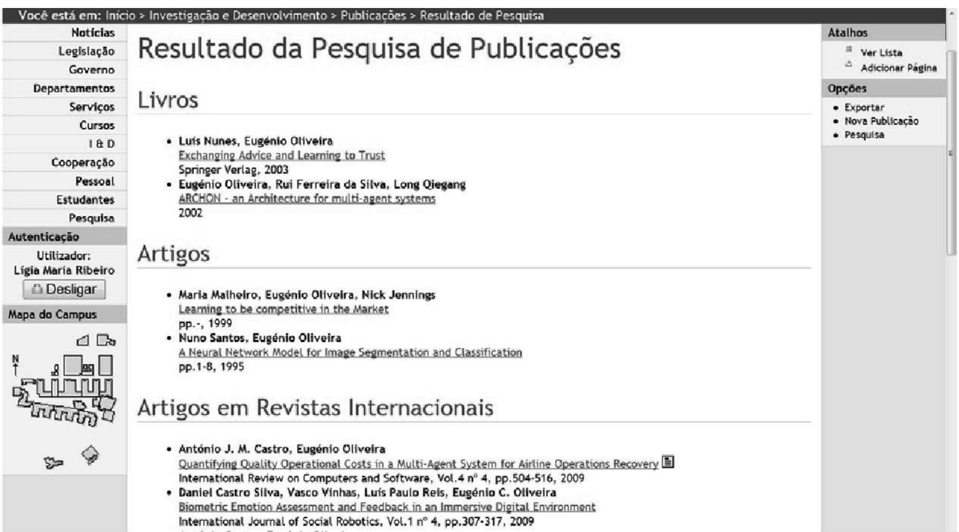

Figure 3. Bibliography of an author, associated to its institutional page in the SIGARRA

The U.PORTO SIGARRA system is accessible at www.up.pt, and collects data on publications from all faculties, offering nowadays a total of 27,008 publications[12].

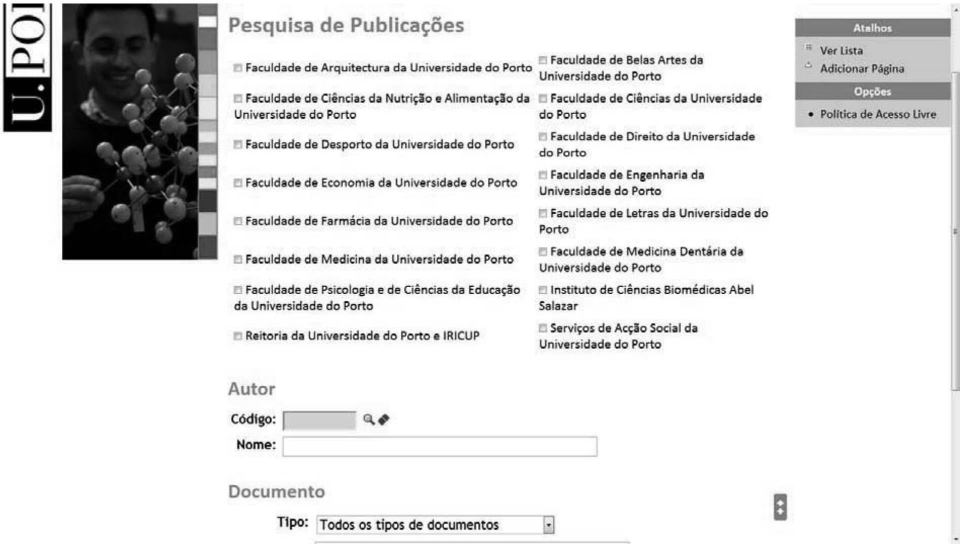

Figure 4. Aggregated search of publications in the U.PORTO SIGARRA system

The fact that the author is required to register its publications once only, which will then be accessible in its Curriculum Vitae, Activity Reports and other institutional reports thereof, is relevant for the increasing support shown by the academic community to this procedure.

Dissertations and theses module

The Dissertations and Theses module, currently being upgraded, will soon be linked to the publications module, ensuring, within the scope of the pedagogical process, the registration of information on such academic works in SIGARRA. Dissertations and theses will be automatically available in the personal institutional page of supervisors and their students. This information is also retrieved to the Curriculum Vitae and Activity Reports supported by SIGARRA.

The Academic Services of each faculty registers the dissertations and theses of students who submit them as part of the requirements leading to a degree. The record includes the text of these works and the level of access is defined as public unless the student does not allow it for reasons he will have to provide. Whenever the level of access is defined as public, the academic work is transferred to the Open Repository, similarly to what has been said for publications by teachers and researchers.

[12] https://sigarra.up.pt/up/u_publs_geral.pesquisa (accessed February 23, 2010).

The repository of the U.PORTO

Despite the potential already supported by SIGARRA, the U.PORTO decided to create an Open Repository for its scientific production, available online since November 2007. The feasibility of coordination between the software used to support the U.PORTO Repository and the existing applications and systems within the *campus* was one of the project's requirements. The choice fell on the DSPACE platform. Once the interconnection between SIGARRA, ALEPH and DSPACE had been guaranteed, and the channels used by the information had been defined, the consistency of data in the various systems was secured, thus avoiding additional work for those that intervene in the process, and facilitating the quality control of meta-data.

The reasons underlying the creation of this repository by the University are related to the acknowledgement that free access to scientific literature is advantageous, and particularly important for the advancement of science and the increase of visibility and impact of scientific works produced by the academic community. It was therefore crucial to aggregate the full text publications in a single "portal", allowing the integrated retrieval of documents from meta-repositories, in both Portugal and abroad. On 2 December 2008, the Open Repository of the U.PORTO was certified as being compliant with the directives contained in the *Digital Repositories Infrastructure Vision for European Research* (DRIVER)[13], and became part of the repository Directory of this European project. A few days later, on 16 December, it became part of the Repositório Científico de Acesso Aberto de Portugal (RCAAP -acronym for Portuguese Open Access Scientific Repository)[14], publicized at the 3rd Conference on *Open Access* that took place at the University of Minho, on 15 and 16 December.

From the moment it was created, the U.PORTO Repository has increased the number of publications available. At the beginning of 2008, the repository totalled about 1,000 open access and full text documents. Two years later, the number of records is well over 11,500, split into the various U.PORTO *Communities* and various *Collections*, each of which corresponds to a specific type of information. The propitious growth of the number of publications available at the U.PORTO Open Repository is responsible for the 1st place it achieved in the national repository rankings from October 2009 on.

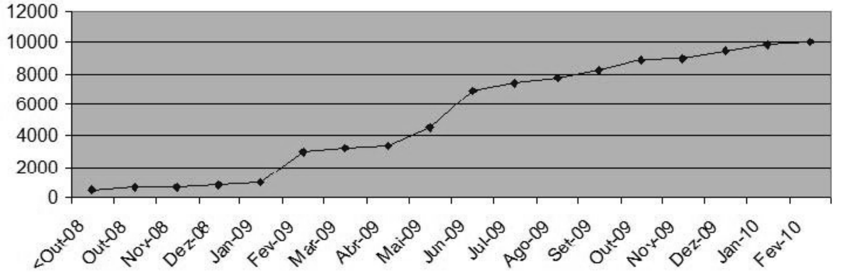

Figure 5. Growth in the number of Publications at the U.PORTO Open Repository

13 http://www.driver-repository.eu/.

14 http://www.rcaap.pt.

It was clear from the start that the academic community wholly supported the university repository, greatly contributed by the SIGARRA information system and its articulation with the repository, as we have already mentioned.

By way of example, Figure 6 shows the percentage contribution of the Faculty of Engineering Community of the University of Porto to the Open Repository, whilst Figure 7 shows the percentage distribution of the different information categories offered by that community.

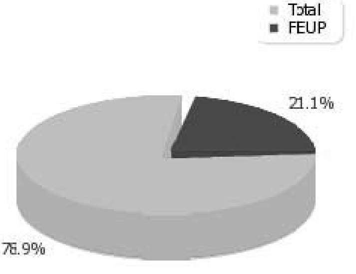

Figure 6. Contribution of the Faculty of Engineering of the University of Porto to the Open Repository

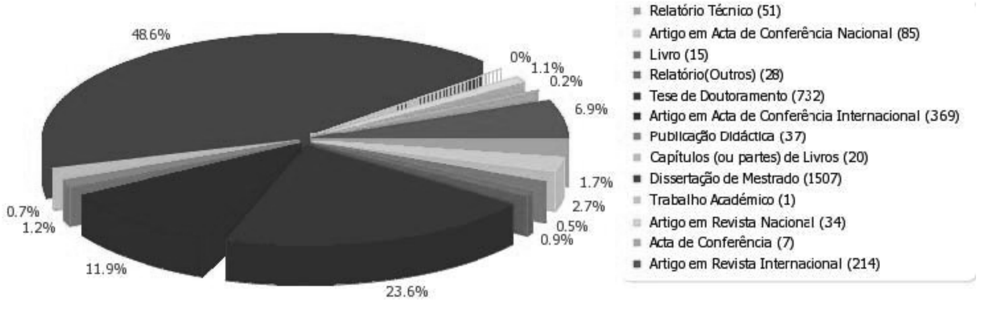

Figure 7. Distribution of Publications sorted by type at the Open Repository (Faculty of Engineering Community of the University of Porto)

Projects in progress and future working guidelines

The Digital Era has set up special and unprecedented conditions and opportunities for the dissemination of all types of organizational information and scientific knowledge. The universities, in particular, are quite aware of the value of digital repositories to manage digital resources, to foster collaboration and development and to obtain international recognition. Even though, the complexities that feature the current work environments require syncretic approaches and better ways of linking users to knowledge.

In fact, digital repositories are proliferating, the information available is frequently replicated and scattered and users may experience difficulties in accessing quickly the exact information they need. In addition, the speed of technological advancements threatens long term preservation.

At the University of Porto we are implicated with the management, the preservation and the continuous access to the information produced and accumulated in the context of the different organizational activities: pedagogical, scientific, technical, administrative, cultural and others.

We have mentioned the importance of the SIGARRA Information System as the main infrastructure for registering and organizing the information produced by the academic community. Specific systems are connected with SIGARRA in order to offer to the users an integrated environment that facilitates their daily work. For instance, the U.PORTO Open Access Repository receives automatically from SIGARRA the metadata and the digital objects of the authors' scientific production if they decide to allow open access to the full text of their works. Another example is the connection between SIGARRA and the Digital Archive system allowing, for instance, the Academic Office to access online academic records of U.PORTO alumni.

Recently, the development and implementation of a new SIGARRA module – Electronic Documents Management – for the registering and processing of the incoming and outgoing institutional mail (postal mail, faxes and e-mail) allowed to reinforce the integrated strategy we are pursuing.

Despite what we have remarked, there is yet a lot to be done at U.PORTO to manage in an integrated way the several components of such a complex and huge organizational system, as well as to contribute to the improvement of information sharing, usage and retrieval, and, as important as this, to guarantee the long term preservation of the relevant one.

In view of this, the Department for the Digital University is focused on the development of an *organizational repository* which will store, after a triage, an appraisal and a validation process, the relevant information that should be preserved in the long term for future reference. The registration of information in this repository will be varied due to the diverse information sources. The organizational repository will include information transferred automatically from SIGARRA, as we have already shown in this article, and will also provide for a self-archive, to be done by the members of the academic community and the organic and functional units of the U.PORTO.

Authors and producers of information may directly access the repository to make the deposit of digital objects and the metadata contextualizing and describing them. The access to these collections that will later be validated by the organic sector responsible for managing the respective information will be done according to the different access profiles previously defined. In some cases, access will be limited to specific users; in other cases, access will be free and with no restrictions. For these reasons, the study in progress includes the compliance of the organizational repository with the authentication and authorization infrastructure (AAI) of U.PORTO, which is wholly part of the national AAI architecture, under development, coordinated by the National Foundation for Scientific Computation[15], which manages the National Research and Education Network (RCTS).

We believe that the acquired experience, the investigation in course and the partnerships established will provide the U.PORTO with sufficient *know how* to find solutions that better fit the integrated management of day-to-day information, which represents the institution's knowledge base and future memory.

15 http://www.fccn.pt/.

Replace or Integrate? — Decision Support for Building a Federated Configuration Management Database

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Keywords

CMDB, federated CMDB, integration, migration, consolidation

Abstract

Meeting QoS (quality of service) requirements for critical IT services, while keeping IT service provisioning flexible and efficient, poses a challenge to IT service providers that cannot be met by technology measures alone. To develop the organizational capabilities for efficient delivery of more available and reliable IT services, best practice frameworks for IT Service Management (ITSM) like ITIL, CobiT or ISO/IEC 20000 (ISO20k) are adopted.

The introduction of IT Service Management processes according to ISO20k requires the introduction of a Configuration Management Database (CMDB) containing information about Configuration Items (CIs) and their relationships. Configuration Items are the entities vital to service provisioning and the management thereof, i.e. servers, software, but also Service Level Agreements (SLAs) and documentation.

The Leibniz Supercomputing Centre (Leibniz-Rechenzentrum, LRZ), an IT service provider for the scientific and academic communities in Munich, is currently introducing ITSM processes and is striving for an ISO/IEC 20000 certification (ISO/IEC, 2005). In this context efforts are undertaken concerning a more mature Service Continuity and Availability Management (Hommel, Knittl, & Pluta, 2009), as well as Incident and Change Management. One of the conceptually most challenging undertakings in the introduction of ITSM at the LRZ, is however the establishment of Configuration Management and a CMDB.

Introducing ITSM is never a "greenfield project": Every IT service provider has management tools and procedures in place. Consequently a CMDB, the central repository of ITSM-related information in an ITSM system, cannot be realized without regard to the tool and documentation infrastructure for IT management that is already in existence. Every project for introducing Configuration Management and building a CMDB will need to assess the management tools, databases and documentation systems which contain ITSM-relevant information.

Experience from early ITSM projects has shown that realizing a CMDB as a centralized, monolithic physical database is not feasible in any but the smallest and least complex scenarios. Existing data stores for configuration information cannot all be replaced by the CMDB and all functionality and information migrated to it. Trying to do so, results in CMDB designs so ambitious and complex, that they either cannot be realized in an adequate time-frame; or the CMDB system becomes all but impossible to maintain immediately after its introduction.

Current good practice for realizing CMDBs in large-scale scenarios follows a federation approach, connecting a central "federating CMDB" with so-called Management Data Repositories (MDRs). Consequently, a major challenge in CMDB design is to decide, which existing tools can be replaced by the CMDB, and which should be kept and, at least in the long run, integrated into a distributed, "federated" architecture for Configuration Management. For this task no standardized method exists and various CMDB-Tool vendors do not provide sufficient concepts.

In this paper we give a short introduction to the state of the art in Configuration Management, the issues concerning establishment and operation of a CMDB and the CMDBf-standardization approach. We introduce a criteria catalogue to assist organizations in finding the right strategy in either integrating or migrating existent MDRs into a CMDB. We outline a pragmatic, phased approach towards developing an information model that aligns with a federated CMDB architecture and conclude this paper with an outlook of further efforts in Configuration Management at the LRZ.

Motivation

When approaching the organizational aspects of IT Service Management (ITSM), most IT service providers now adopt the methods and the process framework outlined in ITIL and

ISO/IEC 20000. Within an ITIL or ISO/IEC 20000 based ITSM system, Configuration Management plays a crucial role, as the Configuration Management Database (CMDB) serves as the source of authoritative information on which decisions in all other ITSM processes are based.

Usually, even before starting to implement a CMDB, IT service providers collect and store much of the relevant management data; e.g. information about services, applications, servers, networks. However, the different functions within the IT service provider's organization – e.g. the networking department, the system management group etc. – typically run their own management systems which they use for collecting their domain-specific data.

The introduction of Configuration Management consequently cannot be approached assuming that one is starting from a "clean slate". While a Configuration Management solution might provide a convincing substitute for some existing management systems, it will need to integrate many others to form a "federated CMDB" (Gartner, 2006).

The Leibniz Supercomputing Centre of the Bavarian Academy of Sciences and Humanities (Leibniz Rechenzentrum, LRZ) is an IT service provider for the Munich universities LMU and TUM. It is currently introducing Configuration Management as part of a larger effort to improve its ITSM system and work towards an ISO/IEC 20000 certification. In this context, a survey was conducted to examine which tools were used by staff to record IT management and configuration information. This survey yielded a much longer list than expected, creating the wish for a methodological approach towards deciding which of these configuration databases to replace and which to keep and integrate into the CMDB.

This paper describes such an approach towards federation and integration of CMDBs. The paper is organized as follows: The next section will summarize the state-of-the-art of CMDB design and federation. Section 0 describes the decision support concept for CMDB federation, i.e. how for each of the existing management systems and data stores of management information, the decision "*replace or integrate*" was made. Section 0 gives a brief overview of the phased approach towards creating an information model for the federated CMDB and Section 0 summarizes the results and provides an outlook towards future work.

State of the art

An effective implementation of a CMDB is a critical success factor in all efforts to introduce ITSM. Still, despite the massive interest in IT Service Management, there is relatively little academic literature on CMDB design and realization and only a single, limited standardization effort regarding CMDB federation.

The concept of a CMDB for ITSM was introduced in the first version of ITIL (CCTA, 1996), but gained popularity mainly with the publication of ITIL V2 (OGC, 2000). According to ITIL's best practice, the entities vital to service provisioning and the management thereof – servers, software, but possibly also services, service level agreements and documentation – should be put under the control of the Configuration Management process, i.e. treated as Configuration Items (CIs). The CMDB contains the relevant information about each CI, as well as the relationships between CIs. It serves as the central information repository for all other ITSM processes.

ITIL V2's guidance on the CMDB was notoriously vague. In consequence, many Configuration Management projects failed when trying to create monolithic and complex CMDBs, leading some to question the feasibility of ITIL's CMDB concept (England, 2006). Based on the experiences of these early projects, the notion the necessary capabilities of a CMDB evolved, with Gartner defining distinguishing functionalities of a CMDB (Gartner, 2006), most of which – reconciliation, federation and synchronization – address the CMDB's ability to integrate other "configuration databases".

Reacting to the evolvement of these requirements, which at the time no established ITSM tool could adequately address, the CMDB Federation Workgroup (CMDBf) was founded by large vendors of ITSM tools (BMC, IBM, HP among others) in 2006. Its goal was to develop a standard for CMDB integration. The CMDBf workgroup has since been integrated into the Distributed Management Task Force (DMTF) and a specification for CMDB federation has been published as a DTMF standard (DMTF – CMDB Federation Workgroup, 2009). The basic conceptual architecture for CMDB federation of this specification proposes is illustrated in Figure 17. To better distinguish the roles within this concept from those of older CMDB approaches, the database at its core is now called a "Federating CMDB". The configuration databases that the CMDBf integrates are called "Management Data Repositories" (MDRs). Essentially, what Gartner called "CMDB" is now a "Federating CMDB" in DMTF nomenclature; Gartner's "configuration databases" have become "MDRs".

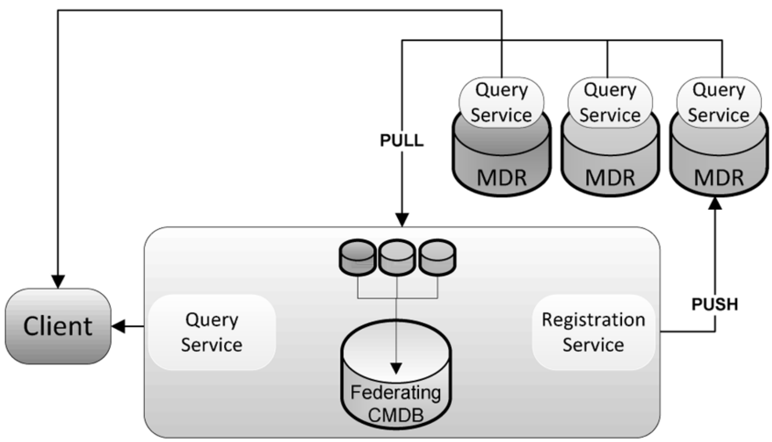

Figure 1. CMDBf architecture

The latest version of ITIL, ITIL V3, has redefined Configuration Management tools in a conceptually similar fashion, but unfortunately uses a terminology different to DMTF or ITIL V2. In ITIL V3 the entirety of all tools, databases and software modules for Configuration Management is called a Configuration Management System (CMS). A CMS has an "Integrated CMDB" at its core, cp. Figure 4.8 in (OGC, 2007), and integrates various "physical CMDBs". While the concepts do not match exactly in every detail, ITIL V3's definition of "CMDB" can be seen synonymous with "MDR" (or Gartner's "configuration database") and ITIL V3's "integrated CMDB" is quite similar to DMTF's "Federating CMDB" (or Gartner's and ITIL V2's "CMDB"). For the remainder of the paper, we will use the terms as they are used by the DMTF.

The Federating CMDB of the CMDBf architecture is a MDR itself, and contains non-federated information about CIs as well as information about CI-to-CI relationships. The architecture further defines a Query Service and a Registration Service. The Query Service makes data stored in the Federating CMDB and MDRs available to clients. It is also used by the Federating CMDB to "pull" data from the MDR. The Registration Service enables the MDRs to register data or data updates at the Federating CMDB, thus enabling a push connect "push" federation mode.

The CMDBf concept is a technical specification for integrating data from various sources, and intentionally limited in scope. It does not define an information or data model for a CMDB. Nor does it address the question which MDRs to connect, which MDR should be the authorative source for a particular piece of information, how to consolidate redundant data kept in the MDRs.

For these practical challenges in realizing a federated CMDB, not much guidance, apart from "white papers" by ITSM tool vendors, is publicly available. In (Brenner, Garschhammer, Sailer, Schaaf, 2006) various IT management standards are examined for their usability as a basis for a CMDB information and data model. In (Richter, 2009) methods for consolidating the management tool landscape at an IT service provider, thus reducing the number of MDR that will need to be integrated, are proposed. But so far, no guidance has been available to support a Configuration Manager in designing concrete federation architecture: which MDRs to keep separated from the CMDB federation, which to replace by the central MDR in a Federating CMDB and which MDRs to integrate.

CMDB Federation

Any CMDB project needs to start with the elicitation of the requirements, i.e. which use cases the CMDB system should address. Most use cases can be realized with a variety of CMDB federation approaches, but short-term and long-term cost may differ greatly. In general, it is not feasible to maintain all management information in a single, monolithic system. On the other hand it is equally inefficient to keep every single MDR that has been designed and deployed in a pre-CMDB era.

A sensible CMDB federation architecture will need to balance various aspects of cost and utility:

- Cost
  - of maintaining the CMDB (correlated to level of detail in which information is stored in the core CMDB)
  - of maintaining each individual existing MDRs
  - of integrating the core CMDB and MDRs and maintaining this integration
- Utility
  - of having management information made centrally accessible via the CMDB
  - of additional functionality in MDR systems, which will not be easily substituted by the central CMDB (or other systems) if it is replaced

Take the documentation of structured network cabling as an example: At the LRZ, network administrators keep detailed data about all cabling in special spreadsheets, so-called "network patch lists". Most of this information has only relevance in the context of network cabling maintenance and has little ITSM-process-related or cross-departmental significance. The utility of having all this information in the CMDB is therefore relatively limited. Maintaining it in a centralized CMDB will however be complex and incur significant cost. Replacing the "network patch lists" with detailed information on cabling in the core CMDB is therefore not a viable option. Leaving the structured cabling information out of the scope of the CMDB is a possible choice, but there will inevitably be some information overlap between the cabling documentation and the CMDB, and important relationships might be left undocumented. Integrating the CMDB with a cabling documentation system seems like the obvious choice, but this can be a complex and costly task, and this cost will need to be balanced against the benefits of integration.

To support this decision process we developed a criteria catalogue, i.e. a weighted rating matrix. We use this matrix as a tool when deciding whether an existing data source is to be integrated into the CMDB and ITSM suite or if it rather is to be replaced by it. Keeping information in existing management tools and simultaneously documenting it in the centralized CMDB / ITSM solution would increase administration efforts, possibly lead to inconsistencies and is therefore not considered an option. Consequently, the decision to migrate data into the core CMDB means shutting down the corresponding existing data sources. However, one still has to consider whether an existing management tool is more than just a MDR, i.e. does it offer additional functionality beyond information management, e.g. automate important administrative tasks or monitor critical system parameters? In such a case, shutting it down might be so disadvantageous that implementing an integration solution to synchronize its data with the CMDB becomes the best option.

Based on internal documentations, interviews with operational staff and comprehensive tests we evaluated our existing MDRs. For this we developed an evaluation catalogue consisting of three main categories:

– Common criteria
– Functionality
– Technology and interfaces

Within these categories we have identified various sub-criteria, like the complexity of maintenance as a common criterion or the existence and usability of export interfaces as a criterion in the technology and interfaces category.

Assigned scores for evaluating criteria can range from 0% to 100%, but to keep the criteria catalog easy to use, we defined the admissible values for the evaluation of each criterion, and assigned each value (e.g. "Yes") a pre-defined score (e.g. "100%"). As a matter of fact, most of our criteria are binary. Others have more admissible values, but we strive to keep the number of possible values (and scores) in the low single-digits to keep the evaluation process simple.

We also assigned a weight to every criterion. Criteria are differentiated between "no significance" (weight 0), "minor importance" (weight 1), "important" (weight 2) and "very important" (weight 4). In Table 1. the common criteria and their individual weights are listed.

The overall result of this evaluation process is a single integration score which helps us to decide, whether integration or replacement of existing tools should be preferred. If this score is significantly smaller than 50%, we decide to replace the existing tool, if the score is considerably higher than 50% we keep the tool and make a plan to develop an appropriate integration. For scores roughly between 40–60% a more in-depth analysis is required. As diverse tools can be integrated into the CMDB federation only one at a time, it can sometimes be a viable option to postpone the *replace or integrate* decision for these borderline cases and to reevaluate these tool at a later time in the project.

Table 1. Evaluation criteria for category common

Common Criteria	Integration Score
Usage scope	Important (2)
Supplier support	Important (2)
Importance within organization	very important (4)
Complexity of maintenance	very important (4)

Table 2. Example of tool evaluation

Integration/ Migration Scoreboard	LRZ Switch Documentation Tool	VMware infrastructure 3.5 Enterprise
Common Criteria (25%)		
Usage scope	Communications Department	LRZ wide
Supplier support	Existent	Existent
Importance within organization	Medium	High
Complexity of maintenance	Low	High
Functionality (25%)		
Additional functionality	No	Yes – controlling of VMware
Technology and Interfaces (50%)		
Database as storage	No	Yes
…		
Export interface	n.a.	Yes – SOAP
Automatic identification of CI possible	No	Yes
Connected to other systems	No	Yes – Active Directory
Result		
Integration Score (%)	20	100
Referral	Replacement	Integration

Table 2 shows the results of our evaluation for two of our management tools – one used for assisting switch management in the networking division and one used for management of virtual servers. Note that the current switch management tool was developed by the LRZ, whereas the management tool for virtual machines is provided by a third party supplier.

Based on the final integration score, we have a sound basis for the decision which of our existing data sources should be replaced and which one should be integrated with the federated CMDB. In the demonstrated case, we are going to migrate the data of our switch management solution completely to our CMDB and dispose the switch documentation tool. For the virtual servers' management tool it is reasonable to integrate it with the help of an appropriate interface to the CMDB.

Design of the federated CMDB

Having identified existing MDRs, and decided whether to integrate them or migrate them to the federated CMDB, the next step is to devise the basic CMDB design. In this section we explain our design process of the CMDB's information model. Building up a CMDB requires a structured approach. First, it is necessary to define the scope and goals of the CMDB, which will differ for each service provider. Defined business and ITSM processes should be placed at the center of consideration. As a rule of thumb, only information which is required by more than one stakeholder and only about CIs which are subject to the Change Management process should be stored in the Configuration Management Database. A formal Configuration Management Plan should be defined according to ISO/IEC20000 Code of Practice (ISO/IEC, 2005) before establishing a CMDB.

In order to set up a CMDB, one needs a corresponding information model. For this, requirement elicitation workshops with all concerned stakeholders are usually the start. The resulting information model will, of course, need to be transferred into a dedicated data model of the database underlying the CMDB at a later point. It is important to take care how the information model is set-up: top-down or bottom-up. When using a bottom-up approach, one integrates the information models of all the existing MDRs into one aggregate information model. This approach doesn't scale well, when manifold MDR's are in place – which is the case in most scenarios of a certain scale. Consequently, the "top-down" approach is usually preferable. For a top-down approach, one starts with an empty information model, which is gradually filled starting with general master data and model elements for the core services of the IT service provider. This model will subsequently be refined with more specific details.

As shown in Figure 2 our phases follow the principle of an onion skin. These phases are explained in the following.

In the first phase the information model is enriched with general master data. Such master data are both static and dynamic. Examples of static master data are staff, customers and suppliers; dynamic master data are orders. In our environment "customers" encompasses all the institutes of the various universities that the LRZ serves as IT provider. Every institute has already been assigned a unique ID in an Identity Management solution. Customers are affiliate to organizations like the Technische Universität München which is sited on a specific location. These locations are within a building which is again located within a specific sector. Thus, the outcome of the first phase is now an information model with entities like organizations, customers or sectors and their relationships.

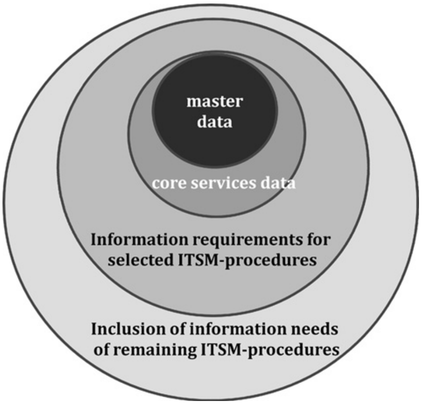

Figure 2. Phased approach towards the information model

In the second phase core business processes need to be analyzed. Thus, in our case, we had a closer look at the entities specific to providing our network services. Herby the information model is enriched with CI-classes for entities like switch, router or access point. In the third phase, selected ITSM procedures are investigated regarding their information requirements. One example in our environment is the change management procedure for the installation of new access points, which leads to new entities like order confirmations. Each of the following phases will be more detailed concerning business specific procedures. In our next phase for example, we have analyzed the required information for our release management procedure of physical servers.

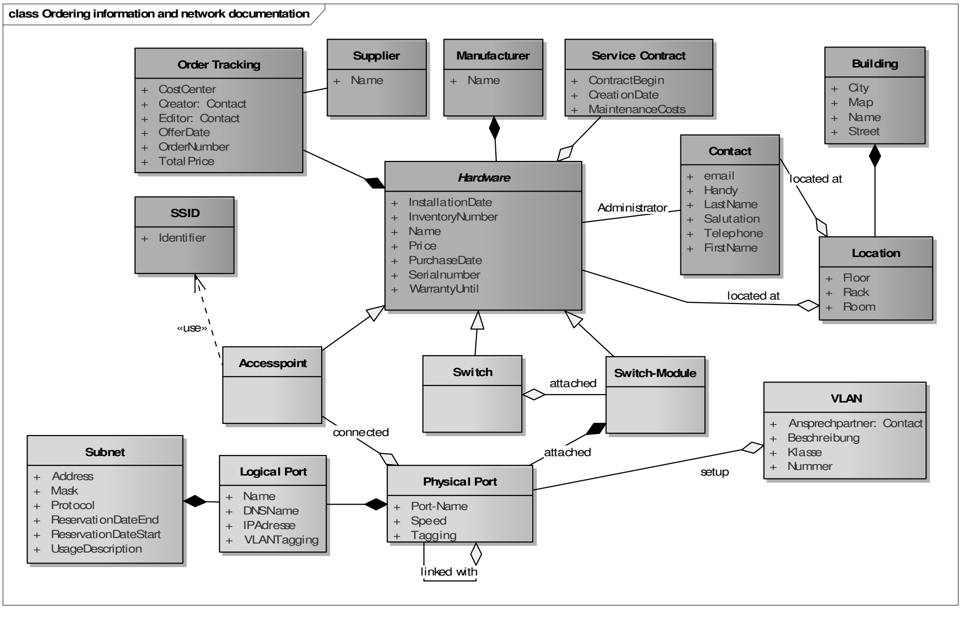

Figure 3. CMDB Information Model excerpt

Figure 3 shows the outcome of our first two phases. After passing through all the phases, an information model has been built up. This platform independent information model is now the starting point for setting up the CMDB. This information model then had to be transferred into a data model suitable for our ITSM suite based on iET Solutions. The method described here will subsequently be applied to other service provisioning areas, and their current MDRs, at the LRZ.

Summary and outlook

The Leibniz Supercomputing Centre (Leibniz-Rechenzentrum, LRZ) is the IT provider for the Higher Education Institutions in the Munich area, offering a wide array of services ranging from computing facilities to networking. It is currently implementing a Configuration Management process aligned to the requirements specified in ISO/IEC 20000. Up until now, management information at the LRZ has been stored in an immense variety of domain specific management tools. To support a comprehensive and effective IT Service Management, it needs to be defined which information will be recorded for each Configuration Item (CI) and how it is to be stored, along with documentation of the relationships between the CIs (IT services and IT infrastructure components), in a Configuration Management Database (CMDB). This is also a requirement by ISO/IEC 20000, a standard for IT Service Management. It is the mid-term goal of the LRZ to certify its ITSM system according to ISO/IEC 20000.

In this article we have introduced a decision matrix that supports Configuration Management in deciding, whether existing Management Data Repositories (MDR) should be integrated with a federating CMDB or be replaced by it. Parallel to this, an information model containing all management relevant information and their relationships needs to be prepared. Of course, the simple merging of the information models of all MDRs in place is not efficient and we have introduced a phased approach to efficiently develop an information model for a CMDB.

The CMDB design and integration of MDRs is under way at the LRZ. This is a complex task: the right balance between the utility and complexity of the CMDB needs to be found, and within this process as many as 100 potential MDRs need to be evaluated. The first integration sub-project addresses the connection of the CMDB and our ITSM suite with our tools for managing virtual machines.

Acknowledgment

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The Adoption of a Smart Card at the University of Porto

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smart cards, smart card technologies, smart card adoption, authentication and authorization

Abstract

The University of Porto, recognizing the relevance of Information and Communication Technologies (ICT) for the overall performance of the institution, is committed to technology leadership for the benefit of the academic community. The Digital University Department is a central department dedicated to ICT, whose mission is to promote and extend the use of ICT to all the activities of the University, as well as to induce the development and adoption of innovative services in this area.

In this context and following a recent partnership celebrated in July 2008 between the University and the Santander Totta Bank, the Digital University Department is supporting the adoption of a university identification card – U.PORTO Card. It is a smart card with sev-

eral embedded technologies allowing the implementation of a campus card system. Although this project is still in the beginning, significant improvements have already been achieved.

The main objective of this work is to present the project of the U.PORTO campus card. The goals, methodology, applications, adoption factors and ongoing developments are here discussed.

Introduction

With its origins dating back to the eighteenth century, U.PORTO is Portugal's largest university in terms of student enrollment. About 30.000 students are currently registered in the approximately 600 study programs offered by the University.

U.PORTO today consists of fourteen faculties, about seventy R&D units, and several other autonomous services. The University premises are geographically spread in Porto city, although aggregated mainly in three areas.

These multiple locations, together with some other factors, support the strong autonomy of the U.PORTO faculties and the University's decentralized governance legacy.

Information and Communication Technologies are playing an important role in creating unity in diversity at U.PORTO (Katz, Dodds, 2009). An excellent example is the U.PORTO Information System for the Aggregated Management of Resources and Academic Records (SIGARRA) (Azevedo, Ribeiro, David, dos Santos, 1997).

SIGARRA is an integrated information system developed to facilitate the production, storage, access, communication and dissemination of relevant information of all the U.PORTO activities, to favor internal cooperation and cooperation with external academic communities and companies, as well as to contribute to the cohesion of the community itself, encouraging good practices and compliance with procedures. The SIGARRA system, used to manage information at the U.PORTO, interacts with other applications and systems within the University, such as library and e-learning management systems. Currently the SIGARRA is used by all the faculties, as well as by the Rectorate, the Social Services of U.PORTO and some R&D entities.

Recognizing the relevance of ICT for the overall performance of the institution, the U.PORTO is strongly committed to technology leadership for the benefit of the academic community. ICT governance is under the responsibility of a pro-rector, being also the director of the U.PORTO Digital University Department (DUD). This department is responsible, in particular, for the information management at U.PORTO and gives support and advice to the ICT offices or centres installed in faculties or other University units.

In spite of its decentralized model of governance and aiming at better supporting student mobility in the campus, as well as increasing the sharing of resources and the enhancement of services offered to the academy, U.PORTO adopted in 2008 a unique identification card for students and staff. In this context and subsequent to a partnership established between the U.PORTO and the Santander Totta Bank, the Digital University Department is supporting the adoption of the U.PORTO card. It is a smart card with several embedded technologies allowing the implementation of a campus card system.

Nowadays the U.PORTO card is in use not only for identification, but also for library loans, authentication in the printing/photocopying machines, staff control of presence, among other conveniences. Efforts have been made in order to extend the referred functionalities to all the faculties and the work already done gives us conditions to predict successful results in the near future.

Project objectives

Goals and objectives

The main goal of this project is to have a unique card for all needed campus applications. To achieve this goal, two main objectives were pursued:

- **Card emission**: ensuring that all academic community have access to the card;
- **Card promotion**: (i) the only identification card at the University; (ii) safeguard of the functionalities currently in use in the faculties; (iii) identification of a set of new key functionalities ensuring its implementation in all faculties; (iv) integration of new systems that may be adopted by the faculties; (v) maintenance of a support structure for the users.

Critical success factors

The most important factors identified to assure the success of the project were:

- Dissemination of the project;
- Decisions taken after hearing the government bodies of the faculties;
- Existence of policies allowing the use of the card;
- Cooperation with the stakeholders of the project;
- Study of systems/applications implemented using preexisting cards in the different faculties;
- Evaluation and implementation of added value applications for the academic community;
- Discussion with companies responsible for successfully implemented solutions at U.PORTO or other institutions.

During the project the success will be measured by:

- Number of users with U. PORTO card;
- Feedback from surveys to the faculties;
- Number of applications in use in different faculties supported by the U.PORTO card;
- Number of applications pioneered by the U.PORTO card.

Main threats

Some main threats to the success of the project were identified:

- Resistances in the intention of adoption;
- Lack of policies allowing the card to be used;
- Existence of other card solutions at some faculties;
- Inexistence of a support structure for the academic community.

Scope

Organizational scope

Currently the scope of this project includes almost all U.PORTO organic units:

- Faculty of Architecture (FAUP);
- Faculty of Fine Arts (FBAUP);
- Faculty of Sciences (FCUP);
- Faculty of Nutrition and Food Science (FCNAUP);
- Faculty of Sport (FADEUP);
- Faculty of Law (FDUP);
- Faculty of Economics (FEP);
- Faculty of Engineering (FEUP);
- Faculty of Pharmacy (FFUP);
- Faculty of Arts (FLUP);
- Faculty of Medicine (FMUP);
- Faculty of Dental Medicine (FMDUP);
- Faculty of Psychology and Education Science (FPCEUP);
- Institute of Biomedical Sciences Abel Salazar (ICBAS);
- Rectorate (REIT);
- Social Services (SASUP).

In the future, the extension of this system to other units may be considered, for instance to include the University of Porto Business School.

Temporal scope

The project has a time span of 5 years. In the first academic year 2008/09, the new identification card should be available to all the members of the academic community and new functionalities should be supported in relation to the current ones.

Development

We may consider four different phases for the development of this project.

Acquiring expertise

This phase involved a thorough study of the technologies present on the U. PORTO card. This study was supported by the Santander Totta Bank, in particular providing technical expertise and documentation.

The U.PORTO card has several embedded technologies (magstripe, barcode, contact and contactless chip). At the beginning of the project the card was provided with independent chips (contact and contactless) but recently the U.PORTO card added value is the hybrid chip (dual interface) produced by Gemalto company. This chip – Optelio Contactless D32 R5 for Santander- includes Mifare capability (4K) and 32k EEPROM for applications/ data with cryptographic capabilities. It's a Java card with several applets already embedded (e.g. Calypso V3, Classic IAS V3 – PKCS#11 PKI, PayPass M/Chip4, etc.) providing conditions for the development of several functionalities.

During this phase the University became a member of the European Campus Card Association (ECCA Website, 2010), aiming to obtain knowledge about the state of the art in the use of cards systems in higher education institutions. Despite there are no standards to implement a campus card system, the exchange of experiences allowed by the ECCA membership was very important for the development of the U.PORTO project, to reinforce within the academic community the value of such a system, in particular because of its ability to permit the offering of new services and by making student and staff mobility easier (Fridell, McKenna).

Card emission

Presently the Santander Bank issues cards for more than 200 universities in 13 different countries. The card issuance (Figure 1) is secured by a common global platform differing only in what respects to the customization, typically performed by a company located in the same country as the university. In the case of the U.PORTO the personalization was made by SIBS company (SIBS Website, 2010).

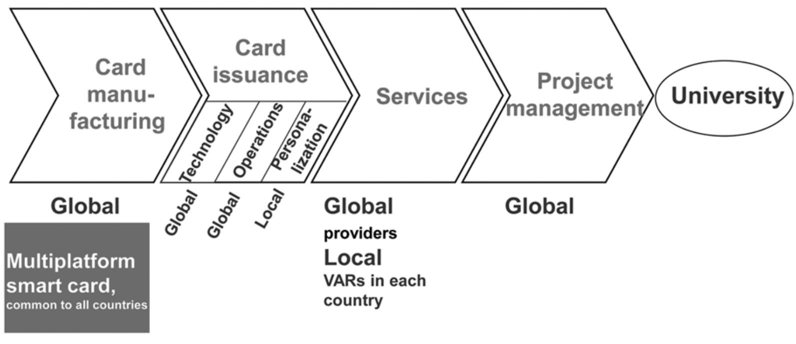

Figure 1. Santander card issuance

The card issuance involved two phases. The first one was the layout design for the U.PORTO card. This design was chosen by the University and conceived by a local designer. The identification of the card owner is assured by several items: photograph, name, U.PORTO identification number, category, and faculty affiliation (Figure 2).

After establishing the university card layout the issuing step follows.

The production of the cards implies the satisfaction of two main conditions:

– **"The University File"** that must follow a set of requirements and includes the necessary data for all the members of the academic community which may have the University card. To provide this file the U.PORTO developed a feature for the SIGARRA

system that creates the file and sends it periodically to a secure FTP service of the SIBS company.
- A "**paper form"** to be completed by the user to acknowledge, verify and accept the usage of the data for the University card and also, if the user wishes, for requesting the additional bank component that the card may include. This form is sent to the company responsible for the card customization that crosses the data with the elements on the University file. If there are no errors, begins the production of the card.

Figure 2. U.PORTO card layout

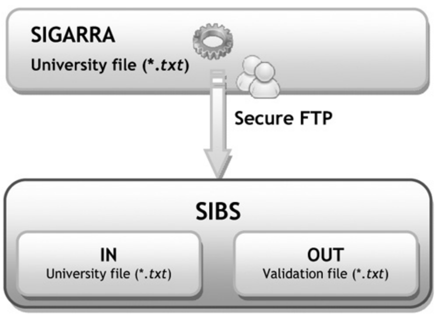

Figure 3. U.PORTO card production: exchange of files

In addition, the success of the emission depends also on the policies adopted to deliver the card to the user. When the card has a bank component the responsibility of the deliver to the address given by each user belongs to the bank. If no bank component is included, the delivery is done by the University at each faculty.

Survey

When this project started it was known that many of the faculties offered differentiated services based on their own identity cards and in some cases even the local production of the cards, using distinct technologies.

In order to know better the functionalities used in the different faculties we launched a survey to identify the systems in use or under development. The data gathered allowed to observe several differences in functionalities implemented in the different faculties. As shown in Figure 4, access control (mainly car parking), printing and library loans were the most used.

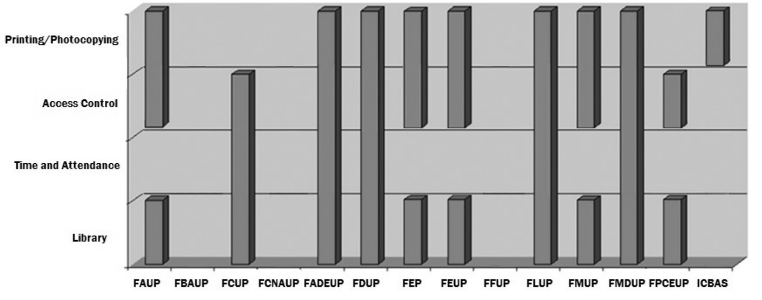

Figure 4. Key features using a card: by faculty (year 2008)

However, despite the diversity of solutions/technologies implemented there were features relying mostly on a solution and/or company. These were the cases of attendance control (Millenio3) and printing control (Xerox).

Implementation plan

In the development of this plan our goal was to set up a procedure that minimizes possible resistances to the adoption of the card, so we offered the faculties the service of dealing with all aspects concerning the adaptation of the existing systems for the new card, if the faculties wished so.

This approach, although more complex since it obliged to work together with the different companies that had systems installed on the campus, was quite successful as it respected the selection criteria adopted by each faculty, so minimizing resistance to change. For this adaptation two scenarios were analyzed:

- Scenario 1 – Adaptation/Conversion of the systems currently in operation (whenever possible there will be no conversion of technologies);
- Scenario 2 – Adaptation/Conversion of existing technologies to more robust ones (e.g. promote the use of MIFARE technology at the detriment of magnetic stripe).

The second scenario was considered the best for superior using of the card potential and also because of being sustained by existing research (Lee, Cheng, Depickere, 2003) that backwards compatibility and relative advantage constructs are the major factors that influence the adoption process of smart cards.

After identifying the technical conditions and financial proposals for the adaptation/ conversion of each feature, each faculty was informed and confirmed the interest in beginning the process. This consultation procedure and the financial support of the University to implement the change contributed strongly to the adhesion to the U.PORTO card.

In a second phase, U.PORTO intended to ensure access to the main functionalities allowed by the University card in all faculties and to implement new relevant ones. In all cases the integration of solutions with the information system SIGARRA was a primary request.

It is worth to emphasize that, regardless of the implementation of facilities mentioned, the new card allows reinforcing cohesion and strengthens the sense of belonging to the University. This is a "cross-functionality" and generates uniqueness.

Results

Emission

In November 2008 the first cards were produced and on February of the following year 16 000 cards were delivered. Approximately two years after the beginning of the project, more than 23 000 cards were produced covering about 52% of the academic community.

Currently 31% of the organic units have values for adoption above 70% (see Figure 5).

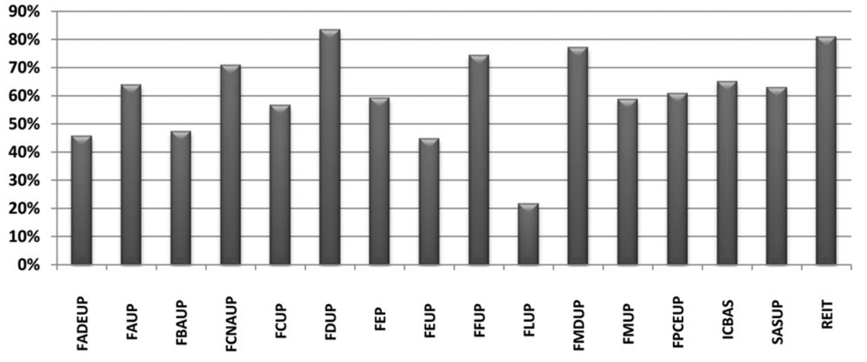

Figure 5. U.PORTO card: % Adoption

Considering the category of users, it can be seen on Figure 6 that at FMDUP, FBAUP and FDUP more than 90% of the respective staff adopted the card. In relation to students about 30% of the faculties have values above 70%.

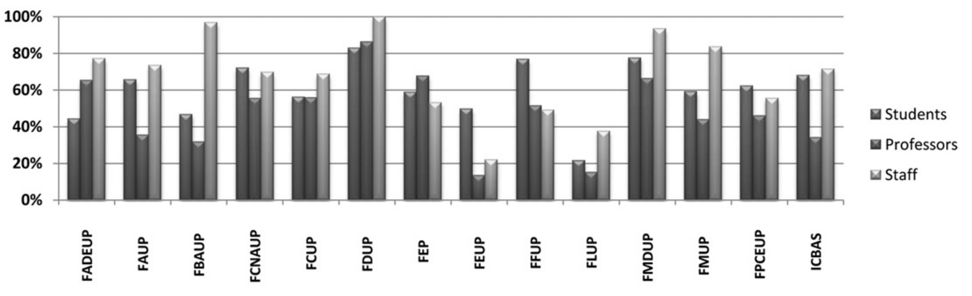

Figure 6. U.PORTO card: % Adoption by type of user

Regarding the issuance process, some improvements are in progress. In fact, some delays were identified in the delivery of cards due to digital characters recognition faults implying inconsistencies with the University file. To overcome these difficulties SIBS is developing an online form to substitute the current paper form. Another important development relates to the disclose of MIFARE serial number for each card produced allowing improving the applications authentication and authorization process.

Functionalities

Nowadays the U.PORTO card is used at the University for user identification and for the utilization of several services, as described below.

Library loans

As most libraries have barcode readers, they were able to use the card since the beginning of the project, as the card includes a barcode with the identification number assigned to each U.PORTO member.

