

UNIVERSITY 2.0 ARCHITECTURE FOR INFORMAL LEARNING

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Abstract- *The Web 2.0 is enabled by the Internet technology. The implementation of Information and Communication Technology (ICT) accelerates the transformation of educational institutions and their methods of operations. The use of ICT at universities opens many possibilities for improving educational services for teachers as well as for students, but also increases their active participation in didactic processes. Students reveal opportunities for their involvement and they are looking for new sources of knowledge, particularly through involvement of other colleagues. The paper aims to understand challenges in developing the open education architecture that supports formal and informal learning at universities.*

Keywords - Web 2.0; University 2.0; Enterprise Architecture, Formal learning, Informal learning, ArchiMate

I. INTRODUCTION

Generally, Web 2.0 refers to a set of social, architectural, and design patterns resulting in the mass migration of business activities to the Internet. Web 2.0 is considered as an infrastructure permitted any information provided by a user to be published, blogged, linked, mashed, streamed, archived and browsed. The Internet is also used as a platform used to connect devices, increasingly via services, but Web 2.0 is much more. As more and more types of devices are coupled with the Internet, the services have to be carefully designed in terms of their architecture, implementation and description. The Web 2.0 reference architecture can provide a working framework for users to construct specialized Web 2.0 applications or infrastructure from specific set of requirements. The list of Web 2.0 related initiatives is as follows:

- Library 2.0 - embraces many patterns, technologies, and flows of information between library users and the library itself [7];
- Media 2.0 - covering newspapers, magazines, and other print media created for users oriented towards emphasizing the issues such as democracy, distributed aggregation, identity and contextualization;
- Advertising 2.0 - as an approach to participatory, scalable advertising;
- Enterprise 2.0 - as the usage of social software and collaborative technologies in enterprise' intranet, extranet, and business processes;
- Government 2.0 - covering the sharing of public information among citizens to involve them in governing processes;
- Democracy 2.0 - including a wide range of community projects and events organized locally by and for the community;
- Music 2.0 - covering individual independent providers of audio content from independent artists, who can contribute audio tracks to existing works, remix other people's audio tracks, and create new pieces of music.

Among them, University 2.0 arrived. At University 2.0, the teaching and the courses do not provide credit towards formal

degrees. University 2.0 supports informal learning at academic level. The motivations of informal learning are as follows:

- gathering the collective intelligence, as an endless supply of existing information to the Web to further browse, analyze and conclude;
- self-organization of individual learning by the Internet users, who are interested in the special content or software to use in e-education.

The paper aims to present University 2.0 architecture model. At first, however, enterprise architecture and its frameworks are discussed. Next, formal and informal education principles, strengths and weaknesses are presented. The third part covers discussion on BYOD strategy and students accessibility to mobile devices. The formal and informal education architecture models are included in this paper. For the model visualization, ArchiMate language has been used.

II. ENTERPRISE ARCHITECTURE FRAMEWORKS

The term "enterprise" can be interpreted as an overall concept to identify a company, business organization, university or governmental institution. According to Robins, an enterprise is considered as a "consciously coordinated social entity, with a relatively identifiable boundary that functions on a relatively continuous basis to achieve a common goal" [9]. In enterprise engineering, system theory and system approach have dominated for the last fifty years, now however the enterprise engineering is underpinned by two fundamental concepts:

- enterprise ontology, where the complexity of an enterprise is captured and understood by focusing on the implementation-independent essence of an enterprise [3], [5];
- enterprise architecture, which reduces the complexity of enterprise by addressing strategic objectives and areas of concern.

The enterprise architecture (EA) is defined as a coherent and consistent set of principles and guidelines that lead system design [11]. For an enterprise, architectural framework as a conceptual structure related to a certain system type consists

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of areas of concern and a necessary and sufficient set of design domains.