Attendance control

The U.PORTO card is used for registering staff's attendance by means of MIFARE technology in the Rectorate, FDUP and FBAUP. Implementation in FCUP, FLUP, FMDUP, FMUP and SASUP is starting.

Currently, the U. PORTO card is being produced with a random MIFARE serial number unknown to U.PORTO. Due to this fact a campaign to collect all the cards serial numbers was launched to associate them to the respective staff members.

An important economy of scale was achieved as several organic units are (or will be) sharing the same technical infrastructure in connection with SIGARRA for attendance control.

Printing and photocopying system

U.PORTO card's MIFARE technology is also being used for the printing and photocopying system, as it provides the mean through which a user may authenticate in the system. This functionality is currently implemented at the Rectorate, FMDUP, FADEUP, FDUP and ICBAS, being the installation process in progress in other faculties (FLUP, FEP, FAUP and FBAUP).

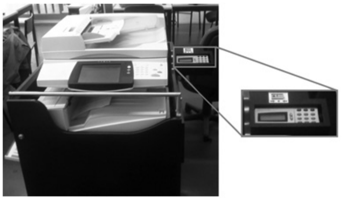

Figure 7. Printing equipment at FDUP: security structure and reader adapter

As mentioned previously, most faculties use equipment supplied by Xerox. The system consists of a server/client infrastructure based in Equitrac software to provide and manage the authentication process. The only prerequisite imposed by U.PORTO was the integration of the card's MIFARE technology in the authentication process, without interfering with the local previously installed system. For instance, specific card readers were designed for fitting in the equipment's security boxes, as shown below, see Figure 7.

Access control

Until now access control is used mainly for car parking and just a few faculties (FCUP, FMDUP and FEUP) have access control implemented for other spaces (e.g. labs) or buildings. Local systems are now being adapted to use U.PORTO card (MIFARE technology) both for car parking and for access control to student residences or other spaces.

Presently 48% of the features supported by the card are implemented and we expect to reach 71% at the end of this year. Additionally efforts are taking place for providing discounts in services like public transports or museums for U.PORTO card users.

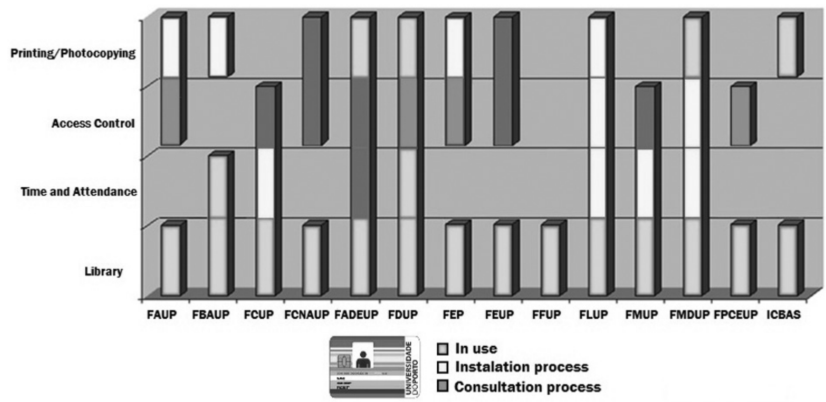

Figure 8. Key features versus U.PORTO card: by faculty

Beyond typical applications, we are studying the implementation of new functionalities and services, the most important being:

Digital signing and secure authentication

In collaboration with the Computer Science Department of FCUP, we are testing the Classic Client solution provided by Gemalto. This application is a smart card-based cryptolibrary product that brings portability and the highest level of security to enterprise networks.

For these tests it was necessary to create a U. PORTO certification authority (CA), enabling to issue certificates for the card. To manage the Public Key Infrastructure (PKI) we selected an open source solution EJBCA to be integrated with the U.PORTO Lightweight Directory Access Protocol (LDAP), as required by the project.

The CA created enables the testing of the following functionalities in a closed user group (test team):

– Digital signing of documents and email, integrated with applications such as Microsoft Office, Adobe Reader, Mozilla Thunderbird, etc.;
– Encryption of emails and documents;
– Web authentication integrated with the most used browsers;
– Computer logon, integrated with Microsoft Active Directory (AD).

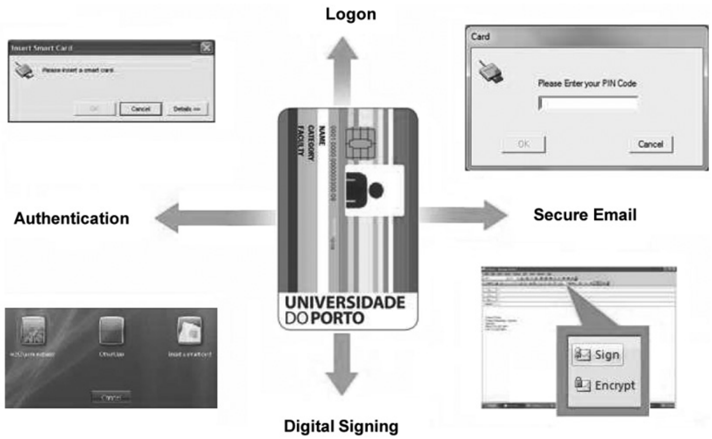

Figure 9. Classic Client — Test done with U.PORTO card

It's also intended that the services offered to the U. PORTO card are extended to the national identification card (e-ID card) (Cartão do Cidadão Website, 2010). The national e-ID card provides also PKCS#11 cryptographic interface, however the fact that this card allows the qualified digital signature and timestamp provides our users with the possibility to issue a digital document with legal value.

The structure currently conceived to bear these features requires three different moments of interaction with the user (Figure 10).

Firstly it is necessary to assure the registration in SIGARRA when the user arrives at the U. PORTO. For this purpose we developed a Java applet that gathers the user information present in the national e-id card, including certificates (authentication and digital signature), and uploads it to SIGARRA. Secondly, after the user received the U. PORTO card, he ought to enable the card cryptographic functionalities and lastly, the user may access the services provided by U.PORTO using both cards.

Knowing that smart cards bring advantages to the users, in particular in online authentication with a high level of security (Burr, Dodson, Polk, 2006), it is also our wish that the U.PORTO Authentication and Authorization Infrastructure – U.PORTOaai (U.PORTO – ICT Website, 2010) – supports the coexistence of the U.PORTO and the national e-ID card.

The U.PORTOaai is in production since March 2010, allowing federated authentication. The technical architecture is based on a *Where Are You From* service (WAYF), a central Identity Provider (IdP) connected with a central LDAP and a few Service Providers (SP) based on *Shibboleth* (SAML 2.0 standard), as shown in Figure 11.

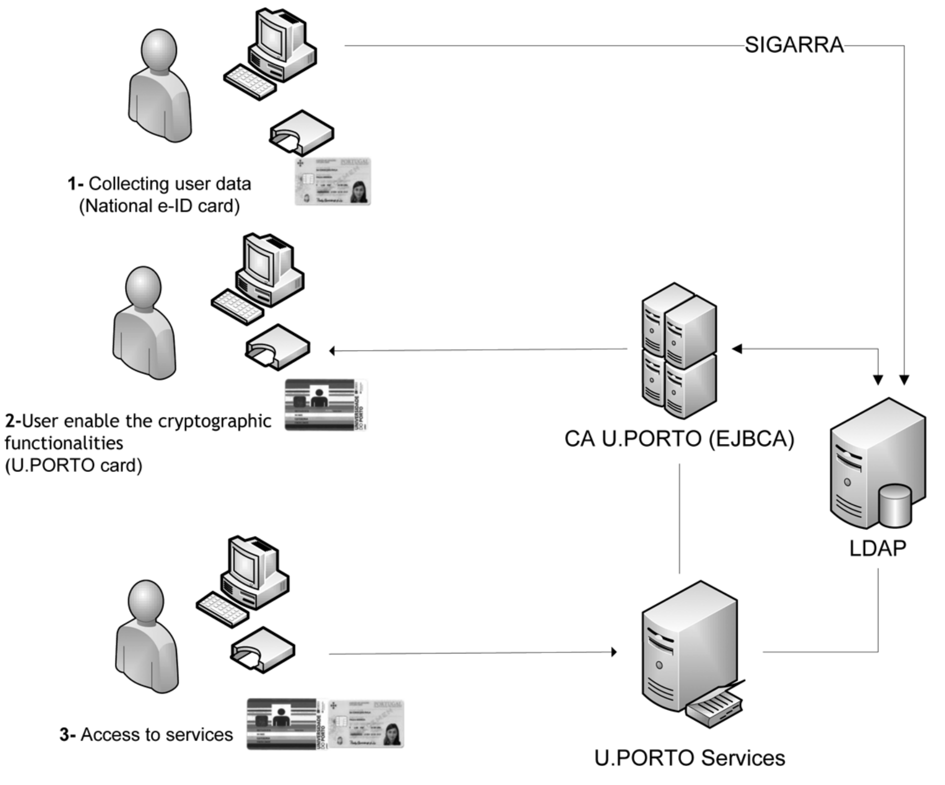

Figure 10. Card cryptographic activation and use

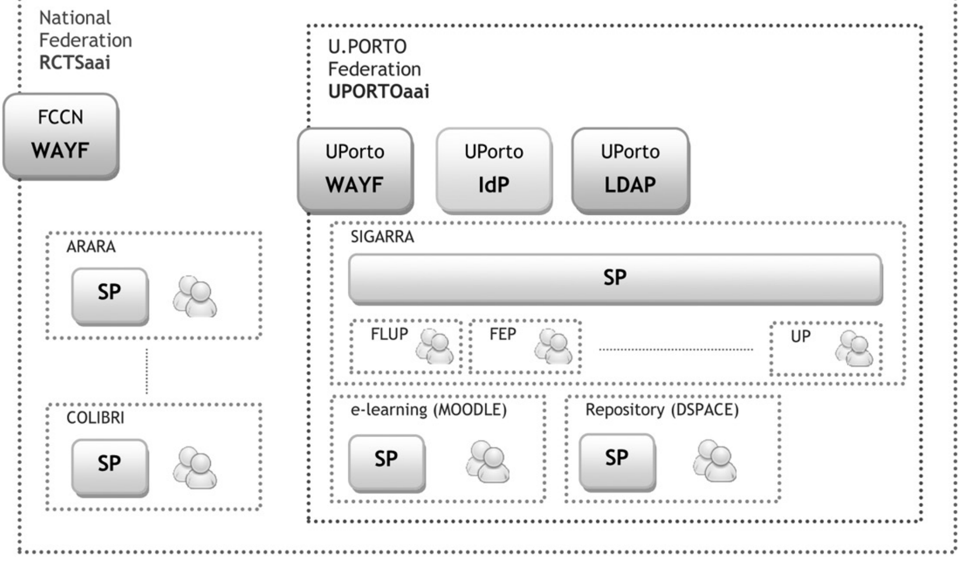

Figure 11. Current U.PORTOaai infrastructure

The U.PORTOaai allows the user authentication in some services provided by U.PORTO and also in some services provided by the National Foundation for Scientific Computation (FCCN – Portuguese NREN).

Future developments and conclusions

The U.PORTO intends to implement a payment system for students and staff to allow more efficient payment procedures and so decreasing cash circulation. The first organic unit where this system will be implemented is SASUP, as this unit is responsible for several bars and canteens in the campus. The solution is under study and should permit a future integration with other U.PORTO services, as shown in Figure 12. A bank account managed by the University will be provided where all values uploaded to the card are deposited, allowing central management and monitoring of all the financial movements.

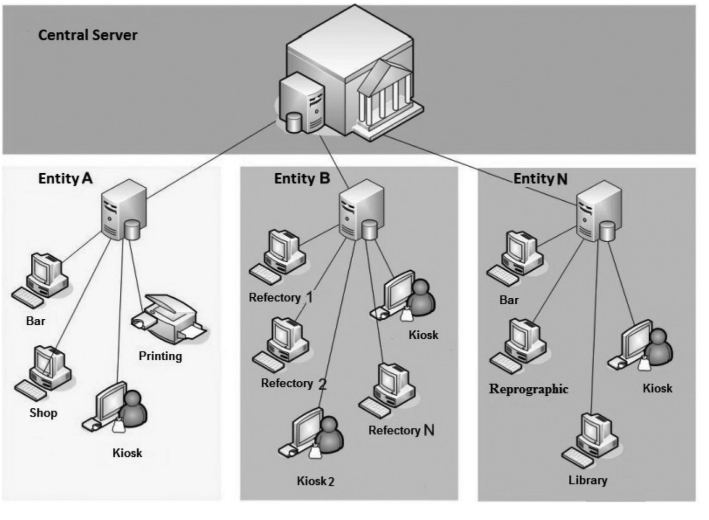

Figure 12. Payment system solution under analysis

Another development being studied in partnership with Xerox is a distributed printing system that will enable students and staff to use printing and photocopying equipments all over the campus, although belonging to different faculties. The increase of internal student mobility justifies this capability.

The possibility of using the U. PORTO card in the city public transportation compliant system *Andante* (metro, bus and train) is also being evaluated.

Another vector of investigation is related with the increasing number of foreign students carrying out their studies at the University of Porto (almost 9% of all students) witch calls up the need of adoption of a standardized campus card system. We are therefore closely following the developments of the European Education Connectivity Solution Project (EECS Website, 2010), aiming at maintaining the compliance of the U.PORTO card with the directives that may result of this European project.

To conclude, and in spite of mentioned factors, such as the strong autonomy of the faculties, its geographical dispersion, the existence of previous solutions and in some cases the local production of faculties' own cards, added with some delays in the implementation of the new card functionalities, we may state that the U.PORTO card project is already a success.

Almost all management bodies of the different faculties and units of the University have expressed interest in adopting the U. PORTO card and teamed up actively in the implementation process. This reinforces the suitability of the U.PORTO's approach in proposing the adoption of a unique card to be used by all U.PORTO members.

Last but not least the project communication was also a key factor for the academic community adhesion to the University card. The U.PORTO Portal (based on SIGARRA) has a special section for the project where, beyond general information, people may find details about functionalities and the state of their implementation, technical details, FAQs (Frequently Asked Questions) and contacts for personalized support.

To evaluate user satisfaction and to identify and prioritize improvements in relation with the U.PORTO card facilities, periodic questionnaires will be issued by the University, the first of them later this year. Apart from this type of monitoring, one of our medium-term objectives is to conduct a study of economic impact to appraise direct economic benefits of the card utilization.

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EdUnify[1]: Harmonizing and Harnessing Electronic Services

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Keywords

system integration, interface, XML, protocols, SOAP, REST, infrastructure, web services, registry, look-up, semantics, vocabulary, data standards, business methods, reuse, harmonizing data, information practices

Abstract

The PESC[2] (Postsecondary Electronic Standards Council) *EdUnify* is a set of core services enabling the universal registration, annotation and look-up of web services allowing users to search, access and secure data exchange through a federated platform supported by software implementers. This global initiative involves the participation of implementers worldwide working to integrate electronic services published by application providers to enable the reuse of shared data and information practices spanning electronic systems in support of research, teaching, learning and credentialing.

EdUnify will address deployed, implemented and abstract web services. Deployed services are operational and can be accessed using prescribed protocols enumerated by the publisher. Implemented services have been defined and actualized, but are not deployed and operational. Abstract services are typically either specifications or designs, and they may or may not be deployed or implemented at any time.

[1] EdUnify, website 2010, Retrieved April 27, 2010 from: https://demo.edunify.pesc.org.

[2] PESC (Postsecondary Electronic Standards Council), website 2010, Retrieved April 27, 2010 from: http://www.pesc.org.

The high-level goals of EdUnify are to:

- open and secure access of structured information managed across distributed stakeholder applications and databases;
- be compatible with existing technologies, tools and applications;
- enable development of new technologies, tools and applications;
- connect disparate systems, applications and technologies;
- leverage internet connectivity;
- provide abstract services to buffer physical properties underlying data sources;
- utilize a common framework, protocols and semantics accepted by industry stakeholders;
- communicate data and processes securely; and
- reinforce reuse of the investment in application integration and interfaces.

This session will provide the background, plan and progress to date of the EdUnify Task Force launched in December, 2009.

What is EdUnify?

*EdUnif*y is a specific web services registry and look-up service intended to augment data and process interchanges between education stakeholders respecting their application rules, security and design. A Task Force was formed by PESC (Postsecondary Electronic Standards Council), with cooperation from SIFA[3] (Student Interoperability Framework Association), to develop this registry and build it as a joint venture for the public and private sectors.

The long-term goal is for *EdUnify* to be part of the worldwide web infrastructure like the plumbing or electricity that we take for granted in our home, business or institution. It is intended to be a network of stakeholders committed to the sharing, reuse and augmentation of present and future information technologies. *EdUnify* will support data, information and process interchange while aligning with the mission of education spanning the education ecosystem. Now is the time to come together and work toward the foundation of new systems to support teaching, learning, credentialing and research across the 21st Century.

How is EdUnify different from other standards inititiatives?

One cannot have a conversation today about electronic data and information standards initiatives without revealing a significant amount of confusion because there is no universal resource one can view to describe all standards and how they intersect or apply. Unlike the building trades where engineering and architecture govern how materials are utilized to build, education does not have such prescribed disciplines available. This renders confusion when searching for what is relevant information. Subcontractors must reference

[3] SIFA is the Schools Interoperability Framework Association, website 2010, Retrieved April 27, 2010 from: http://www.sifinfo.org/us/index.asp.

their local building codes, request third party certifications and validate compliance to safeguard the consumer before occupancy. Imagine having a place that documents electronic services much the same way.

Why are there so many "standards initiatives" across the education landscape? Which ones matter and should be supported? Much of the confusion comes from the organizations stimulating the advancement of common practices and how they relate to the data and information that describe the inputs, outcomes and methods employed by developers of applications and systems. Part of the challenge is rooted in not having a registry or index to search. Developers don't know specifications or standards exist, so they are constantly "reinventing the wheel." That is why *EdUnify* is so different from other standards initiatives, because its focus is on how to reduce the variation in practices while offering the ability for all to publish data and information so it can be found and reused.

What are electronic data and information standards?

Let's define electronic data and information standards as specifications designed, developed, deployed and adopted by stakeholders either on a voluntary basis or by act of governance or law. The level of adoption and uniformity would reflect a significant impact on the education ecosystem. Standards apply to practices that are not just electronic, but that will impact automated systems and applications as well as the data gathered and reported by them. Practices evolve over time through innovation.

Standards are determined by level of conformity and adoption

Just as the means to measure a mile or kilometer requires definition to enable the practice of measuring distance, so do standards. One can derive common meaning and application from the use of standards.

Standards are achieved either through market forces or by law and regulation. There is agreement in definition and specification about how to apply a standard. Both attempt to alter and reduce the diversity of a practice by employing common, comparable methods. Conformance to a definition or specification can be measured. Often we refer to de facto standards, like the IBM-PC or the architecture of motherboards that utilized an 8bit or 16bit bus to connect adapters to the CPU and Memory. If you wanted to create an aftermarket video card for the IBM PC, you had to accept the de facto standard and build to the specification. If you did not follow the specification, the end product would not work and consumers would not use it since its operation would be impaired.

Standards by their nature have to be rated by how they evolve through innovation, experimentation, adjustment, compromise and acceptance across a community. Many standards initiatives currently underway across the education ecosystem are developed in groups and begin with requirement gathering. Specifications drawn are focused on gaining potential adoption around applications, tools, definition of uses and common practices that have been merged to conform to community agreement. The landscape covering the development of data and process specifications mirrors the complexity and breadth of the variations found in business and academic processes spanning institutions worldwide.

There is no easy way to fully characterize it (because there are so many moving parts), even though some have attempted to model the education ecosystem at both macro and micro levels by limiting the boundaries of what is involved or the details surrounding it.

Control and evolution of practices

There are many groups driving the development and adoption of common tools that span teaching, research and learning applications. Everyone from associations to informal communities are combining best practices with the evolution of data and process standards. These groups compete for resources and attention in the education ecosystem. All of this contributes to the lack of adoption, since the voluntary nature must align with the market forces attracting the stakeholders to adopt specifications that merit resources and following.

Organization and methodologies differ

Some standard groups are "open source" playing in a shared competitive sandbox and offering specifications that are licensed or sold as technology itself. These differ only in the economic business models that support sustainability and reuse across an install base. The concept of communities sharing a code base or specification is motivated by cost saving efforts and influence centers driven by collaboration and governance funding the joint development.

There are also communities developing full scale applications such as Moodle[4], uPortal[5], and Sakai[6] that call themselves standards based. These platforms enable clients to adopt a common architecture, following practices explored as a community and published to serve the market as an alternative to proprietarily, home grown or commercially developed applications. Many of these communities build an "open source" product that is then adopted across a range of implementers, some of which build sustaining support organizations around the product. There are other communities like OCW[7] (Open Courseware Consortium) or groups that have an affinity to define best practices through collaboration and sharing that converge on uses of technology such as OpenEAI[8].

Other groups focus on core application specifications, such as e-learning, Learning Management Systems (LMS) and Informational Management Systems (IMS). Still other groups focus on the exchange of learning components or objects such as SCORM[9] and ADL[10]. SIFA has developed an integration platform to augment a district or school's man-

[4] Moodle, website 2010, Retrieved April 27, 2010 from: www.moodle.org.

[5] uPortal, website 2010, Retrieved April 27, 2010 from: www.jasig.org/uportal.

[6] Sakai, website 2010, Retrieved April 27, 2010 from: http://sakaiproject.org.

[7] The Open Courseware Consortium (OCW) , website 2010, Retrieved April, 28, 2010 from: www.ocwconsortium.org.

[8] The OpenEAI Project, website 2010, Retrieved April 28, 2010 from: www.openeai.org.

[9] Sharable Content Object Reference Model (SCORM), website 2010, Retrieved April 28, 2010 from: www.adlnet.gov/Technologies/scorm.

[10] The Advanced Distributed Learning (ADL) Initiative, website 2010, Retrieved April 28, 2010 from: www.adlnet.gov.

agement and governance which enables data and process sharing across common interface points published with message specifications. PESC has developed transactional, data transport and public methodologies to govern how electronic documents and schemas are used across stakeholder applications and systems. Internet2's[11] Shibboleth is focused on how credentials and authentication work across systems supported by trust and assurance. Government formed groups are found everywhere. In the United States, the Department of Education is funding NEDM, the National Education Data Model[12]. Organizations like the Council of Chief State School Officers (CCSSO)[13] and the State Higher Education Executive Officers (SHEEO)[14] are working on policy data standards funded by private foundations trying to address the feedback loop issues facing education stakeholders. In Europe, the Committee for European Standardization (CEN)[15] and the movement fostered by the European Higher Education Area[16] foster initiatives to publish common specifications and funding of adoption across member countries and consortiums throughout the European Union. Metadata for Learning Opportunities (MLO) and PLOTEUS, a portal to promote learning opportunities reveal the grey line between creating specifications and how they are utilized in applications. Europass[17] is a good example of a specification that is governed by principals of collaboration and commitments made by political leaders to foster commerce and mobility based upon the roots of HR_XML. The RS3G (Rome Student Systems and Standards Group)[18] is developing a web service platform to support student mobility through state sponsored consortiums who are members addressing the ELM (European Learning Mobility) specifications.

The confusion across standard groups

The confusion between standard groups is due to the sheer number of groups and the fact that they are poorly defined because their focus has blurred as they compete for resources and adoption given the limited budgets allocated toward improving their IT infrastructure.

Depending upon the need for data standards to support policy or the need to drive improved practices, different groups work on developing specifications aligned with their objectives and mission. Applications under development are impacted, but legacy appli-

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11 Internet2, website 2010, Retrieved April 28, 2010 from: www.internet2.edu.

12 The National Education Data Model, website 2010, Retrieved April 28, 2010 from: http://nces.ed.gov/forum/datamodel/.

13 The Council of Chief State School Officers (CCSSO) , website 2010, Retrieved April 28, 2010 from: http://www.ccsso.org/.

14 The State Higher Education Executive Officers (SHEEO) , website 2010, Retrieved April 28, 2010 from: http://www.sheeo.org/default.htm.

15 The European Committee for Standardization (CEN) , website 2010, Retrieved April 28, 2010 from: http://www.cen.eu/cen/AboutUs/Pages/default.aspx.

16 The European Higher Education Area, website 2010, Retrieved April 28, 2010 from: http://www.ond.vlaanderen.be/hogeronderwijs/Bologna/.

17 Europass, website 2010, Retrieved April 28, 2010 from: http://europass.cedefop.europa.eu/europass/home.

18 RS3G (Rome Student Systems and Standards Group), website 2010, Retrieved April 28, 2010 from: http://www.rs3g.org/.

cations are often ignored due to the cost to retrofit. Given that most stakeholders have systems and hundreds of applications employed, very few retool their systems to support any of the major groups promoting specifications unless there is wholesale change across the enterprise. This is a rare occurrence, since such a high percentage of postsecondary institutions have significant investments in technology that can't be displaced or disrupted.

The standards driven initiatives across education are all faced with the same challenge. The education ecosystem has not evolved as other industries have because of the decentralized nature of governance and lack of oversight. Thus, the standard bodies or communities promoting standard practices are further adding confusion and questions about their viability and following.

The lack of infrastructure to support evolving standards

Our world's investment in knowledge creation, delivery and credentialing in the 21st century is increasing as countries recognize the importance of an educated workforce with the impact of globalization. Even as content expands and alternative methods of teaching leverage internet connectivity, education is impeded by the lack of shared infrastructure to accommodate the basic processes of assessment, validation and authentication of credentials.

People and businesses are mobile and global. We cannot efficiently or effectively address the worldwide need to expand education delivery, satisfy electronic forms of credentialing and foster knowledge creation by duplicating and polarizing our differences when our resources are so limited. For too long proprietary interests, fear of the unknown, the desire to control information because "we" are the custodians of it coupled with the lack of a common technology infrastructure has been at the root of underlying reasons why application integrations, interfaces and the exchange of data or information is so complex, expensive and only marginally effective.

Information management technologies have been haunted by the need to augment and control the technology investment, rendering disparate vocabularies and semantics across applications and systems of all following the path of innovation and improvement. Even in countries that have a common language, advancing the movement of data and information across or between applications and systems is very difficult and costly. We spend valuable resources attempting to artificially support the needs for data and information portability, but rarely accomplish or satisfy expectations.

It has been made ever more difficult, by the applications and systems we employ that cannot communicate outside of their design because external requirements were not considered. The business of education has more commonalities than differences, yet our IT system resources have such difficulty sharing data and information across components that they consume 50–70% of development budgets[19] just to remain operational. Applications that could address data portability reflecting people's mobility are hampered by disparity, frustration and resignation that our efforts will not impact the status quo.

[19] Gartner Group, as reported by P. Hallett, Schemalogic Corporation, at the 2003 Enterprise Data Forum, Philadelphia, PA, November 2003. See http://www.wilshireconferences.com/EDF2003/tripreport.htm.

In order to expand information access as well as social and economic development, we must have a more effective plan on leveraging information technology while working across autonomous organizations that create barriers to reuse, exchange and collaboration. At the core, issues of data security, privacy, identity management, credential claims and validation of those claims must bridge stakeholder systems and individual rights. Governance, whether mandated or voluntary, must respect the natural forces that drive systems and application isolation by locale. Compliance, whether dictated by government regulation or law has not achieved transparency or interoperability and offers further evidence that trying to accommodate differences of region, country, language and practices will be a daunting process no matter where one starts.

Whether we like it or not, market forces will drive us to recognize governance must employ incentives to work toward conformance and collaboration, rather than by force and law. Building the road enables commerce and exchange.

Why is PESC undertaking this initiaitve?

The Task Force was created to face one of the toughest challenges persisting in postsecondary education and all education efforts in general. The inhibitors to data access and movement, as well as the huge costs of the movement and the exchange of data across computer applications are obstacles that need to be overcome. How can we do this in order to foster new methods needed to address the challenges of research, teaching and learning in the 21st century without boundaries, physical or otherwise.

The Task Force of forty participants first convened in December 2009. The participants included people from higher education institutions, the private sector, the Federal government and non-profit organizations. Subsequently, the Task Force launched a Technical Workgroup to develop the Proof of Concept and a Business Workgroup to develop a Business Plan for sustainability.

It is both difficult and costly to access data and processes spanning education because the industry is a decentralized network of stakeholders with individual control over their data systems and applications. The impedance to progress is felt across policy, governance, management and operations. Student services, guidance, measures and progress are directly affected by the lack of a network and connectivity. Data and process interchange standards are not widely implemented by vendors, academic institutions or government agencies. Today, there is an ongoing call for better data management. We need to replace the "afterthought approach" with a proactive strategy. The *EdUnify* data management strategy would replace the current complexity, costs and burdens that impede improving the outcomes of our education investment as a society.

Where standards are implemented, they are not registered or documented in an infrastructure that allows them to be readily used by people building integrations and looking for data. *EdUnify's* infrastructure will allow all stakeholders to register their data interchange specifications and implementations and map them to standard terminology for interoperability. Users of *EdUnify* will be able to employ this registry to build integrations and inventory services, as well as access data available across postsecondary education. PESC, along with SIFA, is the right organization to undertake this effort as the organization is a neutral party with a track record of success in developing and implementing data exchange standards across education.

Today, we can track a package sent by UPS better than we can track a student's progress across educational institutions over their lifetime. It is understandable given the decentralized nature of our education ecosystem, but it is unfortunate we as a society cannot utilize existing technological resources to better serve the challenge of working together while respecting the autonomy of our institutions and privacy of our citizens. *EdUnify* is not about changing how data is used locally or what data is under management. It is about stimulating the development of infrastructure needed to build better systems and applications that will address the challenges of the 21st century learner and the institutions they attend.

The unintended consequence of decentralization

Across education, the utilization and effectiveness of data and information technologies is severely inhibited by access methods, differing protocols, nonstandard payloads, varying data definitions and the inability to trust disparate applications stove piped by proprietary design. Billions are spent annually trying to move data across components employed by stakeholder computer systems, usually with very ineffective and inaccurate outcomes. The current state of automation with all its redundancy, unnecessary aggregation and inaccuracy, render a tremendous burden on the educational investment society as a whole is making.

Policy, governance, research, teaching, administration, funding and learning are all impacted. The unintended consequence of metered design without considering the external interchanges that contribute to additional obstacles and costs is avoidable. The accurate, authoritative and secure transmission of data would respect and reinforce autonomy and roles by connection, rather than push the work around mentality that has been fostered by an industry fearful of data access, use and security.

The education industry spends approximately 4% of operating expenses on information technology, which is $50 billion annually in the United States. The money spent on IT is comparable in Europe, but varies significantly across countries. Of the funds spent, around 50% is used to support connections and movement of data across disparate applications inside and outside the institution[20].

Rationale for EdUnify

We often view external challenges which seem to be outside the boundaries of our organizations as out of reach and not something we can or should focus on. Assumptions are drawn and acceptance of the current state of affairs continues. Innovation and progress push to improve the status quo and this takes effort. We must explore how communities can work through differences, compromise and set the stage for progress. We need to real-

[20] Gartner, Inc. and/or its affiliates. See http://www.gartner.com/research/attributes/attr_47450_115.pdf.

ize progress is incremental and doesn't have to be addressed all at once. We need to apply our efforts to a shared vision that addresses our individual circumstances and know how the effort can help us achieve great things together.

Think about our use of email today and how easy it is to send and receive messages. It does not matter which program we use, the interchange works the same. Who, how and when did we establish the convention of dmoldoff@academyone.com? How does the program I use, reference and send my email and how does it get to its destination without someone lifting a hand? How did the @ sign become the separator? These standards reflect how solutions and decisions made just a few years ago have made email computing services simpler to use. Adoption and compromise were voluntary decisions that made this possible, not laws or governmental decree.

We can learn a great deal by understanding the evolutionary path of email. What came first, the demand or the innovation? How did a community come together to face the challenges of exchanging electronic messages? How can we learn from the path taken by early ventures to bridge email systems? What compromises were made? Moving or accessing data, whatever form it is in, from program to program across computers is complex. How did they reduce the complexity and overcome the legacy of doing it "my way?"

In our recent memory, significant events often fade and we forget about how difficult it was to gain access to knowledge or people prior to Google or the cell phone. How did we search for information in the past? What was life like before Amazon or Facebook? Do you recall Gopher, Compuserve or BackRub? These are three major technology innovations born by a few people who came together to change our world for the better. They decided to overcome the challenges and invest in developing ideas to bridge frontiers once thought of as overwhelming. Not only did they change our world, they improved how we live by reducing the distance and time we spend moving from place to place both physically and virtually. Collaborative efforts can realize great results.

What is the Task Force doing?

We are presently gathering requirements and considering candidate technical architectures and design. However, it is important to put some stakes in the ground and say what we know or what we think we know in order to have a productive discussion about what *EdUnify* will be and what applications we can build using *EdUnify* once it exists. Presently, we believe *EdUnify* will be a:

- **Web service registry or index** with a suite of applications built on top of it.
- **Web service search** implemented as a web application interface for human interaction with the registry or index and an interface for programmatic searches of the registry or index. The service may be free, a fee based service or some combination thereof based on the requirements of the business model (e.g., a simple search may be free, but semantic query tools and functionality might require a fee).
- **Web service search management and notification system** providing users with a means to specify and manage searches of the registry or index over time.
- **Interoperability services** to assist in annotating web services definitions with common concepts, so that *EdUnify* can apply reasoning to infer equivalencies between web services and perhaps mediate in federated queries of multiple web services.

– **Feedback and rating services** allowing users to provide evaluations on the quality of the design and performance of the web services. This provides valuable knowledge to developers and administrators and most importantly generates more metadata for the *EdUnify* web service registry or index. As services are rated, a user may search by quality of design and service level ratings in addition to searching by publisher and function.
– **Monitoring services** included in the registry or index which are designed to be monitored for availability by independent third parties. For example, the publisher of a service provides target service level information and details of how to monitor their service in their publication feed; *EdUnify* monitors that service for availability, presents that data to users and measures the availability of the service against the target service level. These operations provide a valuable service to the web service provider, and this process generates more metadata about the service for the registry or index. Users may search by service level and performance, as well as publisher, function, data, user feedback and ratings.

Functional Goals of EdUnify

The following are examples of potential high-level functional goals:
– Respect the federation and autonomy of information service providers with their own interests to design, develop, deploy and maintain data and analytic systems with different data stores across education enterprises.
– Provide fast, reliable and secure access to a federated Registry and Look-up Service to improve people's productivity through applications designed to channel request for services and response to service requests abstracting the differences in data and methods behind them.
– Enable the PESC and SIFA community to foster sharing of data and method reuse across stakeholder applications, utilizing direct and indirect automated bridges.
– Enable the development of alerts and feedback loops across the P-20 landscape without dictating how, by letting the open marketplace and motives drive improvement in services through collaborative technologies.
– Respect organizational controls, business policies and practices over their data and services.
– Enable people and organizations to align initiatives, improve outcomes and reduce duplication dispersed across information technology investments.

Allow everyone access to data definitions, semantics and enumeration improving how services are developed and delivered to people through online applications.

Create an expandable platform to explore and request advertised services by stakeholders honoring protocols, business rules and requirements managed by providers of the advertised data services.

Build, deploy and extend a commercially profitable online marketplace to foster competition, innovation and the abstraction of proprietary interests among stakeholders reducing risk, fear and anxiety which inhibit efforts to leverage common specifications for data and methods.

The following are examples of enumerated types of services *EdUnify* will register and publish so stakeholders throughout the industry can find, share and utilize them in their applications:

- Student and Faculty Data Services
- Institutional and Academic Data Services
- Course and Program Transferability Disclosure Services
- 21st Century Learners Spanning Multiple Institution Services
- Student Access to their Data through Electronic Services
- Enabling New and Innovative Technologies to Support Teaching and Learning Services.

The Task Force is preparing very specific, structured use cases that the *EdUnify* frameworks will support to help identify specifications and technology it will develop or apply. We are preparing a set of use cases in a common format to help determine the constituents served and processes addressed in each use case.

Who is Involved?

For a complete list of Task Force members and contact information, see the PESC EdUnify Task Force Participants page on the EdUnify WIKI hosted by Emory University. To enroll other participants contact Michael Sessa, PESC Executive Director, at michael.sessa@pesc.org.

Future Applications for EdUnify

This is a summary of some killer applications that anyone (application vendors, states, agencies, academic institutions, people in their garage, Facebook, Google, Microsoft) could develop when *EdUnify* is up and operable. *EdUnify* infrastructure will enable these composite applications. It is not the intention of *EdUnify* to build killer applications, but rather lay the groundwork to promote the development of new applications that reach across postsecondary education stakeholder systems. Building these killer applications without infrastructure like *EdUnify* is cost prohibitive and, in fact, many applications won't even be conceived until the landscape of web service across higher education and other sectors is imaginable.

Here are ten examples, but there are many more. The applications envisioned help provide motivation for building the *EdUnify* infrastructure. Like the Web itself, the real killer applications will likely follow the infrastructure.

- Faculty Search for Expertise, Schedule, etc.
- Student Search for Enrollment Status
- Student Progress Traceback Search
- Teacher Traceback Search
- Look-up Program and Course Learning Outcomes and Comparability
- Government Agency Data and Information Collection
- Student Guidance and Advising Services

– Applications to Accelerate Learning, Research and Knowledge Gathering
– Applications for Mobile, Portable or Wearable Computer Devices
– New Media Applications (gaming, simulations, testing, online labs, etc.).

What funding is needed?

Currently, the Task Force is developing a Business Plan that will determine a sustainable charter and business model we believe will not impede adoption. PESC is seeking seed funding to augment a startup and development phase that will include marketing and promoting *EdUnify* to the PESC and SIFA communities and expanding beyond their footprint.

PESC has gathered sponsorships and partial funding to bootstrap the initial Task Force meetings. New funds will be sought to support the development, beta and production environment of *EdUnify*. PESC anticipates there will be funding for implementation of *EdUnify* through private/public partnership efforts involving governments, private foundations and members.

The return on investment for funding the *EdUnify* project is enormous. Imagine saving just a portion of the money spent ineffectively on integration and information services today which span thousands of organizations, as well as approximately halving the cost of transfer or student exchange costs impacting students, institutions and the government everywhere as they assess methods of credentialing and comparability.

Exchange of Data on Mobility Between Higher Education Institutions and the National Agency for Coordination of EU Programmes in Poland

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Keywords

students and staff mobility, EU programmes, National Contact Points, electronic data exchange, identity management, CAS, on-line surveys, USOS

Introduction

Over the last couple of years many Polish higher education institutions (in short: HEIs) opened up to the international education market and intensified cooperation with other European institutions within the framework of programmes sponsored by the European Union. This trend could not be ignored by the suppliers of student management information systems. One of the leading systems for higher education institutions in Poland is USOS (home page of the University Study-Oriented System: http://usos.edu.pl). System managers started a couple of projects to support the new demands (Mincer-Daszkiewicz, 2008) International Relations Offices (in short: IROs) obtained software supporting their daily duties: cooperation and agreement management (keeping track of partner institutions and exchange programs), mobility management (taking care of outgoing and incoming students and staff, recruitment, registration for courses, transcripts of records, funding, etc.). Departmental Erasmus coordinators got equipped with electronic tools for recruiting outgoing students and supervising the qualification process. A new admission software for handling incoming students has been built as part of the general admission system used for recruitment of candidates for diploma programmes.

There is still a lot to be done to support processes at the local level, however it also becomes clear that the most cumbersome part of these processes is now the exchange of data between local systems and the outside world. For example universities have to exchange with their partners data on international cooperation, student nominations, courses taken and grades obtained by outgoing students at partner institutions. The *Mobility Project* undertaken by the *Rome Student Systems and Standards Group* aims at standardizing a format for the exchanged data and building a prototype network of web servers which would carry out electronic data transfer ((Arcella et al., 2009), (Mincer-Daszkiewicz, 2010)).

In Poland universities have to exchange data with the national agency responsible for coordination of EU programmes. This agency is run by the *Foundation for the Development of the Education System* (in short: FiDES, see home page of FiDES: http://www.frse.org.pl/) which implements a range of initiatives to support educational reform and development of the education system in Poland. In particular the Foundation supervises *National Contact Points* for EU Programmes like ERASMUS MUNDUS or TEMPUS IV.

Managers of USOS got in touch with FiDES and offered their help in building a system supporting some activities of FiDES resulting from the mutual cooperation. The idea was that such initiative would give them an opportunity to influence the system's design and in particular the formats and tools for the exchange of data. The designed system is the subject of this paper. It is called GISE-2, from the Polish name *Giełda Informacji Studentów Erasmusa*, what means *Information Auction for Erasmus Students*; number 2 distinguishes the newly developed system from the previous version. Business processes are shortly outlined in section 2, design goals and system requirements are listed in section 3. In section 4 main implementation aspects of the new application are discussed and some screen shots are shown. Conclusions are gathered in the last section.

Business processes

FiDES supervises EU programmes in Poland, in particular distributes funds and gathers annual reports from HEIs to combine the results of the programmes and finally report them to Brussels. The important part of this activity is the survey carried out among the outgoing students and researchers which gives valuable feedback to all involved parties (in particular funders of the programmes and their contractors in Poland). The following main business processes should be supported by the designed software:

Handling annual reports

Each university should deliver an annual report on the activities involved in student and staff mobility. Such reports are presumably obtained from the information system of HEI (like USOS). Format of the report is announced in advance. Up to now it was defined as a enumerated list of fields. More formal definition would allow to carry out automatic data validation. Correct data would be a basis for valuable statistics which might be displayed in the system on demand.

Managing surveys and statistics

Each year a new survey is designed (although FiDES is willing to change this practice and design a survey which would stay unchanged for a longer period). Outgoing programme participants after return are obliged to fill the survey. Results of the surveys are of interest for the Agency (which wants to improve the involved procedures) and for students and staff – prospective participants of the exchange programmes. Employees of IROs from HEIs might want to extend the questionnaire with own questions (to improve procedures carried out at the university level). Results of surveys should be available in a readable form for various groups of users.

Supporting electronic data exchange

Annual report is not the only data exchanged between FiDES and HEI. HEI should deliver a list of outgoing programme participants, who have to fill the survey after return. HEI may also be interested in getting results of surveys in an electronic form for further processing.

Design goals and requirements

Requirement analysis was conducted by the team consisting of USOS developers, stakeholders from FiDES (programmes' coordinators, system administrator, programmers), stakeholders from the IRO of the University of Warsaw, which plays a leading role in designing software for other HEIs in Poland. The following design goals were stated and requirements recognized (only the most important are listed):

- GISE-2 should be implemented as a module of CMS used in FiDES (open-source Drupal).
- The users of GISE-2 are: superuser, employees of FiDES, employees of IROs from all HEIs, students and staff – participants of the programmes, the general public.
- Participants of the programmes are authorized in the system in one of the following ways: by identity management system of HEI or on the basis of accounts (logins, passwords) created in GISE-2 automatically or manually.
- Supersuser can upload an XML file with the definition of the format of the annual report.
- HEI can upload a final report, its validity is checked against the format defined in the XML file.
- HEI can upload a list of outgoing programme participants for the given academic year/semester with the relevant details of their stay (e.g. host institution, discipline of study, period of stay, exact departure/arrival dates). This is the target group for the survey.
- FiDES can define a survey for the given year. The survey can by extended by each HEI with questions for local participants.
- A participant can fill in the survey within a stated time frame (in one or many steps).
- A list of participants who filled the survey can be exported by HEI (to be imported to a local student management information system).
- Each HEI can export survey results of its students and staff.
- Answers to the survey's open questions can be moderated by FiDES.

– Survey results are made available to the general public (in particular prospective outgoing students), displayed in a readable form (closed numerical questions in easy to follow diagrams and figures).
– All files are imported/exported in either XML or CSV open formats, so that software suppliers can integrate file handling into the developed student management information systems (like USOS).

Implementation

Some aspects of the design and implementation of GISE-2 are discussed in this section.

Identity management

Identity management is an important aspect of the system. GISE-2 is available for large groups of users from various higher education institutions in Poland. In the academic year 2008–2009, 253 universities took part in the Erasmus programme (out of approximately 400). There were 11 784 students going out for part time studies and 1 618 for internships. Out of these numbers there were 1 097 (studies) and 74 (internships) students from the University of Warsaw (the biggest Polish higher education institution). The number of filled surveys was 10 920 (studies) and 1 457 (internships). Numbers of outgoing academic teachers and researchers are smaller but should not be neglected. Groups of programme participants change each year. Only eligible users are allowed to fill surveys. They have to be authorized. They need accounts, which should be made available promptly (students and researchers coming back home have to fill the surveys before finalizing all formal procedures in the home IRO, deadline is usually app. two weeks after return). It is obvious that creating these accounts manually would be very tedious and error-prone. There is also a problem of distributing details of the new accounts. We decided to support the following scenarios:
– If HEI hosts local installation of a central identity management system (like CAS), it needs only to define in GISE-2 the address of the CAS server (see Figure 1).
– IRO prepares the list of outgoing participants. This list is probably available anyway, student management information system like USOS should deliver it with one click.
– The list is uploaded to GISE-2.

Two scenarios are now possible:
– For CAS users: GISE-2 automatically creates internal accounts with logins equal to CAS logins of the participants and sends them email with the information about the new account.
– For non-CAS users: GISE-2 automatically creates internal accounts with logins equal to emails of the participants, generates passwords and sends them to the participants by email. Passwords are valid for one log-in only after which have to be changed.

In both scenarios the IRO staff needs only to upload the list of participants to the system. The CAS option is more user friendly and easier to manage, no extra password handling is necessary. Additional bonus is single sign-on into GISE-2 and university web applications, registered in the CAS server.

Central identity management is not yet widely implemented in Polish universities. To change this unfavourable statistics, USOS developers will soon start distributing an easy-to-use package containing a virtual platform with preinstalled CAS server, LDAP repository, and a synchronization tool automatically synchronizing account data from USOS Oracle database with LDAP repository. Student and staff accounts available in USOS and used for authorization in USOS web applications will by side effect become available for authorization in other systems, like GISE-2.

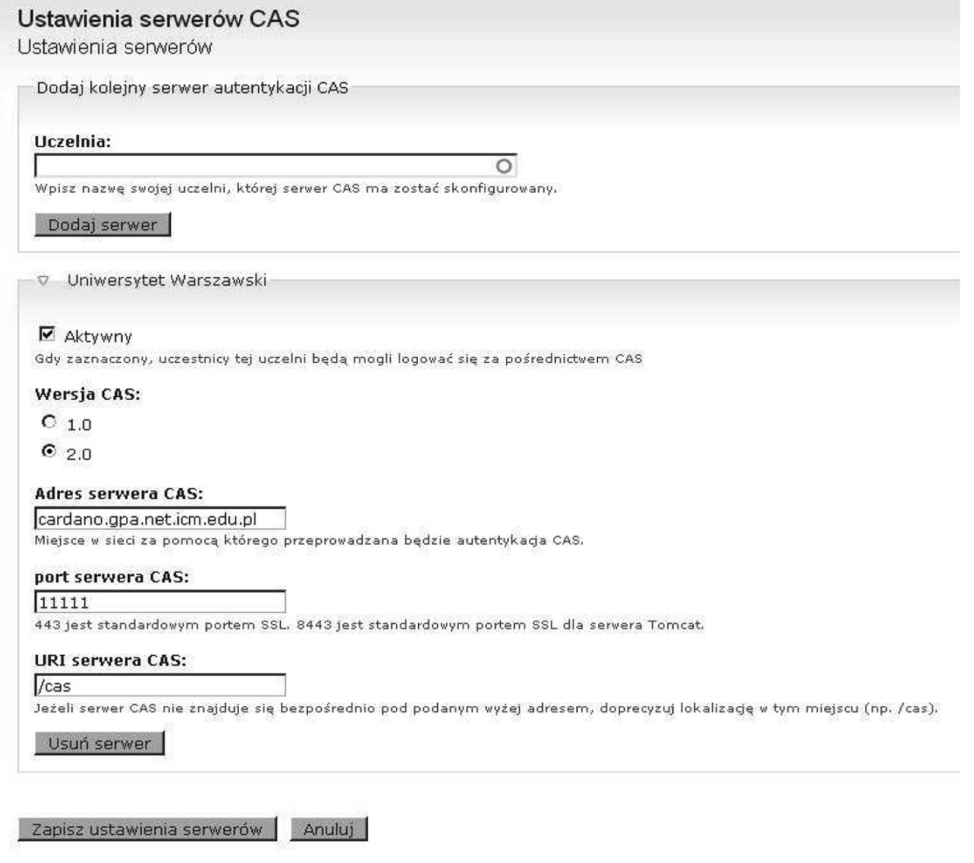


Figure 1. GISE-2 — configuring CAS server for HEI

It is also possible to use Federated Identity Management. There is a test FedIdM server for Polish universities, available at https://aai.pionier.net.pl/DS/. It will make sense to use FedIdM when the number of HEIs using central identity management systems increases. When this happens step 1 in the scenarios described above will not be needed.

Last but not least if some HEI sends abroad a small amount of participants (let say up to ten) and/or does not have an electronic list of nominations, there still is a possibility of manually creating accounts for students and researchers by entering the data straight to web forms of GISE-2.

There is also a question when exactly the list should be uploaded and accounts created. Participants go and return all year round, for time periods of very different length, some of them more than once (e.g. for studies in winter semester and for internship in summer semester). Accounts in GISE-2 should not be activated too early. It was decided that the responsibility of preparing the relevant (for the given moment) list of participants lays on the side of the university system. In USOS the list contains the mobilities which have already started. GISE-2 have to check against data duplications when the list is uploaded, each participant should have only one account, possibly with more than one outgoing mobility attached, but each individual mobility has to be represented only once.

Surveys

Handling surveys is the key functionality of the system. The following aspects should be taken into account:

- Questions are defined in the system using a set of predefined templates. Various types of questions are possible (e.g. open, close, header, text) and various types of answers (e.g. text, numerical, multiple-choice list, radio-button); questions may also be defined as optional or obligatory.
- Surveys consist of questions. Questions may change every year but most of them remain the same. It should be possible to build a new survey staring with the old one.
- Many surveys may be available in the system at the same time.
- Surveys are defined by FiDES employees.
- IRO employees may extend the set of questions. They are only visible to the students of the HEI represented by this IRO.

Handling of surveys is a functionality available for FiDES and IRO employees. First idea was to support surveys delivered in XML files, but after some discussions with users we have chosen a solution which allows users who are not computer science professionals to handle questions and surveys by themselves. Questions and surveys are now defined using easy to use web-forms, question templates are chosen from the list, questions inside a survey may be sorted by drag & drop (see Figure 2), whole surveys can be copied and then individually edited.

Building the interface for survey editing we had to take into account two conflicting requirements. On the one hand creation of the new survey should be as simple as possible. In fact the simplest way would be to enter each question from scratch or copy-paste from the dictionary and then update it freely. However if we want to trace answers to particular questions across academic years to look for trends we have to retain links between the same questions from subsequent surveys. This complicates an interface since we have to keep a list of questions, handle the list separately, construct a survey by choosing questions from the list. Users can not freely delete or change questions from the list since they might have been used in previous surveys. The survey is more difficult to handle but in that case we could not compromise one of the key functional requirements. In fact the task of preparing a survey for a new academic year is trivial if only the survey questions don’t change, what is reasonable anyway from the point of view of the quality and usefulness of statistics in a broader time range.

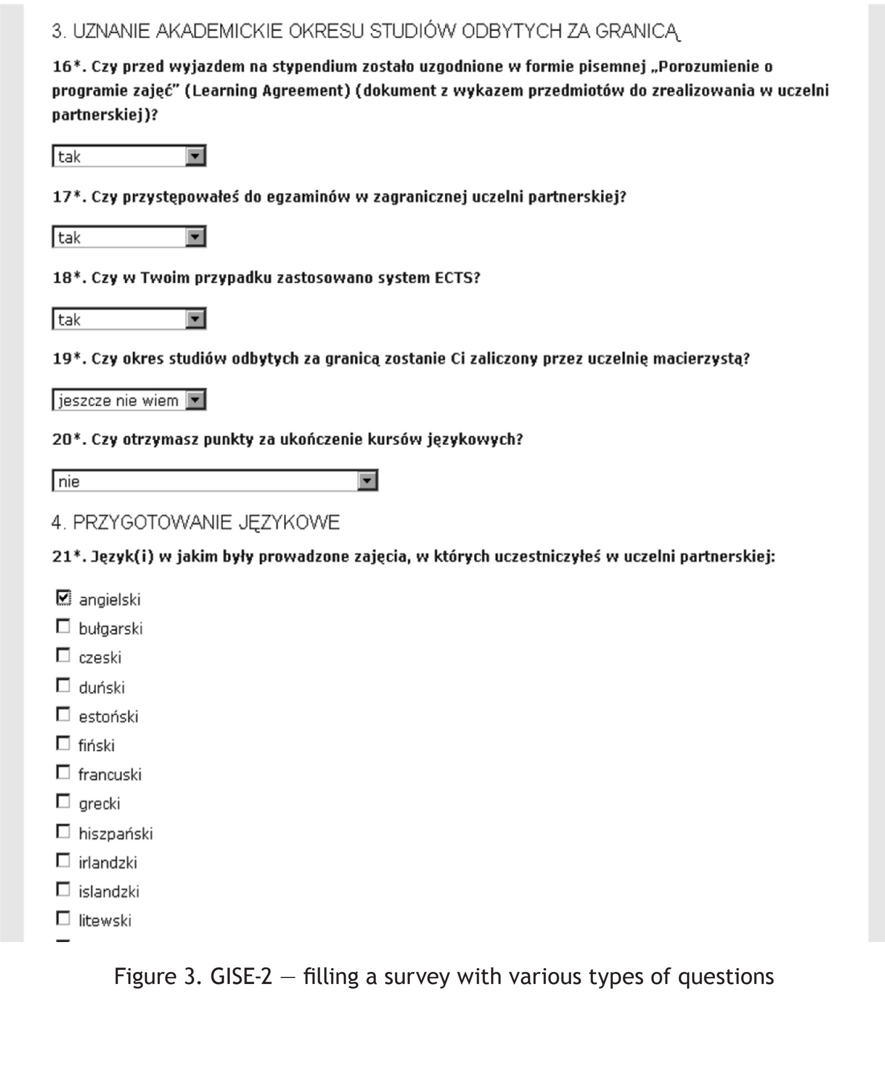
Figure 2. GISE-2 — defining surveys, an order of questions may be change by drag & drop

Employees of IROs are also interested in the surveys, in particular might want to extend the questionnaire with own questions (to get some feedback on the procedures carried out at the university level). Questions added by the university are available only to participants from this university. The answers to these questions can be downloaded by this university together with the other survey data.

Surveys are generally active within a time period defined by FiDES. The IRO staff may manipulate the start and end dates individually for each participant, but within the defined time limits.

Filling the surveys changed substantially in the new system as compared to the old one. Previously participants logged in using one account common for all (the password was passed from FiDES to IROs and from IRO employees to participants – confidentiality of such information was illusory). First part of the survey consisted of questions about participant's personal data, home university and programme of study, details of the outgoing mobility. A participant had to spend extra time entering information which in fact was sooner or later delivered to FiDES by universities in a form of annual reports and stored in its repositories. However this data was not linked to the survey data. This was a source of extra mistakes and extra effort of all involved parties. IRO employees had to browse a system for the list of participants who already submitted surveys to formally finalize the handling of the outgoing mobility. Now totally automatic and asynchronous (from the university side) system of notifications is possible – e.g. GISE-2 might call web-service posted by the university system and send information about the submitted survey.

GISE-2 chooses a survey for a participant on the basis of the academic year in which the mobility took place and type of the mobility (studies/research or internships, students or academic teachers). There can be only one such survey with unique values of these attributes. A participant may fill the survey partially, save it, come back to it after some time, complete, and finally submit. After submission, the survey is available in read-only mode. Figure 3 shows a survey being filled in by a participant.


3. UZNANIE AKADEMICKIE OKRESU STUDIÓW ODBYTYCH ZA GRANICĄ

16*. Czy przed wyjazdem na stypendium zostało uzgodnione w formie pisemnej „Porozumienie o programie zajęć" (Learning Agreement) (dokument z wykazem przedmiotów do zrealizowania w uczelni partnerskiej)?

tak

17*. Czy przystępowałeś do egzaminów w zagranicznej uczelni partnerskiej?

tak

18*. Czy w Twoim przypadku zastosowano system ECTS?

tak

19*. Czy okres studiów odbytych za granicą zostanie Ci zaliczony przez uczelnię macierzystą?

jeszcze nie wiem

20*. Czy otrzymasz punkty za ukończenie kursów językowych?

nie

4. PRZYGOTOWANIE JĘZYKOWE

21*. Język(i) w jakim były prowadzone zajęcia, w których uczestniczyłeś w uczelni partnerskiej:

- [x] angielski
- [ ] bułgarski
- [ ] czeski
- [ ] duński
- [ ] estoński
- [ ] fiński
- [ ] francuski
- [ ] grecki
- [ ] hiszpański
- [ ] irlandzki
- [ ] islandzki
- [ ] litewski

Figure 3. GISE-2 — filling a survey with various types of questions

Survey results should be available on-line for browsing. Internauts looking for information often want to get in touch with the authors of displayed opinions however privacy of students filling the surveys has to be ensured. Email of such person is displayed to the public only under her permission. Statistics are built on the basis of numerical questions and are freely available since they present accumulated (anonymous) data. Survey results are also available for download – they may be imported to professional statistical tools for more sophisticated analysis.

Annual reports

Up to now, in GISE-1, annual reports were delivered by email or uploaded as uninterpreted flat files. The format of the report was defined by enumerating the list of columns (Figure 4 shows fields of the annual Erasmus report for the academic year 2008/09). In GISE-2 the report is defined formally by XML schema and uploaded to the system as CSV file. The data is validated on the fly, only the correct records are accepted. The whole procedure of gathering data may be carried out more smoothly. Data from all reports are used for calculating statistics which may be shown in the system.

S1: ID Mobility;S2 : Home Institution;S3: Country Code of home institution;S4: EUC;S5: ID Student;S6: Family name;S7: First name(s);S8: Date of Birth;S9: Age;S10: Gender;S11: Nationality;S12: Subject Area;S13: Level of Study;S14: Years of Study prior to Erasmus study period;S15: Type of mobility;S16: Host Institution;S17: Country of host institution;S18: Country of Placement;S19: Work Placement Enterprise;S20: Size of the Enterprise;S21: Type of Placement Sector;S22: Actual Length of Study Period abroad in months;S22a: Length of Study Period abroad (in months) initially agreed;S23: Actual Length of Work Placement in months;S23a: Length of Work Placement (in months) initially agreed;S24: Early return;S25: Date Study Commenced;S26: Date Work Placement Commenced;S27: Number of ECTS credits study;S28: Number of ECTS Credits Work Placement;S29: Total number of ECTS credits;S30: Supplement for severe disability – SEV;S31: Taught in Host Lang;S32: Language Taught;S33: Linguistic Preparation;S34: Study grant

Figure 4. GISE-2 — Fields of the annual Erasmus report for 2008/2009

For the users from IROs who use USOS, the procedure is very easy to handle: the report is generated automatically from USOS and can be uploaded to GISE-2. Other vendors of student management systems may deliver the same functionality, since the format of the data is delivered by FiDES in GISE-2 and can be downloaded from the interface of HEI.

Acknowledgements

Many thanks to Sara Wilczyńska, Grzegorz Białek i Adam Ruka – implementors of GISE-2, to employees of FiDES who took a risk of hosting the project, and to employees of IRO from the University of Warsaw for many valuable ideas.

Summary

The project is in an early stage of conduct. At the end of December 2009 the requirements analysis was finished and the requirements specification delivered to the stakeholders. Some prototype screen-shots have also been designed at this stage to better recognize expectations and state priorities of the stakeholders.

At the end of February 2010 the *Identity Management* module and *Survey* module have almost full functionality and were delivered to FiDES for integration with their CMS and for user tests. Other modules are under development.

The full preliminary version is expected to be available at the end of June 2010. The system will go into production the next academic year.

The scale of the project is quite large due to the large (and growing) numbers of mobility programmes. As it was said, in the academic year 2008–2009 the numbers of users to handle were: 253 accounts for IRO's, 11 784 plus 1 618 new student accounts, a couple of hundred new teacher accounts. It would be interesting to know how many prospective candidates have visited the previous portal of FiDES browsing the filled surveys, but such numbers are not available. As can be seen the target audience is quite large and will become even larger if a more friendly interface enriched with statistics and results of analysis is delivered.

This – in some respect – pioneer project in Polish higher education started not as the result of the decisions taken by some high level authorities but was driven by needs of the end users, and made possible due to close contacts, cooperation and trust between stakeholders. It is the first step towards some form of integration of computer systems running at HEIs and various national educational agencies in Poland. Many other possibilities of interfacing academic systems exist, various well known and widely used technologies (like web-services) and/or newer emerging integration tools (like service busses) might be used. Some attempts of such integration in the education field have been undertaken on the global scale by various European and American institutions (see e.g. recent initiatives of EdUnify and Terena Geant projects).

To move these solutions from research to practice first the way of thinking about academic systems has to change among authorities and users. Systems can talk to each other but first people have to start seeing the common goal and begin to talk.

The final outcome will be the more smooth and less administratively tedious handling of study and research mobility and more united Higher Education Area in Europe.

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The Mobility Project — Building Network of Web-servers for Exchange of Data on Student Mobility

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Keywords

student and staff mobility, data exchange, web-services, student management information systems

Abstract

The Mobility Project started in 2008 as a joint initiative of two national consortia, developers and suppliers of student management systems for their home countries, MUCI from Poland and Cineca from Italy. The initial goals of the project were as follows:

- Recognizing requirements concerning exchange of data on international cooperation between higher education institutions and in particular on student and staff mobility, describing business processes of such data exchange, consulting them with employees of university International Relations Offices;
- Defining format of the data to be exchanged in some formal language, like WSDL, and preparing sample data for universities from two involved countries;
- Building a prototype network of web-servers and testing data exchange.

The results of this preliminary phase were presented at (Arcella et al., 2009). The parties involved decided to broaden the scope of the project and organized the workshop (Arcella et al., 2009b). The leading force was RS3G (Rome Student Systems and Standard Group) and among participants were national consortia and suppliers of student management systems in Europe. The participants acknowledged the importance of the project goals and suggested that RS3G should take a lead of the project.

After EUNIS 2009 the development team from the University of Warsaw started working on a new version of WSDL for web-services and software for web-servers, taking

into account the experience gained during the preliminary phase and also comments and suggestions gathered during the EUNIS presentations and discussions. This new version was ready in November 2009 and is fully documented at http://usos.edu.pl/Mobility.

The next step was the workshop in Uppsala in November 2009 and another one in Bologna in March 2010. They brought together consortia and companies willing to take an active part in the project. Among these were some national consortia (OODI – Finland, SIGMA – Spain, CINECA – Italy, Ladok – Sweden, FS – Norway, MUCI – Poland, HIS – Germany, SURF – Netherlands, VHS – Sweden), companies (Digitary – Ireland, AcademyOne – USA, KION – Italy, QS unisolution – Germany) and individual universities. The most important outcome of the Uppsala workshop was the creation of Work Teams responsible for further investigation of various aspects of the Mobility Project. In Bologna the Mobility Group met with TF-EMC2 (*TERENA Task Force on European Middleware Coordination and Collaboration*) to discuss the aspects of security and identity management for the Mobility Project. Possible solutions were recognized and further actions planned. It was also decided that the new version of the software would be deployed in a couple of nodes to make more tests with sending the sample data between countries.

The initiative of the Mobility Group seems to us an important and practical step towards the creation of the European Higher Education Area. We would like to present the project to the wider audience gathered at EUNIS, to report on the undertaken activities, to describe the ideas behind the new WSDL and software, and to invite cooperation of other system vendors. The final success of the project depends on its scope which is proportional to the number of student management systems able to exchange mobility data by web-services.

Introduction

Student and staff mobility is one of the most important priorities of the **European Higher Education Area** promoted by the Bologna process. Long-term trend for Erasmus programme (which is the most important European project promoting mobility) shows almost linear growth of the number of students travelling to other universities for short-term studies. In Europe as a whole, this programme involves over 4000 higher education institutions (HEI) while the number of participating students approaches two million. The European Commission introduced the new Lifelong Learning Programme which is aimed to further stimulate mobility and achieve a number of 3 million Erasmus students by 2012. Therefore it becomes an important part of HEIs' activity. Important also in a sense of the amount of administration work needed.

Management of mobility consumes a lot of effort, time and cost. Unfortunately this effort is perceived by traveling students and academic teachers as bureaucratic, and the huge amount of letters, emails, faxes to be delivered and sent between involved parties is regarded as an obstacle which makes good ideas cumbersome and tedious in implementation. No wonder that recommendations for national and academic-level agencies stress importance of reducing administrative requirements and bureaucracy associated with the participation in international programmes and in particular around mobility, supporting simpler, more efficient and uniform procedures.

Currently, the vast majority of higher educational institutions are equipped with IT infrastructure which enables them to keep all the necessary data needed to run the studies, i.e. personal data, learning achievements data, accounting, etc. However, the process of exchanging the necessary data in order to actually perform the student mobility is still carried out in a manual way.

In (Arcella et al., 2009) we suggested how to change the way in which information is handled. We designed a common format for the mobility data and implemented the software for sending it by web-services delivered by web-servers installed at universities engaged in international cooperation. We deployed a prototype systems in Warsaw and Bologna to make some test data transfers.

The ideas presented at EUNIS 2009 were positively accepted by many national consortia, companies and individual universities, developers and suppliers of student management systems. Some of them decided to join the project. The workshop for the prospective partners was scheduled for November. In the meantime the Warsaw development team started working on a new version of WSDL for web-services and software for web-servers, taking into account the experience gained during the preliminary phase and also comments and suggestions gathered during EUNIS presentations and discussions. The new version is described in section 0.

The workshop for consortia and companies willing to take active part in the Mobility Project took place in Uppsala in the middle of November. Another workshop followed, in Bologna in March 2010, bringing together the Mobility Group and TF-EMC2. Results of both meetings are described in section 0. Final section contains conclusions.

Real life scenarios

Before we describe the second version of the data format and software, let's recall the goal we want to achieve. Let us follow the real-life scenario. In Warsaw (and in 30 other higher education institutions in Poland) we use student management information system USOS (home page of the University Study-Oriented System: http://usos.edu.pl) which – in particular – contains a module for handling international cooperation and mobility. Recruitment for outgoing mobility is done at faculties through USOSweb, the web part of USOS, and at the end the system contains the list of nominated students with all details, like personal data, program of study, destination, period of stay (eventually also Learning Agreements and stipends), all available in the electronic form ready for being send to the partner universities – see Figure 1.

What happens next? Nominations are either typed manually into a partner's system (in practice many different systems), or scanned, faxed, delivered by phone calls – usually many times since updates are common. What might happen instead? We proposed in (Arcella et al., 2009): the operator might click the button (like the one inside the rectangle on the right in Figure 2) and send the list to the partner – the figure shows the result of the remote invocation of the web-service sendNominated-Students). Data obtained from the home institution would be delivered straight to the database of the partner institution and be immediately ready for further processing.

Other possible scenarios are: signing bilateral agreement (sending organization's information record and cooperation conditions of the agreement); sending Learning

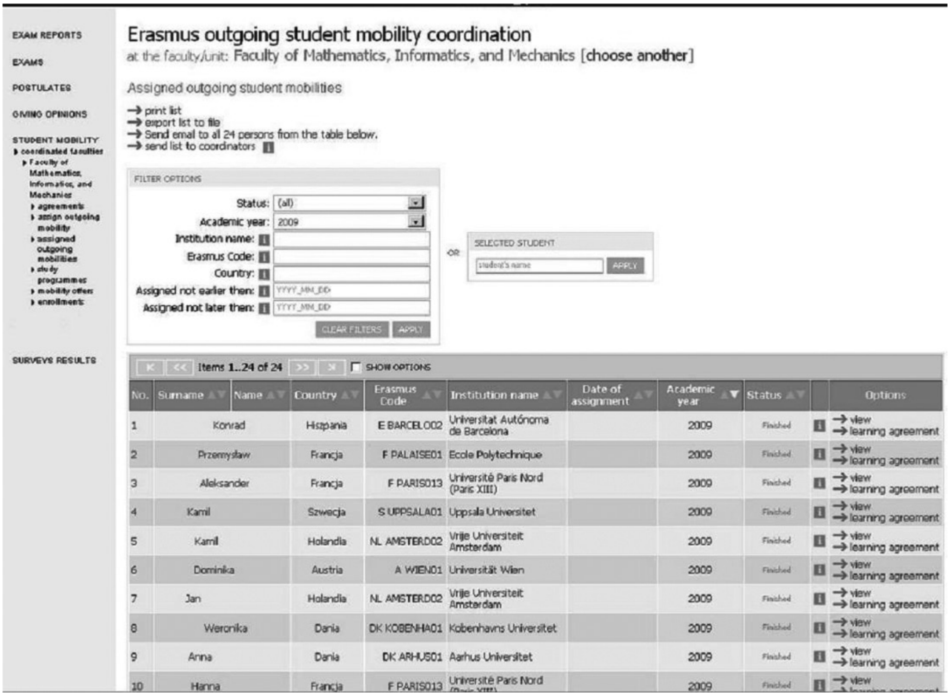

Figure 1. USOSweb — A list of students nominated for outgoing mobility

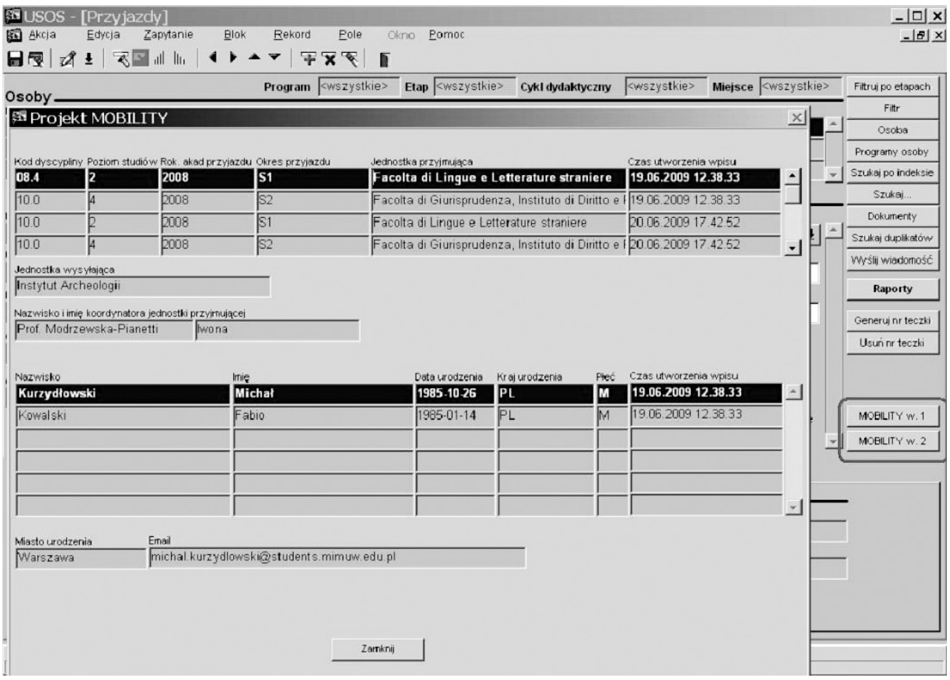

Figure 2. USOS — A list of incoming students obtained from the partner university

Agreements, getting Transcripts of Records (grades), sending departure/arrival dates of mobile students (which are the basis for calculation of scholarships), sending course catalog.

During the first phase of the project we identified business processes and recognized sets of data being exchanged between cooperating partner institutions. We defined WSDL for data like ***HEI information record***, ***Bilateral agreement between two HEI**s*, ***Students nominated for mobility***, ***Learning agreement and Transcript of records of a student***. The proposed set of web-services for the project comprised the methods like sendOrganizationData(), sendAgreementData(), send-NominatedStudents(), send-ArrivalDate(), sendDepartureDate(), sendLearningAgree-ment(), sendTranscriptO-fRecords(), validateNationalPersonalId(). In most cases two symmetric functions were delivered: send() for sending data to the partner and get() for getting data from the partner. Depending on scenarios of cooperation either one or the other may be more suitable in particular cases.

Second phase of the project (June 2009 — April 2010)

During the first phase of the project we gathered experience concerning structure and scope of data, software design, technology used, system architecture. During the presentation at EUNIS'2009 and the workshop of RS3G we got valuable feedback from the audience. As concerning the data format we realized that there are much more various types of "standards" being used by countries (Finland, Norway, Germany), companies (QS unisolution) or associations (TERENA). We decided to have a closer look at these standards and incorporate them into the Mobility Project. We also recognized some specific requirements of the project: since we are going to send data from one database to another, all exchanged objects should be uniquely identified in both systems. There is also an important issue of internationalization – many languages should be handled simultaneously. Some aspects of the new WSDL are described in section 0.

As concerning software we realized that – due to the foreseen changes in the format of the mobility data – we should design it, in particular transport middleware, to be highly vulnerable to such changes, i.e. modification of the data format should have possibly minimal impact on the source code. Software should also be relatively easy to install, especially in diverse environments of higher education institutions, and to maintain. The solution should be scalable. Tools and technologies used to implement the software should be:

- freely available; preferably licensed in a way which allows redistribution – ideally the licenses should be open source compatible,
- maintained and widely used, with strong, active community,
- independent of any specific operating system or hardware architecture.
- There was also an important non-functional requirement specific to the University of Warsaw concerning interoperability with Oracle Database (PL/SQL and Oracle AQ).
- The new software is described in section 0. This section is based on (Nagrodzki, 2009). Details, in particular current version of WSDL, can be found at the home page of the Mobility Project, http://usos.edu.pl/Mobility.

WSDL version 2.0

There are some key aspects to consider when proposing a new standard. First, there is a need to provide a vocabulary of well-defined terms which model the problem domain well. Second, there is a need to avoid unnecessary complexity and keep things possibly simple. Third, a good standard leaves a way to extend it easily. And the last but not least, employment of existing standards and practices to the maximum extent would be highly desired, so the effort of converting the data already formatted in compliance to these standards is minimized.

There are on-going initiatives aiming to develop standards covering various aspects of student mobility. There are some projects having a European scope, like *Metadata for Learning Opportunities* (MLO) which aims to describe programmes of study and course catalogs, or *European Learner Mobility* (ELM) for processing Europass portfolio (Diploma Supplement, Certificate Supplement, Curriculum Vitae, Mobility, Language Passport). Both projects are run by CEN (*European Commission for Standardization*). At EUNIS'2009 we also learned about numerous national initiatives like that of OODI Finland, FS Norway, or German universities. Last but not least there are vendor "standards", for example the one used by QS unisolution to implement web services for users of the moveonnet. There is also a standard called SCHAC (*SCHema for ACademia*), developed by TERENA, which defines a set of attributes to describe individuals in the academic and research institutions and contains an appropriate LDAP profile. Yet there is no official or unofficial standard regarding electronic data in the context of mobility scenarios.

The Mobility Project has its specific objectives and needs:

- data should be well structured;
- pieces of data should be uniquely identifiable (on a database level);
- each party may want to use own identifiers and own language;
- data format should be generic, i.e. facilitate the data exchange not only in terms of Erasmus programme but mobility programmes in general.

We decided to reuse some ideas of SCHAC because its purpose is the closest to the problem to be solved. Besides, SCHAC leverages ISO and RFC norms and provides precise definitions. We have also made a few definitions connected with domain classification, grade, ECTS credits to some extent similar to those found in Europass.

For types of information which already have an ISO standard (like country code, language code, gender) we use ISO. We introduced a helper type **internationalizedStringT** to handle a list of strings in different languages.

To uniquely identify HEI we follow SCHAC ideas and adopt *domain names* (for example for the University of Warsaw that is **uw.edu.p**l, for the University of Parma – **unipr.it,** for the Autonomous University of Barcelona – **uab.cat**, for the University of Oslo – **uio.no**). This identifier is more generic than for example Erasmus code (like PL WARSAW01) since it is available for all HEI's, not only participants of the Erasmus Programme, and also for non-educational institutions, like the ones offering internships to students. We also reuse SCHAC's **schacHomeOrganization** type.

Identifiers of students and employees are coded as **organizationalPersonalIdT** type which consists of an **organizationIdT**-like prefix, a colon and an id given by the organization, e.g. **uw.edu.pl:60225**. Type **organizationalPersonalIdT** would have a more elegant definition, if XML Schema was able to use values of complex types with key definitions (**xsd:key**).

In case a national id of a person is needed, there is the type **nationalPersonalIdT** which is a string based on SCHAC's attribute **schacPersonalUniqueID** but does not use a prefix **urn:mace:terena.org: schac:personalUniqueID** and id type information. Value consists of a country prefix (exactly as in **countryCodeT**), a colon and an identification number, e.g. for Polish citizen that might be **PL:85102702439**. The national identifier is the most convenient kind of personal identifier possible but due to the legal issues connected with personal data protection regulations in some countries it may not be possible to share such data. Therefore its use is optional.

Courses are identified by codes unique within an organization but use of pairs [**organizationId**, **courseCode**] is not a necessity due to the fact that course codes are always placed within a context of an organization.

In order to identify a bilateral agreement between organizations, type **agreementIdT** is provided. It consists of two sub-ids for both organizations. These sub-ids comprise of an **organizationIdT** value like **uw.edu.pl** along with an internal agreement identifier – **localAgreementIdT,** like **1207/E/2009**.

For describing a person there is a type **personalCharacteristicsT** which contains a sequence of personal data. A type **employeePersonalCharacteristicsT** extends it with data specific for an employee, and **studentPersonalCharacteristicsT** with data specific for a student (see Figure 3).

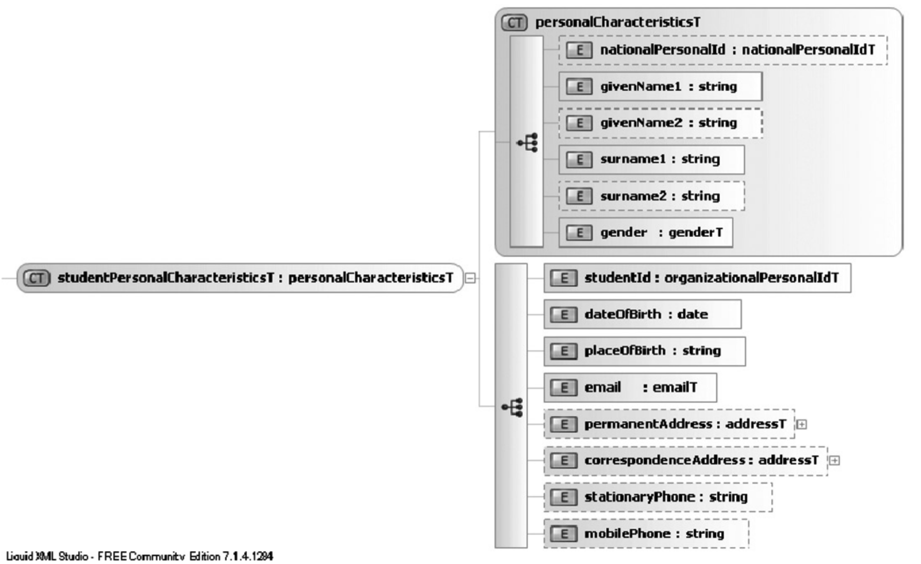

Figure 3. Datatype for describing a student

There are also organization-related types (**organizationDataT**), course-related types (**studyCreditsT**, **contactHoursT**, **courseDataT**, **gradeT**, **academicYearT**), and also agreement-related types (**cooperationConditionsT**). Last but not least there are web-service methods (listed in section ⟐). For example a method **sendNominatedStudents()** sends to a partner organization a list of students from a home organization, using **nominations** element (see Figure 4 and Figure 5).

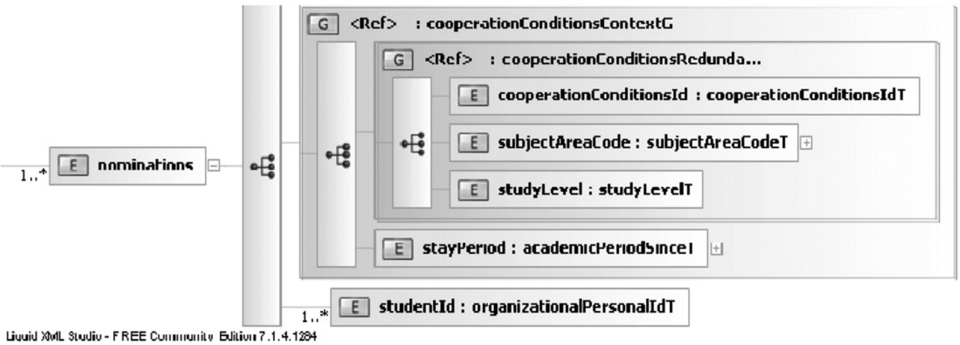

Figure 4. Graphical representation of a nomination element

```
<tns:nominations>
<tns:cooperationConditionsId>1</tns:cooperationConditionsId>
<tns:subjectAreaCode>
<tns:value classification=”eu”>11.3</tns:value>
</tns:subjectAreaCode>
<tns:studyLevel>1</tns:studyLevel>
<tns:stayPeriod>
```

Figure 5. Sample list of nominations in WSDL

We used free version of *Liquid XML Studio* to generate a HTML documentation for the WSDL document enriched with graphical representation of its parts (see Figure 3 and Figure 4).

Software version 2.0

We have chosen P2P-like architecture, where every node acts as a server and client at the same time. UDDI (***Universal Description Discovery and Integration***) registry stores addresses of endpoints. The protocol used to perform data exchange is SOAP defined in terms of a WSDL document.

The software is divided into 4 independent modules (distributed as war archives): 2 transport modules, one for a client and one for a server side of communication, and 2 web interfaces for each transport module. An overview is presented in Figure 6. The modules are all located in the middle part of the diagram, which is labelled “Transport middleware”. The top box represents client transport and web modules while the one at the bottom – server modules respectively.

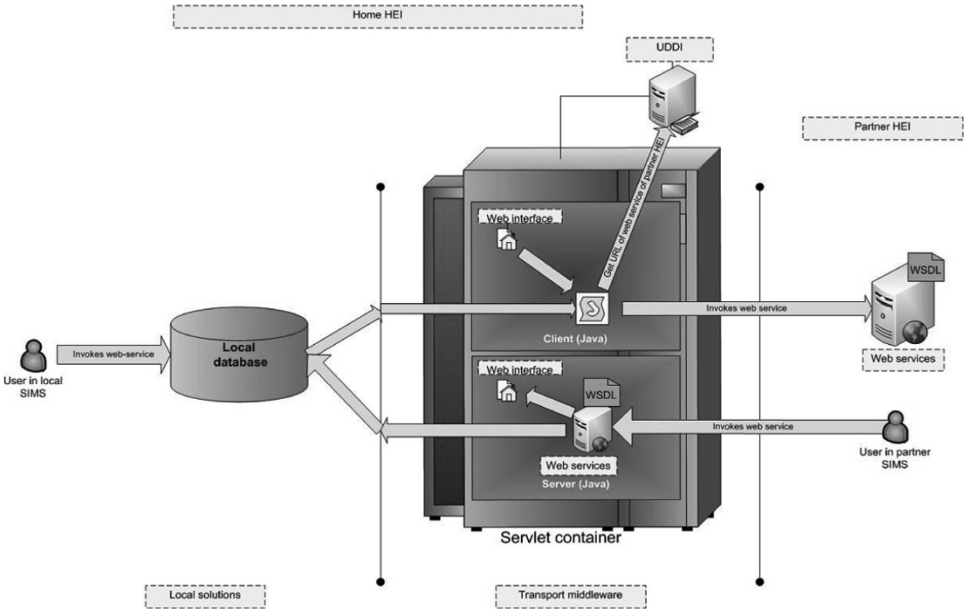

Figure 6. Architecture of the prototype version 2.0

Technologies used in the project

The software platform chosen for the project is Java with Spring framework to manage and configure application objects.

Apache acts as HTTP server and Apache Tomcat as a servlet container capable of running Java applications (the first prototype used Glassfish but we had problems to make it interoperate with Oracle using only open-source solutions).

Apache Camel is a routing and mediation engine which provides an Enterprise Integration Pattern implementation. It can work directly with numerous types of transport or messaging models, including but not limited to HTTP, JMS, AMQP, CXF – the project actually utilizes Camel's CXF support for web services, Oracle *Advanced Queueing* access through JMS (*Java Message Service*) API and AMQP (*Advanced Message Queuing Protocol*) support. Interaction is done through a uniform API for all types of transport, yet it does not prevent access to specific characteristics of the underlying transport layer.

Apache CXF is a web services framework allowing to build SOAP and WS-* standards-based services through JAX-WS API (*Java API for XML Web Services*). It also integrates with Spring framework and is easily embeddable in custom solutions.

Apache jUDDI is a UDDI Registry implementation. MySQL acts as a DBMS backend for jUDDI.

Apache Scout is an implementation of the JAXR API which allows to interoperate with a UDDI version 2 compliant Registry instance.

Apache Qpid is an AMQP implementation.

ICEfaces is a server-based RIA (*Rich Internet Application*) framework. It is an extension to the standard JSF specification. It supports AJAX and thus it can handle rendering phase a bit differently. Other reasons to be in favour of ICEfaces are attractive default look and a rich component library.

Mobility-client-transport and mobility-server-transport applications act as a transport layer between HEI's RDBMS and the web service. Both of them use Camel's Java DSL to route the messages from database and vice versa. The transport layer interfaces to the SIMS with XML payload of the web service messages.

Because of the requirement of interoperability with USOS which has its logic coded in Oracle procedures, the software communicates with it through PL/SQL procedures and Oracle *Advanced Queuing* messaging system abstracted with JMS interface. Other solutions may expose a different interface but there is a great chance that it would be relatively easy to integrate with Camel due to its extensive communication technologies support.

Web client and server

Mobility-client-web and mobility-server-web applications are mainly testing tools. Mobility-client-web enables a user to invoke operations of the web service manually and to edit UDDI Registry. The main parameters are URL of a web server and URL of a web client, e.g. it may be used to simulate a call made by the University of Parma of a web service delivered by the University of Warsaw web server. The interface is demonstrated on Figure 7.

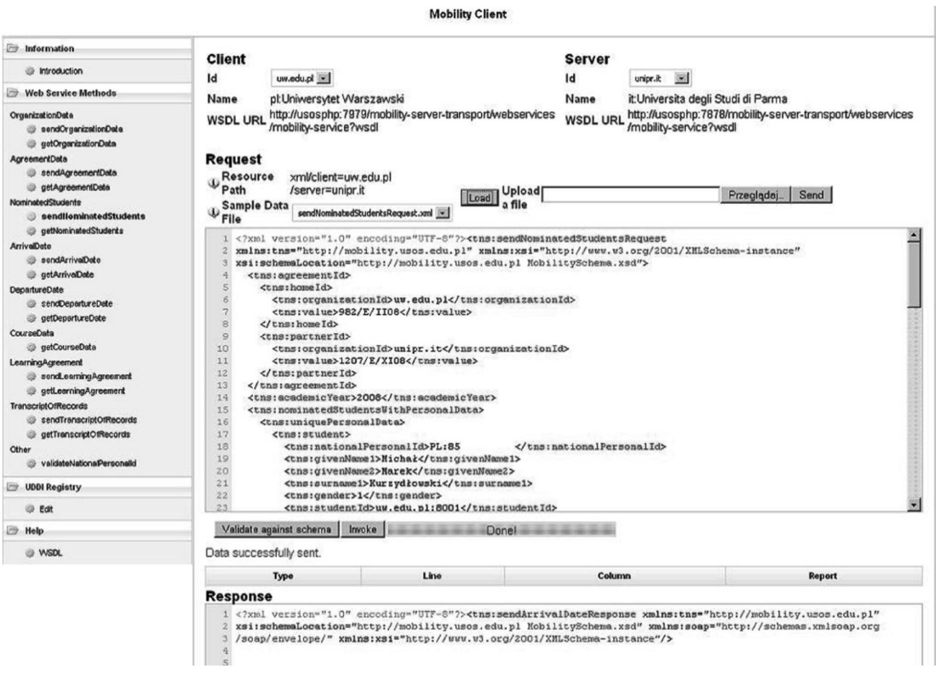

Figure 7. Calling sendNominatedStudents() using the web client interface

Mobility-server-web enables a user to preview requests coming to a server. It accepts web service calls from the net and forwards them to the local system, storing them also in the local file system. The interface is demonstrated on Figure 8.

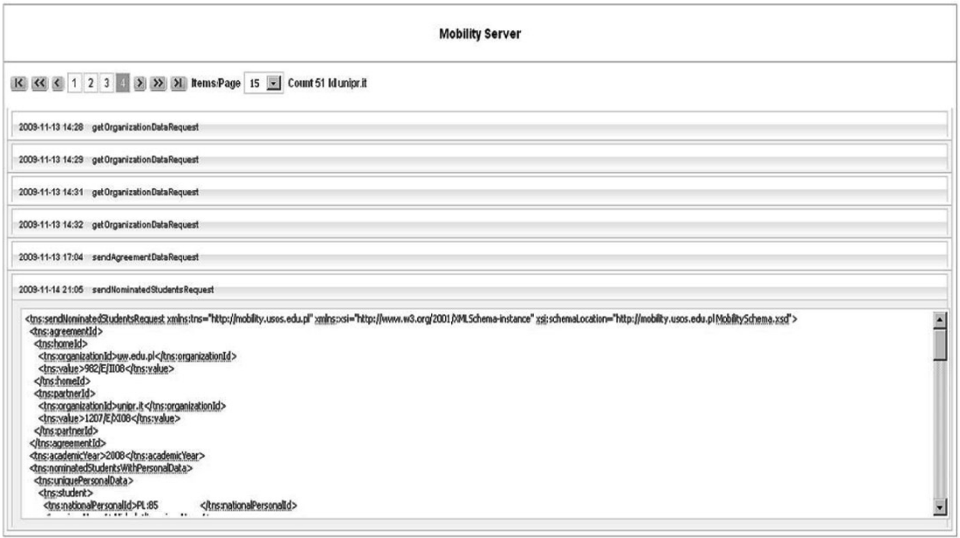

Figure 8. Browsing results of the web-service call using the web client interface

Test deployments of the software

To test the new version of the software we deployed it first in the University of Warsaw, then at three other sites, KION in Bologna (hosting a server for the University of Parma), SIGMA in Barcelona (hosting a server for the Autonomous University of Barcelona) and in the University of Oslo (as for the end of April, 2010). The test nodes of the Mobility network are shown on the Google map in Figure 9.

We found it relatively easy to adapt the software to new versions of WSDL (of course reinstallation is needed each time WSDL is being changed). We encountered some problems with deploying the software in system environments of KION and SIGMA. First, it turned out that although SIGMA uses Oracle as the database engine for the local student management information system, they prefer Glassfish over Tomcat since they use it for other purposes. It thus means that we should have various options possible, i.e. to distribute software which can be used with any servlet containers which might be chosen by deployment teams. In KION it turned out that there are problems when trying to install jUDDI on Oracle. We found out that versions of jUDDI for various databases are not compatible. This needs further investigation – we plan testing the newest 3.0 version of jUDDI.

New installations are on the way which will give us more experience with deployment in various system environments and new requirements concerning the chosen technologies.

To ease the installation of the software we prepared a preconfigured installation package, with the web client and the web server settled inside Tomcat and a small database for UDDI entries. Installation and deployment of the software from the new package takes no more than 5 minutes. We also plan to prepare a package with a virtual platform, like VMware (free version).

For testing purposes we have registered mobility web services at the public, centralised registry hosted by EdUnify at https://demo.edunify.pesc.org/ (they are available at https://demo.edunify. pesc.org/services/11). The EdUnify Registry allows to easily register, discover, annotate, monitor and use web services. Service providers, expert curators and the wider community are invited to enter metadata which is indexed and then used to support searching. It is thus easy to find the registered web service based on its type, category, location, descriptions, tags, input type etc.

Figure 9. Google map showing the nodes of the mobility network

We are aware that the real challenge is the integration of the mobility web services with local student management information systems, which are built in variety of technologies, each of them needing specific solution. In (Arcella et al., 2009) we described a solution for USOS, which is used in Polish universities. USOS is built around Oracle database so we utilize Oracle based technologies: *Oracle Advance Queueing* to implement web services invoked by local users and XML buffers and stored procedures to handle web services invoked by remote users. The module of USOS for International Relations Office is equipped with extra buttons and windows for invoking web services and browsing the received data.

The other foreseen challenge is how to ensure, in the production environment, compatibility of nodes running various versions of WSDL (which is unavoidable).

Workshops in Uppsala and in Bologna

The next step was the workshop in Uppsala in November 2009 which brought together consortia and companies willing to take an active part in the project. Among these were some national consortia (OODI – Finland, SIGMA – Spain, CINECA – Italy, Ladok – Sweden, FS – Norway, MUCI – Poland, HIS – Germany, SURF – Netherlands, VHS – Sweden), companies (Digitary – Ireland, AcademyOne – USA, KION – Italy, QS unisolution

– Germany) and individual universities. Presentations were devoted to various aspects of mobility, standards for electronic data exchange, relevant software systems:

- Business processes in the area of international cooperation and mobility at the University of Thessaloniki.
- Europass Mobility System produced by CEDEFOP (*The European Centre for the Development of Vocational Training*) to support handling of Europass documents in a distributed environment.
- QS unisolution model for exchange of the mobility data by users of *move-on*.
- Update on the MLO/ELM standardization processes.
- Update on European higher education Identity and Access Management.
- Update on the development of WSDL and software for the Mobility Project.

The most important outcome of the Uppsala workshop was formation of the Work Teams responsible for further investigation of various aspects of the Mobility Project: Business Processes, WSDL format, Identity and Access Management, Security and Life-Cycle Management, System Architecture. Team leaders were appointed to animate the work. Some participants volunteered to take part in practical activities, deploy software and test suitability of WSDL by preparing files with sample data.

The workshop in Bologna took place in March 2010. Its main purpose was to bring together the Mobility Group and TF-EMC2 to discuss the aspects of security and of identity and access management of the Mobility Project. There was a presentation on the Security and Document Lifecycle given by the leader of the Security Team. Secure encrypted transfer protocol should be used for sending data since in many countries personal data are protected by law and their privacy cannot be jeopardized. Digital signatures and PKI can be considered if higher level of security becomes necessary. TF-EMC2 shared with the participants the results of the recent Andalusian experience in FIAM implementation (*Federated Identity Access Management*). Vivid discussion followed, the debaters tried to assess how IAM could be brought into the Mobility Project. Possible solutions were recognized and further actions planned.

Conclusions

The initiative of the Mobility Group seems to us an important and practical step towards the creation of the European Higher Education Area. At EUNIS 2008 MUCI and CINECA met for the first time and agreed to start a project on electronic exchange of data on international cooperation and mobility. At EUNIS 2009 the running software system was presented, capable of transferring data between the two countries. We are ahead of EUNIS 2010, having the new more mature version of the software, four nodes in four countries (Poland, Italy, Spain and Norway) ready to transfer data, and a large group of national consortia, software vendors and universities willing to cooperate. The final success of the project depends on its scope which is proportional to the number of student management systems able to exchange mobility data by web-services. There is still a lot to be done but we believe that by such small steps we will eventually make it possible and some day the button inside the rectangle on the right in Figure 2 will become ready to send data to any European Higher Education Institution.

Acknowledgements

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The Utility of ID Cards for the Users of CTU in Prague

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Keywords

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Introduction

In current society where information technologies have become part and parcel of everyday life chip ID cards are used more and more frequently for verification of users´ identity. Generally, the efforts of universities are to support these modern trends and by means of chip cards to offer and provide users with a large spectrum of services related to information systems.

The present

In the environment of CTU (Czech Technical University) there is introduced a standardized process for the issue of ID cards which is implemented in an internally developing application CARD. The main important part of the whole process is carried out in the Issue Department of cards. The whole process of personification of the issued ID card (personalization reprint, download of personalized data) is solved by the application CARD. This application together with the central application IS designated as Exchanger; Swapper (db Oracle) distributes information of the relation of the identifier of the ID card – the person to the other components of the information system. According to user´s role within the IS, an ID card in the form of a card for a student, an employee, or a guest is primarily issued. Moreover, the user with the role of a full-time study student can make use of the alternative of issuing the student card in graphical form of ISIC (International Student Identity Card). Technologically, the contactless technology MIFARE Classic with the capacity of 1 kb is used.

The basic functionality, which was as the first one connected to ID cards, was the access (attendance) system implemented within the server application K4. Its conception is based on the hierarchy of the dB server with a control application (data connection IS) and slave units so-called 'Master'units providing communication with ultimate scanners on particular access points. Access rights are primarily set up fully automatically according to user roles (e.g. Student´s role of the faculty F1) or individually by the administrator of a particular group of access points (organization unit, building etc.) including setting of calendars (schedules).

Thanks to the development of IS the launch of the service 'TINA', which deals with support of unattended copying a printing services accessible to the students and the employees of the university, subsequently followed. Similarly to the access system, the card is only an identifier and it is not necessary to deal with the access rights to the internal data structure of the chip. All the applications are carried out within a server application.

For a further extension of provided services it was necessary to outline and carry out a solution for internal micropayments. For those purposes a Transactional Account System (TAS) was developed in cooperation with external suppliers (BBM, IMA, DERS, and OCE). This system tackles the issue of a single balance of a user of the information system for credit transactions of the payment for all services provided by the university and its connection to the operation-economic agenda of the university. The features of the account in credit and debit areas are automatically set according to user´s role in IS and he/she is given a maximum limit for each operation. The current system meets the requirements of the payment systems in force according to the legislation of the Czech Republic – the law no. 284/2009 Sb.

The standardized solution by means of the payment system K-PAY is used in the area of payment transactions. This system is designed to accept payment operations at payment terminals covering provided services, or purchasing goods by means of bank or university cards. This system is also suitable for the payment of automatically dispatched goods (drinks machines, paid download of files) or directly provided services of administration (e.g. fees).

The service 'TINA'is fully integrated in TAS and it deals with support of unattended copying and printing services accessible to the students and the employees of the university.