The ISO/IEC 42010:2007 shows that architecture is the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution. The goal of EA is to create a unified ICT environment (standardized hardware and software systems) across the firm or all of the firm's business units with links to the business side of the organization, to promote alignment, standardization, reuse of existing ICT assets, and sharing common methods for project management and software development across the organization.

The EA provides a holistic expression of the enterprise's strategies and their impact on business functions and processes, taking the firm's sourcing goals into explicit consideration. The EA helps the business organization to establish technical guidelines of how the service delivery function needs to operate to deliver cost-effective, flexible, and reliable business services. The EA gives user an opportunity of faster delivery of new functionalities and modifications, as well as an easier access to higher quality, more consistent and more reliable information. The EA identifies opportunities for integration and reuse of IT resources and prevents the development of inconsistent processes and information. Especially important to users is the capability of integrating the information among applications and across data warehouses and data marts. The ISO/IEC 42010-2007 standard emphasizes the stakeholder object in the architecture description (Figure 1). Architecture Description identifies stakeholders and system of interests, as well as expresses the Architecture. The following stakeholders can be considered and identified in the architecture description: system users, operators, acquirers, owners, suppliers, developers, builders and maintainers. Therefore, it should be noticed that stakeholders are included in the information system development processes, but the consortium of users of the system should be further discussed in details within a particular EA development project, because it is a group of people highly differentiated, and having different interests, risk awareness and impact on the system.

Nowadays, the EA is considered as the discipline of designing enterprises guided with principles, frameworks, methodologies, requirements, tools, reference models and standards. There are many frameworks that support the EA modelling and development, e.g., Zachman Framework (ZF), the Open Groups Architecture Framework (TOGAF), the Generic Enterprise Reference Architecture and Methodology (GERAM), the Purdue Enterprise Reference Architecture (PERA), Computer Integrated Manufacturing Open System Architecture (CIMOSA), the Lightweight Enterprise Architecture (LEA), Nolan Norton Framework (NNF), the Extended Enterprise Architecture Framework (E2AF), Enterprise Architecture Planning (EAP), the Federal Enterprise Architecture Framework (FEAF), Treasury Enterprise Architecture Framework (TEAF) [11], [12], [16]. Mostly, the mentioned above frameworks are product-oriented, and only some of them, i.e., ZF, TOGAF, FEAF, CIMOSA and MODAF emphasize the role of stakeholders in the EA development processes.

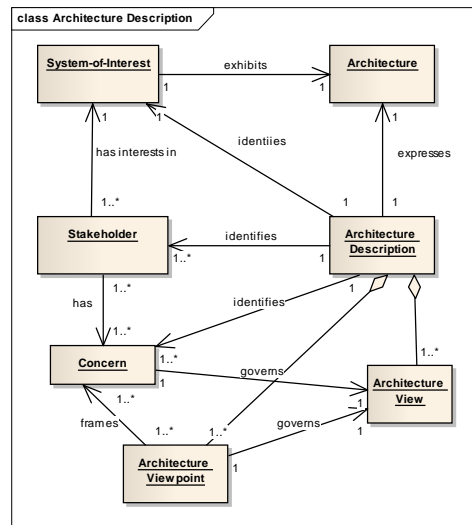


Fig. 1 System Architecture Description. Resource: [10]

The ZF provides a basic structure for organizing a business architecture through dimensions such as data, function, network, people, time and motivation [20]. Zachman describes the ontology for the creation of EA through negotiations among several actors. The ZF presents various views and aspects of the enterprise architecture in a highly structured and clear form. He differentiates between the levels: Scope (contextual, planner view), Enterprise Model (conceptual, owner view), System Model (logical, designer view), Technology Model (physical, builder model), Detailed Representation (out-of-context, subcontractor), and Functioning Enterprise (user view). Each of these views is presented as a row in the matrix (see Table 1). The lower the row, the greater the degree of detail of the level represented. The model works with six aspects of the enterprise architecture: Data (what), Function (how), Network (where), People (who), Time (when), Motivation (why). Each aspect (i.e., column) interrogates the architecture from a particular perspective. Taken together, all the views create a complete picture of the enterprise.

Since 1999, the FEAF has promoted a shared development of US federal processes, interoperability and sharing of information among US federal agencies and other governmental entities. The FEAF components of an enterprise architecture cover architecture drivers, strategic direction, current architecture, target architectures, transitional processes, architectural components, architectural models, and standards. The architect is responsible for ensuring the completeness of the architecture, in terms of adequately addressing all the concerns of all the various views, satisfactory reconciling the conflicts among different stakeholders. The framework emphasizes the role of planner, owner, designer, builder and subcontractor in the EA development process. Planning of enterprise architecture according to the ZF meets some unclear situations (e.g., question When? is difficult), therefore the FEAF seems to be the simplified and more intense version of the ZF.

The Ministry of Defence Architectural Framework (MODAF) is the UK Government specification for architectural frameworks for the defence industry [13].

The MODAF covers seven viewpoints, i.e., All View, Acquisition, Strategic, Operational, System, Service, Technical. The All View viewpoint is created to define the generic, high-level information that applies to all the other viewpoints. In this approach, the architect role is hidden in the particular viewpoints. The Acquisition viewpoint is used to identify programmes and projects that are relevant to the framework and that will be executed to deliver the capabilities that have been identified in the strategy views. The Strategic viewpoint defines views that support the analysis and the optimisation of a domain capability. The intention is to capture long-term missions, goals and visions, and to define what capabilities are required to realise them. The Operational viewpoint contains views that describe the operational elements required to meet the capabilities defined in the strategic views. This is achieved by considering a number of high-level scenarios, and then defining what sort of elements exist in these scenarios. The operational views are solution-independent and do not describe an actual solution. These views are used primarily as a part of tendering where they will be made available to supplier organizations and form the basis of evaluating the system views that are provided as the supplier's proposed solution. The System viewpoint contains views that relate directly to the solution that is being offered to meet the required capabilities that have been identified in the strategic views and expanded upon in the operational views. There is a strong relationship between the system viewpoint and the operational viewpoint. The system views describe the actual systems, their interconnections and their use. This will also include performance characteristics and may even specify protocols that must be used for particular communication. The Service-oriented viewpoint contains views that allow the solution to be described in terms of its services. This allows a solution to be specified as a complete service-oriented architecture where desirable. The Technical viewpoint contains two views that allow all the relevant standards to be defined. This is split into two categories: current standards and predicted future standards. Standards are an essential part of any architecture and it should be noticed that any number of standards may be applied to any element in the architecture [13].

The CIMOSA framework is based on four abstract views (function, information, resource and organization views) and three modelling levels (i.e., requirements definition, design specification and implementation description) [15]. The four modelling views are provided to manage the integrated enterprise model (covering the design, manipulation and access). For the management of views, CIMOSA assumes a hierarchy of business units that are grouped into divisions and plants.

The TOGAF standard takes a holistic approach to the enterprise architecture. TOGAF is a registered trademark of the Open Group in the US and other countries. TOGAF divides an EA into four categories:

- Business architecture: describing the processes that the business uses to meet its goals,
- Application architecture: describing how specific applications are designed and how they interact with each other,
- Data architecture: describing how the enterprise data stores are organised and accessed,

- Technology architecture: describing the hardware and software infrastructure that supports applications and their interactions.

In TOGAF, the architecture of a system is the system's fundamental organization embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution. Similarly to the ISO/IEC 42010 standard, in TOGAF the minimum set of stakeholders for a system covers users, system and software engineers, operators, administrators, managers and acquirers. Beyond that the stakeholders are as follows: the executive management, who defines strategic goals, the client, who is responsible for the allocated budget, with regard to the expected goals, the provider, who delivers the component elements of the architecture, the sponsors, who drive and guide the work, and the enterprise architects, who turn business goals into reality within the structure of their system. Stakeholders have key roles in or concerns about the business information systems. Concerns may pertain to any aspect of the system's functioning, development or operation, including considerations such as performance, reliability, security, distribution, and evolvability. TOGAF as an open framework is very popular in academic environment. Therefore, the considered in this paper architecture models are visualised in the promoted by TOGAF architecture modelling language, i.e., ArchiMate.