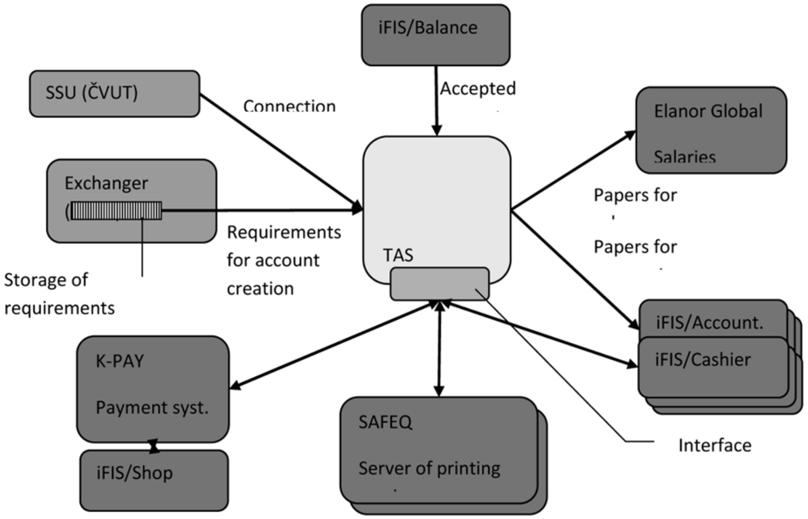

Figure 1. Implementation of TAS in the environment IS ČVUT

System upgrade is also an application E-shop primarily used by the shop of technical literature. In this application it is made use of payment in web interface carried out by the applications of the Payment gateway. To guarantee the security of the transactions accepted that way the user is asked to confirm each purchase by means of an e-mail which the Payment gateway sends to the customer to verify transaction validity. The single number which goes through the net is only the ID code given by the Payment gateway.

In further development we expect interconnection with another important service using ID card, which is catering system.

The card is just an identifier within all above mentioned systems; and thus it is not necessary to take into account the access rights to the internal data structure of a chip. All payment transactions are carried out within a server application. The ID card is strictly used for the identification of a user and the other rights and settings are already proceeded in a server application, such as e.g. TAS (type of account, overdraft etc.)

An application using an ID card takes over catalogue information (registers of persons, cards, working places, bank accounts,) from data sources of the Exchanger from the other components of IS. Connections to data sources from other systems are implemented so that temporary disconnection of a source (typically an upgrade of a primary system) does not have any influence on the round-the-clock service of systems.

Future

It can be applied to all currently operated information systems – the one at ČVUT is not an exception that without any further progress in technology and function its gradual degradation will be followed by subsequent criticism of its users. Not only due to this reason, the projects which incorporate modern trends into the IS of the university are currently being carried out or are at a certain level of elaboration.

PKI (Public Key Infrastructure)

The implementation of tools facilitating the security of information systems, electronic transactions and communications is a project corresponding to the current trend of information systems. The solution is behind the abbreviation PKI. The implementation of this project includes the entire software, technologies and services which make possible to use encryption with an asymmetric key. The utility of this solution is in areas:

- indisputability – utility of electronic signature
- encryption of news and documents,
- news integrity,
- user authentication.

In current practice it is necessary to create a great number of conditions to secure a full functionality. Regarding the issue of PKI (Certification authority – CA, time stamp, certification policy etc.), it is generally beneficial for universities to make use of services of a national coordinator. In case of the Czech Republic it is Cesnet, interest association of legal entities which with contribution of the representatives of particular schools creates and introduces the services of PKI to current operation. Registration authorities will be introduced to individual universities and the identity federation eduID.cz will be used for applications for certain types of certificates. If CA of Cesnet is repeatedly recognized by universities, this process will result in a mutual recognition of documents which will be signed by electronic signature issued by CA of Cesnet.

There are two areas left which are easier for implementation. It is a medium where a certificate will be saved (ID card see below) and an application which authorizes to use the issued certificate. In the environment of IS of ČVUT, a gradual implementation of electronification of administration processes related to university operation with the connection to processing models for specified areas is taking place. There has been created a unifying portal PES (portal of economic services) in economic-administrative issues which incorporates modules of holidays, orders, travel orders, property transfers etc.

Change of Technology

If we leave university environment and consider other services which can be provided to students and employees by means of the ID card, we meet the threshold of technological limitations of the current standard MIFARE Classic. This type of card regarding processes implemented in various kinds' so-called metropolitan cards has been outdated and it is more and more often replaced by the card MIFARE DESFire. This processor card meets the norm ISO 14443. Compatibility is guaranteed also in the area of logical organization of data and communication protocol. Thus, it is possible to use multiapplication utility of the card with compatibility of several users. Security is based on a standard cipher 3DES. This is substantially more resistant to breaking than the proprietary system CRYPT01 (MIFARE Classic). It provides higher bit rates (423 Kbit/s) but it does not support PKI.

The other possibility for the change of technology of contactless chip is MIFARE plus, which was introduced to the first customers in 2009. Its advantage is the possibility of operation at several security levels. The highest level of security uses AES (Advanced Encryption Standard), encryption based on 128-bit key length. AES has been widely analyzed and it is now a recent world standard in encryption as it was with its precursor Data Encryption Standard (DES). At the lowest level of security the algorithm Crypto1 is used, which forms a mutual compatibility with MIFARE Classic. The solution of migration from MIFARE Classic to the infrastructure based on MIFARE plus has one major advantage in comparison to the upgrade to MIFARE DESFire; and this is that it can be implemented gradually. Due to mutual compatibility with Crypto1, the transfer to an operation with a higher level of security MIFARE plus can be proceeded after issuing a new type of the card for all users without re-issuing. This can be the cause of a much faster transfer to an infrastructure for launching operation exclusively at the requested higher level of security.

If we use PKI in the information system, it is necessary for ID cards to use contact technologies with a processor supporting PKI and with a writable memory with the capacity 8–128 KB. It is convenient to use simultaneously programmable chips, such as JavaCard with extensions Global Platform, which is the most universal and the fastest developing accessible technology.

Applications of Universities

Apart from PKI, we have considered so far that the ID card is only an identifier and does not carry any other attached information or application. It is pointed out that we cannot be satisfied with the premise in the event of creating a universal environment of ID cards. That proves those applications which cannot be operated in on-line mode (e.g. public transport tickets). The solution is the utility of hybrid cards (2 divided chips – contactless MIFARE DESFire and contact JavaCard) and implementation of an application loaded directly to the chip. Using the same technology and single application can lead to the state when individual universities start to recognize ID cards. At the same time the university can let use some capacity of the chip for loading applications of other subjects such as Czech Railways, transport companies etc. This will result in improvement in quality in the entire area of school system.

Conclusion

From all above stated, the most plausible step appears to be the change of technology of ID cards. While deciding on technology, the emphasis will be put on future possibility to extend services for users. The same way as it is in transport companies there must be an effort to set a standard of universities and to respect it. Universities have always been at the top of development and they have to show the way also in the recent economic situation and they must not stay at the attained level of the development.

Business Process Variants as a Mechanism for Designing HE Information Systems

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Keywords

Business Process Management, Business Process Variants, Process Building Blocks, Variant Management

Abstract

Business processes form the core of the activities of companies. They are used to describe the main tasks to serve the customer and are object of improvement projects. Documented business processes help to communicate essential operational aspects within the organization. Furthermore, business processes are suited as a blueprint when developing information systems. Static and structured processes are easier to model, manage and implement. Information systems in well designed fields (such as ecommerce) are based on similar business processes. The basic order-to-cash process in every online shop is quite the same. Not so in higher education (HE). The reason is simple: The product of HE institutions is far more complex than the product of an e-shop.

Mayor differences are: First, universities are service providers. They do not ship a standardized product. They educate people. Second, the HE product is a dynamic and

changing product. A degree programme seems static when looking at course catalogues but inside the university the degree programme is highly dynamic due to changing conditions (e.g. new personnel) or new courses.

Additionally form and practice of HE institutions vary between each other and between countries due to individuality of handling business processes.

These factors result in high variation of business processes in the HE area and thus need special approaches to leverage the potential of business process management (BPM).

Business process variant management is a suited discipline to address the need of the European HE area, especially with respect (but not limited) to information system design that supports the whole student lifecycle or that spans cross-country HE scenarios.

This paper discusses the approach of business process variants for the HE area. Chapter 2 describes the basics of complexity in HE business process management. Chapter 3 introduces the concept of variant management and prepares the HE specific illustrative examples in chapter 4. The mechanism of repositories is addressed in chapter 5. The paper closes with related work in chapter 6 and the conclusions in chapter 7.

Complexity in HE Processes

The situation sketched in chapter 1 illustrates a need for support for reference models for the HE area. But there is a lack of open business process models for this domain. Due to the self-interest of companies providing BPM suites or consulting companies there is small interest in exchanging the knowledge contained in the business process models. Additionally different modelling languages hinder the reuse of existing models (Shahzad et al., 2009).

Complexity in general as well as in BPM is driven by two major factors: The number of variants and the dynamic of the elements. The HE area – e.g. in form of a university – exhibits both aspects and thus requires suited mechanism to cope with complexity. Solutions to cope with complexity are generally distinguished between reduction of complexity and management of complexity.

In BPM several approaches are established to manage complexity. Process templates e.g. serve as blueprints for individual projects. But the adoption of theses best practice approaches turn out to be rather elaborate – especially in complex szenarios.

More sophisticated methodologies like reference processes try to design variant-rich process models that are designed to serve the purpose of reuse. By providing process building block or variation points these process models try to deliver a mechanism to cope with complexity however not without increasing the complexity of the application of such a process model. The question is, how different approaches for variant management can be used together within an integration business process variant management methodology.

Variant Management for Business Processes

Conventional variant management as provided by existing BPM tools is usually restricted to separate process models without a strong relation between the variants. The effort for modelling and maintaining complex variant-rich processes thus rises and results in time-consuming and error-prone process management (Hallerbach et al., 2009). This copy & paste approach does not really reveal the power of variant management concept intended by reference modelling not to mention global process templates for such a complex scenario like HE area because "specifying all variants in one process model can result in large models, which are difficult to comprehend and expensive to maintain" (Hallerbach et al., 2009).

The Reference Modelling Cycle

The basis for variant management is the so called reference modelling. This meta-process describes the two phased process of creating a reference model and using it. It is obvious that before a consumer can use a variant-rich reference model it has to be created.

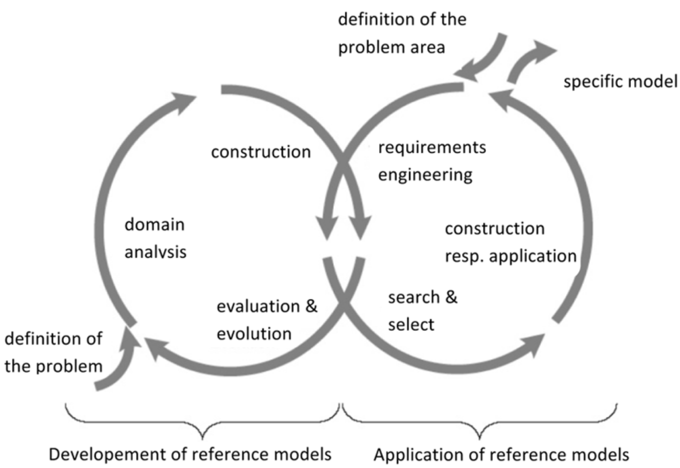

Figure 1. Developement and application of reference models
(according to Schlagheck 2000)

The development and application of reference models consists of the two cycles development and application (Schlagheck, 2000). The development cycle starts with the problem definition, i.e. the definition of the domain (i.a. the industry sector or area) the reference model should be suited for. This domain gets analysed in the second step. Based on this analysis, which reveals the variabilities and commonalities of the business processes in this domain, the reference model is constructed. Once applied in a specific szenario the feedback gets evaluated and can be used to evolve the reference model. The application cycle also starts with the problem definition. In this case it is a specific problem within a domain. Based on the requirements engineering a suited reference model can be searched and chosen. This reference model has to get applied or constructed to suit the specific situation. Once finished this process, the resulting specific model gets applied do solve the problem defined initially. As mentioned above both cycles are connected so that feedback of an application cycle can be used to improve the reference model.

The cycles of developement and application of reference models reveal the capability of this approach. The effort invested in well analyzing a domain pays off once the resulting reference model gets applied by many customers within this domain. The so called dilemma of reference modeling (Becker et al., 2002) is in the coincidental demand for generality on the one hand and specific recommendatory character of the model on the other hand: A more general reference model is suited for a wider market but implicates higher effort for adoption in the application phase. A more specific reference model reduces the effort for adoption but is only suited for a smaller market thus questioning the effort for the creation of the reference model itself. To solve this dilemma alternative approaches like configurative reference modeling are proposed. These enrich reference models by adding alternative elements to support different variants of the same process (Delfmann, 2006).

Process Artefacts suitable for Variation

Key principles of variant-rich reference modelling are modularization & specialization. The former is covered by the provision of artefacts for a foreseen use of the reference model, e.g. alternate sub processes. The later enables the customization of an artefact in a way not directly foreseen in detail but enabled through the underlying methodology, e.g. a generic activity specialized according to legal restrictions of a country. In software engineering modularization gets apparent in component architectures whilst specialization gets apparent in object oriented hierarchies. Both principles combined in reference modelling serve complementary purposes and thus enable a powerful reference model that does not need to specify every possible variation but instead may provide adaption points that enable specialisation case by case. Both principles are supposed to ease both understanding and reuse of process models – as discussed for the aspect of modularization by Reijers & Mendling (2008).

Within a business process three assets may be subject for variation: First, activities may be changed and replaced by an alternative activity. Second the process flow itself may be altered (e.g. omitting activities, moving activities, etc.). Third business rules may vary from organization to organization.

Process model repositories are a way to resolve the problems of specialization and fragmentation. Shahzad et al. identified requirements for business process model repositories to design repositories suited for the reuse of process models (Shahzad et al., 2009).

Example for business process variation in HE

The following example illustrates the concept of business process variants to a HE business process. We chose an administrative process of a university. This business process has two major variants that will be used to explain the power of business process variants.

Due to capacity restrictions the admission for some degree programmes got outsourced to a national service provider. Thus the admission for some degree programmes is conducted by the service provider whilst other admissions are conducted by the Registrar's Office of the university.

When analyzing the business processes of the university, the same business process (Admission) has two variants with some equal areas. It is important to recognize that both variants are only variants of the same process, because the university is stakeholder and service provider. The outsourcing partner only handles some parts of the process. The university still is responsible for the process on the whole and is still involved in major activities.

Traditional business process tools only handle variants by copying the base process. Drawbacks of traditional tools are:

Changes in the base process may not be reflected in the process variant. Thus the lifecycle of HE processes is not satisfactorily supported. Even methodologies that propose the automated reflection of changes in the base process may not fit regulatory rules of once adopted and accepted derivations of the base process.

The customer is not guided through the customization process. Thus the quality of the resulting model is dependent on the designer of the variant. There are no quality mechanisms in place that support the user during the adoption process.

As mentioned above an increasing number of variants raises complexity. The mere provision of a variant-rich reference model is not automatically a mean to handle complexity.

Process variant 1: Admission process through the Registrar's Office

The student's admission with all the documents is sent to the universities Registrar's Office [activity 1.1]. The documents get checked on completeness [activity 1.2]. The formal requirements for the selected degree programme get checked [activity 1.3]. The documents get transferred to the responsible department to perform detailed analysis of the documents and select the students considering the regulations for the admission of the programme [activity 1.4]. The Registrar' Office receives the results and informs the student on the admission process [activity 1.5]. In case of a successful admission the student enrols to the degree programme (i.e. another core process starts). The Registrar's Office updates the list of allotted university places.

Process variant 2: Admission process through the national provider

The student's admission with all the documents is sent to the national service provider for admissions to universities [activity 2.1]. The documents get checked on completeness [activity 2.2]. The formal requirements for the selected degree programme get checked [activity 2.3]. On the basis of the criteria of the faculty (defined beforehand) a detailed analysis of the documents is performed and the successful admissions selected [activity 2.4]. The service provider generates a list with the detailed results of the admission process and the number of the allotted university places [activity 2.5]. The Registrar's Office receives the list and checks the results on conformity to the defined process [activity 2.6]. The Registrar's Office confirms the list and the service provider informs the student on the individual admission process [activity 2.7]. In case of a successful admission the student enrols to the degree programme (i.e. another core process starts).

Handling differences in variant-rich processes

The two process variant show essential differences. Only two variations get accentuated in the following to explain the differences between variations of activities and variations of process flow. (Note: There is no example for variability of business rules in this example.)

First, the activity of the admission feedback on the decision is handled different between the processes. Process variant 1 transfers the feedback per student [activity 1.5] whilst process variant 2 transfers the feedback as a list of the complete results of the admission process [activity 2.5]. Thus a variation concept for activities should enable the recombination of business process activities.

Second, the process flow is changed. While process variant 1 needs several transfers of the document to perform separate activities in each department process variant 2 completes these tasks without transferring the documents to other organisations.

Process Repositories

Leveraging the power of business process variants requires suited process repositories. Current approaches are either company-owned or for general purpose. Company owned repositories are only accessible by the operator e.g. a consulting company or the company providing a business process suite. Thus these in both ways restricted process repositories will not suit the approach discussed in this paper. Open repositories are mostly for a general purpose (i.e. domain independent). These repositories are principally suited but lack of a focus to build a living community of contributors and consumers. Open repositories that are domain-specific (e.g. supply chain) in general do not address the core processes of HE area.

We propose a HE centric (i.e. domain-specific) open business process repository that supports business process variant management. In order to build up a community it might start small with some universities and provide blueprints for variant management to the HE community in a second step. Shahzad et al. envision open process repositories in analogy to Wikipedia to establish a "universal knowledge resource on business process models" (Shahzad et al., 2009).

Community-driven engineering of reference models

Schmidt & Nurcan discussed the potential of social software in the BPM lifecycle (Schmidt, Nurcan, 2008). They recognized the role of social sofware to overcome the deficiencies of classic BPM approaches with a major focus on social production, i.e. "the creation of artifacts, by combining the input from independent contributors without predetermining the way to do this". Along the BPM lifecycle they discuss possible contributions of integration social software into BPM. They see a mayor contribution in the creation, operation and adoption of business processes.

The major issue of reference modeling can be overcome by applying social software to BPM. The so called model-reality divide (Schmidt, Nurcan, 2008) may be resolved by the participation of the consumers in the design process and by simplifying the improvement processes, i.e. integrating feedback of the consumers into the improvement of the reverence model. Schmidt & Nurcan regard this aspect also as valid for reference modeling and expect a simplification of the creation process. Additionally a community driven design process results in a common understanding of terms used in the business process model.

The process of reference modeling (i.e. the concept of managing behind business process variants) is split into two areas: constructing the reference model and using it. Both areas will leverage its full potential if the process gets community driven. Thus the variant-rich reference models should both be engineered by the community and used. By applying mechanisms of social communities the reference models get better by two ways. First, the number of model designers providing knowledge for a special process is greater. Second, the feedback of distributed users within the HE area evaluates the quality of the current models. Their feedback an evaluation may increase the quality of the models by enhancing current versions of a reference model or supplying new, better business process building block or business process variants.

Support for research

The existence of an open process model repository may even support research in the BPM area since this way – as Decker et al. state – the researchers get access to current process models. Thus a new level of enhanced methodologies might arise through the new level of evaluation, validation, demonstration and participation (Decker et al., 2008).

Related Work

Besides the work already referenced during the course of this paper additional areas of related work have to be mentioned:

The software product line engineering plays an important role in managing complexity of software architectures of product families in the area of software engineering. Bachmann & Bass describe the fundamentals on software variability (Bachmann, Bass, 2001). Reducing cost of development and maintenance are driving factors. The analysis of the domain and the identification of variabilities and commonalities of the (software) processes within the domain are central aspects of software product line engineering. The Feature-Oriented Domain Analysis (FODA) and Feature-Oriented Reuse Method (FORM) are the respective methodologies (Kang et al., 1998; Kang et al., 1990).

Patterns as a concept of applying best practice approaches for recurring situations are well established in software engineering (Buschmann et al., 2007; Rising, 2007) but recently are also subject of discussions with respect to business process management (von Brocke et al., 2009; Gschwind et al., 2008; Medicke, McDavid, 2004; Tran et al., 2007; Zdun, Dustar 2007). Patterns may be also considered in the design of business process variants and support the adaption of the reference processes. They help understanding *context* and *consequences* of the *solution* provided by the pattern itself (Gamma et al., 1994) and may thus serve well as a guideline during the process of customizing a reference model. In detail, patterns help especially when consumers of reference model need artefacts that are not directly provided out-of-the-box by the reference model. Patterns thus bridge the gap between the arranged know-how of reference models and artefacts and the methodologies necessary to create these. Gschwind et al. discuss the tool support for the application of patterns during business process modelling (Gschwind et al., 2008).

Conclusion

Business process variant management is well suited for mastering the management of complex process landscapes in domains like HE. The existing approaches do not cover all necessary aspects and lack in a sufficient support of tools. A holistic approach for managing business process variants covering the full power of reference modelling is currently missing.

Success factors from social software (Surowiecki, 2004; Tabscott, Williams, 2006) are able to overcome the deficiencies in BPM and enable a consequent management of a variant-rich business process landscape for HE area. The inclusion of the consumers into the design process hold a solution to the dilemma of reference modelling since an enhanced methodology might rise the complexity of the result.

Additionally concepts like patterns or refactoring applied to business process reference modelling are necessary to empower the users of the reference model and guide the adoption process of the variant rich base model. These concepts may complete the methodological approach and may focus the demand for variability against the background of the levels of flexibility in business process management (Eicker et al., 2010). In some cases the definition of constraints as proposed by Lu et al. may serve as an explicit control mechanism for process adaptation (Lu et al., 2006; Lu et al., 2009).

Further research is focused on identifying suited mechanism of variant management for each business process artifact. Additionally requirements for (open) business process model repositories supporting variants and variant artifacts have to be analyzed. To overcome the dilemma of reference process modeling (i.e. a high the effort in designing and holding ready variant rich reference models) a community-driven engineering process has to be identified. To support easy discoverability of the right business process templates and possible artifacts for adaption a HE process classification framework is necessary. To be able to address business process lifecycle issues the versioning of variants and artifacts too has to be considered.

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The American Recovery and Reinvestment Act of 2009. Efforts in the Commonwealth of Pennsylvania

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United States, infrastructure, Pennsylvania

Introduction

Not since the Great Depression of 1929, and President Roosevelt's "New Deal" programs, has the United States Administration and Congress provided such extensive funding towards rebuilding the economy. Over a Trillion Dollars has been allocated thus far across multiple fronts in an effort to stimulate jobs and economic development. One portion of the American Recovery and Reinvestment Act, (ARRA), of 2009 was focused on expanding the broadband communications infrastructure to the rural areas of all 50 states. This paper shall recount the efforts of a coalition of higher education institutions to seek the necessary resources to build a backbone network in the Commonwealth of Pennsylvania, where 47% of the population lives in rural areas with little or no access to cost effective high performance networks.

The portion of the ARRA devoted to infrastructure was broken into two sections; 1) The Broadband Technology Opportunities, (BTOP), and 2) The Rural Utilities Service, (RUS). The BTOP program was allocated 4.5 Billion U.S. dollars, and the RUS received 2.7 Billion Dollars. The intent in both cases was to extend broadband connectivity to "unserved" and "under-served" regions throughout the United States in the same fashion that the Rural Electrification Agency funded the extension of electric power in 1935.

Once specific projects for computer centers and facilities upgrades, the Act provided for $ 3.7 Billion, (U.S.) to be allocated towards any of 3 project categories; last mile, middle mile, and long haul, and was to be administered by the National Telecommunications Information Agency, (NTIA) under the Department of Commerce. The original solicitation called for 3 rounds of proposal submission, August 2009, December 2009, and April 2010n and estimated a minimum of two grants for each state. Based on the announcement of the program in March, 2009, first round submissions had 5 months in which to prepare a budget based on formal quotations, ecological impact studies for new construction, Native American tribal land impact assessment, governance, and a clear sustainability model to ensure the longevity of the project after the funding period.

It was also critical to spend the money as quickly as possible in order to infuse the economy with much needed funds and to create as many jobs as possible during the national recovery process. So the project timeframe was initially limited to 24 months, beginning at the time the award was publicly announced. This was later extended to a requirement that the project be 75% complete in30 months and 100% in 36months. Another significant requirement was a 20% match from the organization submitting the proposal. Expenses that were ineligible for the 80% were items like equipment maintenance contracts and operating expenses.

Formation of the Pennsylvania Coalition

The Commonwealth of Pennsylvania is one of 13 states that did not have a unified research and education network. There are 3 "Connectors" that had independent infrastructure for this purpose, but had no peering relationship other than their individual connections to the national networks known as Internet2 and the National Lambda Rail. In general, they were in competition and had no real incentive to relinquish their status in favor of the benefit of the larger population. The region was further fractionalized by separate initiatives from the state government, the K12 schools, previous grants for hospitals and health care systems, and pockets of economic development programs based on broadband connectivity. It must also be noted that culturally, the state was divided between geographic regions, (East/West/Central), each vying for public funding. For example, the two population centers, Philadelphia and Pittsburgh, are at opposite ends of the East-West rectangle, and while Pittsburgh has a mid-west perspective, Philadelphia is a part of the New York – Baltimore – Washington megalopolis.

It was no small feat that, in pursuit of this enormous funding opportunity, 11 institutions in Pennsylvania, composed primarily of private and public universities, 2 year community colleges, health care, and economic development organizations, gathered together in March of 2009 to begin discussions. Within two months, several committees were formed and began the arduous process of assembling a proposal that met the governments' guidelines. It must be noted that to their credit, these organizations put aside their competitive differences and were able to provide their best human resources towards the construction of the proposal. Table 1 depicts the 11 founding institutions.

With this aggregation of communities, aligning the needs to the principles of the grant was one of the simplest tasks. Hospitals are unable to take advantage of telemedicine initiatives or participate in Health Information Exchange programs because they lack the necessary bandwidth. Research is increasingly dependent on the ability to share large data files with collaborators, and unless the institution was connected to one of the 3 national network connectors, this was simply not practical. This left many universities in rural areas unable to apply for a growing number of grant opportunities. Distance learning, faculty sharing, videoconferencing, and other educational technology tools were simply not feasible with the constraint in bandwidth.

Table 1. Charter Institutions

The Pennsylvania State System of Higher Education	The Pennsylvania State University	MAGPI/The University of Pennsylvania
Drexel University	3ROX/Carnegie Mellon University	Lehigh University
Bucknell University	The Hospital Association of Pennsylvania	The Pennsylvania Association of Community Colleges
The University of Pittsburgh	The Association of Independent Colleges and Universities of Pennsylvania	

After more than 2000 staff-hours, in August of 2009, a technical design, budget, and plan for sustainability were submitted to the National Telecommunications and Information Administration, the agency charged with the management of the BTOP program.

Designing PennREN

As was previously mentioned, there are currently 37 states in the U.S. that have some form of high performance network infrastructure dedicated to research and education. Pennsylvania is not currently one of them. With approximately 5,180 square kilometers in size with a diverse population, the initial challenge was to determine a middle mile or backbone pathway that covered the most underserved areas while working within the limitations of accessible right-of-ways and mountainous terrain. The commercial telecom providers had limited infrastructure in many areas, primarily due to the lack of potential for a return on such an investment. Populations in the rural areas are small and so the customer base did not warrant costly fiber builds or optical equipment.

Using the engineering talent of the charter institutions, and the required census block data, the coalition was able to map out desirable sites that could be used as telecom centers, and then literally connected the dots. A Request for Proposal was sent to 6 different companies, specifying the desired locations and the technical requirements for the fiber cabling. Figure 1 depicts the early sites and pathway designations. It should be noted that when presented to state legislators, the project quickly became known as the “Bowtie Collaborative.”

The basic design began to formulate in May of 2009 with a strategic partnership formed with Fiber Tech, a fiber optic cabling company based in Rochester, NY. In their bid proposal, they offered to provide 48 strands of fiber cable across 1,696 miles or 2,729.5 kilometers. The construction would include terminating every strand at 13 core nodes and 12 strands at each of the 52 local nodes, (described below). In addition, FiberTech would provide the NTIA required 20% match in the form of a cash contribution to the coalition. The total cost was predicted to be approximately 110 Million dollars, and the electronics had not yet been determined.

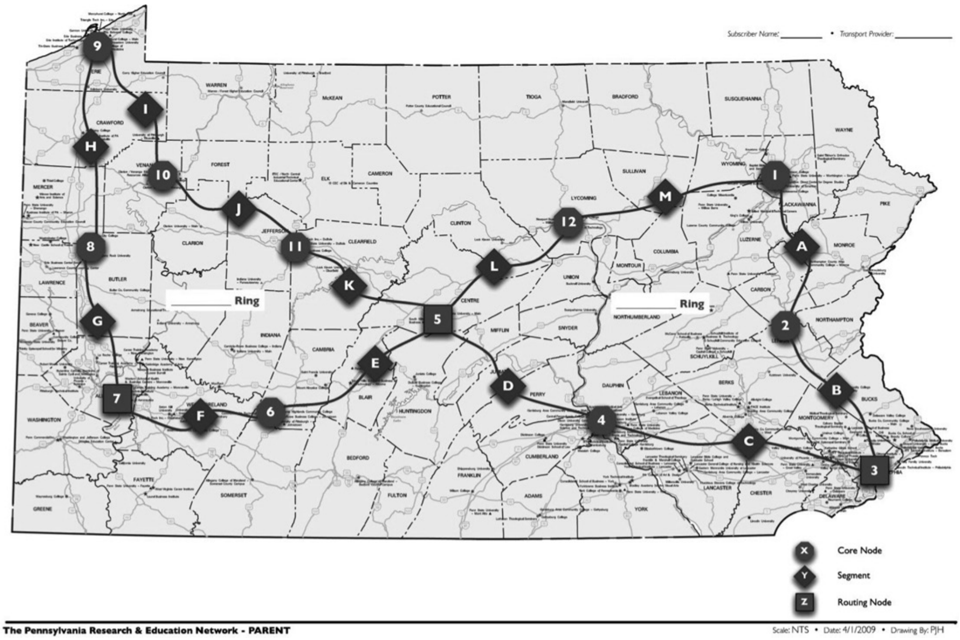

Figure 1. First Design of the Backbone

With 48 strands of fiber optic cabling available to the coalition, it was determined that only a single pair would be lit initially with 4, 10 Gbps wavelengths going in each direction around 3 separate rings. The project was already in question by state government officials, asserting that it would be too expensive to fund by the NTIA. So with this in mind, similar quotations were solicited by the technical working group.

Ciena was finally accepted as the vendor of choice, since they would also provide the 20% matching funds in the form of cash. Ciena was known for its resiliency and excellent performance, and although not the least expensive, it was considered the best value for this project. In planning ahead, the CN 4200RS, 17 slot chassis was upgradable to accommodate future optics capable of 100 Gbps wavelengths.

Access to the backbone will be provided by Force 10 C300 8 slot chassis with 48 ports of 1 Gbps and 4, 10 Gbps uplinks that can be mapped to the individual 10 Gbps wavelengths on the Ciena DWDM hardware. Figure 2 Depicts a typical rack elevation for a core node site, with a Juniper MX480 router. There are 3 router nodes; Philadelphia, (MAGPI), Pittsburgh, (3ROX), and State College PA, (Pennsylvania State University). These locations were chosen for the available expertise of the host institutions, each having expert staff in the management of high performance networking electronics. Core nodes have identical equipment configurations with the exception of the Juniper routers.

Having accomplished a suitable equipment design capable of accommodating large scale connections from anchor institutions throughout Pennsylvania, it was time to review the pathway and the sites where the equipment would reside. Original sites changed as the ability of the core nodes to accommodate redundant power, space, and HVAC was assessed. In some cases, the institutions were not comfortable with hosting the equipment and so modifications were necessary.

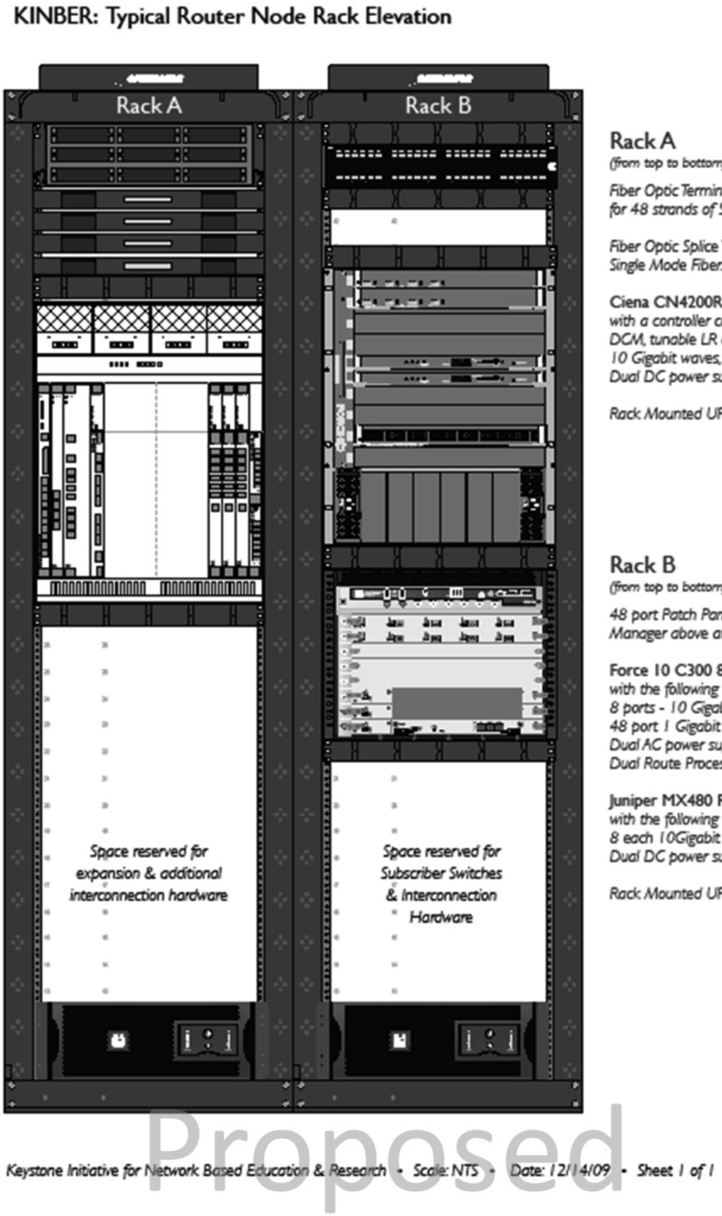

Figure 2. Typical Router Node Rack Elevation

It also became apparent that many sites that were not designated as core nodes were perfect examples of underserved locations that would benefit from the network connectivity. The concept of "Local Nodes" were added to the design in an effort to extend the connection capability to as wide a region as possible. Local Nodes are designated sites that have access to the fiber but do not house any electronics. The 52 local nodes must use their own hardware to connect to the nearest core node for access to statewide services. Local nodes and Core nodes are required to allow access and connectivity from the surrounding region to any qualified member, that being defined as any organization engaged in some facet of research, education, or health care. Figure 3 depicts the current pathway with both core nodes and routing nodes shown in their precise locations.

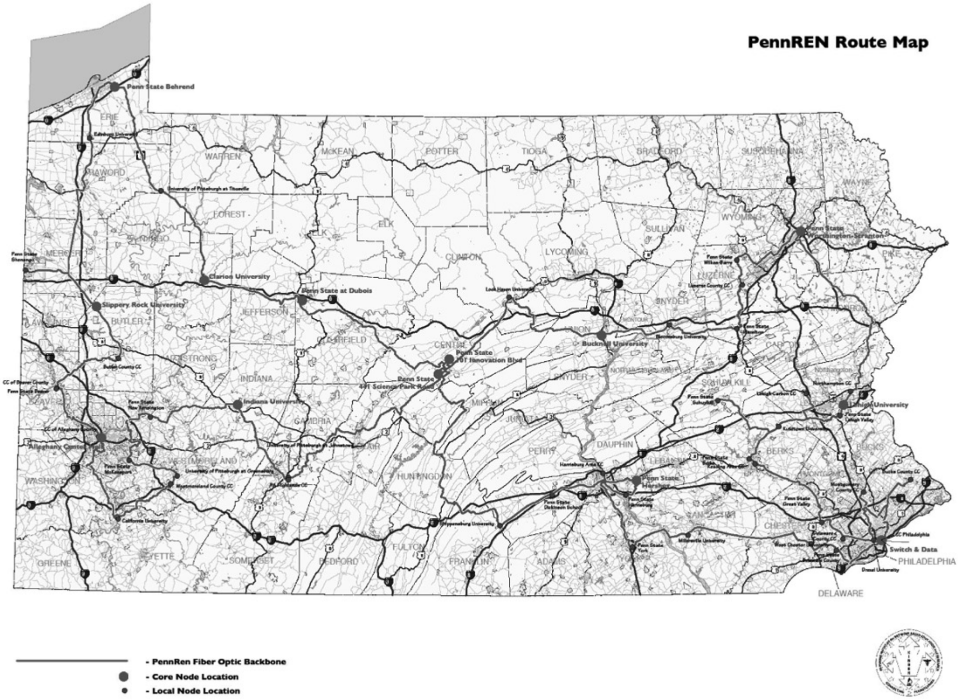

Figure 3. Current Pathway Design

Core nodes and local nodes

There are 13 core nodes, strategically placed to accommodate optical and network access hardware, and to ensure that regeneration properties are within specifications. These sites are predominantly higher education campus data centers where strict requirements will be met for power, cooling, and other environmental considerations. The host institution will also provide limited "hands and eyes" support for the technicians.

Governance and the Award

It became immediately apparent that despite the collaborative spirit of the coalition, a separate entity must be created to manage the affairs of the network, now known as PennREN, (Pennsylvania Research and Education Network). Also, in the event that we were successful in attaining the award, there must be a legal entity that would act as the Primary Investigator and could manage the funds, the memberships, and the revenue from the services that would eventually be offered. And so KINBER, (Keystone Initiative for Network Based Education and Research), was formed as a 501c3, non-profit corporation. Funded initially by the 11 founding institutions, there is a board of directors appointed by the Presidents and CEOs of each institution. Their first action was to approve the by-laws, establish bank accounts, and hire staff such as an Executive Director, Project Manager, Government Compliance Officer, and technicians.

On March 16, 2010 after 152 due diligence questions from the NTIA, KINBER was awarded \$99.6 Million to create PennREN. We are now in the process of finalizing contract negotiations with Fiber Tech, Ciena, and Foundry and anticipate the construction to begin this summer**.** Figure 4 depicts the governance model for KINBER.

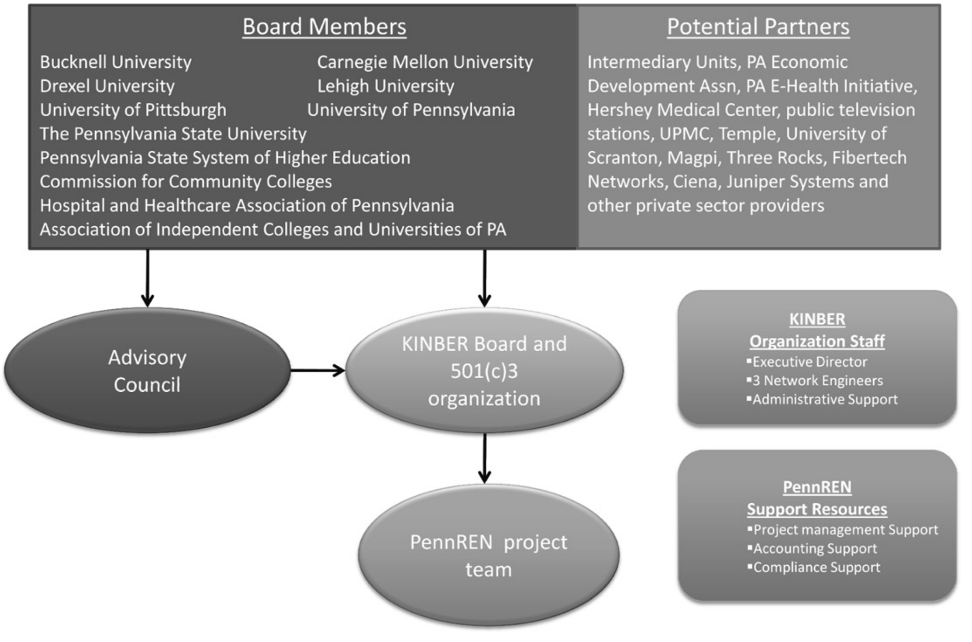

Figure 4. KINBER Governance Model

Sustainability

A critical element of the ARRA of 2009 is that the project be sustained after the 30 month construction period. In order for KINBER to pay the \$1.6 Million annual maintenance fees on 1,696 miles of fiber optic cabling they must charge both membership and service fees for the use of the network. Since there are currently no consistent connectivity options available from commercial providers, PennREN will address the great demand for broadband while offering data transport services below commercial rates. In addition, KINBER will provide Commodity Internet access to anchor institutions such as schools and hospitals at rates as low as 1/10th of what they are currently paying.

Several universities with branch satellite campuses will benefit from the transport pricing that will permit them to cost effectively unify all of their sites. And hospitals will be able to receive continuing medical education from the large medical research institutions in Pennsylvania, the United States, and the world. This will truly benefit the organizations and citizens of Pennsylvania.

Conclusion

Of the more than 2,000 applications totaling more than 5 times the available funds for Broadband Stimulus funding, the KINBER/PennREN initiative was among the first 22 selected for "due diligence" questions from the Federal Government. Although the program is not yet finished, KINBER remains one of the top monetary awards announced so far. KINBER continues to fine tune the technical design and service offerings and waits for the press release. When the network is finished, universities, colleges, grade schools, hospitals, libraries, and cultural institutions will have access to a statewide high performance network, thereby enabling their individual and cooperative goals and objectives.

A Process Oriented Approach Towards Open University Management Software

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Keywords

integrated university management, process design, internationalization

Introduction

The Hochschul-Informations-System GmbH (HIS) is a nonprofit support organization for universities and other institutions of higher education. Our primary target audience are universities in Germany, but international activities are increasing.

HIS is developing and introducing a new software generation for university management under the label „HISinOne". There are similar activities in several European countries.

In this contribution we will outline methods and tools to facilitate cooperations between these developments at various levels from process design to running code.

Is SOA the answer? What is the problem?

Many approaches (including HISinOne) aim at an integrated system with a fairly homogeneous design. They bring their own infrastructure in terms of technology, database and web services. Typically there are dedicated mechanisms for customization and maintenance (how do we handle upgrades?…). This makes it difficult to exchange parts or pick "interesting" components or ideas from other projects.

In theory any service oriented architecture (SOA) should facilitate combination and linkage of system components from different origin. This will probably not always be cheap and easy, but doable. One or more layers with the respective services from potentially different projects are combined (Figure 1).

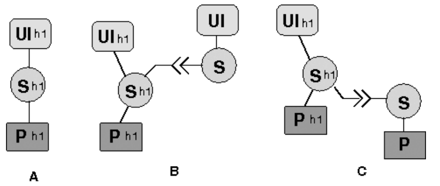

Figure 1. Service Layer Options

For this first approach we only differentiate the user interfaces (UI), service components (S) and persistence/data base (P). A simple case without any "foreign" components is shown as option A. Option B shows an additional service "above" our service, possibly implementing an alternative user interface. In option C the services of a "foreign" component are used, this component brings its own persistence (aka data base). Combinations of B and C are not unusual.

Selection of a process description tool

Before we combine services to a useful system we have to make sure that the business processes are well understood, and we have to find their counterparts in the software.

The „business" of a university is different from that of a manufacturer of material goods. This starts with the identification of "products". One can argue that the product should be "knowledge for the society". For our purposes we assume that graduates are a main product.

A closer look reveals a special „domain language". Domain processes are used to describe the student life cycle. As a picture is worth a thousand words, a graphical representation of processes is sensible.

The "world" of process design languages and tools is diversified. Some of the more common options are

– BPMN – Business Process Modeling Notation 2.0
– UML – Unified Modeling Language 2.0.

Manufacturer-specific methodologies and tools (like ARIS) are sometimes positioned as additional alternatives, but currently these proprietary tools are integrating the standard notations too. The expressiveness of the various notations is very similar, if used properly. This is illustrated for example in (Schedlbauer, 2010); note however, that our methodology is a bit different than that described there.

After some evaluations, debates and collection of experiences we selected UML for process design. This was motivated by the sustainability, availability of good free tools and usability for other design levels as well. Occasionally we hear the argument, that UML is only understandable by computer professionals and not by the domain experts (or managers for that matter). We can avoid this trap by a proper selection of the notations (we do not "throw" all 14 diagram types at the unsuspecting staff member) and a careful choice of an appropriate detail level. Some UML diagram types (like class hierarchies) are reserved for developers.

A (simplified) example should illustrate our approach. Processes can be expressed as activity diagrams in UML (Figure 2). In this case we have a simple "string" of consecutive action nodes. The small fork in the action nodes expresses a possibility to "zoom" into this node to see a more detailed description level ("call behavior" in UML speak). The important aspect of a changing role is expressed in "notes" here.

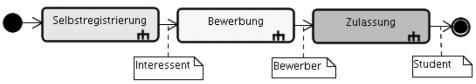

Figure 2. Activity diagram example

What are some lessons learned? It is important to take the opportunity to explain and discuss the processes with all involved stakeholders. Sometimes we find existing process documentation done with alternative process description methods or have to deliver other formats. This is easier by following some common guidelines, for example the flow of activity is generally from left to right to facilitate easy comparison, horizontal "swim lanes" are used to illustrate actions by different participants of the process. Our current tool selection for UML is "astah" (formerly "Jude") (http://astah.change-vision.com), the professional version is advisable for certain diagram management tasks; otherwise the community version is sufficient.

Getting process designs "internationalized"

The diagrams from the last chapter are not too useful for those trying to make sense of it in a non-German speaking country. Real systems have thousands of nodes and labels, so a manual translation is not very attractive. This is compounded by a significant amount of changes over time; each change may cause a correction to all "translated" diagrams.

Our current new software systems already have arrangements to provide user interfaces and database content in multiple languages (internationalization and localization). It would be nice to have something similar for the process designs and other high level documentation. This would be an important first step to bridge the gap between solutions in different countries (and possibly different "higher education cultures").

UML tools typically support export and import of the open representation XMI, which stands for XML Metadata Interchange (MOF 2.0 / XMI Mapping Specification, v2.1.1, Object Management Group (OMG), http://www.omg.org/technology/documents/formal/xmi.htm). We should note that the XMI standard has found some well earned criticism, because the results of exporting XMI from one tool and importing into another are often less than optimal. For our purpose this external representation of process designs is "good enough".

Next we need a multi language glossary. This is currently implemented as a wiki article for easy maintenance. Other more sophisticated concepts like GNU gettext with "portable objects" are possible alternatives here (GNU gettext, http://www.gnu.org/software/gettext/).

With these components process representations can be translated with proper tool support (Figure 3).

Those terms without a match in the glossary will be kept in the original language. These would be candidates for inclusion in the glossary. Longer explanation texts are not handled well; these are largely avoided by including references to other documentation where appropriate.

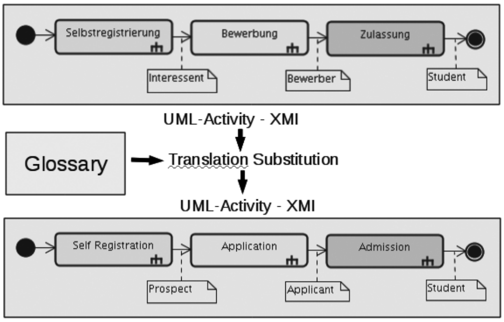

Figure 3. Internationalization support for process designs

This internationalization is not tied to a specific tool or even UML and should be usable with any XML representation (but of course different tools and representations are always a source of additional complications).

Handling other documentation

The process flows are important, but often there are textual documents necessary as well. These typically include business concepts ("synopsis") and collections of business rules.

How do we handle these textual documentations? A first try with automatic translation services was not very encouraging; many important concepts were no longer understandable in the translation. If we do manual translation, we have to find a way to handle changes. If the "original" is changed, there should be a well defined process for maintaining the correct translation. Currently the original documentation consists of linked wiki articles. The translations are wiki articles too with a fixed naming convention to associate these with the "original". Most wiki engines (we use mediawiki) have functionality for time stamping of changes and version comparison. This helps to identify those translations needing an "update". The process is currently manual at fixed times, but automation seems possible.

Getting the pieces together

Now we should have a better mutual understanding of "what the university **and** the software do". In the next step we will evaluate the potentials to combine parts from different origin.

The findings presented here come from our own practice in introducing the "new" HIS system. In many cases it is not practical or not intended to change everything at the same time ("big bang"). A stepwise approach is often regarded as the more sensible option.

Therefore it is important to identify process chains with clean and "slim" interfaces to the surroundings. One such example is application/admission with a "turning point" when the applicant becomes a real student (which may be handled in the same or another administration system).

Preferably the process and information flow should have exactly one direction. A counterexample would be if a student can apply for participation in a course either in the study planning system or in an supporting e learning application (with the hope that this is automatically consolidated). Such "process designs" are complex and error prone.

Depending on the actual procedures and performance characteristics we use a range of interworking options:

- Web services
- ETL
- Dedicated exports/imports.

A second dimension is the frequency and the initiating event. Often a process event in the source process triggers the transfer. The most simple case is an event caused by the user interface (the user finishing an interaction). Special attention is needed here to preserve the responsiveness of the user interface; potentially time consuming operations are better scheduled in the background.

The other case are transfers triggered periodically at fixed times or time intervals. This is certainly needed for deadlines set by the administration. For more time consuming operations (those involving all students, all applicants…) this may also be the most sensible solution.

An additional thought should be given to robustness and repeatability of transfers. An event based interface – which transfers only changes – looks attractive in terms of data volume. But if we "miss" an event for whatever reason the consistency is in danger. On the other hand if we transfer the same persons multiple times we do not want to end with multiplying persons. This latter problem is solved by establishing a common identity for all objects, then if the same object is "seen" by a system the second time only the attributes of the object are updated.

Web services

The first alternative uses the well established SAOP protocols. Our implementation is based on the Apache Axis 2 library.

For each process coupling we have to decide, which part is the web service provider and which one is the consumer. Web service provider interfaces typically expose the same services as the user interface. That way the full business logic is available to web service clients (Figure 4).

For services with a high volume of parameters we have to account for the overhead caused by the XML serialization/deserialization and SAOP protocol handling. We observed a factor >100 in terms of memory footprint and elapsed time compared to an equivalent local method call.

In a number of cases the REST paradigm (Representational State Transfer) with a resource oriented interface, typically without the SOAP layer, is more appropriate.

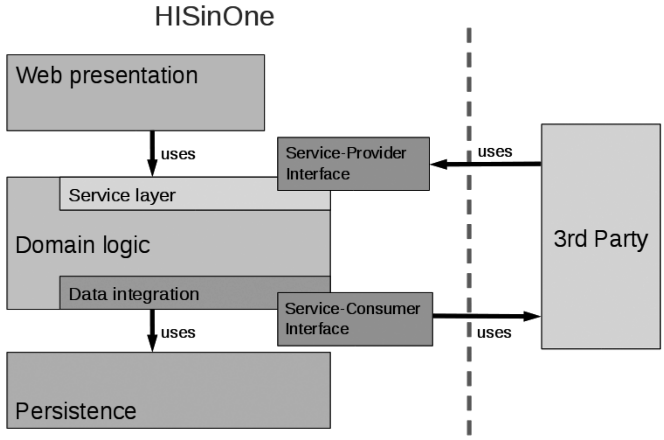

Figure 4. HISinOne service architecture

ETL — Extract, Transform, Load

In the world of data warehouses and business intelligence solutions a similar interworking challenge is well known. An operational database is often highly optimized for fast and consistent transactions with no redundancy and good normalization. For analysis and reporting this may not be the most favorable structure. We would rather have a denormalized data base with time series of historical data.

A solution to this problem is a separate database for the data warehouse and a process for transferring the "interesting" data to a data warehouse. In this process appropriate transformations like denormalization or anonymization are included.

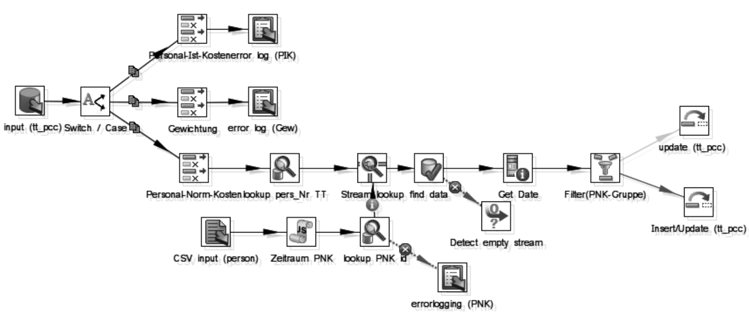

Figure 5. Example of an ETL design with PDI

There are a number of commercial and open source solutions supporting this paradigm of "extract – transform – load" (ETL). We selected the open source tool "Pentaho Data Integration" (PDI, formerly known as "kettle") (Kettle Pentaho Data Integration, http://kettle.pentaho.org/). The ETL process is designed with a graphical user interface, which also serves as a nice documentation, for an example see Figure 5. Source and destination of data objects can be data bases, but other representations (XML, CSV, xls…) are supported as well.

Many otherwise rather complicated operations have very simple expressions, for example "insert or update rows in a database based upon keys" in an output data base.

Dedicated exports/imports

This category caters for interfaces to legacy systems, which should be kept stable and which may need a certain amount of manual monitoring. An example is the transfer of a list of examination results from a software based examination system to the grade registration part of student examination management. Here the equivalent of personally signing a list of grades by a faculty member is often required.

Student administration and human resources can fill and update an external identity management system or simply an LDAP server.

The "big picture"

The high level functional architecture of HISinOne should illustrate the findings from the previous chapters (Figure 6). The integrated university management system currently consists of four segments. Each segment contains a number of high level processes (which we also call "product areas"). The "borders" of these product areas are prime candidates for potential linking points to alternative components. At this level we cannot express "all" process and data flows, as this would render the diagram incomprehensible.

At the next level there are more detailed descriptions of the data objects "traveling" between the components. We are still evaluating a number of representations for a database independent description of these aspects.

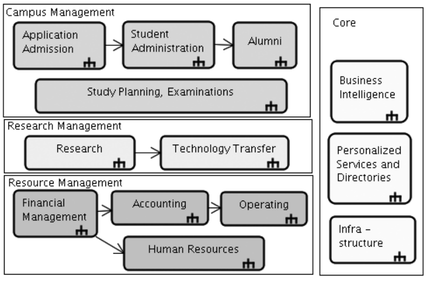

Figure 6. Functional architecture of HISinOne

Business models for cooperations

One of the prime properties of our service for the universities is sustainability of the developments. It is a myth that open source software is created or supported only by enthusiastic volunteers in their spare time. Even as a non-profit organization we need a solid business model to support future developments and continued service, which both call for a certain capacity of qualified developers, QA, customizing and support engineers.

Some of the newer HIS developments are licensed as open source in the strict sense, the rest is distributed (including source) via contracts which should ensure a fair participation in further developments. This is usually done in the form of a support contract, which determines a minimum work volume depending on the size (number of students) of the institutions using the software. Shared developments have the additional option of reciprocity.

Conclusion

Useful cooperations require more than sharing code, they require sharing the understanding of the involved processes. We hope that the suggestions and methods shown here will improve cooperation potentials and initiate more activities towards open university management solutions in Europe.

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New Challenges

Collaborative Teacher Work and Active Methodologies in Higher Education. ICT as a Cross Tool

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Keywords

collaborative teacher work, active methodologies, higher education, ICT

Abtract

The new requirements related to the implementation of the European System of Higher Education involve – regarding both teaching staff and students from university spheres – the need of methodological, curricular and assessment reorganization.

The experience presented here begins from a research set into motion within the heart of a team of teaching professionals in the Faculty of Pedagogy in the University of Barcelona and its main objective is the proposal of changes in the existing teaching-learning processes, focusing its attention on the students' autonomous work and collaborative work among teaching professionals. These changes have involved redesigning our current basic objectives and competences, proposing a new teaching methodology, new collaborative-work mechanisms among teaching professionals and new viewpoints in teaching-learning evaluation.

Through non-participant observations within the classroom, discussion groups with students, analysis of the students' teaching files and teaching professionals' reflexive diaries, we are currently following up both the results of the project and the satisfaction of both the students and teaching professionals involved regarding the changes conceived and proposed.

The present research is contributing interesting data about the new ways that should be followed by university teaching within the frame of the challenges involved by the application of the Bologna Process.

Background experience

European universities are currently immersed in the process of "European Convergence" which shall lead to the formation of the European Space for Higher Education in 2010. As pointed out by the "Message of the Convention of European Higher Education Institutions", developed in Salamanca in March 2001 (www.unavarra.es/conocer/calidad/pdf/doceur4.PDF), the development of the European Space for Higher Education is aimed at providing Europe with a homogeneous, compatible and flexible university system which allows European undergraduates and graduates enjoying of greater mobility as well as providing the European University System with higher transparency and quality levels by means of evaluation systems which make it attractive and competitive at international level within the current globalization process.

The European Credit Transfer System (ECTS) has been proposed within this context and putting it into practice involves focusing the teaching-learning process on both contents and the effort necessary to learn them (Font, 2003, p. 2). In some way, the prevailing conception of learning is changing and the student is the element that shall become the axis in such change.

Within the framework of new guidelines in the Bologna Process, changes involved by this new vision of the teaching-learning process imply generating methodological changes that do not only affect what takes place in the classroom but also involve a new way to reorganize teaching work. Thus, this new vision involves reformulating objectives, contents, methodologies, evaluation, etc., but it especially involves a new working methodology for teachers. Within this context, teaching teams appear as true agents for planning, developing and evaluating the teaching process, while their efficiency directly influences the teaching-learning process.

Taking the previous consideration into account, the experience put forward in the present paper shows the changes introduced into a teaching team with the aim of adapting a core subject in the Faculty of Pedagogy to new demands in the European Credit Transfer System. Precisely, it proves that the teaching staff involved in this subject needs to count on academic, methodological and evaluation coordination and organization.

Our particular contribution is focused on the joint reorganization, coordination and planning of the teaching staff involved in a core subject in the Degree on Pedagogy through its adaptation to the European Credit Transfer System with the aim of improving applied teaching methodology.

The present project is part of a set of actions completed by the consolidated research group FODIP (Teaching Training and Pedagogical Innovation, research group no. 2005SGR00713), acknowledged as a consolidated innovation group by both the Catalonian Regional Government and the University of Barcelona.

Up to date this subject was given by 5 teachers in morning- and afternoon-groups. In order to achieve the objectives established in research, 3 more teachers have been added, so that the teaching team for this subject includes 8 teachers.

In spite of the fact that pilot experience is carried out only with this teaching staff and in this particular subject, obtained results attempt to contribute knowledge, processes and working methodology transferable to other similar subjects within Teaching Sciences and Pedagogy.

Main goals

The aim of the present Project is researching, designing and developing new working methodologies and teaching strategies that allow adapting the subject "Formación y Actualización a la Función Pedagógica" (Degree on Pedagogy) to the European Space for Higher Education. With that purpose, attention is focused on the **needs of reorganization and teaching planning**, as well as on the reformulation and extension of **professional training and development of the teaching staff involved**.

Specifically, the main aims of this project are:

– Designing and elaborating innovation proposals aimed at changing teaching methodology by promoting students' autochthonous and semi-in-classroom work in the core subject "Formación y actualización en la función pedagógica, en la enseñanza de Pedagogía", following the guidelines of the new European Credit Transfer System (ECTS).
– Preparing students to face the education challenge according to the new European Credit Transfer System (ECTS).
– Raising awareness, reorganizing and training teaching staff in the field of Training in the Department of Didactics and Educational Organization in the University of Barcelona for imminent curricular and methodological change within the university context.

The achievement of these objectives is currently being carried out through:

– Planning and coordinating the 8 teachers developing the subject "Formación y actualización en la función pedagógica" in three groups of students (two groups in the morning and another one in the afternoon).

- Redesigning the subject's learning objectives according to the academic and professional competences students must achieve at the end of the year according to the professional profile expressed in the curriculum.
- Developing collaborative work among teaching professionals and students and support systems through the use of ICTs, and promoting the creation of teaching cooperative structures with the aim of promoting students' learning autonomy and effort. In this sense, we attempt to develop collaborative and dialogic learning based on teamwork.
- Looking for, adapting and implementing active methodologies through specific strategies such as collaborative learning, autonomous learning, self-evaluation, problem-based learning, case study, etc., always counting on the support and aid provided by the use of technological resources.

Participants, instruments and proceeding

The experience presented here is being carried out in the subject "Formación y actualización de la función pedagógica", a core subject in the third year of the Degree on Pedagogy.

As a summary, it can be stated that:

- The experience involves 8 teachers, some of whom had already given lessons in such subject and some other had not.
- The main idea of the experience is that the 8 teachers get involved in subject teaching, giving their lessons co-ordinately in the three groups of students (2 morning groups and 1 afternoon group), which implies that the three groups are given lessons by all 8 teachers at different times.
- With that purpose, we have carried out an important effort to coordinate and distribute the different contents of the subject, especially emphasizing the introduction of participative methodologies focused on students' learning.

In this sense, the experience is currently being developed and shall last for two years (2007–2009), being subdivided into several relevant moments or stages.

Teaching-staff internal training and subject re-planning

Such training has been centred on the analysis of active and cooperative methodologies focused on students' learning. We have debated on the methodologies which adequate most to the objectives we attempt to achieve, the size of our student groups (this experience is applied to three groups: the first includes 96 students, the second has 72 students and the third includes 63 students), atmosphere in classroom, time available, students' characteristics and our abilities and preferences as teachers.

Some successful experiences and good practices developed in other Spanish universities have been studied, while emphasis is especially drawn on the involvement they mean from the viewpoint of teaching planning and development. Stemming from such analysis and in the specific case of this subject, counting on 8 participating teachers has underlined a first finding: the need of coordination among teaching professionals was raised as an essential requirement not only to guarantee correct follow-up of the teaching process but also to propose minimum common axes both at methodological and content and evaluation levels among involved teaching professionals.

Specifically, regarding methodology, several strategies aimed at promoting students' participation have been considered, among them: Project elaboration, directed study, quick discussion, forum, demonstration, role play, case method, critical incident, organization in advance, flash, simultaneous dialogues, etc.

Likewise, we are completing a series of actions aimed at training teaching professionals taking part in this experience, bearing in mind they have different degrees of teaching experience (the group is formed by a Professor, a full-time teacher, an assistant teacher, an associated teacher, a support teacher and three novel teachers (pre-doctoral scholars), which includes exchange seminars among teaching professionals involved in innovation and other training actions focused on improving university teaching within the framework established by the European Space for Higher Education.

From certain principles agreed upon by all teachers and reflection on the experience in this subject in previous academic years, the subject has been redesigned, readapting its teaching plan according to ECTS, reformulating proceeding for student grouping and elaborating teaching and learning activities and didactic resources as appropriate as possible for the way we understand teaching and learning. We have also established a new system to follow up students' development as well as new criteria and a new evaluation model both for students and teachers.

This process has been very complex, since it has demanded us redefining the subject's learning objectives according to the developed methodology and the academic and professional competences students must acquire. Furthermore, we have also improved teaching methodologies to bring activities nearer to professional spheres, promoting learning autonomy, effort and collaborative work among students both in classroom and virtually.

With that purpose, the subject is designed with 6 predominating modalities:

– *Theory-practice sessions*: master sessions in classroom at which complex issues are developed. Together with expositions, practical activities are developed with the aim of strengthening theory.
– *Reflection sessions* are similar to seminars and students reflect on developed theory, frequently through the situations and experiences lived by the students themselves.
– *Construction sections* are similar to workshops, at which practical activity predominates.
– *Sessions of practical activities*: in which students complete activities individually and working in reduced groups, are aimed at monitoring their evolution and detecting possible problems.
– *Sessions of autonomous work*: students read and complete activities individually or working in reduced groups. In these sessions students build their understanding hypotheses on developed theory, these hypotheses being subsequently validated, clarified or extended by their classmates and teacher.
– *Synthesis sessions*: students relate concepts and principles, allowing teachers detecting possible conceptual misunderstandings, gaps and confusions, clarifying and extending connections among the different aspects tackled.

The following chart describes each of the modalities implemented within this educational innovation and the percentage of theory/practice it entails:

Modality	Theory	Practice
Theory/practice: master sessions, in-classroom sessions including some kind of practical activity	50%	50%
Space for reflection (seminar)	60%	40%
Space for construction (workshops)	40%	60%
Practical activities	0%	100%
Autonomous space	0%	100%
Topic synthesis	0%	100%

All the previous has shaped a new pedagogic-didactic approach in this subject adapted to new ECTS and in agreement with the guidelines marked by the European Space for Higher Education.

Subject planning was carried out attempting to respect the inclusion of 33% of in-classroom credits, 33% of semi-in-classroom credits and 33% of autonomous work, as we attempt to promote reflective and experiential learning.

The 33% of credits corresponding autonomous-work sessions shall be devoted to autonomous reading and individual reflection, relation, analysis and questioning tasks involving an increasing degree of difficulty.

In semi-in-classroom sessions, tasks are intended to be shared among students to make them contrast and deepen into their understanding hypotheses.

Finally, in-classroom sessions are aimed at clarifying, extending and validating the students' understanding hypotheses regarding different contents in the subject.

Implementation and development

At the moment of implementing and developing this experience, different key points directly influence the teaching team's planning and organization.

After designing and planning the subject jointly, its implementation began with three student groups counting on a total number of 229 students, which entails close coordination among teaching professionals in those aspects regarding planning, contents, objectives, methodologies, space, timing, curricular materials and learning evaluation. As a support resource for learning, we have made use of the 7.0-version Moodle Platform, which allows supplementing in-classroom sessions with autonomous-but-guided learning.

Teaching-staff organization. Functions

For implementation, teaching organization has been planned according to the following functions:

– A coordinator in charge of the design and implantation of the whole subject.

– A student-group coordinator as a constant reference for students. As a group tutor, this teaching professional has a minimum teaching load of 6 credits (out of the existing 9 credits) and works as a contact point for students and a connection for the remainder members of the teaching team.
– A person responsible for the thematic block (one per block, out of a total number of 4). This teaching professional works on the follow-up of the different sessions in each topic (both in-classroom or through the reports each teacher completes regarding session development), collects teaching material for each topic and elaborates and evaluates a synthesised working-proposal connecting all thematic blocks.
– Different teaching professionals for teaching implantation: 8 teachers were assigned to give the subject according to the credits available for each of them.
– A person responsible for virtual-platform coordination, independently from the participation of all teachers in forums, virtual activities, comments, etc.

Communication mechanisms within the teaching team

A key question for the implantation of this experience is the establishment of communication mechanisms within the teaching team. These mechanisms have mainly been aimed at guaranteeing correct development and follow-up of different sessions and, especially, at detecting any possible mismatch at level of contents, activities, etc.

The main communication and follow-up mechanisms during the first year of implantation have been:

– **Periodical meetings**: Including the whole teaching team, it is to emphasize the following two key factors:
  • On one hand, the stage devoted to subject preparation, formation and design. In this case, certain part of this work was completed by each teaching professional autonomously and another important part of the work was completed through teamwork by means of monthly meetings throughout the year previous to implantation.
  • On the other hand, the implantation stage: meetings at this stage took place at different levels: Plenary (once every 15–20 days) and parallel (teachers in charge of groups, teachers involved in each topic, etc.).
– **Partial reports**: Each of the teaching professionals giving lessons linked to each thematic block elaborate a brief report of each session, which is handled to the remainder members of the teaching team. Such report collects session follow-up and possible incidences. At the end of each thematic block (4 in total), a brief synthesis of the main ideas regarding student follow-up is completed.
– **Communications among group coordinators**: Once a week virtual communications are made among group coordinators to comment questions related to group operation, incidences, working rhythms, etc.
– **Assistance to peer sessions.** One of the tools that have been highlighted as key to coordination within the team is attendance at lectures of other team teacher's. Knowing what contents has been developed, how a particular strategy is implemented or what final evaluations are made in one session, it is certainly a key to both individual and group development of the teaching staff involved. This helps to avoid overlaps, gaps, inaccuracies, or also strengthen links and anchors to ensure the consolidation of con-

tent throughout the sessions. Logically, this means an important investment in time throughout the semester.

Information on the working process of the teaching team, as well as on the feedback provided by students, is collected from meetings, reports and communications among coordinators.

Practical training and data collection

Throughout the first year of implantation of this experience, we have drawn special attention on the teaching team's practical training, especially that of those teachers who had previously given either partial or no lessons in this subject.

This internal, practical training was specified through non-participating observation of different members of the teaching team. In this sense, observation and follow-up sessions were organized, in which one or more teaching professionals attended lessons given by counterparts. Such observation had different objectives:

- On one hand, collecting the necessary information to complete content follow-up; that is, the attendance of other teachers who usually give lessons on the same topic assures content coordination (avoiding information overlap and gaps, task coordination, etc.) and helps maintain the line of thinking in each content block at all times.
- On the other hand, visualizing the application of certain participative methodologies, both by those teachers who had not ever put them into practice and those who had. In this sense, it is about employing new teaching strategies from direct application.
- Finally, facilitating opinion exchange and valuation regarding the teaching practice developed. Specially in those teachers who had not previously developed the different strategies, deep analysis of their action – evaluating positive and improvable aspects with the aim of fostering the students' meaningful learning – was completed.

During the whole process of implantation of this experience, the process of information collection included non-participant observations in classroom, discussion groups with students, reports from periodical meetings and students' learning file. All this information shall allow us analysing process development in depth: students' perceptions, teachers' reflections, positive and improvable aspects, future challenges, etc.

Some starting conclusions

After two years devoted to the implantation of the innovation process, our first results are highly illustrative of the changes implemented in our everyday teaching practice. According to the initial conception of a new approach for the subject (the application of active methodologies in the classroom and the promotion of collaborative work among the eight teaching professionals taking part in this subject), our first results prove interesting achievements that can be used as a starting point for future steps.

Subject's approach and the application of active methodologies in the classroom

As described previously, the team proposed a subject redefinition that comprised from the determination of the subject's specific competences to the applied teaching methodology. Obviously, these changes were considered very differently by students. However, in any case, according to their comments, they have been widely well-received. Among their comments, we shall highlight those focused on the active methodology and promoted participation in the classroom, which have facilitated their involvement in the learning process:

- G1A3-M2: "*Participation has been high. In the end, we are the ones to follow the subject, support the teacher, and receive his/her help to draw our own conclusions. We have carried out a joint teacher-student interaction work*".
- G1A1-M2: "*I believe that spoon-feeding us is not an appropriate learning strategy, since we shall face these problems on our own in our professional career soon. Now you do it yourself, you face it and have to deal with it, so you value it*".

On the other hand, it should be taken into account that the subject "Training and Updating in the Pedagogical Activity" is aimed at training and teaching teachers (i.e., it gives rise to isomorphism between the physical location of the training and that of the professional practice which training is aimed at and focuses on). That is, our method became the object of training contents. If we bear in mind that reproduction dynamics may sometimes occur, this situation is undoubtedly beneficial, as long as 1) there is a high coincidence level between the teacher's contents and arguments, and the activity developed daily in the classroom; and 2) students (future teachers) are invited to take part and involve in the deliberating reflection on the training situations developed. As two students pointed out:

- G4A2-T1: "*Leading by example is an interesting idea. Some subjects deal with participative strategies and teachers only turn to master classes and a set of standard definitions. It is not this way here, since we deal with reflection, reflexive teachers, and have also been forced to think by ourselves and analyse both out and in the classroom. We have also observed this in some of the subject's teachers. I have really enjoyed experiencing contents' strategies throughout the academic year*".
- G2A2-T1: "*It is all about this idea you have highlighted so much that the method is part of the contents. It is not all about talking, but contents have been observed in teachers and we have experienced them ourselves as future teachers*".

Teachers' collaborative work

As commented previously, collaboration among teachers was one of the key issues regarding innovation. The involvement of the eight teachers (with different educational levels and experience) has undoubtedly been rather enriching. We shall now highlight several comments made by students:

- On one hand, the whole re-planning of the subject allowed us establishing an internal collaboration mechanism based on collaborative decision-making processes. Participation in this process gave rise to a sense of involvement in both junior and senior teachers.

– In turn, contrast among senior teachers' expertise and junior teachers' dynamism involved and promoted mutual interchange and learning in many aspects.
– On the other hand, re-planning the teaching methodology posed the need to revise the experience itself and contrasting at all times the practice itself and its conception with those developed elsewhere. Undoubtedly, this contributed professional enrichment and development.
– Finally, the put into practice of new methodologies involved incorporating new mechanisms, tools and viewpoints on the role of teachers and their everyday teaching practice. This task involved several difficulties, since complementing different teaching styles, or changing pre-established action schemes or routines is no easy task. Perhaps the main challenge we faced was being willing to pay attention to "new teaching ways", sharing and even yielding to ideas and decisions which – in spite of questioning our conceptions and habits – led to improvement for the subject, students and teachers. Anyway, in spite of reluctance, this reflects our openness to new perspectives in university teaching practice.

Influence of eight teachers on the subject's teaching and development

As pointed out previously, all teachers in this subject have worked with the three groups of students in this subject, completing different tasks and functions. All of them, with greater or lesser participation, have taught the three groups. This experience has been one of the most rewarding aspects for students, since it has allowed them observing different teaching/training styles and ways to face teaching complexity:

– G1A3-M2: "*It is interesting to observe eight different teachers, since they contribute their particular and personal teaching style: serious, straightforward, etc. Your teaching model shall depend on the typology of the group you are teaching to*".
– G2A4-M2: "*I think it is a positive experience. Although eight might be too many teachers, this high number has enabled us to observe different teaching styles and how they solve or give a response to similar situations*".

Even though, the responsibility of a large number of professionals teaching the same subject to the three groups involved some schedule and subject-planning problems, as well as certain discrepancies regarding the teachers' indications on subject organization and development. We certainly set off from a closed schedule, in which the time available for each of us to develop a topic was predetermined before the onset of the subject. Timing was considered an important issue and given relevance, since otherwise topics and teachers could overlap. Naturally, this organization of the teaching staff has sometimes reduced the possibility of improvising in the classroom or prolonging a topic if the current teacher believed it convenient.

On the other hand, teachers' indications did not always agree, especially when related to learning evaluation, an aspect mentioned in a discussion group:

– G1A6-M2: "*I think there was no communication among you (teachers) in Topic 3, corrected by Professor X. Our perception as a group was that we focused more attention on* *the first and second parts than on the final reflection, while reflection was focused on these 1st and 2nd parts, thus proving this lack of communication*".

According to the students, another disadvantage of such a large number of teachers in the classroom was the absence of an unequivocal reference and, consequently, the difficulty to set close relations with the teachers.

– G2A1-M2: "*I think that disposing of a large number of teachers is highly enriching, since they offer you different teaching styles but, at the same time, this high number of teachers involves limitations to create close confidence links with these teachers, since teaching periods are shorter, thus breaking the dynamics of personal student-teacher relations*".

To sum up, we can concluded by saying:

– The complexity involved by redesigning and re-planning an already-existing subject to adapt it to the European Space for Higher Education has been shown up, understanding such re-planning from a collaborative and collegiate viewpoint. The need of collaboration among 8 teachers (with different professional trajectories, experiences, etc.) shows up the need to combine visions, objectives and assumptions regarding the teahing-learning process which shall be promoted in students.
– The adoption and implantation of participative methodologies in classroom has involved providing students with specfic weight in the learning-teaching process. Rethinking the training methodology has allowed both teachers and students taking responsibility on the specific weight each of them should have in such process, which shall improve university-teaching quality and therefore undergraduates' learning thanks to the development of a teaching and learning participative methodology based on students' autonomy as well as on collaborative work. The use of this kind of methodologies is being supplemented with new technologies, especially with the use of the Moodle learning platform.
– Thirdly, regarding aspects referred to the subject's teaching plan, it becomes necessary to emphasize that its joint elaboration has allowed revising and in some cases adjusting objectives, contents, methodology, space, timing and learning evaluation. Given the new ECTS conception, in which in-classroom and autonomous learnings constitute a unity, different articulated curricular materials have been reelaborated and elaborated for students' collaborative and autonomous work.
– It has also been shown the need of a strong coordination aimed at improving the process of internal (within the teaching team) and external (for students) communication. All teachers are currently working with the three groups with different tasks and responsibilities, which involves previous joint reflection on the learning objectives planned for students and on the didactic proposals developed to achieve them.
– Finally, related to the previous point, it is necessary to point out that the joint and coordinated work of 8 teachers with different individual profiles (teaching scholars, assistants, associates, full-time teachers and professors) has generated and generates a true space for professional training for university teachers. This space allows exchanging visions, experiences and practices, allowing rapprochement among novel, intemediate and experienced teachers, and certain reflection on the conception of the teaching practice in general and personal teaching practice.

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Cloud Computing and Its Impact on European Universities as Developers and Consumers of Technology: A Call to Action from EUNIS

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Keywords

cloud computing

Introduction

This paper is an overview of issues in cloud computing from a European University perspective. It recommends some strategies and solutions for European Universities as both consumers and innovators of technology solutions, but does not recommend specific vendors or solution providers. This paper is also a call to action from EUNIS as the IT representative body for the European Higher Education community.

Abstract

Cloud computing had been identified as one of the major IT megatrends for the upcoming decades long before it grew in interest as a result of the current economic crisis. Cloud computing will shift the economic landscape of information and communication technologies to the same magnitude as did the first wave of the Internet. It will profoundly change the way Universities consume, deploy, and develop technology. It will allow digital technology to penetrate all dimensions of the economy and society. On the one hand, it facilitates access and empowers individuals, the public sector, and small enterprises to participate in the information economy on par with large companies. On the other hand, it may concentrate a critical piece of socio-economic infrastructure in the hands of a few large cloud providers.

What are Clouds?

"Cloud computing" has become a generic umbrella term for flexible, IT-related services – such as storage, computing power, software development environments, and applications – combined with service delivery through the Internet to consumers, Universities and businesses. The main innovation is that the IT infrastructure no longer lies with the user, meaning that even inexperienced users can access these services. The key feature of all of these service offerings is that they break up the previously monolithic ownership and administrative control of the assets in the various technology layers and distribute them across multiple entities. In effect, "cloud" is an abstraction for the complex infrastructure of the computing resources – their accessibility and provision cannot be traced by the user. They appear as if they were "in a cloud".

What is the economic impact of cloud computing?

Clouds provide Universities with major opportunities for new business and educational models by restructuring the value chains in the information and communication industry. In addition, cloud computing dramatically changes the dynamics for new service offerings, since it considerably lowers the entry barriers for newcomers by shifting from huge initial capital investments to pay-what-you-use business models. The demands that the visions for the "Internet of services" and the "Internet of things" place on the infrastructure can be met most economically by the cloud computing model.

In the commercial sector it is especially small, innovative companies who will use cloud computing as a scalable service. Large companies might be forced to use cloud computing more often to reduce operational costs, particularly those of their IT systems. Using cloud computing will certainly give companies a competitive edge.

What are the opportunities and risks of cloud computing?

Using clouds is more efficient and more flexible than maintaining internal IT departments and may lead to a new wave of outsourcing. The biggest advantage lies in a very low entry hurdle for all players – including Colleges and Universities – and flexible consumption. Furthermore, clouds offer a very affordable provisioning of IT services. Small businesses, in particular, wanting to launch innovative business ideas, and Universities incubating businesses, would benefit the most from these advantages. Moreover, resource sharing via clouds offers overall optimized energy usage.

Reservations about cloud computing derive from concerns about dependability, vulnerability, and lock-in to providers, as well as security-related issues when there are no longer true internal systems. There is no uniform service-level agreement (SLA), and the third-party cloud providers involved are dealing with sensitive data such as student academic and financial data. Indeed, hardware breakdowns, loss of data, and a critical reduction in performance have occurred in today's cloud-computing offers. As a result, several users are choosing to combine internal IT and cloud computing.

In general, the question that arises, especially in Europe, is how national privacy and security standards can be ensured in a global cloud environment. So far, a few cloud providers have addressed national privacy and security standards by establishing national or regional hardware clouds. However, in the long run, the global harmonization of national privacy and security standards would be desirable in order to exploit the full potential of cloud computing. In terms of what cloud computing means for an information society as a whole, there are three aspects of particular concern from a European perspective, namely, dependence, vendor lock-in effects, and missed opportunity.

Dependence

Cloud infrastructures play the same role and have the same importance to an information economy as did roads and electric grids to the classic industrial society. They create a deep user dependence on the reliability and availability of the supply and accessibility of the service while establishing a balance of power between providers and consumers. Since cloud computing, by its very nature, is global, there are no short-term concerns of any geographic region being at a disadvantage despite the current U.S.-dominated field of providers. At least low-level interfaces for hardware clouds are reasonably standardized, and there is a healthy level of competition. Still, the European Higher Education community should strive to develop hardware cloud infrastructures, since this will become a strategic asset in the digital economy. Moreover, the European Higher Education community needs to be much more active in creating development and application clouds regardless of underlying hardware infrastructures.

Vendor Lock-in

The second concern of cloud computing is lock-in of end users, particularly into proprietary development environments and dependence on single vendors. So far, no current cloud provider has achieved a dominant position. In addition, some of the big U.S. players are pushing for open standards to foster interoperability between clouds and, hence, to reduce lock-in effects to any particular cloud provider for small and midsize businesses. Many requirements that are met by in-house-deployed services regarding security, reliability, and interoperability still need to be fulfilled when these services are provided by a cloud. The *Open Cloud Manifesto* outlines an approach to ensure openness and interoperability in cloud computing based on industry-driven global standardization.

Missed Opportunity

On the consumer side, Europe generally (not only the Higher Education space) lags behind the United States both in actual uptake and in the ecosystem required to rapidly take advantage of clouds, potentially creating the largest risk by missing the mostly positive impact that cloud computing can have on Higher Education in general. We recommend targeted action to foster education about the opportunities and pitfalls of cloud computing and to provide a regulatory framework around clouds that ensures privacy, dependability, and a fair distribution of power between providers and users.

Recommendations

Companies participating in the cloud community recommend that policy makers keep regulatory intervention of cloud computing to a minimum at this stage in order not to hinder the development of this emerging market. However, the European Higher Education community could pursue the following actions:

- Launch an economic study on the global trends in cloud computing and the respective challenges and opportunities for the European Higher Education space.
- Launch University councils with all relevant stakeholders on the risks and opportunities of cloud computing, in particular Colleges and Universities of all sizes.
- Leverage Research and Development instruments of Universities for the development of cloud computing in the European Higher Education space.
- Leverage European Union programs to promote the effective and secure use of cloud computing by small and large Colleges and Universities.
- Encourage the public sector in Europe to become early adopters of cloud computing.

The history of cloud computing

Cloud computing builds on technological and business trends that have been around for several years. On the technological side, key drivers are grid computing, which was originally devised for cooperative resource pooling for science applications, the virtualization of storage and computing resources, and the ubiquitous availability of cheap, high-bandwidth connectivity.

Grid computing distributes available work to idle computers dynamically instead of dedicating a particular resource to a specific function. In the same way, the virtualization of storage and computing resources can slice up physical IT assets into virtual portions that can then be securely provisioned to users. This provides the necessary flexibility and security to make the services offered affordable for providers. Europe has played a leading role in grid computing in the past with its e-science infrastructures and projects such as Enabling Grids for E-sciencE (EGEE). The European strategic research agenda on business grids, developed within the Networked European Software and Services Initiative (NESSI) grid project, paved the way for bringing grid paradigms to the world of services – thus being a forerunner of the cloud paradigm. This agenda is currently being executed and extended on issues regarding reliable engineering on complex commercial cloud workloads – with projects such as RESERVOIR and SLA@SOI – in addition to broad Internet-of-services scenarios piloted in the German lighthouse project THESEUS.

On the business side, the ongoing decomposition of value chains in all industries and the transformation of business networks have led to an increased demand for flexible delivery and consumption of information and communication services. In the software industry, the key enablers of this tendency were a shift of licensing and business models for applications, such as the availability of open-source software, software as a service (SAAS) and on-demand software.

Consumers of cloud services can be even more flexible, scaling their resource consumption up and down very quickly. However, services are not yet being tailored to take advantage of clouds; this is not yet widely practiced as a proper engineering discipline in the technology industry.

The company that jump-started the entire notion of cloud is Amazon.com Inc., a large U.S. retailer that invested in making a service offering based on a cloud-computing infrastructure. Amazon started to offer Web services in 2006 to provide companies of all sizes with an infrastructure – Web services platform in the cloud. Today a number of additional large players have entered the field – Google, HP, IBM, Microsoft, and Sun – with offerings of different kinds, at different levels, and addressing different user groups.

Cloud-computing environments will build the infrastructure for the new Web-based service industry. As an application layer on top of the cloud, the Web-based services will transform the service sector into the biggest and fastest-growing business sector in the world. Accordingly, the compliance of this new infrastructure with EU privacy and trust regulations will be one of the major goals in order to allow revenue-sharing operations and establish industry-wide resources for global service provisioning.

The current situation: lack of standardization

Cloud offerings today fall roughly into three categories: hardware clouds, development platform clouds, and application delivery clouds. They address three target audiences respectively: service providers, software developers, and users. Making productive use of services offered by hardware clouds requires the highest degree of sophistication; using application delivery clouds requires the least. Providers who offer software as a service (SAAS) in the application delivery cloud or platforms as a service in the development platform cloud often layer their offering on a third-party infrastructure as a service in the hardware cloud. This creates layered value chains as in other industries. Multiple layers may also be offered by a single player – for example, Microsoft's Azure, which combines a development platform and an application delivery cloud.

Since the field has grown organically out of a number of disparate earlier trends and is still fairly young, there is currently a lack of standardization. Also, since operational experience with large-scale deployments is not yet widely available, there are many open questions about what constitutes best practices and how to apply an engineering discipline to many of the unresolved problems.

<table>
<tr><td colspan="4">Application Clouds (Software as a service)</td></tr>
<tr><td>Megaservice</td><td>Targeted cloud</td><td>FaceBook</td><td>G-Mail</td></tr>
<tr><td colspan="4">Development Clouds (Platforms as a service)</td></tr>
<tr><td colspan="2">Open-source software</td><td colspan="2">Google Application Engine</td></tr>
<tr><td colspan="4">Hardware Clouds (Infrastructure as a service)</td></tr>
<tr><td>Grid Computing</td><td>Virtualization</td><td colspan="2">Amazon Web Services</td></tr>
</table>

Hardware clouds

Hardware cloud services include low-level storage and computational services, usually presented as virtual machines mimicking popular commodity hardware with storage based on network-attached storage, and some Web services for managing groups of these resources. Current examples of hardware cloud providers are Amazon and Sun.

The interface offered by hardware clouds is one of virtual commodity hardware, which makes this type of offering not only very generic but also rather well standardized between vendors. Emerging standards, such as open virtualization format, minimize lock-in to any particular underlying virtualization solution.

For providers of cloud services, the ability to exploit common physical resources to service many subscribers enables them to leverage economies of scale and effectively harvest the benefits of statistical multiplexing of multiple workloads. This leads to much better utilization of otherwise wasted hardware resources. Consumers of these offerings may be providers of legacy services, sophisticated providers offering platforms or applications, or enterprises aiming to outsource pieces of their internal IT.

Universities can leverage otherwise unaffordable amounts of hardware for peak demands as well as state-of-the-art system management skills from hardware cloud providers. To give you a feeling for the scale of the U.S.-based providers, consider that Google's quarterly hardware budget exceeds the entire hardware infrastructure budget for the Seventh Framework Programme for Research and Technological Development (FP7). Microsoft currently adds approximately 10,000 servers, or about half the total capacity available for the large hadron collider (LHC) experiment at CERN, per month. On the storage side, Amazon's S3 storage service contains 14 billion storage objects.

Development platform clouds

Development platform clouds offer integrated development environments and are typically domain-specific for various industries or application domains. Typical consumers of these platforms are independent software vendors (ISVs) and individual developers as well as sophisticated power users, since only limited programming skills are required. This is an area which offers European Universities an opportunity for collaboration.

These environments are appealing to small independent software vendors (ISV's), University IT development teams, or individual developers who cannot afford to build local development environments. Usually there is also deep integration with an application delivery cloud, making it possible to immediately deliver the resulting applications to large user groups without an initial capital investment. The flip side is that the applications are often completely locked into the development platform provider. The primary usefulness of development platform clouds is that they facilitate the establishment of new developer communities of enormous size at a fast rate, thereby leveling the advantages of entrenched software vendors with proprietary programming and developer base. One large European software provider makes use of Amazon's computing cloud to offer its complex enterprise composition development environment to third-party developers. Other exam- ples of this model are Salesforce's Force.com and the emerging attempt by Microsoft to rescue its.NET environment from the onslaught of alternatives with its Azure development platform.

Due to the complex nature of software development environments and their dependencies, partial lock-in cannot be entirely avoided. Today there is no single dominant provider in this space, and the range of offers has led to a healthy level of competition. Users and developers need to be properly educated about the potential risks, and they should balance their concern about lock-in with the advantage they have of using proprietary features of development platforms. Development platform providers cannot entirely avoid tying developers to their particular platform, but some actively encourage this while others try to mitigate the lock-in effect through judicious use of open-source software. Other vendors, such as Microsoft, try to extend their traditional offerings into a highly functional, integrated development and application platform (Microsoft Azure).

Application delivery clouds

Application delivery clouds are sometimes called software as a service (SAAS). The distinction is oftentimes more in the provider's underlying business model than in the technology used for delivery. Consumers of these applications range from private consumers of services, like e-mail, to enterprise customers operating entire business processes, such as customer relationship management (CRM), on such infrastructures. Sometimes completely decentralized applications, such as peer-to-peer applications, are also classified as cloud applications. Customization can be performed by end-users without programming skills.Due to the nature of application development, the lock-in effect to any given platform is very high. Most of the cur-rent players who offer development platforms also simultaneously own key pieces of the application delivery clouds. This combination often poses a real competitive threat to established industry players.

Projected future development: enormous economic opportunity

Provider proliferation

Due to the relatively high degree of standardization of hardware cloud provider interfaces, we can expect European providers to enter this space alongside the current big U.S. players. Obvious candidates for this are large computer and network hardware manufacturers who also have the required expertise to design and operate large data centers, as well as telecom operators who wish to diversify their raw data service offerings into higher-level offerings, potentially differentiating themselves with added service-level guarantees at the network level. This particularly applies to services with real-time requirements.

The IT departments of many enterprises, including some Universities, are also changing the management style of their internal data centers to a cloud-type interface, thus offering a compatible in-house alternative and minimizing lock-in risk to external cloud providers. The flip side of this development is that providers will have to compete almost entirely on price and the value of their service-level guarantees, which gives a head start to the large U.S. players, who already have several years of experience with such infrastructures.

Key questions regarding the future architecture of hardware clouds are concerned with the integration of data and applications into the existing infrastructure, integrity of the data, and the development of a more flexible cloud architecture to integrate complex business applications.

ISV adoption

Hardware and development clouds have rapidly been adopted by numerous small ISVs around the world, mostly new players who use the agility and scaling capabilities offered to quickly develop new service offerings. They offer quick, low-cost, borderless access to markets with an unprecedented time-to-value factor, easily challenging the market presence of other ISVs. In addition, they tend to offset their late entry into a specific market segment or industry through a new and highly disruptive business model. While similar in some respects to the disruptive factors inherent in the world of physical globalization, ISV adoption has, with almost no physical constraint, a much broader and faster reshuffling effect on targeted industries. It is predicted that a new form of ISV ecosystem will emerge in the cloud, fueled by developers with no geographical limitations. Cloud application players will tend to fight with others in their attempt to attract the largest possible community, developing and monetizing a broad or highly specialized variety of applications and services. The ability of cloud players to quickly attract talented developers will have a direct effect on their performance, which will greatly rely on the monetization of their application, service portfolio, and market coverage.

The uptake by traditional software vendors has been considerably slower. This is in part due to structural mismatches between the execution and management requirements of their software environments and cloud infrastructures and in part due to missing service-level agreements on the side of the cloud service providers. The reengineering effort for existing software technology can be substantial and may take several years of effort for complex technology environments. SAP AG has embarked on a number of projects to ensure a smooth coexistence of solutions for its customers, both in cloud and in mixed deployment scenarios, maintaining cloud portability across major hardware cloud offerings. Enterprise applications, such as enterprise resource planning (ERP), currently stretch the technical capabilities of cloud providers, but even this space is rapidly moving toward enterprise clouds that fulfill the added requirements of reliability, security, and special transactional guarantees.

Internet of services

Use and trading of services (also referred to as the Internet of services) will quickly outpace the trading of goods, setting up opportunities for a brand new set of offerings to fuel the economic transformation, both on a national, European, and global level. This is already happening with a great deal of success in the consumer space, giving a preview of how this could evolve in the enterprise commercial and University world.

Existing business service providers like Brightcove started to enter the space delivering bundled offerings of software as a service in the cloud as well as full outsourcing services. Overall, in this space, cloud computing will accelerate the globalization process.

With very few barriers, the trading and brokering of services developed and hosted in the cloud might quickly end up being concentrated in the hands of a few large global players. These players will take full advantage of their ability to assemble their value chain with the best components from all over the world, giving limited space for national vendors to play. This is similar to what happened in traditional supply chains.

Opportunities & risks: rapid scalability vs reliance on web connectivity

Besides the drastic transformation that cloud computing could bring to the European Higher Education space in the medium term, we can also see opportunities and risks for developers and users of cloud services in the short term.

Energy efficiency

On the provider side, the economies of scale and a renewed interest in very effective data center operations can help further the possibilities of cloud computing. These benefits include very affordable provisioning of IT services as well as an overall optimized energy usage through resource sharing and state-of-the-art data center design and operations. It is noteworthy that with current technology and energy prices, energy costs already exceed the pure hardware costs of data centers over the lifetime of the equipment.

The ability to rapidly scale their use of computational resources is attractive to all users of cloud services. The benefits of data storage in the cloud are independence of storage medium and high, long-term reliability.

Disaster tolerance

A large, competent cloud provider will, in most cases, match or exceed the reliability and availability guarantees of most in-house IT departments. However, even top-notch providers, such as Amazon, have experienced outages of several hours that took down entire key services (most such providers can survive any kind of hardware problem up to the loss of entire data centers) due to the fact that the management software controlling the internal operation of these clouds can have systemic problems.

Challenges remain for transactional workloads, such as ERP and financial software systems, but ongoing research is addressing these one by one. FP7 projects, such as RESERVOIR and SLA@SOI, will create the necessary management protocols and mechanisms to operate complex enterprise system landscapes reliably in a cloud environment.

Additional dependencies and security concerns

With all cloud offerings, the reliance on the Internet and basic connectivity at all times adds an additional degree of vulnerability. Exposing both data and code to a third party rather than keeping them in-house creates a different set of vulnerabilities to those that Universities are used to today. The security models for applications need to be quite different when there are no longer truly internal systems for running in-house applications.

While the economies of scale, potential availability, and disaster tolerance features of most cloud providers are attractive for most customers, this has to be balanced against the access costs for storage and the lock-in to a cloud storage provider. Furthermore, a particular concern lies in the questions of privacy and jurisdiction – for example, if the data owner resides in Europe, and the cloud hardware is distributed over several data centers in different countries. Depending on the regulatory environment of the provider's home country, there are legal implications as to whether or not it is even possible to use such services for certain types of data. Internal clouds or clouds operated by others in the same regulatory environment could serve as an alternative for sensitive data such as student academic, financial, and other personal information.

Opportunities for universities as users and developers

The biggest advantage of all types of cloud offerings is the very low initial hurdle for new players wanting to enter and the flexible consumption options for users of such services. In general, this should clearly be a favorable point for Colleges and Universities that cannot afford the steep initial investment for operational environments and that do not have the IT staff to operate IT solutions on a large scale.

For both developers and consumers, the question of lock-in to providers is one of the key concerns. The lower the abstraction level of the offering, the better the standardization and, hence, mobility of solutions. Pending is the standardization of operational practices and particularly engineering discipline for creating reliable services that are portable across different cloud platforms.

Conclusions and recommendations

The emergence of clouds at all levels offers exciting new capabilities and benefits for Universities as consumers as and as developers and providers of IT services. It will significantly impact the IT industry and become a key driver of innovation and productivity in almost all sectors of the economy, including the Public Sector and Higher Education. To ensure its future health, European Higher Education must become an early adopter of cloud computing and exploit the full potential of these new technologies.

From the perspective of European Universities, both as consumer and developers of technology, there are three aspects of concern in both the medium and long term.

First, cloud infrastructures play the same role with the same importance in an information economy as roads and electric grids had for the classic industrial society. As hardware cloud infrastructures become a strategic asset in the digital economy, Europe must find ways to deal with the current dependency on non-European players, either by developing its own hardware clouds or by guaranteeing multiple alternative competitive sources. Moreover, Europe needs to be much more active in creating development and application clouds, regardless of underlying hardware infrastructures.

The second concern is lock-in, particularly into proprietary development environments, resulting in dependence on single vendors. So far, no cloud provider has achieved a dominant position. Some of the big U.S. players are pushing for open standards to foster interoperability between clouds and, hence, to reduce lock-in effects. Indeed, standards-based access to cloud services is a prerequisite in order to avoid lock-ins to a single cloud provider. Many requirements that are met by in-house-deployed services regarding security, reliability, and interoperability still need to be met when these services are provided by a cloud. The *Open Cloud Manifesto* outlines an approach to ensure openness and interoperability in cloud computing based on industry-driven global standardization.

Third, on the side of the consumer of cloud computing, Europe lags behind the United States both in actual uptake and in the ecosystem to rapidly take advantage of clouds. This is Europe's potentially largest risk: missing out on the mostly positive impact cloud computing can have on Higher Education and the economy in general.

Recommendations

Cloud community members recommend that policy makers keep regulatory intervention of cloud computing at a minimum at this stage in order not to hinder the development of this emerging market. However, the European Higher Education community should consider the following actions:

Sponsor a study on the global trends in cloud computing and the respective challenges and opportunities for Europe. The study should, among other things, address the reasons for U.S. dominance in cloud computing and why European cloud providers have not yet emerged, opportunities for the creation of European clouds (players, business models, incentives, and drivers), use of cloud computing in different regions (United States, Europe, Asia), hurdles to uptake in Europe, and recommendations on the role of University IT policy makers.

Sponsor national committees with all relevant stakeholders on the risks and opportunities of cloud computing, in particular for Universities. The committees could be based on the findings of the study and possibly lead to a commission for communication on cloud computing.

Leverage the R & D instruments of the EU for the development of cloud computing in Europe, such as adding a dedicated objective to the next work program of FP7. Important research topics include questions of appropriate market and business models for cloud computing; flexible and efficient service combinations of different providers; solutions and tools for closed cloud models like Google's AppEngine; and new methods for application development, deployment in cloud environments, and data migration. Open Cirrus, the HP/Intel/Yahoo! open cloud-computing research test bed, can be seen as a forward-looking and innovative approach for interdisciplinary research focused on industry, user, and application.