III.FORMAL ACADEMIC EDUCATION

Formal education is provided by schools and universities. In Europe, almost all universities are required to implement European Credit Transfer System (ECTS), European Qualification Framework (EQF), and National Qualification Framework (NQF). NQF is an instrument for the classification of qualifications according to a set of criteria for specified levels of learning achieved, which is developed to integrate and coordinate national qualifications subsystems and improve the transparency, access, progress and quality of qualifications in relations to the demand on the labour market [6].

The traditional emphasis on factual knowledge provided by universities no longer meets the requirements of a changing society. The word "competence" is more attractive for both educators and employers, because it is easily identified with value capabilities, qualifications and expertise. Competence is defined as knowledge, skills and attitudes. It is the proven ability to use knowledge, skills and personal, social and methodological abilities, in studies and in professional and personal development. In the context of EQF, competence should be described in terms of responsibility and autonomy. Simultaneously, universities defined the learning outcomes, which are also expressed in terms of knowledge, skills and attitudes (KSAs). Beyond KSAs model, there are some other similar models, e.g., Knowledge, Attitude, Skills and Habits (KASH) model [8], and Knowledge, Experience, Skills, Aptitude and Attitude (KESAA) model [18]. For example, in the KSA model, knowledge should not be identified only with understanding.

Understanding represents the intellectual capability to use information in a sensible and meaningful way. The information from observations, personal experiences, beliefs and prejudices in everyday life is also referred to as knowledge. Skills are associated with activities like problem

solving, reasoning, assessing, concluding and they include the mental process of analysis, synthesis and evaluation. The cognitive skills are observable in practice, but social competences, i.e., attitudes, are revealed in student behaviour. The KSAs learning outcomes are specified in university program of studies as well as in the individual course description cards. Course tutor is characterized by name, department, field of study, projects, publications, faculty to which they are affiliated. The teacher requirements concern hardware, software, and group size. Learning outcomes are divided into three groups, i.e., knowledge, skills and attitudes. Course status means that the course can be mandatory for field, mandatory for specialization, or just optional. Course references can be treated as recommended or optional. The courses are provided to students on Bachelor or on Master level. Course prerequisites established by course tutor are usually accepted as recommended or compulsory. Student grading requires the establishing of assessment techniques and assessment criteria. The applied educational methods are divided into learning methods and teaching methods. Student learning outcome (SLO) describes what a student is expected to learn as a result of participating in academic activities or experiences [4]. Sometimes, beyond SLO, student progress outcome (SPO) is developed to reflect student progress in course sequences and in degree programs. Examples of direct assessment techniques usually applied at universities comprise the use of written communication, project work, portfolios, grading system with rubrics, theses, reflective essays, and performance assessments. Examples of indirect assessment methods are surveys of employers, comparison with peer institutions, surveys of past graduates, retention rates, analysis of curriculum.

Student learning outcomes must be monitored, registered, evaluated and stored in a documentation computerized system. The simplified process of SLOs realization includes the following phases:

- defining the program and plan of studies, and simultaneously defining the student learning outcomes,
- aligning course components with learning outcomes,
- selection and implementation of assessment methods,
- evaluation of evidence gathered in the assessment activities.