Leverage EU programs (for example, Structural Funds) to promote the effective and secure use of cloud computing by Universities. In particular, University IT, business, and academic leaders should be enabled to fully understand the benefits and risks of cloud computing for Higher Education.

Encourage Public Sector administrations in Europe to become early adopters of cloud computing. Cloud computing could significantly reduce the cost and enhance the quality of public services. It is recommended that cloud computing be put on the agenda of the next Ministerial eGovernment Conference in November in Stockholm. Cloud computing should also be addressed in the EU's next eGovernment Action Plan. Finally, the European Commission should consider launching a competitiveness and innovation framework program (CIP) pilot on cloud computing in 2010.

Initiate discussions with major trading partners for the global harmonization of national privacy and security regulations in cloud computing.

Institutional Intelligence: Does Business Intelligence Apply to Higher Education?

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Business Intelligence, Institutional Intelligence, higher education, data warehousing, data management

Abstract

The collection and manipulation of data in Higher Education Institutions is growing every day; however, business intelligence adoption and effectiveness in the sector is still low, risked by several, sector specific complexities.

This paper presents, under the concept of "Institutional Intelligence", a general view of the current state on this topic and set of good practices that can help Higher Education Institutions achieve better results in its adoption. The paper assumes that the reader is familiarized with the concept of business intelligence.

What is Institutional Intelligence? Why not simply BI?

"Institutional Intelligence" (I2) is the term we use to refer to the application of Business Intelligence (BI) techniques and technologies to the specific context and needs of Higher Education (HE) Institutions. The term was introduced in 2005 by Eric Donohue and Debra

Friedman, both working for the University of Washington at the time. It was first publicly used in this HE context at the 2005 TDWI World Conference, and was later popularized in Dave Wells' "*Institutional Intelligence: Applying business intelligence principles to higher education*" article in *Campus Technology* magazine.

Why use a different term for "business intelligence" in this specific Higher Education context? Odd as it may sound, one of the basic reasons for us is psychological: in our experience, the term "business" causes rejection when applied to public academic environments in certain audiences. Other reasons are related to certain specific challenges that business intelligence has to face in the Higher Education environment, making these initiatives particular enough to set them apart from traditional business intelligence as known and practiced in corporate environments – as probably every BI professional with a previous corporate business intelligence background would attest after some time working in the HE sector. Some of these particularities are:

- A different, wider and more intangible set of goals, where profit no longer plays a central role, and a lack of standardization in metrics, measures, KPIs, etc.
- Organizational complexity: hundreds of administrative and academic units usually arranged in a non-hierarchic, dual, highly de-centralized organic structure.
- A greater influence of politics, with a potentially more volatile governing structure due to periodic provost elections.
- A traditional lack of fact-based decision making and business intelligence culture in general, and hence an absence of specific business intelligence awareness, staffing, skills and structure.

We think that all these aspects make business intelligence initiatives in Higher Education institutions particular enough to reclaim its own industry-specific name. Note, though, that the term "Institutional Intelligence" may be ambiguous (especially when translated to other languages such as Spanish) and although it has been adopted by a good number of important stakeholders in the sector, there is certainly not a full consensus about it. In fact, business intelligence in Higher Education is also referred as "Academic Analytics" too. We chose "Institutional Intelligence" because we feel that "Academic Analytics" may fall short in its perceived scope, since it may be interpreted as restricted to pure docent-related subjects; while business intelligence initiatives in Higher Education definitely addresses several other areas as human resources, financials, research and potentially every other area inside a University.

Is Institutional Intelligence necessary?

Do Higher Education institutions really need business intelligence, or is it a specific corporate discipline not really suitable to Higher Education? We definitely think that Institutional Intelligence is a real need.

It is, on one hand, a natural evolution to a more mature data management environment once the core administrative processes of any organization have been automated, which is something Universities have already achieved to a great extent in the first decade of this 21st century via the implantation of ERPs and other administrative information systems. Institutional Intelligence solutions allow the derivation of new value from the existing institutional investments in these transactional information systems.

On the other hand, Institutional Intelligence is being driven by the advancement of several information-hungry initiatives and trends that foster the establishment of a more business-like fact-based management style, mainly:

– An increasing pressure for accountability and supervision from funding entities and society in general.
– The increasing importance and adoption of a quality assurance culture and quality accreditations in Higher Education.
– A bigger, more diverse and more competitive space (dare I say "market"?), due to technical and organizational advancements, such as e-learning and the European Higher Education Area.

All these trends are much easier to follow when the institution has a single central information repository and the corresponding set of processes, services and procedures to cover the increasing information requirements across the institution.

In our experience, there is, however, still a long road to walk until we discover and reveal the full value that Institutional Intelligence can offer to Universities across and along the organization, and at all levels. As we will later see, current usage of existing Institutional Intelligence platforms tend to be very focused in only a very small part of administrative processes and units. There's a lot of potential to be unleashed.

Is Institutional Intelligence a reality?

If we observe the Higher Education sector worldwide, we can easily detect an undeniable increasing attention from Universities and vendors to this topic, as has been reflected in some media (Briggs, 2008a) We are, nevertheless, still far from the adoption level and awareness already present in the corporate world, where, according to Gartner, business intelligence holds the record of being the number one priority for CIOs for as long as the last 4 years. Certainly, higher education has lagged behind other industries in the adoption of business intelligence, as Dave Wells points in his previously mentioned article, stating that "*Higher education, generally among the leaders in technology adoption, is late to embrace data warehousing and business intelligence*". While it is true that his statement refers to North American Higher Education institutions, we feel that, in general, the situation is not much different in Europe. In fact, it seems to be worse: based on the amount of public available information about Institutional Intelligence activity, United States institutions seem to be clearly leading Institutional Intelligence adoption and evolution when compared to Europe.

For Spain, a country we know well, we have some statistics that can give us an approximate idea of the level of Institutional Intelligence penetration and success. Table 1 shows some numbers about data warehousing initiatives in Spanish Universities in the last 4 years. It's been taken from the "Universitic 2009" report (http://crue-tic.uji.es/index.php?option=com_remository&Itemid=28&func=startdown&id=229) a very interesting annual study about Information and Communication Technology in the Higher Education environment, conducted by the Spanish Conference of Provosts.

Table 1. Spanish Universities with a data warehouse. Source: "Universitic 2009" report

Year	2.006	2.007	2.008	2.009
% of Universities with a DW	58%	51%	56%	46%
Nº of respondents	52	49	48	54
% of total Universities covered	70,4%	69,0%	67,6%	76,1%

Surprisingly, the evolution shows a global *decrease* in the number of Universities declaring to have an I2 initiative in the form of a data warehouse, with a 2009 result well below the obtained in year 2006. It is unknown if this is an effect of the increase in the number of respondents (which in 2009 rise to a very good 76,1% coverage of all Universities), or an evidence of the termination of some previous Institutional Intelligence projects. Anyway, the conclusion is that about 46% of Spanish Universities have a data warehouse, so we can conclude that there is a notable presence of Institutional Intelligence initiatives, even if the glass seems to be more half empty than the other way around. It would be very interesting to know what these numbers are across Europe.

So Institutional Intelligence has a notable penetration, but, what about the results of these initiatives? Can they be qualified as a generalized success? Some studies suggest that the short, general answer is "no".

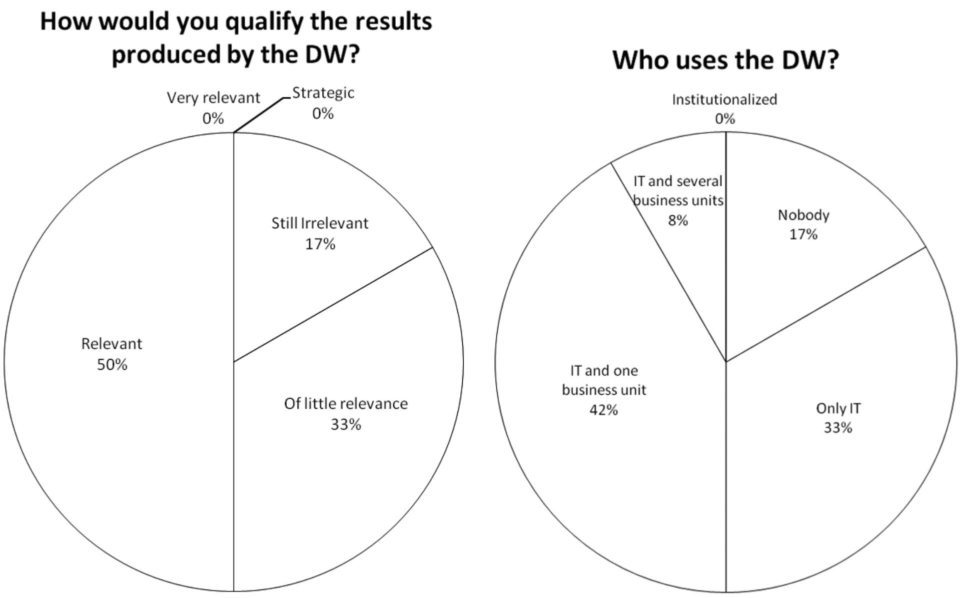

Figure 1. Relevance and usage of data warehouse systems — Source: OCU

First of all, we have a traditional high failure rate of business intelligence projects in the industry in general, which is something backed by several studies along the past years. For example, a very recent survey published by United Kingdom's National Computing Centre (http://www.ncc.co.uk/article/?articleid=1581) suggests that the percentage of business intelligence projects undertaken in the United Kingdom considered to be performing "well" or "moderately well" is well below 50%. A possible scenario of more than 50% of general business intelligence project failures in the industry is not very encouraging.

How does the Higher Education sector numbers compare to these general industry results? In Spain, our own study on this subject covering about 50% of Universities declaring to have a data warehouse, point towards a similar, if not worse, scenario:

- The average age of the Institutional Intelligence initiative was about 4 years.
- For 50% of them, the results of the I2 initiative were qualified as "*Irrelevant*" or "*Of little relevance*". In all these cases, the DW used by "*nobody*" (17%) or "*only IT*" (33%).
- The remaining 50% are qualified as "*relevant*" (note that none gets a "*Very relevant*" or "*Strategic*" qualification) and used by "*IT and business units*". It is worth noting that of these, only an 8% declare that it is used by more than one business unit, revealing a very narrow niche of users scenario.

If we combine and extrapolate all these numbers, the situation in Spain may very well be like this: about half the universities have Institutional Intelligence initiatives, only a half of those are currently producing relevant results, and only a half of these are currently used by at least one business unit other than IT. Depending on how you define success, this could mean that the percentage of Spanish universities with an Institutional Intelligence initiative that may be considered as a success may be as low – or lower than – 25%.

Some good practices

We are now presenting a handful of good practices. You'll see that most of them are just common sense or widely known practices in the general business intelligence landscape. There are many more, but, in our experience, these are key to Institutional Intelligence success, and often neglected or underestimated.

Develop *your own* Institutional Intelligence business case and strategy

It is surprising the number of Institutional Intelligence initiatives that are based *only* in generic or commercial arguments. We take the typical topics and make them our own, and we justify the initiative with generic claims such obtaining "a single version of the truth" or deploying a system that will be able to "deliver the right information to the right person in the right moment", etc. Sometimes, we don't go further, and what "true" information, which persons and when, and specially what are they supposed to do with that "true" information and how it is going to benefit the institution's goals, is left to the imagination of the reader.

Generic approaches are fine for a first, very high level approach. But if you base all your Institutional Intelligence initiative only on them, at best you'll get a generic platform that is potentially applicable to lots of problems but effectively applied to none. Institutional Intelligence value happens when its results are effectively and seamlessly interweaved in very concrete administrative and decisional processes. Aim for them. Identify the "pain points" that you want to be solved. Link the initiative with the Institution's goals and demonstrate alignment with its mission. Be as specific as you can to demonstrate value in tangible, named scenarios. Set clear institutional goals for the initiative and a mean of measuring its achievement. Too often a lack of goals or too generic ones make success infeasible by definition, or subjective at most. Once you've specified the problems you want to address with the Institutional Intelligence initiative and the goals to achieve, develop a written strategy to achieve them. A goal without a plan is just a wish.

We also have to avoid the temptation of making a goal from the mean. A lot of Institutional Intelligence initiatives set its primary goal as "Building a BI platform that will… (<put some generic benefits here>)". But the building platform should not be the goal, it is a mean to achieve other superior institutional goals that are kept vague too often.

Of course, the development of a deep business case and the accompanying strategy is not an easy task at all, often requiring a previous consulting project. But by doing these you are building a solid foundation for any serious I2 initiative.

You need permanent executive sponsorship

The strategic, cross-functional nature of the whole Institutional Intelligence initiative needs high level vision and sponsorship in the form of a high level governing unit that believes in the initiative, funds it, sets the strategic, institutionally aligned goals, and prioritize the projects. This governing unit usually takes the form of a steering committee, with a good representation of the "business" units, IT, and the executive board. Institutional Intelligence initiatives lead from the bottom-up are much more difficult to evolve than those with a top-down impulse. Our study showed a clear linkage among sponsorship and the appearance – or not – of "relevant" results: a 66% of the Universities with a "relevant" qualification of their Institutional Intelligence results had a "clearly defined sponsor", while the 83% of those with "irrelevant" or "of little relevance" results had "no clear sponsor".

Do not conceive Institutional Intelligence as an IT centric initiative

Remember: the technical platform is the mean, not the goal. The goals are much more "business" oriented, and hence the "business" component of any Institutional Intelligence initiative should be the central one. Technology plays an important role as the main enabler, but the main risks and the domain of the results to be achieved are not technology related, but cultural, political, organizational and functional. Aim for the solutions to the identified business problems, not for the platform which will come as a mean.

This heavily contrasts with reality, where, in our experience, I2 initiatives are often led by IT, and business units are "difficult to involve" stakeholders.

Prove the concept with a "quick win" and be iterative

Institutional Intelligence initiatives are complex, wide, cross functional programs that can take years to achieve full potential. Thus, a "big bang" approach is usually not the best approach. An iterative life cycle with smaller, more frequent releases is much better suited to the various levels of uncertainty the initiative has to face. The first iteration is the most important, because it is paramount that it achieves a "quick win": a successful, small-scale but real demonstration of the benefits the initiative can achieve if institutionalized. This first iteration should be also used as a reality-check of our organizational and technological approach and readiness to face a big scale program. Often, this quick win is a proof of concept that, if successful enough, brings the necessary momentum to transform an "experimental" initiative into a full-fledged I2 program.

Buy or build, but make it truly yours

Without entering in the discussion of whether it is better to buy an already built standard or template-based Institutional Intelligence solution, or to build – or getting built – your own, one thing is clear: it is healthy to develop and maintain your own business intelligence skills, something that usually is not initially found in Higher Education staff. It is especially desirable not to depend entirely on external vendors to give first level support to our users, because it usually harms the speed of response to lower than acceptable and raises communication problems. Flexible partner-style relationships, where vendors and the Institutional Intelligence University staff form a team that shares the same goals and internal customers are usually better suited than pure rigid vendor-consumer, SLA based ones. Vendors should offer flexible relationships and services to Universities, specifically tailored to each particular situation, evolution and skills.

It is wrong unless proven right

Be prepared to demonstrate the correction and validity of the results of your Institutional Intelligence platform. Chances are that everyone has been or is currently obtaining a large part of the same information (albeit probably fragmented) from very different sources and procedures in the past. The first thing everybody is going to do is confronting the data obtained by the alternative previous or current means with the results offered by the Institutional Intelligence platform. If they do not match (and they usually don't), it is the Institutional Intelligence platform the one to be questioned, not the alternate source. Be prepared to quickly and gently demonstrate why the results differ, and act in consequence.

The best way to prevent these situations is doing these very same confrontations before the system is rolled out to users, identifying the group of key users in each functional area and considering them very relevant stakeholders in the validation and testing phase.

Make every effort in the validation phase. As we all know, user trust is something very difficult to build, and very easy to destroy.

Institutional Intelligence requires a dedicated team

If we want to be serious about Institutional Intelligence, we have to accept this: an Institutional Intelligence initiative needs a dedicated team. Voluntarism doesn't work (for long). If the Institutional Intelligence initiative means extra work for everyone implied, it will never have the necessary focus and steady effort it requires, especially if it competes with more critical duties. In the previously mentioned study about Spanish Universities, the results about Institutional Intelligence relevance and usage showed a direct relationship with the number of full time employees. The higher this number, the higher relevancy and usage.

"Business Intelligence Competency Centers" (BICCs) is nowadays a well documented and widespread concept that was originally coined by Gartner in the early 2000s to address traditional business intelligence problems. Wikipedia (Wikipedia, Business Intelligence Competency Center) defines it as "*a cross-functional organizational team that has defined tasks, roles, responsibilities and processes for supporting and promoting the effective use of BI across an organization.*" Several studies (Gartner) suggest that they are heavily linked to the success and sustainability of BI initiatives in any industry. In the following figure we depict a very general schema about the diverse skills that need to converge in a BICC:

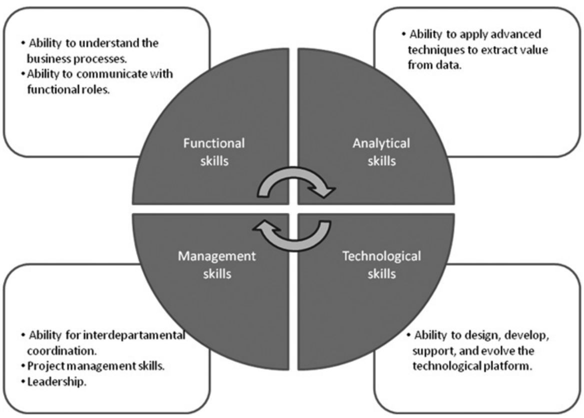

Figure 2. BICC skill set

Unfortunately, BICCs structure and functions is a complex topic that cannot be addressed in this paper; there exists, anyway, extensive information about this topic for the interested reader in digital and printed resources, as well as real world examples from leading universities in this area.

We strongly think that Higher Education institutions need to take this BICC approach and adapt it to their organizational structure and peculiarities. It is clear that this is something difficult to obtain, especially from the very beginning. Convincing higher management to create, fund and staff a new unit is usually no easy task in a Higher Education institution. This is where the "quick win" mentioned before may help.

As with the life cycle of the Institutional Intelligence platform, a BICC does not need to be a very ambitious unit at the beginning. Model it to meet the initial needs of the Initiative, and let it grow with the scope of the solutions delivered. Many institutions start with a "virtual" BICC, that is, a team of non-full dedicated employees who share Institutional Intelligence with other tasks and responsibilities. This approach is softer in organizational burden (reporting structures usually are left unchanged) but also of limited efficiency, for obvious reasons relating to conflicting duties. We strongly suggest that people in a virtual BICC get public, official, named roles and responsibilities -the type you can put in your professional mail signature – as a way to encourage sense of membership and dedication, recognizing at the same time the importance of the BICC related duties.

Of great importance also is the role of data stewards. Data stewards are subject matter experts whose mission is to assist and share responsibility with the BICC in data quality, data acquisition and functional criteria issues in the scope of his/her natural business unit. Each unit whose data is feeding the Institutional Intelligence platform should designate its own data steward. Again, the official recognition of this role is equally important.

Define processes and assign roles to support all necessary activities

Institutional Intelligence is not a project, but a permanent program, a new internal service. As such, Institutional Intelligence has no end, and there's a lot more to it than the initial development and deployment. A lot of different activities and processes, ranging from the strategic to the operational level, need to be consistently defined standardized. The following table shows a no-necessarily exhaustive example that gives an idea of the variety and complexity of the activities that need to be addressed in a working Institutional Intelligence environment:

Table 2. Activities in a working Institutional Intelligence environment

LEVEL	AREA	FOCUS	ACTIVITY
Strategic	Government	Stablish Mission, Scope and Institutional Objectives	Stablish I2 Program: High level scope, Institutional objectives & general strategy
			Stablish mission and scope of BICC
			Approve neccesary new policies
	Direction	Stablish & organize involved resources	Organize BICC
			Budget and get fund for the I2 Program
			Support and advocate I2 program
			Identify and propose new necessary policies
Tactic	Management	Design and control a set of I2 projects aligned with institutional objectives	Define low-level objectives and tangible projects to achieve them
			Identify and coordinate stakeholders
			External provider relationship management
			Stablish a training plan for users
			Stablish a marketing campaign for the I2 program
			Launch new projects based on user feedback
Operational	User Support	Improve user experience & solution value	Create and maintain proper user documentation
			Create and maintain a web site for the I2 initiative
			Operation support
			Corrective support
			Usage monitoring
			Evolutive support
			Content Delivery
			Carry out training sessions
			Carry out marketing sessions
	Infrastructures	Maintain base technology	Define and monitor SLA
			Resolution of Technical problems
			Define and execute backup policies
			Performance tuning
			Base software and hardware upgrade
	Systems	Maintain Desktop technology	Technical support for client desktops
	Operations	Application administration	Security management
			ETL control and monitoring
			Data administration
		Change Management	Identify and register changes
			Plan changes
			Apply and verify changes
			Communicate changes
	Development	Build & evolve solutions	Build and maintain a set of standard information deliverables
			Error correction
			Business requirements gathering and analysis
			New data sources are integrated and new solutions are developed
	Data	Certify data integrity and usability in each domain	Solve data quality problems
			Supply domain-specific technical knowledge
			Supply domain-specific functional and business knowledge
			Certification and validation of domain-specific data content in the system
	Analysis	Extract knowledge from data using advanced techniques	Predictive modelling
			Statistical Analysis

Communicate, divulge, promote, train: go out and find your users

Once you roll out the system, don't expect a legion of users calling on the phone with creative ways of using the Institutional Intelligence platform for their business units (especially if you've abused of the "too generic goals" approach we talked about before). The "build it and they will come" tactic is hardly a road to success here. Business Intelligence awareness and culture is still sparse among Higher Education institutions, and probably the 90% of your potential users don't understand what is possible, so they won't ask for it or even care about the initiative. A conscious, proactive, permanent effort to reach potential users and explain the benefits they could get by using the platform must be carried. Be warned that these efforts are disheartening at first. You will have to be creative and do a good internal marketing work. You will also have to prepare very well thought training sessions with different itineraries tailored to each user type. You will have to repeat these campaigns again and again. And then again. We've seen very creative ways to face this "hunt for the user" challenge: mailings, podcasts, on-line divulgation videos, itinerary "shows", prizes for best usage of the platform, practice communities, etc.

Do not underestimate the maintenance effort

Entropy is the worst enemy of Institutional Intelligence platforms. From the very moment we roll out the first results to users (sometimes even *before* that), the surrounding environment becomes a permanent menace. Source systems change their data models, DBMS upgrade to newer versions, business processes change and adapt to new realities. Change and dependency management takes a lot of effort and very fine tuned processes and coordination with several different teams and stakeholders. Plan and prepare for this; otherwise the impact of changes in your users will be enormous.

Share, communicate, learn, teach, evolve: Network!

I2 is still a new area, and there are a lot of topics to define, refine, prove and evolve. As we've exposed before, there seems to be not so many success stories. Why not join efforts and share our good and bad experiences to enrich each other?

An example: The "Higher Education Data Warehousing Forum" (www.hedw.org) is a United States originated community of currently 706 Institutional Intelligence related professionals from 395 Higher Education institutions spread along 22 different countries. They hold extremely interesting yearly conferences since 2003, where different institutions share their knowledge in this topic, and maintain several very active mailing lists where Institutional Intelligence professionals are constantly sharing day to day experiences. It is a very good example of how a contributing community can empower the advancement of a discipline. Currently, European professionals in this community seem to be completely absent, representing just a 1,5% of all registered users.

We find extremely interesting and useful this kind of initiatives, and encourage the participation in this community or any other with similar goals.

Conclusion

We have to be serious facing Institutional Intelligence. It has the sufficient importance and complexity to be considered a strategic initiative, and treated as such. It is also a new discipline that still has to find its way inside Higher Education structures and processes. We have a lot of room for improvement. By sharing experiences, we'll all grow faster and contribute to the advancement of a more modern and efficient Higher Education.

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Does the Cloud Have a Silver Lining?: The Future of Flexible IT Service Delivery

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Abstract

The IT industry is undergoing a period of significant change. There is a growing trend away from monolithic ERP (Enterprise Resource Planning) type systems and in-house development towards a diversity of approaches that capitalise on the new capabilities of web technology. The higher education sector has been relatively slow to respond to these changes yet difficult economic conditions mean universities are being required to deliver more with less investment of public funds and they are increasingly looking to IT to solve this problem. The purpose of this paper is to take a critical look at some of the service delivery options available and to consider the potential pros and cons of adopting such approaches within the sector. We will also summarize some of the work currently going on in the UK to pilot and evaluate new approaches to flexible service delivery.

Introduction

The IT industry is undergoing a period of significant change. There is a growing trend away from monolithic ERP (Enterprise Resource Planning) type systems and in-house development towards a diversity of approaches that capitalise on the new capabilities of web technology. The higher education sector has been relatively slow to respond to these changes. The last major wave of system replacements in the sector was prompted by the 'millennium bug' fears at the end of the last decade. Having invested significant sums in large-scale corporate systems, universities necessarily wish to get the most out of that investment and change is not undertaken lightly. Difficult economic conditions have also played their part in fostering conservatism. The natural response to the economic downturn in most cases is to delay hardware and software replacements. Extending the lifespan of system components is of course an approach that brings its own set of risks and organizations must look to develop strategies for the future before it is too late.

The purpose of this paper is to take a critical look at some of the service delivery options available and to consider the potential pros and cons of adopting such approaches within the sector. We will also summarize some of the work currently going on in the UK to pilot and evaluate new approaches to flexible service delivery.

Enterprise Architecture

Enterprise Architecture (EA) is, as the name suggests, an institution-wide approach to technical architecture. It is however about much more than technology. The real purpose of undertaking an EA approach is to align your ICT strategy and implementation with the overall organisation strategy. EA is therefore very much about business goals, business needs and business processes. EA can help your ICT services work together, evolve effectively and serve and enable achievement of the organisation's vision. Business Process Review is only about process, Service Oriented Approaches (SOA) are only about systems. EA brings it al together. In this way EA is a significant enabler of change. Implementing EA may put IT managers in the role of change agents who need to be as concerned with business process improvement and relationship building across the organisation as with technology. In order to be effective enterprise architects IT staff must develop an understanding of the business processes that underpin their organization and must be able to communicate in terms that business users, especially senior managers, understand and can relate to.

In its simplest form EA means taking a structured approach to managing your ICT portfolio. The starting point is to map the portfolio. You may need to create a number of different views showing business processes, information and data flows, applications and services, infrastructure and security. The primary driver is however always the business processes. You may choose to use tools and approaches with which you are familiar or to adopt more formal EA approaches using established frameworks such as Zachmann or TOGAF.

Once you have mapped the existing portfolio the 'As is' situation you can begin to decide how you wish to move forward and design your desired future state. Key tasks include identifying areas of redundancy and duplication in your applications. You may wish to investigate how SOA can help with interoperability and issues of data duplication. You should also think about the replacement cycle for each system and consider where alternatives such as Open Source, SaaS, Shared Services etc may offer benefits.

From this you should be able to develop a governance model focused on ensuring the systems support key business goals. Such a model should empower senior managers to take effective decisions regarding investment in technology and will allow them to see the value of IT in supporting strategic objectives. From the outset you should look to scrap projects that don't meet these criteria and all new projects should be scrutinized to ensure they align clearly with business goals.

One way of looking at EA is to see the different layers as different states of matter: solid, liquid and gas. The data layer has to be solid. It needs strong governance and policies and defined standards. The Middleware layer which represents the business logic can be more liquid and new approaches mean you may be able to change from commercial to open source products relatively easily. The user facing layer is the gas: it can take any form and may change often as new portals are developed and mobile devices introduced etc, etc. One advantage of EA is that by helping you understand things in a holistic way it reveals the space where you can innovate.

Because EA has grown out of the IT arena it can often be difficult to show senior managers in other areas how it is relevant to them. This is a significant obstacle but one that has been overcome before. In many universities it was the IT function that introduced the concept of formal project management techniques to the institution at large. Just because project management is useful in IT doesn't mean it is only relevant to IT. The shared vocabulary of project management has escaped the IT department – EA now needs to do the same.

Many organizations are beginning to see real benefits from adopting EA. In the UK the government department for Children, Schools and Families is saving c20% on ICT capital costs over a 5-year period as a result of its EA work and the resulting simplification of data and services. Universities are beginning to look at these approaches and pioneering work has taken place in the UK and Netherlands.

In 2008 four UK universities; Cardiff, Liverpool John Moores, Kings College London and Roehampton were funded to explore the potential in the EA approach and related industry frameworks, learning to ‚do EA' on real projects. Their experience has been documented in two reports: 'Doing Enterprise Architecture: Enabling the agile institution' and 'Unleashing EA: Institutional Architectures and the value of joined up thinking.' As well as containing detailed case studies, 'Doing Enterprise Architecture' contains an excellent introduction to Enterprise Architecture itself, industry frameworks such as TOGAF™ and Zachman, The Open Group and its Architecture Forum and to modelling and the emerging Archimate® open standard. 'Unleashing EA' reflects on the experience and identifies the major issues and challenges institutions face when confronting change and looks at how EA can help.

Service-Oriented Approaches

'SOA' can stand for either Service Oriented Architecture or a more general Service Oriented Approach. It is an approach to IT architecture that that replaces the traditional linkage between applications by separating data and the tasks and business processes that use it. Instead of bespoke software to join different applications and data sources together, the 'spaghetti' of integration, data and applications are linked by a 'service layer'. This enables the reuse of common data and software in different ways at much lower cost and with the flexibility to meet new business requirements without the need to acquire bespoke packages. In this way we might describe applying an SOA approach as turning the spaghetti of point-to-point integration into a lasagna.

SOA works with existing software systems and replacement applications re-use the links already made and can plug in to the service layer without affecting other users of the data. New applications can be added and the data in each application is offered up as a service which any other application can consume. When the Service Oriented Approach is evolved in to a system-wide architecture, it allows connections and service sharing opportunities between organisations nationally and globally.

As an example, an institution might be tracking student debts, student complaints and the progress of disabled students. Typically they might use three different student datasets, and specialised applications, for example within finance, CRM and HR. In a service-oriented environment they are all examples of case management, where the basic service can be adapted easily to serve three different business needs, and using common data with managed access and editing rights.

SOA is always linked to and driven by business process change. The international e-Framework website http://www.e-framework.org/ identifies and describes service components and provides blueprints and reference examples for those in the community who want to gain a greater understanding and knowledge of how to implement a Service Oriented Approach. JISC CETIS has also produced a useful online information pack on the topic.

SOA is a key enabler to underpin change and cost saving. It has reached a reasonable level of maturity both within the IT industry and within the higher education sector and is a means of allowing organisations to get the most out of their existing investments. It is possible to undertake EA without SOA and vice-versa but most universities would be well advised to consider these approaches when reviewing their technology portfolio.

Software As A Service (SaaS)

Software as a Service (SaaS, typically pronounced 'sass') is a model of software deployment whereby a provider licenses an application to customers for use as a service on demand. It has its origins in payroll bureaux and HR applications still dominate the market. SaaS vendors may host the application on their own web servers or download the application to the consumer device, disabling it after use or after the on-demand contract expires. The on-demand function may be handled internally to share licenses within a firm or by a third-party application service provider (ASP) sharing licenses between firms. SaaS is usually taken to mean hosted services via the Internet.

SaaS breaks the link between machines and solutions, theoretically enabling firms to license only what they need. Because many firm use the same basic service there is a rich source of ideas for improvements and additional features. Upgrades are rolled out to all users at the same time (which may or may not fit your plans). A range of 'multi-tenancy' arrangements exist and your data may co-exist in the same space as that from other organisations.

The classic example of SaaS is the e-recruitment service www.salesforce.com which accounts for 15% of the market.

At the present time it seems that SaaS is generating a lot of noise whilst remaining a relatively small phenomenon. In other words the reality doesn't yet match up to the hype. It is only really mature in some aspects of HR and, increasingly, CRM and is unlikely to be the best model for end-to-end business processes in large organisations.

Whether or not SaaS can save you money may depend on your existing licensing agreements. If you already have campus-wide licences with a number of major software suppliers then you are unlikely to make great savings by moving to SaaS for the relatively small applications currently available under this model. You will need to consider the full lifetime cost of the application and be aware that 90% of existing SaaS offers are not genuinely 'pay-per-use'.

You also need to consider how well a particular SaaS application will fit with your existing architecture, systems and data. It is notable that the primary SaaS application is recruitment which is of course a business function where only a small sub-set of the data requires transfer to your core HR system. A notable trend is for SaaS vendors to talk direct to business users on the premise that 'the IT department doesn't need to be involved'.

Although there is not yet a compelling case for SaaS in core areas of university business it may be worth investigating in order to try out emerging technologies in areas that aren't mission critical.

Cloud computing

Cloud computing is where most data, applications, processing power and services are provided and managed on remote servers and accessed via the internet or intranet. In its ultimate form the user just needs a simple PC as a terminal. Clouds may be 'public', 'private' or 'hybrid'. Web mail hosting and online banking are simple examples of cloud computing. In education Federated Access Management is a good example of a critical service provide from a private cloud.

Public and hybrid clouds are being provided by major suppliers like Microsoft, Google, Amazon and Cisco, who are all building huge server facilities. Google is leading the market at the moment – it is focused on services that make life easier for individuals whereas Microsoft still targets the enterprise market. Many of Google's free services provide useful data about user behaviour that it can sell to other companies.

The main concern at the moment is the extent to which a highly distributed and virtualised environment can ever be sufficiently secure for mission critical data. There have been some high profile failures e.g. Monster.com had 4.5 million customer CV records stolen. It is difficult to get enough data from vendors to adequately assess risk. The idea of SaaS/Cloud ESCROW is theoretically possible but not offered at present. Most trusted SaaS vendors are currently using non-cloud platforms.

The potential benefits of an approach that eliminates most of the capital costs associated with physical IT infrastructure are evident. Cloud computing is also often promoted as a 'Green' approach with implications for your institution's energy costs. The approach is also instantly (and infinitely) scaleable with additional computing power available on demand.

Therein of course lies the downside risk. Backing up an infinitely scaleable cloud isn't easy. Data interoperability is also an issue as standards are relatively immature in the proprietary services available at present. Security however remains the big issue. Encryption is only a partial solution as the data must be unencrypted in order for any transaction processing to take place.

The fact that in a cloud (or SaaS) environment you lose control of new releases to users may also be a downside for many IT departments. The approach means an end to the traditional cycle of testing and planned roll-out. The evidence from many social applications suggests that, on the whole, users will probably just get on with this and cope with the changes but the implications for IT support must be considered.

Despite the risks and concerns, the sheer volume of investment suggests that cloud computing is here to stay as a route to flexibility and low cost. It may well be that the HE sector opts for investment in private cloud space, particularly for research purposes, rather than favouring the public or hybrid approach.

Open Source Software

The term 'Open Source' applies to software whose source code is made widely available under a liberal 'public license' at zero cost. Anyone may exploit and adopt the software for their own and for commercial use. The ethos of Open Source is that users contribute back to the development effort, which usually results in much more rapid problem solving and quality improvement. Created as an altruistic movement by Richard Stallman, father of the GNU project and the Free Software Foundation, as a response to the commercialization of formerly 'open' software like the forerunner of UNIX®, BSD, and even early IBM software. Well known examples include Linux, Apache web server, the Moodle virtual learning environment, and Java.

While many developers use open source software because of the absence of licensing costs, the more important reason is quality and reliability, through access to the widest community of developers. Open Source is also free from proprietary supplier lock-in which is often an attractive ethos in education. The absence of a license cost does not of course mean that the software is entirely 'free' in terms of total cost of ownership. Products like Red Hat, Ubuntu Linux and Moodle are supplied free by companies who charge for support and implementation. Where a university chooses to adopt open source software without a support contract of this type it will need to consider the implications for the skill-sets needed by its own staff. Following the lead of a small number of Open Source enthusiasts in your IT department can leave you exposed to considerable risk if those people leave.

In summary Open Source is definitely here to stay. Many universities have large–scale Moodle implementations. The Open University is the largest in the UK and it has adopted Moodle institution wide and reckons the change was cost neutral, what they save on licenses they spend on development and support. The end result is however that they end up with the developments they want.

The JISC OSS Watch Service provides advice and guidance on the use of Open Source Software: http://www.oss-watch.ac.uk/.

Shared Services

The term 'Shared Services' means institutions cooperating in the development and delivery of services, sharing skills and knowledge, perhaps with commercial participation. These typically include services such as student records, timetabling, finance, estates, human resources, library management, virtual learning environments (VLEs) and customer relationship management (CRM).

Institutions may use a common, hosted service for these services, for example HR, student records and information. Their data is secure and some local variations can be accommodated. Shared services that interface with other systems and services within an institution need to be conceived within an overall architectural framework. The most sophisticated models of shared services involve establishing a completely new organisation, run and managed as an autonomous business. The term ‚shared service' does not necessarily mean outsourcing and there are forms of sharing and partnering arrangements which do not necessarily involve a private sector provider.

One example of how shared services can operate effectively in a highly competitive environment is the development of large shopping centres or malls. The retail outlets within the shopping centre may be in direct competition with one another yet they benefit from sharing services such as car parking which would cost a lot more if each shop had to provide its own car park.

In the UK the economic and political drivers for shared services are strong yet the amount of shared service provision in place is generally small, in non-critical service areas and predominantly regional in nature. There are however some significant exceptions to this. Shared services that cover most or all of the four UK nations include:

- Universities and Colleges Admissions Service (UCAS)
- Higher Education Statistics Agency (HESA)
- The JANET network that connects all universities, colleges, research councils and regional broadband consortia (schools). Its success was recognised by winning the shared services category of the e-Government National Awards 2007
- JISC also runs a range of UK wide Advisory Services via a not-for-profit company known as JISC Advance
- RCUK Shared Services Centre Project, probably the largest shared service initiative in the sector, covers all seven Research Councils, HR, payroll, finance, procurement, IT, telecommunications and grants processing.

Other examples include:

- Association of Northern Ireland Colleges (ANIC) consortium manages the supply of CIS services to the country's six large multi-site FE colleges
- M25 Consortium of Academic Libraries shares services for the benefit of students and researchers
- University of the West of Scotland and South Lanarkshire Council shared data centre

Flexible service delivery

Having looked at some of the new and emerging technology options available how might we apply these to the idea of Flexible Service Delivery? Flexible service delivery is about helping universities and colleges deliver new and integrated services through joining up disparate information systems such as library management, virtual learning, finance, student records, or timetabling.

By integrating and service-enabling these systems, coupled with optimising business processes, institutions can:

– Be more agile and be able to meet changing demands;
– Provide services more efficiently;
– Access business intelligence across the institution more easily, and
– Be able to share data and services within and across institutional boundaries.

To facilitate this in the UK, JISC is running the Flexible Service Delivery (FSD) programme supporting universities and colleges who wish to address the challenges and inefficiencies caused by the lack of interoperability in their systems and processes, and explore the possibilities and benefits of a more flexible information environment both within their institution and across institutional consortia. This includes exploring the practicalities of universities and colleges operating certain functions and activities through a flexible and shared service solution.

Flexible service delivery means different things to different people, and so different stakeholder groups have varying requirements and expectations. A key factor in success is understanding the needs of all of the stakeholders including senior managers, academics, IT managers and, not least, learners.

Each college or university will find itself at a different starting point in the process of adopting flexible service delivery. This may range from building understanding on the benefits of flexible service delivery within the institution, to scoping projects and initial exploration, to realising early organisational benefits and ultimately to embedding and managing a set of practices. The FSD programme is designed to help support strategic and IT management in navigating the step-by-step processes of implementing flexible service delivery across an enterprise. Benchmarking progress is a critical component and recognized in the programme design; like any kind of change process, investment in flexible service delivery must be guided by strategic priorities and demonstrate a measurable impact via performance indicators.

The FSD Programme Management Team has defined four key building blocks needed in supporting flexible service delivery:

– Senior management buy-in
– Service-enabling disparate legacy systems
– Cost baselining and modelling
– Opening up the market, unlocking inertia.

The following organisations are together exploring how the delivery of corporate administrative services, student records and information management services, and student and academic services can be improved through flexible means of service delivery, including the possibility of operating certain functions and activities through shared service solutions. A cluster of HE institutions are also using, adopting or interested in the Enterprise Architecture (EA) approach to support strategic change and improvement.

Blackpool and The Fylde College is reflecting on its recent successes in business systems integration implementations and reporting these as a case study, to build the capacity and upskilling necessary to put in plans for a more business-led and service-oriented approach to interoperability across their corporate services. Alternatives to traditional software supply models, such as Shared Services, Open Source products, Cloud applications or SaaS, will also be considered.

Bloomsbury Consortium. This civic grouping of six non-competing institutions (Birkbeck College, The Institute of Education, London School of Hygiene and Tropical Medicine, the Royal Veterinary College, the School of Oriental and African Studies and The School of Pharmacy) is being funded to deliver a consortium-pilot project which builds upon their portfolio of shared licenses, and using service-oriented approaches. It aims to establish a shared media platform across the consortium, including working with Apple iTunes U to create a consortium site which interfaces openly with consortium data architecture and systems. This offers the programme references to excellent examples of license sharing and joint governance across consortia.

Cardiff University is seeking to develop a common and shared understanding within the university, and within the wider sector, on how to build the capacity and maturity to advance towards achieving an environment of flexible and shared service delivery, through the development of an FSD Maturity Roadmap.

Coventry University is baselining its current systems provision and identifying opportunities for the use of SOA.

De Montfort University and Southampton Solent University have delivered a SOA/Middleware demonstrator project focused around the scenario of student tracking and engagement. This project used a solutions provider (Fulcrum Ltd) to develop a working prototype of a web-based application system which demonstrates how SOA and Enterprise Service Bus (ESB) technologies can be used to gather information from multiple application systems across the two universities, irrespective of the vendor and versions, store it in a secure and consistent form, and create an integrated report instance.

Imperial College London is defining its FSD maturity roadmap and business case to help consider the relevance of EA as an approach for strategic change and improvement, so that the college's ICT department knows how best to deliver agile, flexible and cost-effective services to their customers within the college, and have a strategic approach to building an underlying Service Oriented Architecture.

King's College London is delivering a project that enables and positions the Centre of Research (CeRch) at KCL to learn of ways, and of the cost, risk and impact, of how research information systems and practice, and digital repositories, could all be made available as a flexible and shared service, achieved principally by identifying common services for sharing within the e-Research domain and demonstrating where flexibility can be exploited.

Leeds Metropolitan University is delivering a project that enables and positions the Academic Support and E-Services department to learn of ways, and of the cost, risk and impact, of improving their service delivery mechanisms for their current portfolio of student services, as well as for future service provisions.

North Hertfordshire College, in partnership with City College Norwich, The College of West Anglia and SHM, are investigating the practicalities of a Further Education College operating certain finance functions and activities through a shared service solution, and to pilot a shared service solution within a real consortium setting.

Nottingham University is currently participating in the programme to share their experiences and lessons learned in developing a long-term strategy and business case for the implementation of a new service-oriented student management system, with the aim that this new implementation will be capable of improving the service delivery mechanisms to both students and staff at Nottingham University and across their campuses in China and Malaysia.

RMAS HE Consortium: The six institutions, with the University of Exeter leading and partners University of Essex, London School of Economics and Political Science, the University of Kent, Bournemouth University and the University of Brighton**,** will receive support in making technical decisions, specifying the statement of requirements, and engaging with suppliers of a potential shared-service Research Management and Administration System solution. This HEFCE-funded shared service feasibility project provides an excellent example of a community-driven shared service under development. They are also looking to expand their FSD activity by assessing the business benefits from implementing such a solution and demonstrating the benefits of moving from the current mix of research support systems to a ‚cradle to grave' solution which uses open, interoperable and service-oriented (or modular) technologies.

Roehampton University is sharing the work they are doing in developing a ‚shared services' roadmap, which addresses moving towards a process-led business environment which leads IT service development, and introducing the development of an EA approach using TOGAF.

SnUG Consortium. This consortium (Liverpool John Moores University, the University of Manchester, University of Cambridge, University of Derby, Queen's University Belfast and the University of Glasgow) is currently discussing shared service developments between the HEIs using/implementing the Oracle Peoplesoft Campus Solutions (CS) Student System. Developments being investigated include areas of interfacing (e.g. to VLEs), or in the development of required UK extensions to CS functionality, as generic shared services, which could lead to future collaborations with Oracle. The group is currently considering ways to work together to identify and deliver flexible/ shared services and would like to explore possibilities before embarking on pilots or trials. The FSD programme therefore offers an important support service to help the group formulate ideas not only for the group itself but also for the sector.

Staffordshire University is currently engaged in piloting Enterprise Architecture (EA) through JISC's Curriculum Design Programme. They are using this forum to share experiences and discuss common issues and practice with other institutions who have also adopted EA as an approach to strategic and technological change.

Thames Valley University is delivering a consortium-led project that scopes the demand and requirements for, and possible solutions to, an Intelligent Decision Support in HE (IDS-HE) as a shared service to the sector.

University of Bristol has as a strategic goal to better understand how FSD and EA can benefit the University and also to explore best practice techniques with other institutions around getting senior management support for a more strategic, architectural approach to systems development (the FSD business case).

University of Oxford is delivering a project to address the lack of provision in the area of assessment management. The project recognises that there has been little or no work done in terms of assessment management systems to support the process of marking and moderation by external examiners and review by examination boards, and that current student system providers do not address this requirement within their products. This means that these processes are managed (at significant cost) at departmental level in most universities – either through local systems, spreadsheets or very manual methods. The objective therefore is to address this and define the requirements for a service that could be plugged into any student system and provide the appropriate functionality. With this programme, the University is also delivering a project which identifies and pilots approaches to baseline costing of IT services so that it is possible to assess where cost savings and process improvements can be made.

The progress of these projects is being reported via the JISC infoNet website and the Flexible Service Delivery pages can be found at: http://www.jiscinfonet.ac.uk/flexible-service-delivery.

A 10 point plan for managing your portfolio

We have looked at some new approaches to delivering IT services and at some of the risks and opportunities inherent in these approaches. We have suggested that managing your technology portfolio is best achieved by using an EA approach that takes a holistic view of your organisation and its strategies, processes and systems. We recognise that this is a challenging agenda. In practice EA thinking may be best promoted within your organisation by starting small and delivering some quick wins by using this type of approach before you try to 'sell' EA as a big idea or a means of driving strategy.

For those of you wanting to get started on improving the management of your technology portfolio and better aligning your technology choices with the university's strategic objectives here is a simple 10 point plan for the first 3 months:

- Review a copy of your university's strategic plan and understand your Vice-Chancellor or Rector's main goals for the coming year.
- Create a basic view of your IT Architecture showing the applications and services, the interfaces between them and the data transferred.
- Identify any 'bloated' or redundant applications that consume resource far in excess of their actual value to the organisation and plan to phase them out. In time you will look at the business processes that drive this.
- Then use the IT architecture conclusions as a starting point for discussion with management and teaching colleagues about architecture at enterprise level. Look at your main business processes, the weaknesses or 'pain points' in them and where they interact, and how this relates to your conclusions on IT architecture. Use this debate to build a roadmap of integrated process and ICT change.
- Identify the likely lifespan and replacement cycle for the applications.
- Consider how a service-oriented approach (SOA) to your data layer could streamline the architecture and reduce the need for interfaces/data retyping. Plan to turn the 'spaghetti' into a 'lasagne'.

– Consider where approaches such as Shared Services, Open Source products, Cloud applications or SaaS could add value or reduce costs.
– Produce a 'Roadmap' of how you hope to develop the Enterprise Architecture in conjunction with business colleagues. Relate this to the key business goals of the college.
– Talk to others about this and keep an eye on developments coming out of the JISC Flexible Service Delivery programme.
– Review your Roadmap regularly in the light of any changes to the university's strategic goals.

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Addressing Risk Management Efforts for Cloud Services at the Technische Universität München

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Keywords

cloud services, types of clouds, risk management

Abstract

Cloud Computing has become the new hype in IT, although the main idea behind Cloud Computing is not new. In fact, Cloud Computing is a new cover for already established outsourcing models. So Cloud Computing includes the outsourcing of infrastructure, software and entire platform. Cloud providers (CP) are IT outsourcing services provider. They offer Infrastructure as a Service (IaaS), Platform as a Service (PaaS) or Software as a Service (SaaS). This article aims to give a brief definition of Cloud Computing. We already have an infrastructure in place at Technische Universität München (TUM) that can be seen as Cloud Computing. It has successfully run for years. Based on this definition we introduce Cloud Services already in use at Technische Universität München (TUM). These Cloud Services are provided by the Leibniz Supercomputing Centre (LRZ) – our Cloud Provider.

"Every cloud has a silver lining" states a proverb. Silver linings of Cloud Computing are: increased flexibility, reduced costs, benefits from the providers' expertise, and more efficient resource utilization at the CP side. Although these and other positive impacts may be very important advantages, it is important to understand that Cloud Computing can expose one to many risks. According to the European Network and Information Security Agency (ENISA) (2009) such risks can be classified as policy and organizational risks, technical risks, legal risks and risks not specified by the cloud. Risks we encounter at TUM are risks that we have identified as particularly important for our environment such as loss of governance, supply chain failure or resource exhaustion.