Beyond that, universities should ensure the necessary technical tools and consultancy to simplify assembling different items of assignment works and to enable the integration of student works into a coherent personal portfolio. Students usually complete and submit their portfolios during their studies, particularly during their Master studies. Evaluation and scoring of the portfolio can be done by a team of faculty teachers working as a commission. Simultaneously, they participate in faculty strategy development and campus discussion. A portfolio includes works demonstrating: 1) critical thinking and writing, 2) interdisciplinary thinking, 3) historical analysis, 4) creative work and reflection. Students can be requested to present the most personally satisfying works and add the cover letter to the portfolio as well as the learning experience questionnaire [17]. Student competence portfolio is developed as a certain portrait of student capabilities. provide potential employers and the community with credible evidence of student

achievement, and inform governmental institution about the university education system.

Taking into account that personal competences and learning outcomes are the basic categories in the university education, the computerized learning management system should include the modules concerning students', teachers' and courses registration. Each course should ensure the achievement of the pre-specified competences. Courses are grouped in programs and plans of studies. Programs explain what courses are offered to students and by which teachers. Plans present when the courses will be provided. Evaluations of student works during their studies are also included in the system. The system covers evidence of student portfolios. The learning controlling system is to control if the courses were provided by teachers, cancelled or postponed.

The ArchiMate metamodel is an open, independent, and general modelling language for enterprise architecture. The primary focus of ArchiMate is to support stakeholders on how to address concerns regarding their business and the supporting IT systems. ArchiMate is based on the IEEE 1471 standard. The ArchiMate metamodel consists of three layers; the Business layer, the Application layer and the Technology layer. In the metamodel, the technology supports the applications, which in turn support the business.

In this paper, the proposed, formal education architecture model in ArchiMate is organized into the following layers (Figure 2):

- **BUSINESS** containing the following elements: actor (i.e., Student, Teacher), role (i.e., System Developer, Patron), process (i.e., General University Education Process consisting of eight sub-processes), service (i.e., Learning Object Specification, Program and Course Description Browsing, Courses' Collecting, SLOs Specification, Student Enrolment Controlling, Learning Outcomes Controlling). In the paper, teach course is assumed to consist of some components i.e., Learning Objects, which are developed by teachers and re-used.
- **APPLICATION** covering elements such as University Politics, Students Enrolment System, Students' Evaluation System, Learning Controlling System for the control of the course realization by teachers, Students' Portfolios' Registration System, IT Support.
- **TECHNOLOGY** including elements such as Data Server, Application Server.
- **MOTIVATION** containing the following elements: drivers (i.e., Course Participation, Learning Management and Knowledge Dissemination), principles (i.e., Guides for Plans and Programs of Studies), assessment (i.e., Accreditation Commission Assessment), goals (i.e., Graduate Satisfaction, Appropriate Competences), requirements (i.e., Programs', Plans' and Courses' Proposals), stakeholders (i.e., Student, Teacher, Employer), constraints covering Course Registration Availability.

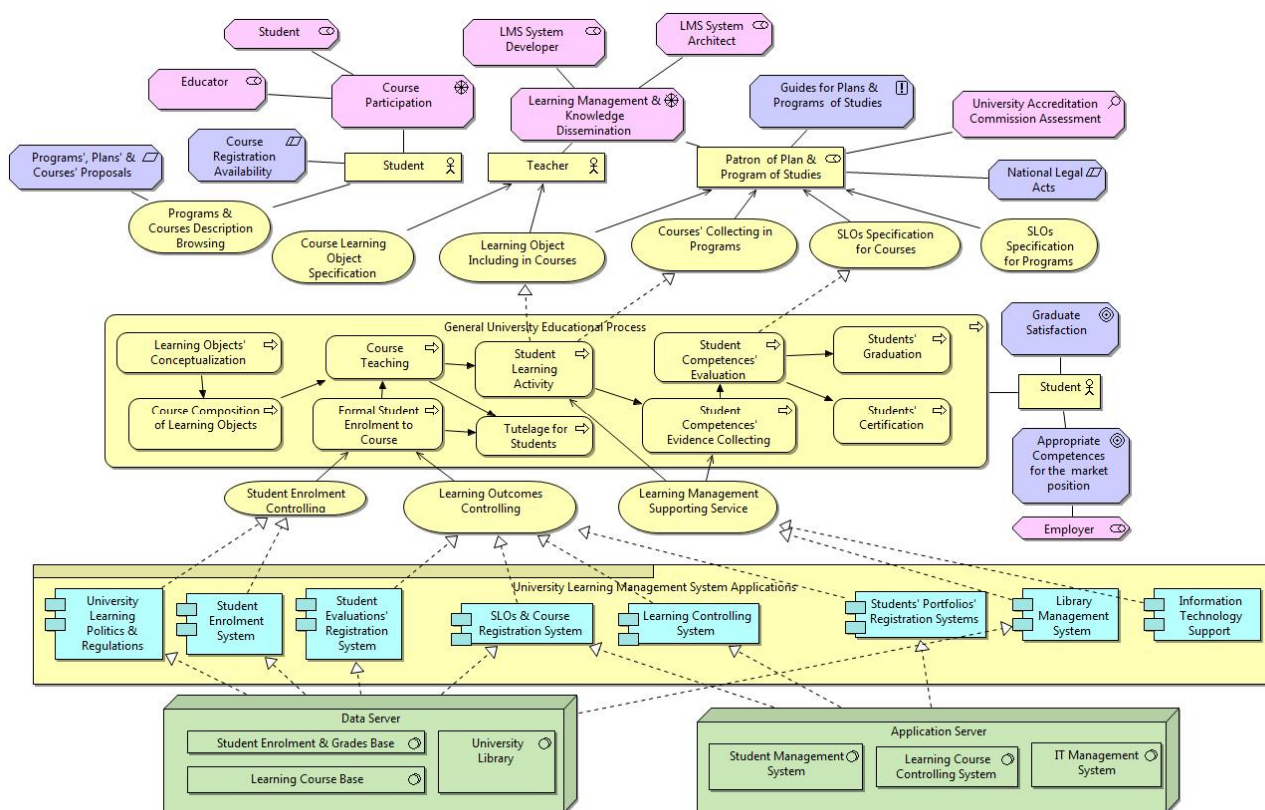


Fig. 2 Formal education architecture model

IV. IN FORMAL ACADEMIC EDUCATION

In contrast to formal learning, informal learning is organized by students. It has no objectives in terms of learning outcomes or acquisition of any competences. It includes socialization, support, gathering opinions, consultancy, and self-directed learning. It can be widely used in a community of students supporting themselves in projects, knowledge creation. In contrast with the traditional view of teacher-centered learning via knowledge acquisition, informal learning is peer-to-peer learning. In the informal learning process, students read self-selected books and e-books, participate in self-study programs, watch YouTube films, navigate Internet support materials, seek advice from peers, participate in virtual communities of practice. Informal learning occurs in a community, even if the participants only observe, play or take part in social events. In informal learning students do not receive grades nor certificates of completion. There are other important opportunities, i.e.,

opportunity to listen to a lecture provided by a famous professor or expert. Informal learning is a way to the globalization of education, because of the open access to the same course materials and e-books in all of the world. Informal learning is oriented towards reception of additional and supplementary knowledge, which could be useful to pass a regular exam in formal education. The globalization in university education impacts the brick-and-mortar studying. The fees for informal online education are not high, because

there are many open courses online. Students are seeking educational materials everywhere for their self-studying and for the extension of their regular courses on their own terms. Excellent teachers will have the opportunity to be heard in the Internet by hundreds of students. Perhaps in that way, teachers attain their recognition and they gain more readers of their publications. The informal education is expected to stimulate global creativity, innovativeness, and opportunity to create millions of newly-educated readers in less-developed countries.