In the second part of this article we will focus on these particular risks and outline our management approaches like reducing the risk of supply chain failures through better transparency achieved by maps of our IT landscape or the sharing of the risk of resource exhaustion through splitting responsibilities in the resource allocation process. In the third and final part of this article we give a brief conclusion of our risk management activities and give an outline of our further activities like enhancing our Configuration Management Database with the possibility to create the above mentioned maps to assist our risk management in future.

Introduction

As most European universities, at Technische Universität München (TUM) we put tremendous efforts into converting our degree courses into the bachelor and master system. To support this effort we introduced a new campus management system called TUMonline (Pongratz, Wülbern, 2009). TUM comprises 13 faculties, functional units, central service institutions and a central administration located at three major sites. Following this organisational structure our IT infrastructure is decentralised throughout these sites. The integration is then accomplished via our CIO/IO board. This board is responsible for the optimization of our IT strategy.

Parts of our IT are also operated by the Leibniz Supercomputing Centre (LRZ). The LRZ is a common IT service provider for all Higher Education Institutions (HEIs) in the Munich area. The LRZ offers services like groupware, file servers, backup and archiving, WLAN and VPN access, and operates the Munich Scientific Network (Münchner Wissenschaftsnetz, MWN) infrastructure connecting more than 400 buildings and 60,000 end systems.

Supporting research and teaching at a technical university also means offering dedicated IT resources in a flexible manner. One mean of doing this is using Cloud Services. Cloud Services are mainly used to benefit from the Cloud Provider's know-how and to safe costs due to economies of scale. Figure 1 outlines the three main layers of Cloud Services. A Cloud Provider (CP) may offer Software as a Service (Saas), Platform as a Service (PaaS) or Infrastructure as Service (IaaS) or a combination of all of these. Each layer has various components which in turn also have relationships between them. The lines illustrate these connections. There are also relationships in between these three layers, but for clarity reasons they are not shown in Figure 1.

According to the European Network and Information Security Agency (ENISA) the main characteristics of Cloud Computing architectures are (ENISA, 2009 based on (Mell and Grance, 2009), (Vaquero et al., 2009) and Wikipedia):

– highly abstracted resources
– near instant scalability and flexibility
– near instantaneous provisioning
– shared resources
– 'service on demand' usually with a 'pay as you go' billing system
– programmatic management.

Cloud Computing fundamentally differs from standard outsourcing. As opposed to standard outsourcing, Cloud Computing is relying on economies of scale in offering com-

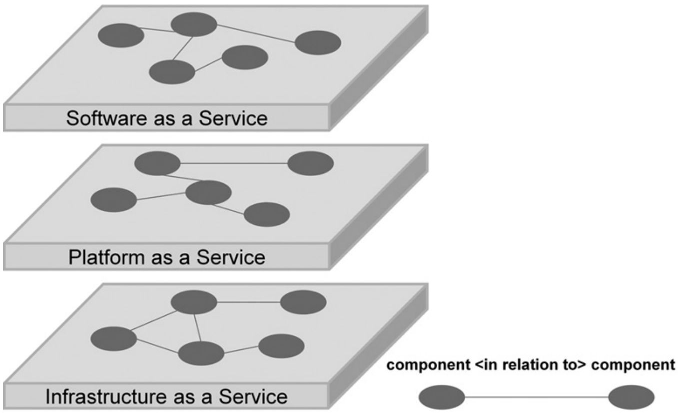

Figure 1. Layers of Cloud Computing

modity services rather than customizing services specifically to customers. A further distinction can be made according to the visibility in public, private or partner Cloud:

- Public: available publicly – any organization may subscribe
- Private: services built according to Cloud Computing principles, but accessible only within a private network
- Partner: Cloud Services offered by a provider to a limited and well-defined number of parties.

According to this definition, the idea of Cloud Services is in fact not completely new. In order to efficiently operate TUM's IT and offer the required flexibility for our users spread over our various locations the LRZ has developed and successfully implemented the same model years ago. While this was not called Cloud Computing, it was based on the same principle and structures. In the following section, we will describe examples of TUM's Cloud Services as offered by the LRZ.

Cloud services at Technische Universität München

At TUM our CP LRZ offers us implementations on all three levels: infrastructure, platform and software. Examples of such services are introduced in the following section.

Infrastructure as a Service (IaaS) used at TUM

On the infrastructure level, TUM is using virtual servers, databases or storage facilities for various services, e.g. TUM's Identity and Access Management (IAM) infrastructure (Hommel, Knittl and Pluta, 2009). For example, Figure 48 shows the basic architecture of the storage solution provided by LRZ. TUM users can access their own dedicated storage either via internet or via their local computers by connecting it using the Common Internet File System (CIFS) protocol.

On the CP side, the LRZ operates a web and application service to handle HTTP-requests. This service is connected to the Network Attached Storage (NAS) filer which then stores all the data on archival storage. This storage is mirrored at a second location, the RZG (Rechenzentrum Garching of the Max Planck Society and the IPP).

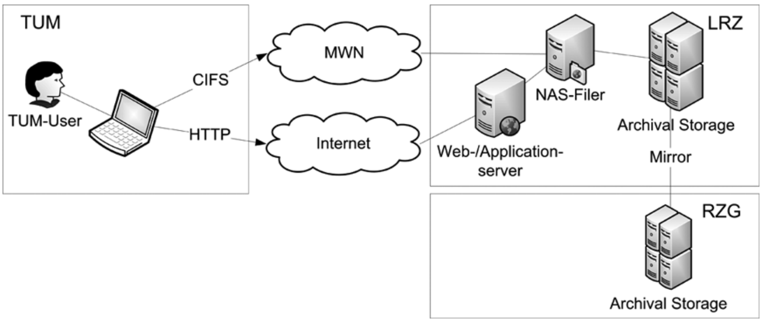

Figure 2. IaaS: Storage Services for TUM

This architecture gives TUM a higher level of data security and flexibility. By using this storage infrastructure TUM also benefits in case of recovery activities. Users can restore their deleted or damaged files on their own by using a dedicated web interface. In case of disaster recovery, the normal operation can be restored quickly. This is made possible by mirroring the first archival storage to a second one located at a separated location at the RZG. For extra safety all the data are additionally secured on tape libraries. The same service is used by the Bavarian State Library for the long time archival of their digital collections (Reiner, Wolf-Klostermann, 2008). Thus, the library is able to concentrate on their own strengths like collecting or ingesting and benefits from the know-how of the LRZ to establish a sustainable long time archive.

Platform as a Service (PaaS) used at TUM

One example of PaaS commonly used by TUM's researchers are computing services which are also offered by the LRZ. Hereby the developers at TUM are uploading their applications and data via internet to the computing facilities. Examples of such applications are complex simulations of various flow phenomena like tsunamis or the simulation of mixtures of materials on a molecular level. The developers themselves do not have to care about operation and administration of the server hardware and software. In this way, TUM benefits from saving costs for administration and other amenities like storage space, air-conditioning etc. This service is quite commonly used by TUM researchers in the high performance computing (HPC) area. For this purpose the LRZ operates one of three national supercomputers in Germany and a Linux cluster for the researchers from Bavarian universities.

Software as a Service (SaaS) used at TUM

On the SaaS level, TUM members can use the MWN-wide mail services operated by the LRZ. As shown in Figure 3, our users log in to their mail account via web interface. The LRZ runs all the required software and hardware like mail servers, load balancers, mail forwarder and security facilities like spam and virus filtering software. TUM's only responsibility here is to take care of the immediate activation/deactivation of mail accounts when users enrol/sign off at our university. This is accomplished via automatic provisioning procedures implemented in the new campus management system and connected to our comprehensive IAM-infrastructure.

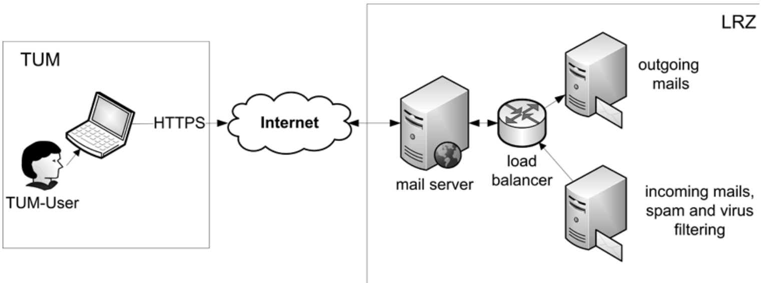

Figure 3. Mail Services for TUM

The described examples above confirm that the application of the diverse Cloud Services is already prevalent for our users. In the next section we demonstrate that although the usage of such services is commonplace for our users, the management of such an environment is everything but trivial. Based on specific risks of Cloud Computing we show our approaches to manage these.

Risk management for cloud services

Installing Cloud Services has many advantages like reducing administration efforts both at customer as well as on CP side. Common benefits for Cloud customers are cost reductions due to fewer expenses for staff, space, electricity or purchasing costs whereas the CP profits from a more efficient utilization of resources. Such advantages result also from the usage of virtualization techniques. Miscellaneous possible formations of Cloud Services are outlined in Figure 4.

It is possible on every level – infrastructure, platform or software – to introduce Cloud Services and every Cloud Service could be provided by different a CP. When using such a set-up, new inter-organizational relationships occur that have a rising complexity the more CPs are involved. For that reason, it is necessary to cover aspects like security or governance in line with an inter-organizational management approach. In style of meteorological Cloud terms, we call this *cumulus* Cloud management.

Although there are many good reasons to introduce Cloud Services, there are also manifold risks that need to be managed. Risk management's activities in general are identifying, assessing and treating risks. Possible strategies are to avoid, reduce, share or the retention of risks. In the following section we describe which risks are particularly relevant for TUM's services and explain how we anticipated these. The risks described here have already been identified and listed in ENISA's report (ENISA, 2009). According to ENISA, the risks in Cloud Computing can be classified as *policy and organizational risks*, *technical risks*, *legal risks* and *risks not specified by the cloud*.

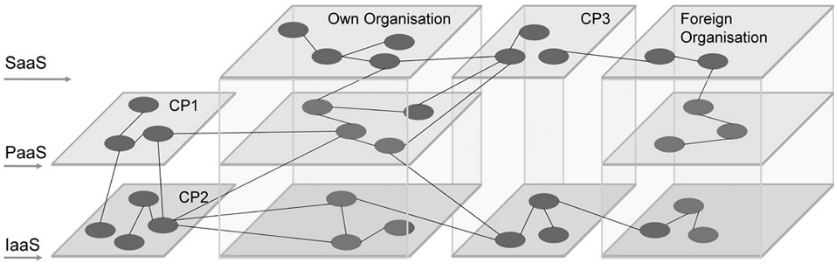

Figure 4. Formations of Cloud Services

Policy and Organizational Risks

One serious risk of using Cloud Services is the possible loss of governance. Complex Cloud environments as shown in Figure 4 have elaborate cross-organizational relationships. This is why governance needs to involve all connected CPs as well. Otherwise hidden dependencies or unclear roles and responsibilities will lead to confusion.

To address this, we have defined inter-organizational IT Service Management processes. In Hommel and Knittl (2010) we describe our approach of establishing an inter-organizational fault management process between TUM and LRZ. It includes organizational, technical and procedural aspects. On the organizational level, regular trainings of process participants on both sides are undertaken. To improve the technical connections we created interfaces between our tools to assist routing of requests from TUM to LRZ and vice versa. We have also defined roles and responsibilities when implementing procedures of our inter-organizational fault management. Our next steps will be the introduction of Service Level Agreements to make responsible persons on both sides aware of the vital interconnection.

When there are sophisticated cross cloud applications present, hidden dependencies might occur. Therefore, interruptions or corruptions in the supply chain are difficult to discover. TUM's IAM-Infrastructure for example is installed on virtual servers. These virtual servers are connected to the file services as above described. If there is for example a down time on the filer due to maintenance, TUM's users wouldn't be able to log in to the campus management system any more, since this is depended on the IAM-service, which would not be reachable because of dependencies. Thus, having an overview of the architectural landscape of the Cloud environment is an important aspect for our management. For that we have started to generate different maps of our IT infrastructure. Figure 5 shows one map showing the relationship between services and the organizations responsible for its operating. We have also build maps showing dependencies between interconnected IT components or maps outlining the relevant IT systems for certain student lifecycle phases.

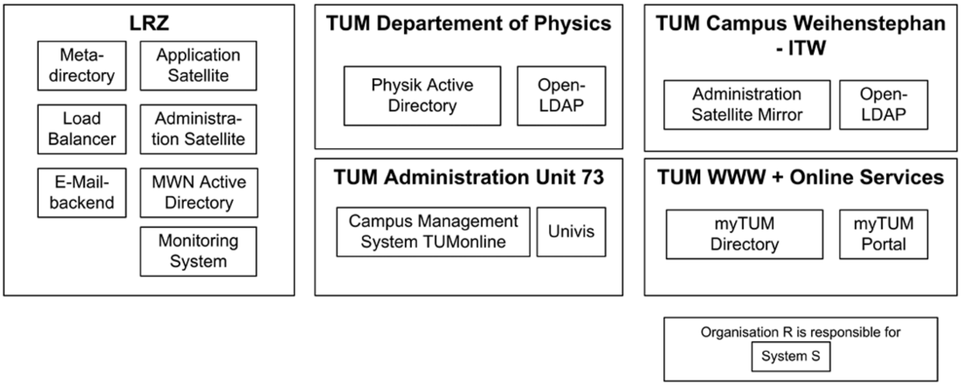

Figure 5. Cluster Map: Subset of IT services linked to our IAM infrastructure (Ciechanowicz et al., 2009)

Such maps helped us to identify miscellaneous dependencies. Hence, in the above described maintenance case, we were able to react promptly and temporarily moved our IAM components to a backup system so the maintenance downtime didn't affect our services.

A further risk we identified is lock-in. Lock-in would be significant if the chosen CP is not using standard technologies. In that case, organizations that want to change their CP are facing enormous investments when migrating. In our case, we have chosen our lock-in position voluntarily in a way. The cooperation between TUM and LRZ is based on a long-term relationship. Additionally, the members of the LRZ steering board are selected from the Committee of Informatics, whose members itself are composed of representatives from TUM and other universities of Munich.

Table 1 subsumes our strategies and implementations for risk identified on the policy and organizational area. In the next section, we describe technical risks and our counteractive measures.

Table 1. Strategies for Policy and Organizational Risks

Risk	Strategy	Implementation
Loss of Governance	Risk reduction	Definition of inter-organizational processes including roles and responsibilities
Supply Chain Failure	Risk reduction	Better transparency through IT infrastructure maps
Lock-in	Risk retention	TUM representatives are part of LRZ's governance structure

Technical Risks

One major reason to choose Cloud Services is the increased flexibility in case of varying resource utilization. Therefore one risk when outsourcing services could be the inability of the CP to provide additional capacity. In order to reduce this risk and to be able to offer further capacities quickly to our users, we have decided to split responsibilities in the provisioning process of the above described storage service. On TUM side, we have introduced so called storage administrators for every department. They have been granted an initial storage capacity by the LRZ. Our storage administrators can allocate this initial capacity to users in their departments on demand. The LRZ itself is responsible for the overall management of the storage system and the overall capacity management. By splitting these responsibilities we are able to provide our users the needed storage instantaneously, without having to deal with complicated request procedures at the LRZ.

Essential parts of TUM's IAM-Infrastructure are operated by the LRZ. For this purpose, exchange of identity data like user id, password, address etc. takes place constantly. Therefore we are facing the risk of having the data intercepted in transit. To reduce this risk, we are transferring data only via secured channels in a VPN-like environment.

As can be seen in Figure 4, one essential property of Cloud Services on the CP side is resource sharing between multiple customers. The risk of this is isolation failure or lack of resource isolation. Thus, so called guest-hopping attacks or side channel attacks might be possible because of failures in separating storage, memory or routing, leading to a loss of sensible data or service interruption. For this risk, we have chosen the strategy of risk retention. The LRZ as our CP provides a Partner Cloud, with the LRZ sharing the resources only with other universities in Munich. Therefore, our risk is lower. This has also been proved by ENISA, who asserts that those isolation failures are more likely to be a risk in public clouds.

Table 2 shows the sum of our activities in managing the technical risks. ENISA's report is listing many more technical risks, like economic denial of service or ineffective deletion of data. Here we have given a small excerpt of our risk management efforts for those risks that are most important to us.

Table 2. Strategies for Technical Risks

Risk	Strategy	Implementation
Resource exhaustion	Risk sharing	Shared responsibilities
Intercepting data in transit	Risk reduction	Secured transaction channels
Isolation failure	Risk retention	Low risk, because Private/Partner Cloud

Legal Risks

When choosing a CP, it is vital to address legal risks in advance. CPs might be located in different countries with different data protection laws or unpredictable legal frameworks or enforcements. We have experienced this in the DEISA (Distributed European Infrastructure for Supercomputing Applications) project, where data protection and archiving laws of the participating members in the different European states are in conflict. An example are accounting data: Some countries require them to be stored for a long time due to archiving laws, whereas other countries data protection laws prohibit storing personal accounting data for a longer time period.

TUM services operated by the LRZ are within the same legal framework. However, for all data processed by the LRZ, TUM's data protection commissioner requires a data protection approval (Datenschutzfreigabe) to act in accordance with the German data protection law called "Informationelle Selbstbestimmung". This data protection approval contains a process description listing all stored data in detail and a general description of the used technical and organizational means of our CP.

Risks not specified by the cloud

Besides above described cloud specific risks, there are also ones that could occur in any IT environment (cf. Table 3). The core feature of many (Cloud) Services is access via network. Thus, the network becomes a critical component, especially concerning security. It would be no sufficient solution to offer only non web accessible services, since our users are requesting flexible access. As described in ENISA (2009), security measures are cheaper when implemented on a larger scale. Thus we benefit from our CP's expertise: the LRZ is also operating the Munich scientific network and manifold security facilities like routers or firewalls. Some of our Cloud Services are only accessible within the MWN for security reasons and can therefore be classified as Private Cloud Services.

Network outages are affecting all our users. Thus, network management also is a vital activity. Our CP is responsible for the operation of the MWN as well as all relevant network management activities, like patch management, routing, monitoring, capacity, availability, and continuity management. Our departments benefit from these experiences by having access to the LRZ's networking know-how.

Although we benefit from the widespread expertise of the LRZ in the network management area, all our sensitive data and applications especially in the HR field are operated in a separate net.

Theft of vital IT components is a further serious problem in any environment. All hardware operated by the LRZ, our CP, is located in the LRZ data centre. Hereby we trust to the access restrictions of the LRZ, only authorized staff is allowed to enter its data centre.

Table 3. Strategies for risks not specified by the cloud

Risk	Strategy	Implementation
Network outages	Risk retention	No own implementation – Trust in CP's know-how
Network management	Risk retention	No own implementation – Trust in CP's know-how
Theft of equipment	Risk reduction	Comprehensive access restrictions to CP's data center

Conclusion and outlook

Cloud Services may be installed as Infrastructure as a Service (IaaS), Platform as a Service (PaaS) or Software as a Service (SaaS) accessible mainly via internet and provided on demand. In this article we have described various implementations of Cloud Services used at Technische Universität München (TUM), e.g. personal storage facilities, mail services or virtual servers. As many Cloud users, TUM benefits from using such services in gaining higher flexibility and reducing costs. The Leibniz Supercomputing Centre (LRZ) is TUM's major Cloud Provider. The LRZ is offering its services to all Higher Education Institutions (HEIs) in the Munich area. Although using Cloud Services is not a new experience for us, we have been benefitting from it for years; however, Cloud Services are also posing several risks.

Such risks might be loss of governance, legal risks like data protection risks or technical risks like network outages. The report of the European Network and Information Security Agency (ENISA, 2009) about Cloud Computing gives an excellent starting point for one's own risk management activities. In this article we have described risks that we have found vital for our environment and our approaches to manage these successfully. Examples include the risk of resource exhaustion and our approach to reduce this by sharing responsibilities in resource allocation or the risk of losing governance where we have reacted by defining inter-organizational processes. We have started with the inter-organisational fault management process but in future we want to extend it to further IT Service management related processes like change or release management. To reduce the risk of supply chain failures we have started to introduce maps showing different viewpoints of our IT environment and thereby gained better transparency. We are planning to enhance our Configuration Management Database (CMDB) with the feature of generating such maps automatically in future.

Our examples demonstrate that managing risks in Cloud environments is a necessary task that needs a comprehensive approach involving Cloud customers and providers. Activities in risk management are certainly not once-only issues but need to be reassessed on a regularly base to either identify new risks, or to reevaluate the already established measures for known risks. Valid measures in risk management are targeted to either leave it, avoid it, share it, or mitigate it. When a comprehensive risk management for Cloud Services is in place, Cloud Computing offers a great potential for assisting HEIs for example in offering flexible teaching labs as demonstrated in Lindinger et al. (2008) where a dedicated IT lab environment has been established by using virtual machines which could be operated by a CP.

The concentration of hardware resources enables economies of scale. The actual development of the LRZ demonstrates this, since the square footage of the data center which was built only in 2006 will roughly be doubled by 2011 and we thus have a powerful partner on our side capable of providing more of our IT as Cloud Services. The higher Cloud Services are on the Cloud stack – infrastructure, platform, service – the more business-specific is its implication. It probably might be an upcoming business model for some vendors to offer "campus management as a service".

To create the awareness to take risk management in Cloud Computing seriously, we want to conclude this article with ENISA's note to governments (2009): "The use of public clouds (..) is not recommended for anything but the lowest assurance classes of data. For higher assurance classes of data choose and check CP carefully."

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Open Software & Open Content

Motivations to deposit: Two Approaches to Open Educational Resources (OER) Within Languages and Social Sciences (LSS) at Aston University

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Executive summary

In Spring 2009, the School of Languages and Social Sciences (LSS)[1] at Aston University responded to a JISC (Joint Information Systems Committee) and Higher Education Academy (HEA) call for partners in Open Educational Resources (OER) projects. This led to participation in not one, but *two* different OER projects from within one small School of the University.

This paper will share, from this unusual position, the experience of our English tutors, who participated in the HumBox[2] Project, led by Languages, Linguistics and Area Studies (LLAS) and will compare the approach taken with the Sociology partnership in the C-SAP OER Project[3], led by the Centre for Sociology, Anthropology and Politics (C-SAP). These two HEA Subject Centre-led projects have taken different approaches to the challenges of encouraging tutors to deposit teaching resources, as on ongoing process, for others to openly access, download and re-purpose. As the projects draw to a close, findings will be discussed, in relation to the JISC OER call, with an emphasis on examining the *language* and *discourses* from the two collaborations to see where there are shared issues and outcomes, or different subject specific concerns to consider.

The background

It is acknowledged that the language used to discuss repositories and open access educational resources can mean quite different things to different groups. There are also many sensitivities concerning making educational material public (Rothery, Hayes, 2008). The C-SAP and Humbox OER Projects have each sought to reveal the embedded pedagogical assumptions within the example learning materials shared, and acknowledge learning design to try to reduce barriers to sharing. A strong element within both project collaborations has been the sense of subject community (Wenger, 2002), as discussed in the 'Good Intentions' report for JISC. Ownership and trust are identified by many studies as crucial requirements for sharing, together with a resource collection built up by the subject group providing a shared focus (Currier, Duncan, Douglas, 2008).

The approaches of the Humbox and C-SAP OER Projects

The Humbox Project adopted a *practical approach*, with 11 partners within universities across the UK, *encouraged to deposit Humanities resources from the start, in an easy to use repository* (HumBox). HumBox is a Web 2.0 style repository, adapted from Eprints open source software, developed by Southampton University. Support for both technical issues and process-related concerns was provided, along with a peer review facility. Space to experiment, prior to the release of content, was provided and depositors actively helped to refine the key features of the collaboration. At Aston University, the English lecturers

[1] http://www1.aston.ac.uk/lss/.

[2] http://www.humbox.ac.uk/.

[3] http://www.c-sap.bham.ac.uk/subject_areas/elearning/oer/.

contributed their TESOL (Teaching English to Speakers of Other Languages) materials to Humbox and were interested to know how the collaboration might broaden the range of resources that might be offered to their distance learning students.

"One of the reasons I am excited about Humbox is because of the potential I see for the distance learning programmes that we run here" Dr Fiona Copland, LSS, Aston University

The Humbox launch for open access was on 26 February 2010 in Sheffield.

The C-SAP OER project has been evaluating the process of opening up resources for learning and teaching in the Social Sciences, with 6 core project partners across the country. This project has sought *to develop an appreciation of the cultural shift required to move from an individualised activity to a more dialogical production of teaching resources*. A key aim has been to:

"use the analytical tools of the Social Science disciplines to help make current tacit knowledge visible" (C-SAP),

to inform production of learning materials and effective reuse. The emphasis has been on adopting a learning design approach which considers how teaching materials might be designed *for* reuse. One output is a toolkit that focuses on readiness to share and includes tools to help Social Science staff review their teaching and learn about the benefits of OER. Another important consideration has been whether there are in fact issues that are *particular* to the Social Sciences, when assessing feasibility of design for OER.

Resources from C-SAP partners will go into the JorumOpen repository.

Conclusions

Whether contributing teaching materials to JorumOpen, or to Humbox, there has been active discussion amongst the respective partners in these two OER collaborations. Debates about the processes involved in depositing teaching materials for open re-use via repositories have been captured via a *C-SAP wiki* and *Humbox Basecamp*. Therefore some basic analysis of this discourse from within these online discussion texts, from the Humbox and C-SAP OER Projects, using a simple tool for corpus analysis, called AntConc, will be included in this paper. A 'corpus' is the Latin term for a 'body of texts'. Such discourse can be systematically searched and compared to determine patterns of authentic language use and *quantities* of particular terms. This can help identify which 'buzz words' occur *and in what context* and where there may be 'dominant' voices.

The OER Programme[4], for those participating in LSS, began with a debate about 'teaching materials', it has to, as this is what is being sought from people, *open access to their teaching materials.* In looking at the language surrounding just these two words alone, as they are central to the OER debate, 'teaching' and 'materials' can bring with them, in discourse, much to aid our understanding of 'where people are' in relation to this complex agenda.

Given that discourses carry a contextual, ideological and historical perspective, and the fluid interplay of language in use (Santos, McAndrew, Godwin, 2007), these multidisciplinary conversations about OER provide useful material from the projects for a dis-

[4] http://www.jisc.ac.uk/oer.

course analysis. There is not scope within this short paper to offer anything more than the most basic of introductions to some techniques by which the various 'voices' from current OER projects might be explored. Findings will only suggest therefore what might be possible from research of this nature, and further exploration by the authors is intended, as well as dissemination at future OER related events.

The anonymous, quantitative results from this small study will hence be presented as data to invite further discussion on the patterns in language that emerge. Could corpus analysis of discussions about OER help inform us on where we should concentrate future activities and funding? Has this JISC-funded project research into the release of open resources helped to reduce the perceived barriers to sharing amongst the academics taking part? Or is further culture change required and what are the prospects for *sustainability*? Conclusions will be drawn from staff who have participated from the School of Languages and Social Sciences at Aston and from the C-SAP and LLAS HEA partners, and subject centre staff who have led the collaboration.

Shared resources, unshared language?

What do we mean by OER?

A frequently used definition of OER is, "digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research" (OECD, 2007).

Both Humbox and C-SAP project discussions began in early 2009 with careful consideration of what offering such materials *freely* might mean for the academics preparing them for release and re-use.

The JISC OER briefing paper

These projects began initially with scrutiny of the JISC OER briefing paper to discuss practicalities in both applying for this funding and then meeting JISC requirements. Discussion about the present structure and location of the teaching materials to be contributed and how to transfer pedagogical information, particularly the tacit, embedded assumptions that a tutor would relate to his/her resources was expressed by partners in both projects.

The aims of this JISC OER pilot were outlined at a briefing meeting in January 2009:

"to support institutions, consortia and individuals to release open educational resources for use and repurposing worldwide, by assisting the development of appropriate processes and polices to make this process an integral part of the learning material creation workflow" (JISC, 2008).

An emphasis was placed in the briefing paper on taking an innovative approach to hosting and metadata, with minimal level tags such as 'ukoer', title of resource, author information and subject area being the most basic requirements. However in aiming to encourage ease of deposit, and quickly build a collection, the 'pedagogic metadata', usually of real interest to a tutor wishing to repurpose a resource such as a Powerpoint lecture, can unfortunately be omitted.

In order to try to address this, to some extent, a peer review approach was suggested, where resources would be initially assessed by project partners for potential re-usability. The lack of clarity of ownership of many academic resources would be addressed as a part of this review process, together with use of creative commons licenses. Outputs from this pilot year with regard to copyright and IPR would be fed back into the UK creative commons group.

In short, the intention was to find out 'what works' in the OER process and to consider what cultural changes might also be required in order to motivate people towards an OER approach.

Why are teaching resources not shared much 'openly' in the UK?

Motivation to deposit *teaching resources* in repositories of any kind has been minimal in the UK, despite many funded projects in recent years offering *technical* solutions. These projects have often focused on the *platform* that will be used to store the resources, coming later to examine reasons why items have not been uploaded.

Some of the *tutor barriers* have included concerns about potential misuse of their materials, anxieties about the quality of resource design, possible and often inadvertent copyright infringement and, not least, the time involved in uploading, even if a desire to share materials is clearly established.

It would also be fair to comment that for many lecturers, despite a rapidly increasing array of free-to-access learning materials available, it is quite possible that many still do not 'see the point'. Potential benefits are not apparent if your teaching is already successful. Why change anything?

Stephen Downes declared that learning design itself is simply incompatible with re-use:

"Learning design and reusability are incompatible. Design requires specificity, and specificity prohibits resuability" (Downes, 2003).

It is that very specificity, and perhaps the relationship that flows between lecturers and students that should be the actual starting point to any discussion about the value, or not, of a plethora of open educational resources. If we do not begin with the teacher perspective, and closely related learner benefits, then who will use the materials?

There are also many *technical barriers* to allowing the ideals of OER to flourish. Stuart Lee, writing a chapter entitled 'The Gates Are Shut', within *Opening Up Education* (2008), reminds us of the complexity of higher education roles, citing an example of a tutor teaching on a particular module within a learning management system (LMS) which is considered a user-friendly 'personalized' area for the students. If the tutor decides to refer the students to a useful example within another discipline and suggests consulting particular resources on that module:

"When the student logs on they may well find their way barred, the gates closed, because the system only recognizes them as a student of one discipline. Educational resources then, even within the institution, are not "open". They are controlled, managed, restricted, and channelled" (Lee, 2008).

"Additionally, although LMS and VLE systems may have originated from academic projects, within universities, many are now multi-million dollar international companies" (Lee, 2008).

The economic implications and interests are complex, and for tutors, who during the last decade have been encouraged to deposit resources via a VLE, *for their students alone*, it has made little sense to upload elsewhere, for altruistic reasons.

Certainly for some lecturers, who liaise on a regular basis for teaching, with communities and organisations outside of university, VLEs have not been an entirely helpful progression. More open systems would have allowed regular participation and interaction for students on modules where professional colleagues in, for example, the health service, police or schools and colleges could also have participated.

If progress is to take place, or at least answers to be sought, about the feasibility of the open sharing of teaching resources in mainstream higher education, tracing what teachers actually do, how they do it and why they would consider making any changes would seem to be important activities. Furthermore, what they do within different disciplines might also vary considerably, as might the related discourse.

Why consider a 'critical' discourse analysis (CDA) approach to OER?

The *language* that has been in use now for a number of years, in relation to more traditional, largely 'library' type in focus, repositories for both research, and learning and teaching purposes, can create barriers to sharing resources, as people simply do not understand the terminology. For example, 'metadata', 'reusable learning object', 'interoperability standards', to name a few, have been dominant terms that are unfamiliar to lecturers. In terms of *learning and teaching* repository discussions, these words do seem to be finally slipping a little from use in the UK. Instead, as many repositories become more 'Web 2.0' in style, and about 'personal ownership' in focus, the use of terms like 'tagging' and 'reviewing', 'commenting', 'subject community' and 'social networking' are more frequently heard. Indeed it was observed at a recent repository discussion event in Worcester[5] that even the word 'sharing' has not been of primary concern in some learning and teaching repository reports and discussions of late. The process of sharing no longer needs to be discussed, it seems, as a 'desirable phenomenon' assumed unattainable, no matter what approach is taken.

It is therefore the intention in the next section to compare some of the discourse from the C-SAP and HumBox projects to see what patterns emerge in the use of language and in turn to see how this may vary, or overlap, with the JISC/HEFCE/HEA agenda. A *critical* approach to discourse analysis will enable an examination of the social, cultural and political environment around OER as an 'interpretive resource' (Mautner, 2005). Fowler suggests that the speaker "embodies in language his experience of the phenomena" (Fowler, 1991). If this is the case, a closer scrutiny of the OER discourse might enable analysis of "opaque relationships of dominance" (Wodak, 2001), if these should exist. Whilst releasing open educational resources for all to access would appear to be a worthy enterprise, there may be other factors at stake that, at first glance, are not apparent.

The simple methods used to collect and search the discussion texts for quantitative data will now be described. Then one example of a search on the words 'teaching' and

[5] *Learning and Teaching Repositories: is this the last chance?* Repository Symposium Event, Worcester http://wlbrproject.wordpress.com/learning-and-teaching-repositories-is-this-the-last-chance/symposium-presentations/.

'materials' will be provided to illustrate how basic analysis techniques might be applied. If there are barriers, or opportunities, or perceived benefits, what are people saying about the 'OER experience' so far? What can the discourse tell us?

Corpus tools for oer discourse analysis

A simple approach using AntConc for analyzing comparable corpora

This may at first appear a little unrelated to a paper about repositories and open educational resources. This section will show how a simple corpus tool was used to examine and search the texts from the spontaneous discussion comments that participants posted to the C-SAP wiki and HumBox Basecamp. These were then compared to the JISC/HEFCE/HEA documents that invited participation and have since offered updates on OER progress. Those involved in the C-SAP and Humbox projects have given their permission for such analysis and the JISC/HEFCE/HEA documents are freely available to read on the web and have been listed in the references section of this paper.

So firstly, what is AntConc? AntConc is a freeware concordance program, a useful tool essentially, that can be downloaded from http://www.antlab.sci.waseda.ac.jp/ and can quickly provide a comparison of texts, which can in turn reveal 'points of interest' for analysis of the discourse within.

For example, repeated use of certain words or phrases may merit further enquiry, particularly when 'collocation', the juxtaposition of these words together with others, co-occurs more often than might be expected by chance. Such quantitative patterns can be observed and commented on using techniques defined for the analysis of discourse.

What is the difference between language and discourse? Essentially, discourse is language in real contexts of use, which for this purpose, is providing the data for analysis from the discussion texts about OERs. Discourse is a particular way of constructing a domain of social practice (Fairclough, 1995) and critical discourse analysis asserts that dominent ideologies might be 'sustained through textual practice' (Simpson, Mayr, 2010).

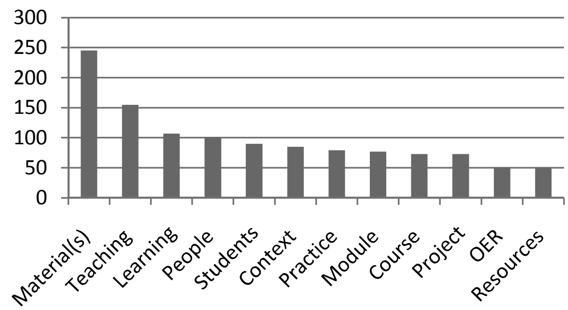
Therefore the study of this discourse may reveal how social practices, in relation to OERS are regulated, how identities are created and linked with other contexts. *Interdiscursivity* refers to the relationship of discourse with other discourses and the resulting interplay. Examples of where the discourse overlaps and is related to other discourses can be seen within the discussion texts below. The analysis of discourse can go further than simply describing linguistic features of texts, it can pinpoint where there is an imbalance, or some inequality in the spread of power or authority. What implications this may have for OER will be discussed in the conclusions with a recommendation that further studies be undertaken to reveal where the range of motivations lie for participation.

The process followed for this study

Organising the texts to be analysed is an important first practical step. All discussion postings to both the C-SAP wiki and HumBox Basecamp forums were saved into separate folders as.txt files using Notepad. AntConc can easily generate lists of words and their frequency of use. Below are the word counts of *frequencies of the 12 most popular words* from the three separate searches:

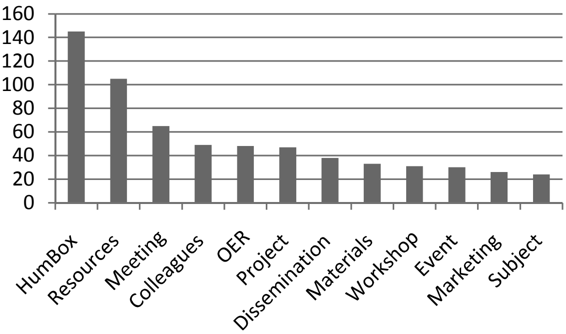
The C-SAP OER discourse

Material(s)	245
Teaching	155
Learning	107
People	101
Students	90
Context	85
Practice	79
Module	77
Course	73
Project	73
OER	51
Resources	50



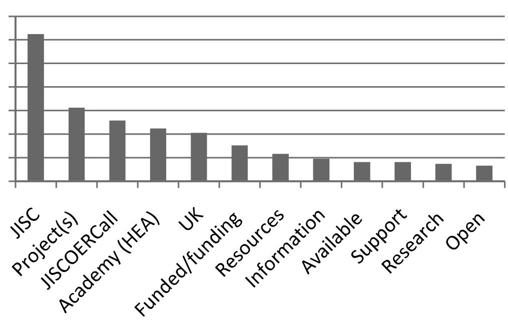
The HumBox OER discourse

HumBox	145
Resources	105
Meeting	65
Colleagues	49
OER	48
Project	47
Dissemination	38
Materials	33
Workshop	31
Event	30
Marketing	26
Subject	24



The JISC OER call for bids

JISC	312
Project(s)	56
JISCOERCall	129
Academy (HEA)	112
UK	103
Funded/funding	76
Resources	58
Information	48
Available	41
Support	41
Research	37
Open	33



In themselves, the above frequencies do not offer a lot to go on, except in showing initially where the *most* emphasis seems to be: in C-SAP discussion on the *Materials*, and what these represent to those involved, in HumBox on the *HumBox* itself (through which the materials will be released) and in the JISC documents: the *JISC* (Joint Information Systems Committee), the funding body.

The *lowest frequencies* in this sample were: in C-SAP discussion on the *Resources*, in HumBox on the *Subject* and in the JISC documents: on the word *Open*.

In a bigger study these observations would be useful leads for further analysis. It is important though to clearly emphasise here that, whilst tools like Antconc can quickly sort useful quantitative data from discourse, a "critical interpretation requires historical knowledge and sensitivity which can be possessed by human beings and not by machines" (Fowler, 1991). Therefore, the automated process of searching the discourse is just a 'first step' to finding points of interest in the body of qualitative data where collocation and other features might be examined.

Moving from frequencies to collocation

Repeated use of certain words or phrases invites further enquiry. The *collocation*, or juxtaposition of the words listed above, together with others, could reveal areas for further analysis. Given that there is limited scope for detailed analysis in a short paper, the two most frequently used words from the C-SAP wiki discussions: 'teaching' and 'materials', will be chosen as a 'first line of enquiry' just to see what emerges from the comments that surround usage of these *in each of the three areas of comparison.* A window of 1000 words has been allowed to ensure that some breadth of context can also be identified. In the next section some of these comments will be examined and compared as we get deeper into the OER discourse.

Getting deeper into the discourse

The search on the terms 'teaching' and 'materials' has been selected for initial enquiries, as teaching materials are essentially the 'bread and butter' where the OER Programme in the UK is concerned. If no one deposits their teaching materials for open use then we can expect a rather short pilot programme!

What has been fascinating already, however, is that things have quickly moved beyond a requirement to deposit resources alone, in return for funding. The discourse below reveals glimpses into the sort of conversations that a discussion about **teaching materials** has provoked. For each person contributing these comments, it is important to remember that *within and around the words there is a social context*. This includes personal history and understanding, institutional concerns and constraints, a unique relationship with their own students and colleagues, a personal teaching philosophy and their own motivations for participating in their broad subject community. Furthermore, the multiple roles we each hold could potentially enable insights to different views of the world in moving from one mode of discourse to another, but Fowler states: "people are not terribly conscious of linguistic variety" (Fowler, 1991).

Getting deeper into the C-SAP discourse

With this in mind, we will now examine the C-SAP online discussion paragraphs around use of the words 'teaching' and 'materials'. These words are shown in bold to aid the identification of where they occur and the context they occur in.

– To some extent re-usability and shared resources involve the same issues. These debates clearly turn on the sorts of things that other contributors have discussed—ownership, power relations and the like. Perhaps I can summarise my own views briefly by saying that I hope this whole exercise will reopen possibilities which had been closed off by universities and publishers wanting to manage bureaucratically, constrain and hide resources away.
– In the context of my own **teaching** practice, I want to use openly accessible resources to encourage students to be 'syllabus independent', or, less grandly, to be able to find good quality **materials** in a convenient electronic form, to wean them away from their current inefficient search strategies, which consists of typing key terms into Google and using whatever comes up. For instance, during discussions within the project team, we commented on the fact that a lot of **teaching materials** we received are embedded in the context of a particular institution and rely on implicit pedagogic assumptions.
– I think that **teaching materials** are always embedded in contexts, and that users need to read them critically so as to identify both contextual elements and pedagogic assumptions. It is not always unhelpful to see the effect of context on other people's work, of course in that makes you realise those effects operate with your own work. The same goes with implicit pedagogic assumptions. I think it can be particularly helpful to students to realise that there are certain contingent elements to curriculum, pedagogy and assessment, and I think the project team might consider adding some encouragement for basic techniques for students to do that with our **materials**.
– I would like to see OER definitions that include discussions on creativity, subjectivity and more theorised, like for example what does 'exchange' mean, in the context of **teaching**. Here I am biased because my work in anthropology is about exchange and as such it is one of my preoccupations in work and theory overall. I am not sure how OER and discussions about OER are entering larger discussions on pedagogy and **teaching** elsewhere. I am very interested in knowing how theories of pedagogy of **teaching** (large ones) introduce OER to their discussions, in other work, how are our discussions about e-learning, open access and so on understood and seen from an outsider's perspective, people who discuss **teaching** and learning but who are not participants (yet) of projects like OER and so.
– Yes, a lot of **teaching materials** are embedded in the context of a particular institution and rely on implicit pedagogic assumptions. They also rely on implicit political inequalities, financial or managerial crisis and political (funding, employability, resource allocation) strategies by each particular institution. I believe we put a lot of emphasis on the pedagogic assumptions because we are all concerned, primarily with pedagogy. However, in my experience, the larger political and managerial decisions taken about **teaching** have a strong impact on re-usability, albeit take longer to see their impact. Sometimes I feel that our focus on pedagogy must also include a focus on the larger and political implications of teaching in Higher Education.

- I would like to have a visual image of all there is in a module that I can transform into a re-usable object, so I can show others easily. Right now I do have a conceptual image but that's harder to extract! And I would like software I can't afford in order to take all my content into presentations. If I had really lots of money I would probably have a site where anyone using it can access anything from it, where there is no restriction of use of software by the user as well as the user that re-uses and produces new things. If I had money I would pay someone at Google to invent a desktop application that can do all software transformations easily whilst incorporating web 2.0 applications all in one. I have two groups in Ning and I belong to another 4 ning groups and as great as it for networking, there is no unification of tasks. I feel I am in too many online spaces at once. It doesn't get solved by having a phone that access them. The same happens with **teaching materials** for OER. I would not like it to be based on an academic institution. I would like it to have the full support of academic institutions but not be funded or stored in a server of which me and my partners have no control and can be switched off by people I don't know at any time. I would like more ownership of the toolkit: not dependent on the funding body and their server.
- I guess many people are nervous about their **material** seeming mundane, boring, lacking in innovation etc. It raises issues about who OWNS the **materials** – the individual or the institution? I have always found people very helpful in offering to share **materials** with me but at the same time I would NEVER actually ask someone for their **materials** (even though it might be really useful for me)… how do you feel about that? An efficient method of storage, presentation, and access is needed.
- What about an open access institutional repository for **teaching materials**? One could monitor downloads etc of **materials** and overall traffic as an indication of usage. How do you make this content accessible/searchable. This is linked to the general problem of information overload. There is so much information and links to resources out there. It is hard to know where to go to most conveniently find useful **materials.**
- I would like to be able to search by assessment in general, not by subject. That would be great! The issue, of course, is one of buy in. With a research repository, staff will put their publications up because that is where the data will be drawn from for the REF, promotions etc etc. What would encourage academics to upload their **teaching materials**? Grouping resources by module is the default position because that is the structure that constrains and forms our **teaching.** It assumes certain contextual features that are easily identified by module documents. The basic context in which we teach determines much of what we can do and what is appropriate: what preparation students need to take the module, how many weeks of teaching, how many classes/contact hours, what formats the **teaching** takes. Since we design our **teaching** with these constraints in mind, it makes sense to compare to similar units that do the same thing. Even if the context changes, you can see how someone approaches a particular topic. It tends to hold subject specific aspects (somewhat) constant, which makes comparisons easier. Ultimately, these **materials** need to be easy to share. That is more important than cleaning them so thoroughly. I would have to do a lot of cleaning up of my **materials.**
- I make my **teaching materials** as specific to the year group as possible. So I include even room numbers and time etc and update this each year. This makes more work for me in the long run and I probably should keep those separate as a 'housekeeping

appendix' so that is something to think about. In terms of how this should be handled for the OER project, it just has to be stripped out. Each subject in an institution has varying levels of constraints and pressure to conform to common assessment patterns. I suspect that systematic planning of assessment based on learning outcomes is very rare compared to the influence of existing practices and peer pressure.

- How a module is taught doesn't just depend on the availability of appropriate and useful **materials.** It depends on the dynamism of the teacher, the rapport with the class, the adjustments that need to be made depending on the different needs within a class cohort or in different years.
- We started from our previous position of wondering about the value of (seemingly) mundane teaching materials. We both found each other's **materials** far more interesting than we at first imagined that we would. Can a PPT be re-used by someone else if it is de-nuded of content? This is a fundamental question. We found each other's **materials** interesting (and useful) but we felt that this was because we share a knowledge base. This knowledge base might be making the **materials** re-useable for us in a way that might not be for others. So do we have to assume a certain level of knowledge/understanding of the subject matter in the potential re-user? We are not writing texts books, we are merely sharing **teaching** ideas and so can we assume that the future users of these materials will also be teachers with a certain knowledge base? We cannot be expected to write copious background notes to explain each artefact but a contextual case study might be useful for each set of **materials** (or some form of caveat to be attached which states that a certain level of knowledge is assumed?). Yet when we thought about this, we compared it to research. When we write and publish our research, we do not necessarily explain the whole background. We assume that the reader will be able to draw on the implicit disciplinary knowledge, and will take responsibility themselves for any 'gaps'. Could this be assumed for any reader of our teaching materials?
- Are we assuming a shared understanding of delivery – most universities have VLEs, online access to journals, use PowerPoint etc.. Do we all have to follow the same format as each other in the way we construct **materials**? However, not everything is commonly understood – for example language use (Module handbook/outline – terminology!!)

In brief summary, the C-SAP extracts above range from expressing a wish that OER might:

- "Reopen possibilities which had been closed off by universities and publishers wanting to manage bureaucratically, constrain and hide resources away".
- "If I had really lots of money I would probably have a site where anyone using it can access anything from it".
- "The same happens with **teaching materials** for OER. I would not like it to be based on an academic institution. I would like it to have the full support of academic institutions but not be funded or stored in a server of which me and my partners have no control and can be switched off by people I don't know at any time".

Here the main barriers to OER seem to be concerns that institutional decisions and management might intervene, almost to 're-possess' what has been freely given by tutors. However, as teaching materials are usually deemed to be owned by the university when produced by employees, there are complexities that need to be clarified for tutors to become more at ease about what OER means.

Some further comments remind us that:

- "**Teaching materials** are always embedded in contexts, and that users need to read them critically so as to identify both contextual elements and pedagogic assumptions".
- "Are we assuming a shared understanding of delivery".

However, on balance:

- "When we write and publish our research, we do not necessarily explain the whole background".

The underlying concern that people's materials might be used indiscriminately, without a sufficiently critical approach that ensures students contest, as well as absorb, knowledge is communicated. However, it is also noted that when research papers are published it is not deemed necessary to explain all of the surrounding details. OER is bringing discussions about the relationship between our research and teaching under the spotlight, not least because there is ever present pressure to publish, whilst also to teach in innovative and engaging ways. What were the HumBox comments on this topic, and where is emphasis placed in that discourse?