Informal learning is strongly supported by Web 2.0, which is a conglomerate of technologies, software, principles, business models, and a different user behaviour in the Internet. The business models of Web 2.0 are no longer centered on competition between applications. The feature of Web 2.0 business models is that they change the passive role of the Internet information consumer into active participation. As active participants, Internet users spread the news or recommend products. Information providers use viral marketing to influence the autonomous and anonymous users, who evaluate products, write critiques and guides, and publish hints and tricks. In contrast to pre-Web 2.0 times, it is now much more difficult for a company to control the public image of their offerings [2]. The same situation is at universities. Therefore, there is a suggestion that University 2.0 platforms must be governed by carefully defined rules and norms. For example, rules of Wikipedia are the guides for the direction, content and etiquette of such a system.

There is an opinion that contributions to University 2.0 platforms must be evaluated by the authorities or highly respected persons. However, the feasibility of that task questionable. Beyond Web 2.0 the rapidly increasing accessibility of mobile devices is a premise of informal learning development.

V. M-EDUCATION

The e-business is constantly changing into mobile (m-business). Mobile business is the best where the consumer is driven by a sense of urgency, and when they need to have their goods and services delivered immediately for upcoming functions and events, although the consumer must wait for the material product. User with the same device is able to communicate over a wireless network and view office documents at the same time. M-commerce enables users to access the Internet without the need to find a place to plug in through a cable connection.

Mobile users draw daily news i.e., stock quotes, weather information, entertainment, sports scores from their mobile devices. Mobile devices enable students a quick verification of program and plan of studies, as well as course schedule and course venue. Known as next-generation technology, mobile enterprise systems can either be enterprise system extended to support process mobility or separate mobile applications integrated with the existing enterprise system.

During the development of mobile devices and services the consideration of market offers plays an important role. However, a business considering enterprise-wide process mobility requires a mobility strategy. Mobility strategy should guide operations and technology employees through the process redesign, application design, and implementation of mobile enterprise systems. Alag argues that mobility strategies depend on factors, such as the business nature, strategic goals, need for process mobility, existing IT infrastructure and financial capabilities [1]. Mobility strategies are unique for enterprises and cover many important problems, e.g., risk and expected benefits of mobile devices usage, BYOD approach implementation. For instance, making decisions and quantifying risks about mobile devices is difficult without good investigation of mobile devices' usage in a business organization. Some organizations permit end users to take care of device management but some may want more protection. Anyway, the business organization should be able to track, monitor, and control mobile network usage for business purposes. For example, if any of the users works with critical and unique data, they should consider using a backup and recovery solution. Bring Your Own Device (BYOD) is a recent idea to exploit the personal communication devices for work-related tasks. Although, some business organizations have for years provided smartphones, laptops and tablet computers to employees, nowadays, personally-owned mobile devices are permitted to access the organization's networks and data. The obvious advantage for the enterprise is cost savings achieved by not having to purchase these employee-owned devices.

Soon, the computer laboratories will not need to be supported by desktop computers, instead there is an opportunity to use private mobile devices to connect through Internet to server and utilize business applications. However, wide implementation of mobile education is still a challenge. Some of the problems are mobile service costs, the need to

change attitudes and institutions' policies against using electronic devices. It should be noticed that nowadays students have the possibility to use the same mobile device as a phone, calculator, private notes' archives, spreadsheets. Therefore, sometimes teacher has a problem to verify if a mobile device is used honestly.

M-learning is not simple a direct extension of e-learning. So, what may work perfectly well in traditional education or even in e-learning system, may not fit the dynamic mobile environment. M-learning seems to support individual learning in the special context. Glossaries, dictionaries, phrasebooks, learning tips, examples, games and other learning aids are important in m-learning. M-learners within a community share the ideas, stories, opinions or ratings, and utilize the student-to-student and student-to-teacher interactions. Mobile devices allow for the realization of education process in a particular socio-natural context, where teachers are able to explain more precisely the course topics during the field works.

The research on mobile devices usage was realized to evaluate the context of informal learning at university. The research covered a survey done at University of Economics in Katowice, Poland year by year in 2013-2015. The survey will be repeated next years. Students accepted the questionnaire as important for the evaluation of their competencies to use mobile devices in learning processes as well as in other activities.