Getting deeper into the HumBox discourse

- I'd like to ask you the following: Do you think that we may be helping the Humbox to succeed by a) trying to introduce the dissemination of **teaching materials** in School or Faculty's strategy maps? b) trying to convince research units and researchers that impact can be achieved through dissemination in Humbox? c) trying to convince HEFCE that OERs are a way of to achieve impact that to be recognised in the REF? Or are these efforts in any way incompatible with the community-driven bottom-top approach of Humbox that we all share? A meeting of colleagues involved in uploading resources for this day had to be cancelled as we all were called, exactly at the same time, to extraordinary School Boards where we were informed about the 10% budget savings proposed by our VC. The response from Departments and Schools, in the form of action plans for the implementation of these savings, has been taking up a lot of our energy. An alternative date for the meeting will be arranged soon. 22nd October: Meeting with my deputy Head of School to discuss on Humbox and Research Impact, as he is working on the School response to the REF Consultation.
- Our revised School strategy map does include now a reference to dissemination of **teaching materials** as part of our core activities: "develop and disseminate high quality teaching materials, making innovative use of new technologies where appropriate".
- I think the Humbox Project Team should discuss whether it is approapiate to submmit a response to the HEFCE consultation on the assessment and funding of research by HEFCE *http://www.hefce.ac.uk/pubs/hefce/2009/09_38/* I believe that we can manage to convince HEFCE that publication of research-spun **teaching materials** in Humbox and other OERs is one of the best ways to achieve impact of research in many disciplines. If we were to succeed on this, we would guarantee very high levels of user

engagement for the Humbox. Please find attached a draft proposal for a response that I have written for the section of the consultation that concerns us.

- I want people to realise the potential Humbox has in relation to both **teaching** and research and the building of a personal profile that will allow the kinds of cross transfer of knowledge that you refer to. Humbox also provides a superb way for new academic staff on the PG Cert for HE to address the relationship they are required to establish.
- I have spoken to relevant colleagues in my Department, School and Faculty, including those with responsibilities for Learning and Teaching at different levels and explored with them the potential benefits that the Humbox can have for our institution and for the specific academic units. We have agreed on some basic questions that we think need to be addressed in the next months, mainly in terms of format and institutional presence (I reported all these questions in our last 3rd of July LLAS meeting). Overall, though, everyone is very excited about the project and people agree that the basic aims and principles of the HumBox are sound. We've collated our own **teaching materials**, but generally we've been working on getting access to other's.
- We've also disseminated the project information to the institution-wide Learning & Teaching Online Steering Group. Finally, we have at last managed to gain access to our colleague's **materials** held on our institutional VLE, which we are in the process of looking through to select a variety of different types of resource (in the sense of range and content, rather than file type). It has been a bit of a slow start, but we're hoping that the pace will pick up now that the ground is prepared.
- The project has raised the awareness about the need to open our resources to the world and has allowed colleagues to find a safe and very attractive way to do so. The reasons why practitioners decide to share are varied, but the big advantage of the Humbox is that it caters for every member of the **teaching** and learning community.
- Publishing resources in OER is now one of the key points of the Learning and **Teaching** Strategy of our School.
- The HumBox is a crucial resource for **teaching** and research communities as it helps to release and enhance the potential force of these communities.
- Why are colleagues ready to get involved? The reasons are varied. The first involves an element of pride: there is a willingness to share **teaching** resources when these demonstrate (a) an original and innovative approach to **teaching** (b) the use of original resources which is not easily available (c) a willingness to share research or scholarly-led **teaching** resources (d) a desire to be part of a wider community (especially when opportunities to exchange ideas are limited within the home institution).
- Most colleagues have paid a lot of attention to the resources they up-loaded, as these resources are likely to be formally or informally scrutinised by a wider community. In that case, peer-review has proved to be an excellent feature of the project. In the medium term, the quality of **teaching material** is likely to be improved. To an extent, 'trust' and 'reliability' may prove to be as important as 'diversity of resources' to the overall success of the project. As such, peer-review is one way to 'professionalise' the production of **teaching material** in the way which is not to dissimilar to research peer-review. In that way, what may be initially perceived as a major 'hurdle' ('I will not share for fear to be exposed to the feedback of my peers'), may become a sought-after professional recognition.

– Two light initiatives could be implemented fairly easily (a) to find a way to showcase existing collaboration between institutions on the Humbox itself (b) having a space where people can post something akin to 'a call for papers' with the view to incite participation to a specific project. I will present a paper on this subject to the Teaching and Learning Conference, University of Portsmouth (Faculty of Humanities) 23 June 2010 entitled: OERs and the development of trans-institutional learning communities: the case of HumBox. Abstract: This paper argues that the expansion of OERs is encouraging the development of trans-institutional communities of teachers with three major consequences for learners: (1) **Teaching** resources, with or without learners' input, will become more rigorously peer-reviewed and will be scrutinised by a greater number of actors within and outside HE, within or outside the UK; (2) Sharing **teaching** resources will become common practice, but cultural rather than technical hurdles will have to be negotiated; (3) Whether access to a wide variety of sources will change (a) the way learners engage with their studies, (b) existing learning practice is open to debate. These ideas will be presented with specific references to the HumBox project.

To summarise what is only a small percentage of the overall general discourse from the HumBox project, the comments around 'teaching' and 'materials' also led into a discussion about the research-teaching relationship:

– "Dissemination of **teaching materials** as part of our core activities".
– *http://www.hefce.ac.uk/pubs/hefce/2009/09_38/* "I believe that we can manage to convince HEFCE that publication of research-spun **teaching materials** in Humbox and other OERs is one of the best ways to achieve impact of research in many disciplines. If we were to succeed on this, we would guarantee very high levels of user engagement for the Humbox".

The publishing of teaching materials is described here as a means to increase impact. Recognition for high quality teaching materials might in turn increase the impact of people's research in their discipline. For those not research active, there is a means to disseminate their teaching approach. Like the C-SAP discourse, there is also reference to the restrictions and constraints within academic institutions:

– "A desire to be part of a wider community (especially when opportunities to exchange ideas are limited within the home institution)".

The effect on lecturers in building connections in *wider communities* and in turn on students' learning practice is considered:

– "Expansion of OERs is encouraging the development of trans-institutional communities of teachers".
– "Whether access to a wide variety of sources will change (a) the way learners engage with their studies, (b) existing learning practice is open to debate".

The possibilities that the building of communities, through engagement with the HumBox, might offer has been strongly present in this discourse:

– "Two light initiatives could be implemented fairly easily (a) to find a way to showcase existing collaboration between institutions on the Humbox itself (b) having a space where people can post something akin to 'a call for papers' with the view to incite participation to a specific project".

– "The reasons why practitioners decide to share are varied, but the big advantage of the Humbox is that it caters for every member of the **teaching** and learning community".
– "The HumBox is a crucial resource for **teaching** and research communities as it helps to release and enhance the potential force of these communities".

The next section contains the text around 'teaching' and 'materials' from the current JISC OER update. This is an initial glimpse at the way that ideas from the initial pilot projects are being consolidated and communicated, much more will soon be available for consideration.

The JISC OER update

The JISC OER update on activities is available at: http://www.jisc.ac.uk/media/documents/publications/briefingpaper/2010/bpopeneducationalresources.pdf

Since April 2009, the Higher Education Academy and JISC have been collaborating on the Open Educational Resources (OER) pilot programme, helping universities to share educational **materials** freely online. This paper gives an overview of what has been achieved to date.

Making educational resources 'open' broadens their use and enables them to be repurposed. Through Open Educational Resources, students gain access to a broader range of **material**s to suit different learning styles and obtain a range of perspectives on individual topics. Academic staff can reuse and repurpose **material**s rather than needing to develop them from scratch. This frees up time to work on aspects of their work where they can truly add value, such as furthering their research and effectively tutoring their students. Sharing quality learning **materials** in this way can enhance a university's reputation and provide prospective students with a taste of what to expect – a 'shop window' for the university's work.

The focus of the programme is very much on sustainability, so that universities are able to continue sharing **materials** at a similar pace beyond the funding period. Many projects have found the most sustainable approach is to put processes in place to empower academics to release their own educational resources, rather than take on the financial burden of building a centralised team to make materials public.

As well as making more **materials** freely available online, the Open Educational Resources programme has, in some cases, become a catalyst for a change in the way universities operate.

Universities have found solutions to complex intellectual property issues. In order to open up their educational resources, they have had to clarify their processes for creating, managing, approving and accrediting academic **materials**, and as a consequence have made their systems more efficient.

Moreover, making educational resources more visible encourages proactive quality management, especially when **material** is being used as a marketing tool.

Comparing C-SAP and HumBox discourse with the JISC OER update

Whilst it is inevitable that the overall understanding about OER is that *universities* are sharing materials freely online, this does subtly shift the emphasis from the *practitioner* sharing materials discourse discussed so far, to the more official:

– "helping universities to share educational **materials** freely online" (JISC OER update)
– "so that universities are able to continue sharing **materials** at a similar pace beyond the funding period" (JISC OER update)
– "Sharing quality learning **materials** in this way can enhance a university's reputation"
– "a 'shop window' for the university's work" (JISC OER update).
– "especially when **material** is being used as a marketing tool".

This may inadvertently have a deterring effect if too much official marketisation, is felt to be present:

– "However, in my experience, the larger political and managerial decisions taken about **teaching** have a strong impact on re-usability".
– "Sometimes I feel that our focus on pedagogy must also include a focus on the larger and political implications of teaching in Higher Education" (C-SAP).

A *personal academic profile* though seems to offer both recognition and a spread of knowledge:

– "the building of a personal profile that will allow the kinds of cross transfer of knowledge" (HumBox).

But it is noted that possibilities for operational change in HE are unfolding in some cases:

– "the Open Educational Resources programme has, in some cases, become a catalyst for a change in the way universities operate" (JISC OER update).

The discourse from the partner discussions around the 'teaching materials' has revealed a range of motivations and overlapping concerns. There seems to be consensus that OER is generally good, but what teaching materials are perceived to represent can differ considerably across the many voices.

Are teaching materials more than just 'resources'?

Emphasis is placed here on freeing up time in reuse of materials to enable lecturers to really add value:

– "Academic staff can reuse and repurpose **material**s rather than needing to develop them from scratch. This frees up time to work on aspects of their work where they can truly add value, such as furthering their research and effectively tutoring their students" (JISC OER update).

But time involved in repurposing for different needs is also acknowledged by C-SAP:

– "How a module is taught doesn't just depend on the availability of appropriate and useful **materials.** It depends on the dynamism of the teacher, the rapport with the

class, the adjustments that need to be made depending on the different needs within a class cohort or in different years" (C-SAP).
- "We found each other's **materials** interesting (and useful) but we felt that this was because we share a knowledge base. This knowledge base might be making the materials re-useable for us in a way that might not be for others. So do we have to assume a certain level of knowledge/understanding of the subject matter in the potential re-user? We are not writing texts books, we are merely sharing **teaching** ideas" (C-SAP).

Here C-SAP partners exchange ideas about the tacit nature of the materials, their delivery and the understanding that may be required by the reader in order to repurpose. As part of their pilot project, they have also developed (in collaboration with the project partners), an interactive 'toolkit' to help map and describe their module content for the purposes of releasing as OER. Whilst on one level this is about capturing appropriate metadata to help in the future discoverability of the resource, the toolkit also encourages contributors to reflect on the learning design and implicit pedagogies that are embedded with the delivery and (re)use of the module materials.
- To an extent, 'trust' and 'reliability' may prove to be as important as 'diversity of resources' to the overall success of the project. As such, peer-review is one way to 'professionalise' the production of **teaching material** in the way which is not to dissimilar to research peer-review (HumBox).
- Here HumBox partners consider the role of peer review and overall profile of a lecturer, their research and their teaching and the current values that are placed on each. It is interesting to note how much has been brought into the discourse in and around the topic of 'teaching materials'. The OER Programme has raised conversations and reflections of this nature, bringing fundamental questions about the relationship between research and teaching to the forefront. Partners who teach, but are not research active have discovered that they can disseminate their materials via Humbox. Indeed those with strong research profiles can also use the Humbox to link to these within systems such as Eprints online research repositories.
- Some debates about imbalanced values placed on research and teaching have been brought into the discourse, with arguments that good teaching of a high quality deserves recognition, both within and beyond the HE environment. Within HumBox, review and commenting capabilities are enabled and these facilities allow teaching materials to move from something 'static' to knowledge-enhancing, as practice is discussed. The C-SAP toolkit enables reflective learning design that aims to actively encourage reuse by others and to try to avoid the valuable tacit experience being lost.
- In this sense, activities within both projects have moved the discourse from looking for solutions to the creation of teaching materials as an *individualised* activity to a much more *dialogical production,* with 'tools' that have been created and developed *from the discourse* and that will *enable the discourse* to continue.

Conclusions

So, has this initial JISC-funded and HEA-led project research into the release of open educational resources helped to reduce the perceived barriers to sharing amongst the academics taking part? Or is further culture change required and what are the prospects for *sustainability*?

This paper has attempted to provide a small glimpse into one of many ways in which, rather than take at face value the 'storefront for OER' we might 'browse a little deeper' into the discourse to consider the range of motivations for OER deposit. Using simple and freely available tools we can quickly collect discussion texts. These can be carefully examined to reveal what is embodied within. More detailed linguistic analysis could reveal much more, as this is just a small study where further comment from readers is warmly invited. It is important that a very 'open' approach is taken to participation and dissemination of 'open' educational resources and that people speak freely about the experience and its potential, but also any concerns and hurdles still to cross. We need to acknowledge the challenges that lie ahead and not miss the 'quieter voices' that are present. As Santos, McAndrew & Godwin put it:-

- "These discourses are what regulate the social practices and the language used to foster desired actions. In this sense, they are very powerful and subtle, because they can be taken for granted if not brought into evidence" (Santos, McAndrew, Godwin, 2007).

It is important to acknowledge the *whole context* of any of these snippets of the discourse, but in turn, clusters of frequently arising words and phrases can pinpoint that which can be hidden from view, at first glance.

For example, the 'sharing of resources' in dialogue can be seen to change almost imperceptibly to 'marketing of resources' in places. OER provides a vehicle through which institutions can market resources that are clearly 'branded':

- "Sharing quality learning materials in this way can enhance a university's reputation and provide prospective students with a taste of what to expect – a 'shop window' for the university's work" JISC (2010).

This can be seen positively in one sense, but we should also ask, if marketing is a priority, then are we missing out on some real opportunities for the exchange of a more creative dialogue:

- "I would like to see OER definitions that include discussions on creativity, subjectivity and more theorised, like for example what does 'exchange' mean, in the context of **teaching**" **(C-SAP)**.

Santos, McAndrew, & Godwin comment that "OER initiatives can draw strongly on institutional discourses that aim to raise profiles, leaving to a second plan the commitment to offering true possibilities for the knowledge construction" (Santos, McAndrew, Godwin, 2007).

However, the marketing aspect can also be from a personal, not just institutional point of view:

- "to introduce the dissemination of **teaching materials…** trying to convince research units and researchers that impact can be achieved through dissemination in Humbox…trying to convince HEFCE that OERs are a way of to achieve impact to be recognised in the REF? Or are these efforts in any way incompatible with the community-driven bottom-top approach of Humbox that we all share?" (HumBox).

What has been interesting from this OER project participation so far, for us in LSS, where Languages and Social Sciences have much to offer each other in 'exchange' of resources for teaching and research has not been the intended 'end result' of the openly shared materials alone. Rather the much wider debates about how we work in HE, with and around the materials, when currently there are many constraints. For us, too, the active participation with both the respective HEA Subject Centre staff who led the projects and subject community colleagues is also valued. Indeed this discourse around OER has raised the wish to *share personal and critical pedagogies*, rather than teaching materials alone, within and between subject communities. Sustaining ways to do this is possibly an important key to ongoing engagement.

With this in mind, it has yet to be established how and where *learners* fit in with the OER drive to share materials, both as users and creators of resources, and it is necessary to raise this in future projects:

"I want to use openly accessible resources to encourage students to be 'syllabus independent" (C-SAP).

Within the discourse of OER there is, amongst others, "the discourse of widening participation, the discourse of globalisation, the discourse of social inclusion and the media discourse" (Santos, McAndrew, Godwin, 2007).

Now too, we can add to this list the discourse of *economic crisis*. Since the 2008 *On-line innovation in HE report* in which Prof Sir Ron Cooke outlined the plans for a corpus of high quality openly accessible teaching materials, the economic downturn has swiftly taken hold, and with it, reassessment of priorities for all. The impact that economic factors may have, where OER is concerned, will be interesting. The necessity for smarter working practices in HE and use of online tools to forge collaborations and research opportunities may encourage OER participation. It is important though to retain the values that flow through our teaching. Institutional marketing alone, as a main motivation, would surely cause us to lose something, if this becomes the 'dominent voice'.

The fluidity and movement of discourse means that the OER movement is not only about *open educational resources*, it is about *open educational discourse* too, about how and why we teach the way we teach, and with the materials we use to teach. The HumBox and C-SAP Projects have revealed shared concerns, hopes and aspirations for what OER might bring. We now look forward to the next round of projects that will in turn generate more online discourse and further opportunities for a critical analysis.

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Web 2.0
& Social Networking

Social Networking at the University — Student Research Patterns and Online Activities

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Abstract

Academic environments, such as universities, are often sources of new ideas and approaches that explore the potential of new generations. At the same time they are primarily organized on traditional principles of knowledge sharing, such as print resources and usage of library collections, usually slow in accepting and implementing new approaches. Exploring how students use online services and cope with the development of technology, and how they perceive the role of academic educational environments together with their supporting services, such as library, in their online social spaces may give us some answers on how these changes can influence work at the university. In order to better understand students' information needs and behavior and to draw some conclusions on the role of library in the educational environment and how should learning environments be designed to satisfy those needs, a broader pattern of online usage as well as more specific aspects of usage of existing services is needed.

Paper discusses the results of survey conducted in January of 2010 with graduate students of Faculty of Humanities and Social Sciences (FHSS), University of Zagreb. This re-

search aims to shed some light on students' information universes, their perception of the library, use of online services, and new approaches to the educational information space, mainly based on social networking and its tools, influencing the change in traditional models of communication and knowledge transfer.

Introduction

Sociologist C.Shirky was one of the first do define the notion of social software in simple words: "It's software that supports group interaction" (Shirky, 2003). Since his speech at the O'Reilly Emerging Technology conference in Santa Clara in 2003, the idea and the development of software built around that simple idea of enabling group interaction thorough online services really took off. Social software soon became the fuel of new emerging trends on the internet, for which Tim O'Reilly soon after coined the term Web 2.0 (O'Reilly, 2005). Social networking, instant messaging, picture and video sharing or the increasingly present idea of cloud computing has influenced every aspect of information and knowledge exchange process. Such an environment changed the traditional form of communication and learning models. Facing the new generations of "digital natives" (Prensky, 2001a; Prensky, 2001b; Long, 2005) i.e. people that think and process information in a completely different way, there is a growing importance in gaining better understanding of their information behavior and learning. Academic environments, such as universities, are often sources of new ideas and approaches that explore the potential of new generations. At the same time they are primarily organized on traditional principles of sharing knowledge, such as print resources and users capacities of using library collections, usually slow in accepting and implementing new approaches. As academic libraries have always been center of educational process with main goal to respond to its users' information needs the transition currently affecting information environment has posed new challenges on them. Today, the main task of libraries is to deliver good quality information to their user and new information environment (Web 2.0) with its tools enables libraries to simplify this task and create closer interaction with the users (Banek, Eremic, 2009). In order to create better educational environment for our students we need to research their information behavior and create spaces that can help them in information overload, respond to their needs and create information literate citizens of the knowledge society.

Student online behavior and library position in Web 2.0 environment

The most comprehensive recent report that gave the insight into social networking, use of online services and the digital lives of the students is probably the OCLC report "Sharing, Privacy and Trust in Our Networked World" (OCLC, 2007). Compared to their previous report "Perceptions of Libraries and Information Resources" carried out about 18 months earlier, some of interesting findings are:

- The use of search engines and e-mail has grown by more than 20%; user participation in basic Internet services such as searching and e-mailing is approaching total participation; internet has infiltrated our lives.

– Social web sites have gone from obscurity to mass use in the last two years; 56% of college students now use social networking.
– Less than 15% of the users, or library directors, think libraries should construct or sponsor social networking sites.
– 60% of survey participants rate their libraries as trustworthy; but, libraries have been unsuccessful transferring this brand promise online; online libraries are seen as no more private than commercial sites and social sites.

The report concludes: "Open the library doors, invite mass participation by users and relax the rules of privacy. It will be messy. The rules of the new social Web are messy. The rules of the new social library will be equally messy. But mass participation and a little chaos often create the most exciting venues for collaboration, creativity, community building—and transformation…The new Web is a very different thing. Libraries need to be very different, too" (OCLC, 2008).

Stating that social web sites are now a part of everyday life of library users, and on the other side looking at the small number of users (or library directors) that perceive libraries as an integral part of the social network activities, and the significant drop in use of library web sites, can raise concerns on the future of libraries in an online environment. This result shows that libraries have a long way in front of them in becoming as important online as they are in their offline activities. On the other hand, as the report puts it, "the rules are messy", so although the climate for now isn't too favorable, leaping into that unknown territory of social networking and Web 2.0 services can be very awarding for libraries in the long run.

Another study on students and the use of social networking, Web 2.0 services, and libraries was conducted on the University of Michigan (Chapman, Varnum, Creech, 2007) where a total of 330 students responded how they participate in online activities, use the library, and view the different Web 2.0 services that the library offers. The main findings of the survey are:
– The top five student online activities are (in descending order): e-mail, social networking, IM, using wikis, reading blogs; the more "2.0" the activity, the less frequently respondents undertake it.
– Students mainly go to the library to borrow books, use the computers, use online databases and to do homework or study.
– The students find new research resources mostly through the library catalog; browsing the library or book store shelves is still a very popular method.
– Only 17% of respondents would like to contact a librarian via Facebook or Myspace; 36% thinks that the social network environment isn't appropriate for libraries.
– The findings of this study confirm the results of the OCLC report in terms of perceiving the library services "outside" the social networking circle. The library is still perceived as a place that deals primary with "offline" activities, such as borrowing books or studying.

The relationship between major social networking sites and libraries has been a subject of research for some time now. A recent publication "Checking out Facebook.com: The Impact of a Digital Trend on Academic Libraries" (Charnigo, Barnet-Ellis, 2007) reported on a survey of 126 academic libraries concerning their perspectives and opinions toward the popular social networking site Facebook.com. The survey examined the librarians' awareness of Facebook, how they might use it, what services could the library offer through Facebook and their general attitude towards the use of Facebook in an academic environment. The results showed that librarians were overwhelmingly aware about Facebook, but "…*while some librarians were excited about the possibilities of Facebook, the majority surveyed appeared to consider Facebook outside the purview of professional librarianship.*" (Charnigo, Barnet-Ellis, 2007). On the other hand, the authors also found that a small group of the respondents were extremely positive and excited about the possibility of online social networking. They have also started a Facebook group "Librarians and Facebook" that had 11,545 members as of January 2010. So, this could be a hint that the librarians are embracing social networks and are more willing to participate in them. Another case study "Libraries and Facebook" (Secker, 2008), explored Facebook as a tool for libraries and librarians. The research has focused on documenting the experiences of libraries and librarians who have used Facebook and draw their own personal experiences of using the site. The study showed that although some students are concerned about their "social spaces" being infiltrated by academic and support staff, providing a service through a social networking site could have enormous benefits in terms of raising the profile of a library.

Situation at the FHSS, University of Zagreb

In order to better understand students' information needs and behavior and to draw some conclusions on the role of learning environments that should be designed to satisfy those needs, a broader pattern of online usage as well as more specific aspects of usage of existing services is needed. Two approaches taken from the described studies were combined. The broader context of students' online activities gave us the generic preferences, while the specific patterns of library usage through Facebook answered the questions of the perceived role of academic institutions (in this case the faculty library) in the context of social networking. The aim was to broaden the previously conducted studies and to confirm and compare their results with our findings.

The research was conducted in January of 2010 where a total of 107 graduate students from the Faculty of Humanities and Social Sciences (FHSS) responded to an online survey. The sample consisted of graduate students selected from the fourth and fifth year of study since it is considered that their experiences from previous undergraduate study greatly increase the quality of the sample. There were 95 respondents (89%) that finished their undergraduate study at the Faculty of Humanities and Social Sciences and 12 respondents (11%) that finished their undergraduate study at some other faculty of the University of Zagreb. The sample showed that two faculty departments were represented with the highest number of respondents – the Department of Information Sciences with 47 students (43%) and the Department of Croatian Language with 32 students (30%).

Results

The questionnaire was designed as an online survey consisting from 14 questions. The results are presented in two main parts corresponding to the areas surveyed: student online behavior and library usage and Facebook. Graphical representations will be given where appropriate.

Results show that there are no students kept out of the networked environment. This result is influenced by the fact that FHSS has an e-learning system Omega, based on Moodle, which enables students to use electronic environment for their educational advancement. Survey shows that majority of students (n=77) spends on average more than 15 hours per week on internet.

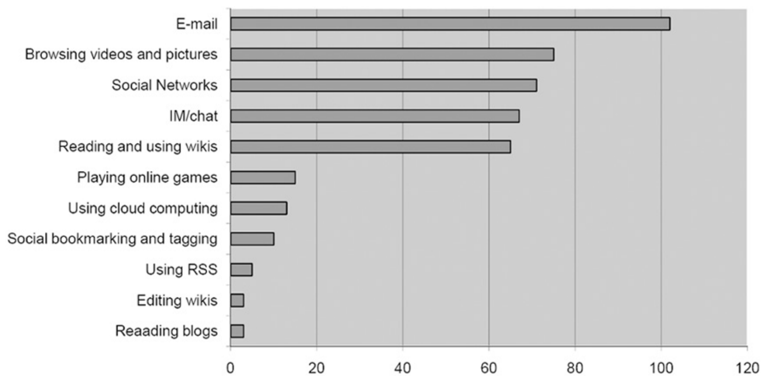

Figure 1. Commonly used online services — answers *daily* and *often* combined

Regarding the services that students use on a daily basis in their leisure time most commonly used are (Figure 1): e-mail (96%), browsing video and pictures (70%) social networks (67%), IM/chat (62%), and the use of wikis (60%). It should be noticed that although a very high percentage of students use social networks often there is a significant number of respondents that never used social networks (19%). When asked how they have learned to use these online services the majority of respondents (92%) answered that they were self-taught. This might be the reason why some of the Web 2.0 tools like social bookmarking, RSS, blogs and wiki creation and editing are less used.

Table 1. Most common places to find new resources

Service	Always	Often	TOTAL
Library catalog	47%	35%	82%
Following citations, footnotes	20%	35%	55%
Suggestions from friends/colleagues	7%	40%	47%
Browsing library shelves	15%	30%	45%
Searching online bookstores	11%	21%	32%

One of the questions that interested us is student behavior during their information or research activities (Table 1). When asked about searching for new resources 82% of the respondents indicated the library catalog as their starting point in most of their searches, followed by the often use of citations, footnotes and bibliographies (55%), suggestion from friends, colleagues or professors (47%), browsing through library shelves (45%) and searching websites of online bookstores. Surprisingly, only 15% of respondents ask the librarian for help in finding new resources.

Secondly, interest was on students' usage of the faculty library. The results show (Figure 2) that the student most commonly use the library for borrowing books or journals (71%), 64% of students use library for research, 58% go there to use the internet while 40% of students go to library to do their homework or study. Interestingly, results showed that minority of the students perceive library as the social place used for meeting with friends. Still 60% of respondents stated that they have never or rarely used library for social gathering.

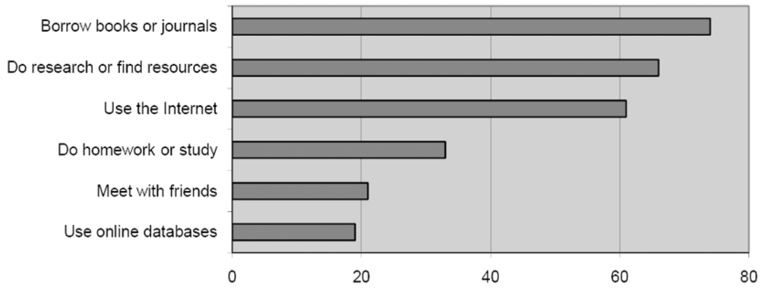

Figure 2. Most common use of the library — answers *most often* and *often* combined

As stated before, apart form researching students' online behavior our interest was on library integration in Web 2.0 environment, specifically FHSS library integration with the social networks like Facebook. This service was chosen due to its popularity among students as it was confirmed in the survey where 78% of the respondents have a Facebook account. As FHSS library is part of the Facebook community with teachers, students and other librarians being part of the group, question was are all student on Facebook members of the library group. The results showed that 69% of them were not a member. When asked for a reason most of them indicated that the were not aware of such a group (81%), with a small number of respondents stating that they were not interested in joining due to their usage of Facebook primarily for fun. It should be mentioned that the respondents not owning a Facebook account did not participate in answering the questions so the sample that covered questions regarding the presence of the faculty library on the Facebook consisted of 83 respondents (out of original 107 respondents).

Most of the students that have a Facebook account would like to receive notifications from the group created by the faculty library, mostly on new book arrivals (81%) and new activities taking place in the library (72%) (Figure 3).

When asked about the types if library services they would like to use through Facebook application (Figure 4), most of the respondents would like to search the library catalogue (64%), contact library staff through chat/IM (60%) or have the ability to suggest new library services (56%).

A very high percentage of students (73%) see a role for social for social networking sites in the library. Compared to the results of the OCLC report, where under 20% of respondents worldwide believe that the library is for learning/information and do not see the connection with social networking and libraries, these results are surprising.

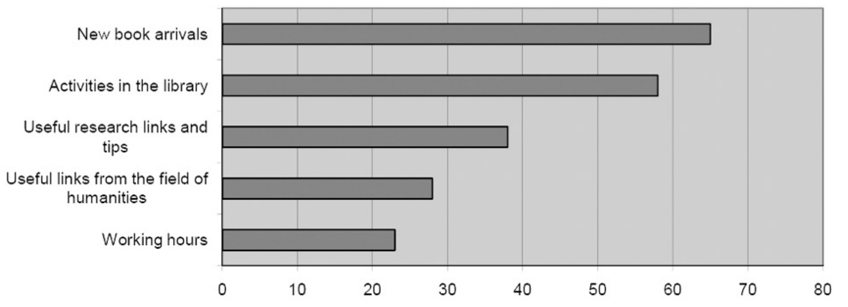

Figure 3. What notifications would you like to get as a member of the Facebook group *"Library of the Faculty of the Humanities and Social Sciences?"* (n=83)

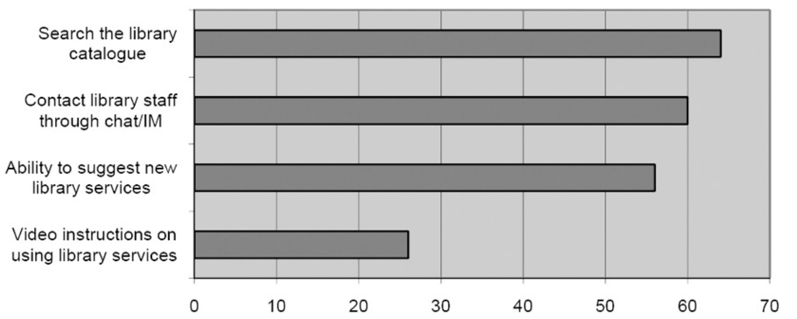

Figure 4. What library services would you like to use through the Facebook application (n=83)

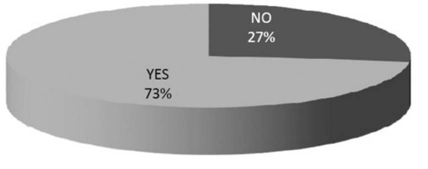

Figure 5. Do you think it should be the library's role to build a social networking site for the student community? (n=106)

Discussion

The results of this small scale research that surveyed the students of Faculty of Humanities and Social Sciences in Zagreb showed that the internet and participation in various online activities has infiltrated the way they learn, communicate and search for new information. Vast majority of respondents are familiar and often use e-mail, IM services and social networks to communicate in real time with their friends, colleagues or peers. Students often browse video or picture sharing sites and use wikis, showing their preference towards new ways of discovering information, either by visual stimulation (watching videos or pictures), or using sources created by group efforts and without strict control (wikis).

Although respondents are ready to use those new ways of discovering sources, their willingness to take part in creating them is not that strong with around 95% students rarely or never edit wikis or write blogs, around 66% never or rarely share pictures or videos via user account, and more than 75% never or rarely use online services for tagging and bookmarking or those relying on cloud computing. By analyzing those answers we can see which form of communications students are more wiling to participate in. They show that the students are familiar with consuming information through visual stimulation and that they are willing to use wikis, social networks, e-mail or IM so those activities should be the basis in creating a learning environment for them. Students are still not that familiar with the notion of cloud computing or RSS, activities that, if used in a learning environment, should be implemented in such a way that that the students will have time to familiarize with them. An overwhelmingly large number of students (92%) are self-taught when it comes to learning how those services work which indicates that their knowledge of those services probably vary from one student to another so their skills regarding those services should be further examined.

The results regarding discovery of new resources show that the students are still using the traditional methods and patterns, with searching of the library catalog, following of citations and footnotes and recommendations form professors or colleagues being the most common ways. New online services such as Google Books or Google Scholar are not that popular with little over 60% of students using them rarely or never. Although the traditional methods score high, students are not that keen in asking the librarian for help in their discovering of new resources, with 57% of doing that rarely or never. The reasons for that may be that the students surveyed were from the graduate study where they have already developed a certain experience and expertise in their field of research so they don't perceive the librarian as an expert that could discover valuable sources to them.

A high percentage of students is enrolled at the faculty library (94%), showing that the library is a vital part of their information environment and an important place to cover their information needs. Library is commonly used for borrowing books, doing research or using the library computers to access internet, which are all results in accordance with the previously described researches. The use of online databases is low with more than 62% of students using them rarely or never. Also, the library is not perceived as a place of meeting with friends, with only a little under 20% of students going to the library for that purpose.

The last part of the questionnaire surveyed the relation student-Facebook-library in order to examine the perceived role of the library in the online social spaces of the students. With 78% of respondents owning a Facebook account, the popularity of that social networking service between the students is obvious. Trying to see how the students would respond to the presence of the faculty library on Facebook, the library created a group called "Library of the Faculty of Humanities and Social Sciences" which had 1,091 members since January 2010. Our survey showed that only 31% of the respondents are a member of that group, and that the main reason why other students are not a member is that of not knowing it exists (81%). Those students that own a Facebook account would mostly like to receive notifications about new books, library activities and useful links for their field of research. The respondents presented an overall positive attitude towards the library "invading" their personal social space they have created through Facebook, so no negative statements were made. When asked what library services they would like to use through their Facebook account, most of the respondents expressed their desire to search the library catalogue (64%), contact library staff through chat/IM (60%) or have the ability to suggest new library services (56%). These findings are consistent with the previous research and the various services some libraries worldwide already offer through different social networks. The final question asked should be the library's role to build a social networking site for the student community. A very high percentage of students (73%) see a role for social for social networking sites in the library. Compared to the results of the OCLC report, where under 20% of respondents worldwide believe that the library is for learning/information and do not see the connection with social networking and libraries, these results are somewhat surprising. The future researches should try to deeply investigate the needs and possibilities of creating such a social network using, for example, the Ning service.

Conclusion

There is little doubt that information landscapes and learning environments change continuously (Alexander, 2006; Downes, 2005). The emerging idea of social software, one of the latest additions to the field of teaching and learning, allows the student to be in the centre of the dynamic learning process. The academic institutions, such as universities, are dynamic environments where new approaches to standard teaching and learning patterns are a must. In order to track the changes in information and learning preferences of the students, their attitude and user preferences towards new emerging tools and services, a continuous research is needed. In this paper we have tried to answer some of these preferences and attitudes of the students of the FHSS in Zagreb.

When the broader picture of the results is taken into consideration, two visible patterns emerge. On one hand, students are familiar with some of the new emerging services, such as social networking, instant messaging and that they often use picture and video sharing sites as well as wikis. They also use the internet on a daily basis, and want the library to be a part of their online social spaces, either by using the existing social networks as an outreach tool, or by creating a social network of their own. But, on the other hand, some of the worldwide popular services such as cloud computing or RSS or even the use of online databases are not that widely used. Also, the classic forms of research, including the use of library catalog or the following of citations, bibliographies or citations is heavily used. The library is still mostly used in its classic role, for borrowing books, doing research or studying and to access the internet.

These findings tell us that in order to design a learning environment in which the maximum of student capacity and attention is utilized, both traditional and new approaches and services should be implemented. Teaching the students to do proper research, to know how to use printed materials, how to engage in all those offline activities that often form a basis of any research is equally important as showing them the advantages of new emerging services and trends.

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Communication Builder — a Tool for Universities. Engage Your Communities in Digital Dialogues

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Abstract

A need has recently emerged among Italian universities, concerning communication: a need to stay up-to date with trends and habits typical of its main public – the students – and also with other relevant audiences: high school students, former students, firms and public institutions' representatives, etc.

Digital media are smart, quick, up-to-date, largely customizable according to the target: through digital media it is possible to get the user's attention by providing him with the information he is interested in through a personal one-to-one and yet machine-driven and cost-effective communication.

KION is supporting universities in conducting such dialogues through digital media with *ad hoc* instruments, communication planning and web analysis services.

This technique of managing targeted communication has been applied in the context of incoming students, with positive results concerning the engagement level as well as the return in terms of actual enrollments.

The tool: Communication Builder

In order to make it easy for the University's staff to start and manage communication on digital channels leveraging their most peculiar characteristics, the U-GOV Suite includes a specific tool: *Communication Builder*.

Communication Builder offers a way to build communication plans – or *campaigns*; realize them through different digital channels; keep track of both digital and traditional communication actions; re-use the same contents on the four – and growing – supported channels; address direct communications with adequate contents to a specifically profiled target; manage contact information about a University's audience; accurately monitor the success of actions landing on the web through Google Analytics; customize Google Analytics monitoring thanks to a flexible and user-friendly interaction.

Communication Builder, together with KION's communication consultancy, is the instrument allowing universities to build interactive dialogues with their audiences leveraging the peculiarities of digital media.

Campaign design and content management

Once the university has identified its purpose and the related audience, a consistent communication plan is designed, involving actions on different channels, or *media*: each action – it might be an e-mail, a website, an SMS, etc. – is designed to exploit the characteristics of its medium, target a specific audience and interact with other actions.

Campaign management of *Communication Builder* includes:

- A multi-channel content management system, allowing the use of same contents on different media without any need for duplicate information.
- A tight interaction with Google Analytics allowing to activate and customize Google's monitoring system without any need for coding skills.
- Roles distinction (editors, web designers, marketers) allowing each contributor to cooperate according to his/her specific skills.

Contacts management

A university has its own audience: students, potential students, former students, teachers, high schools, other universities, business representatives. *Communication Builder* offers a contacts database allowing the management of all kinds of contacts with their specific qualities; a user-friendly and non-technical interface allows the use of such qualities for target segmentation in order to send out interesting communication to an interested public.

Communication Builder's Contact Database is going to be integrated with Kion's student management systems for universities using them, so that all information already owned by a University about its public for management purposes can now be used for communication purposes.

Use case

Communication Builder has been so far successfully used in the context of incoming students, with the purpose of contacting them in an early stage of their decision process and provide them with the information and support they need. The first project has been realized with Roma Tre university in summer 2009, revolving around the university's open day: launched in July, the project was mostly over by the end of August.

The core of this communication plan was an e-mail based information service: students could subscribe to it through a small dedicated website in order to receive detailed and targeted information about the university. Contextually they could give some information about themselves, such as wich faculty/faculties they are interested in: this data was then used to fine-tune the communication and adapt it to individual needs. Students were also asked to answer to an anonymous free-will questionnaire, aimed at providing the university with some statistical data as well as providing an evaluation of the project from a user's point of view.

After subscribing to the service, students received e-mail communications from the University, meant to help them better know the University itself and its offer, and find their way towards enrollment.

Communication plan

		DATE	ACTION
1	2	3	4
	1.	July 21st	Contact data of students who asserted interest towards Roma Tre university through the official website "**Universo**" are loaded into Communication Builder's contact database
	2.	July 22nd	**Website** http://orientarsi.uniroma3.it is online: a small website specifically designed for incoming students. It collects all potentially interesting links; it also has a small form where students can leave name, surname, email address, phone number and faculty of interest – everything except email is optional.
	3.	July 22nd	**E-mail** sent to contacts loaded from "Universo" to let them know about the website and invite them to subscribe if they'd like to keep in touch with the university

1	2	3	4
	4.	July 23rd	**Open Day** at Roma Tre University: contacts of students are gathered through oral interviews, computers connected to the website are available for subscriptions, flyers about the website are distributed
	5.	July 24th	**Contacts** gathered during the Open Day are added to the contacts database
	6.	July 24th	**E-mail** sent to contacts gathered during the Open Day, inviting them to confirm their interest by subscribing to the website
	7.	July 25th – August 5th	Informative **e-mails**
	8.	August 5th	Holiday closedown – **e-mail** sent

Results

Subscriptions

Contact data of students have been gathered during live events organized by the university, through official services for early-enrollment to universities and directly from the web.

The distribution of overall gathered contacts is as follows:

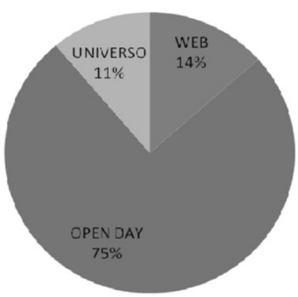

Figure 1. Sources for contacts

But we need something more than simple contacts: people have to be interested enough to **subscribe** to the service. So, how many among the contacts gathered at the open day did subscribe? How many among those who simply found the online website?

The distribution of sources for active subscribers has a much different appearence:

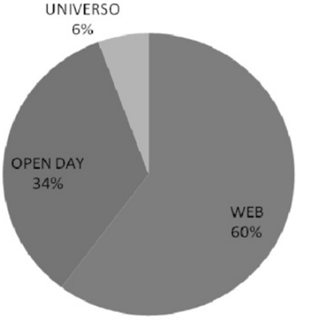

Figure 2. Sources for subscriptions

These data show that contacts gathered through digital media are more active and willing to be engaged, as they widely took all offered chances of participation, by subscribing to the service and answering to the questionnaire: while 67,3% of contacts coming from the web turned into real confirmed subscriptions (i.e. students willing to stay informed about the university), only 8% of contacts from other sources converted to actual subscribers.

The users' opinion

The questionnaire was anonymous, it was freely accessible on the website and it was suggested to subscribing students at the end of the subscription process. It included questions about the University itself and also asked for opinions about the website and the email service.

94% of students stated through the questionnaire that the service actually helped them out and 97% of them considered the site as well-structured and clear, while negative remarks have been extremely few.

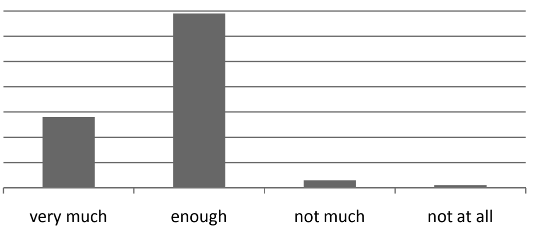

Figure 3. Do you think this site is well organized?

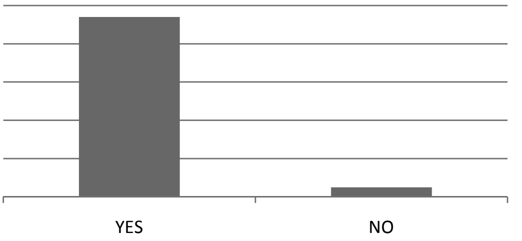

Figure 4. Do you think that consulting this site is useful to resolve your doubts?

Emails, visits and content relevance

The interest of users can also be measured through visits on the website and response to emails. During the active period of the service, from July 23rd to August 3rd, emails have been the most important source of visits after the direct link from the main university portal:

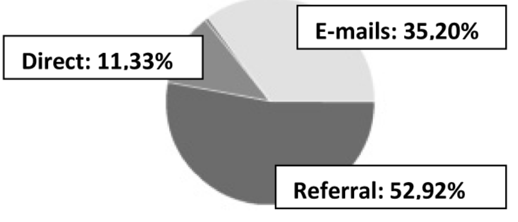

Figure 5. Visits sources 23/7—3/8

Later on, from August to October, 11,30% of visits were still coming from e-mails sent during the active period of the service – which confirms that contents were interesting for users, who saved the received emails and later picked them up to follow the contained links.

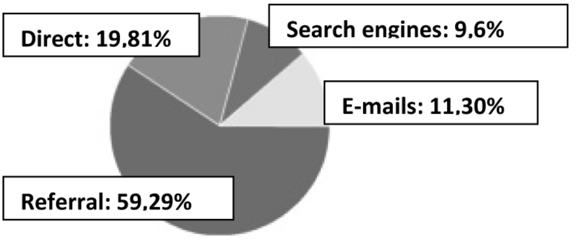

Figure 6. Visits sources August—October

The tool used – Communication Builder – gave us the opportunity to track visits coming from each email sent, so that we can see which emails brought more visits to the website:

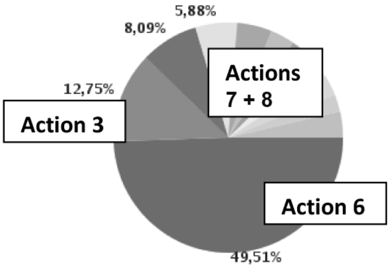

Figure 7. Visits per e-mail

The **ratio** between **emails sent** and **visits** coming from them gives us a different perspective concerning contents relevance: it tells us which contents have been mostly interesting for the receivers. From this perspective, it turns out that the highest ratio came from emails with information concerning single faculties sent to students who expressed their interest in them: specific information sent to a specific target gives the best results.

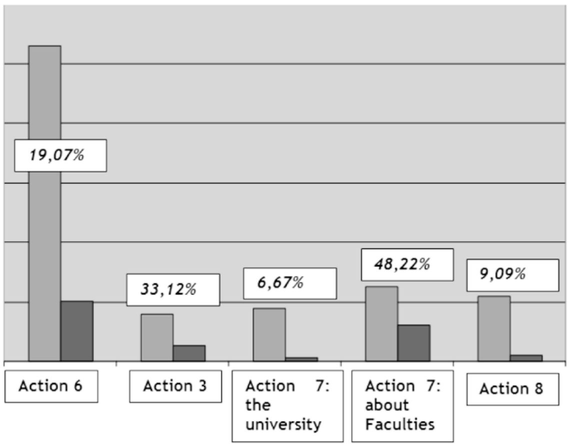

Figure 8. Ratios between emails sent and visits

Figure 9. Visitors location

Concerning the visitors' location, it reflects the university's main audience, which is located in Rome, but also demonstrates how the website is successful in being a reference point for students who wouldn't have had another chance to get directly in touch with the university.

Enrollment

The website and email service were meant to help students find their way towards the university, let them know the reasons to choose Roma Tre University, make it easy for them to enroll: so we'd like to know how effective it all has been, how many students followed this new service and then actually enrolled.

Results from this point of view have been very satisfying, as an especially strong conversion rate has been observed: 40% of students who subscribed to the e-mail information service actually enrolled to the university, and another 11% of them tried admission tests.

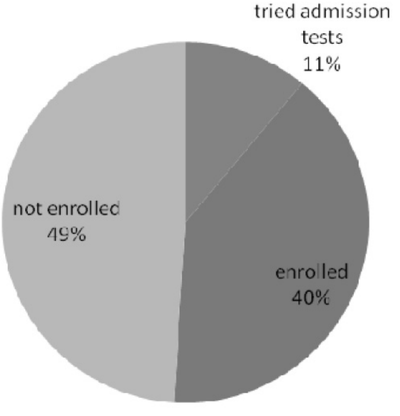

Figure 10. Enrollment rate

Next steps

Such positive results despite the short time have brought the same university plus another one to start a similar projects earlier this year: the concerned websites can be seen at http://orientarsi.uniroma3.it and http://www.lumsaorienta.it, while their outcome will be evaluable by the end of the year.

Both projects started in the first months of 2010, with the purpose of being the main reference point for students attending their last year of high school, as they think about their future university. Students may become acquainted with a university in many different ways, including activities with high schools. For students already in touch with the university thanks to these activities, as well as for students who don't have such opportunity due to their location, the website and email service become a reference point and main source of information.

Other channels

In order to get in touch with more students, different channels are being used for the *Lumsaorienta* project: not only the main university portal and direct contact from university staff to high schools and students, but also:
- email communication towards the officially available **high schools** email addresses,
- online advertising campaigns on **AdWords**,
- activities on social networks through a **Facebook** Fanpage created especially for the incoming students service.

More specific information

As a longer period of time is now available, it is possible to send more information and follow the students as they choose not only the university but also the main subject of their future studies. In order to be able to give to each of them the most interesting information, students subscribing to Roma Tre's online service are now asked not only which faculty there are interested in, but also which kind of school they come from.

From management information to contact details

The belonging of Communication Builder to the U-GOV suite makes it possible to use it not only for incoming students, but also for communication towards people who already are among the university's contacts: actual students, former students, teachers, researchers. Thus it becomes possible to use all administrative information available in the Student Management System as details useful to select contacts, in order to build a specific communication.

Conclusions

Actions on digital media appear to be effective in contacting students, keeping the contact alive, making them feel actively involved and engaged. Such actions cannot completely substitute traditional communication, but are successful in reinforcing and completing it: contacts obtained through traditional communication are reinforced through dialogues set up on digital channels, and contacts who couldn't have been established in other ways can now exist.

The audience gathered around digital media doesn't yet correspond to the university's audience as a whole, but appears to be especially active and willing to be engaged.

One-to-one communication requires engagement also on the staff's side, as it is necessary to create many different specific communication, but such effort is rewarded by the appreciation of the public, who actually gets the information needed, feels cared about as an individual and therefore raises its opinion about the University offering the service.