Generally, the students' tasks can be categorized based on the areas that can be affected by mobile technologies. So, there are three categories of students' tasks: information and knowledge acquisition tasks, interaction tasks among students and teachers, and future work planning tasks. Although, each category of tasks has specific requirements in terms of mobile support and there is a need to fit mobile technologies characteristics with the requirements in terms of content, processing, and device portability, this research considers which software applications and devices are used for learning (Table 1, Figure 2). Each column in Table I includes the percentage of positive answers for the question on usage of the devices included in the first column.

TABLE I TECHNOLOGIES AND MOBILE DEVICES USED BY STUDENTS

Mobile device & technology	2013 n=114	2014 n=127	2015 n=114
stationary phone	2 ^a	4	2
mobile phone	31	42	45
smartphone	26	64	61
iPod	3	2	0
iPad	5	6	3
notebook	67	68	66
netbook	20	25	20
desktop computer	43	56	55
tablet	10	14	22
GPS device	1	4	7
RFID device	0	1	5
automatic personal identification device	2	1	2
biometric personal identification device	2	1	1

Taking into account the answers, it should be noticed that students reject stationary phones for mobile phones and smart phones. The devices for automatic identification and

biometric identification are not very popular, although many people have passports supported by the biometric identification of the owner. Students still prefer to use desktop computers, although for learning they have sometimes more than one desktop computer or they use desktop computer and any other smart device. The new information technologies are expected to create the potential to overcome the traditional division between many computers of one users.

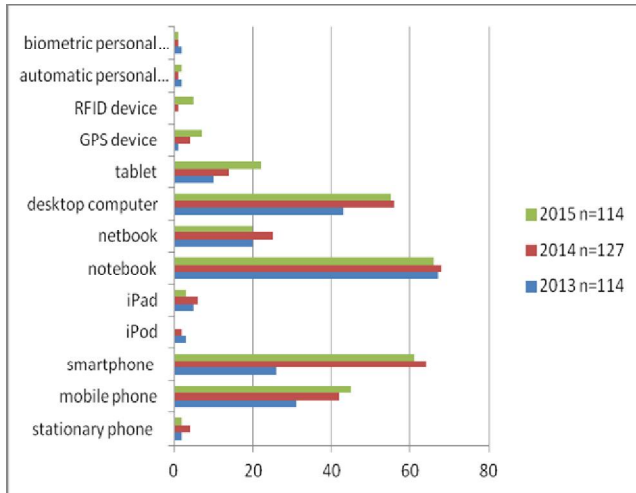


Fig. 3 Percent of students using the mobile devices

A challenge for the next years is the development of a computing environment allowing for an easy access to data and software for processing and retrieval any time as the users want.

Proposed informal education architecture model in ArchiMate is organized into the following layers (Figure 4):

- **BUSINESS** containing following elements: actor (i.e., Student), role (i.e., Information Broker), process (i.e., Informal Education Process covering eight sub-processes), service (i.e., Information Seeking, Service Conceptualization, Knowledge Component Registration and Organization in Catalogues, Service Security). In the paper, the knowledge management is component-oriented. Therefore, each service consists of some knowledge components, which are designed, constructed and selected to provide optimal advice to users. The knowledge components can be further designed as learning objects for formal education of end users.
- **APPLICATION** covering elements such as Financial Application, Open Library, Recommender System, Social Network, Portal, Communication System, IT Support.
- **TECHNOLOGY** including elements such as Data Server, Application Server.
- **MOTIVATION** containing the following elements: drivers (i.e., Consultation Needs), principles (i.e., Information Acquisition and Dissemination Principles), assessment (i.e., Consultation Evaluation), goals (i.e., Student Satisfaction), requirements (i.e., Information Requests), stakeholders (i.e., Student, Tutor, Website Developer, System Architect), constraints covering Legal Acts, Information System Availability.

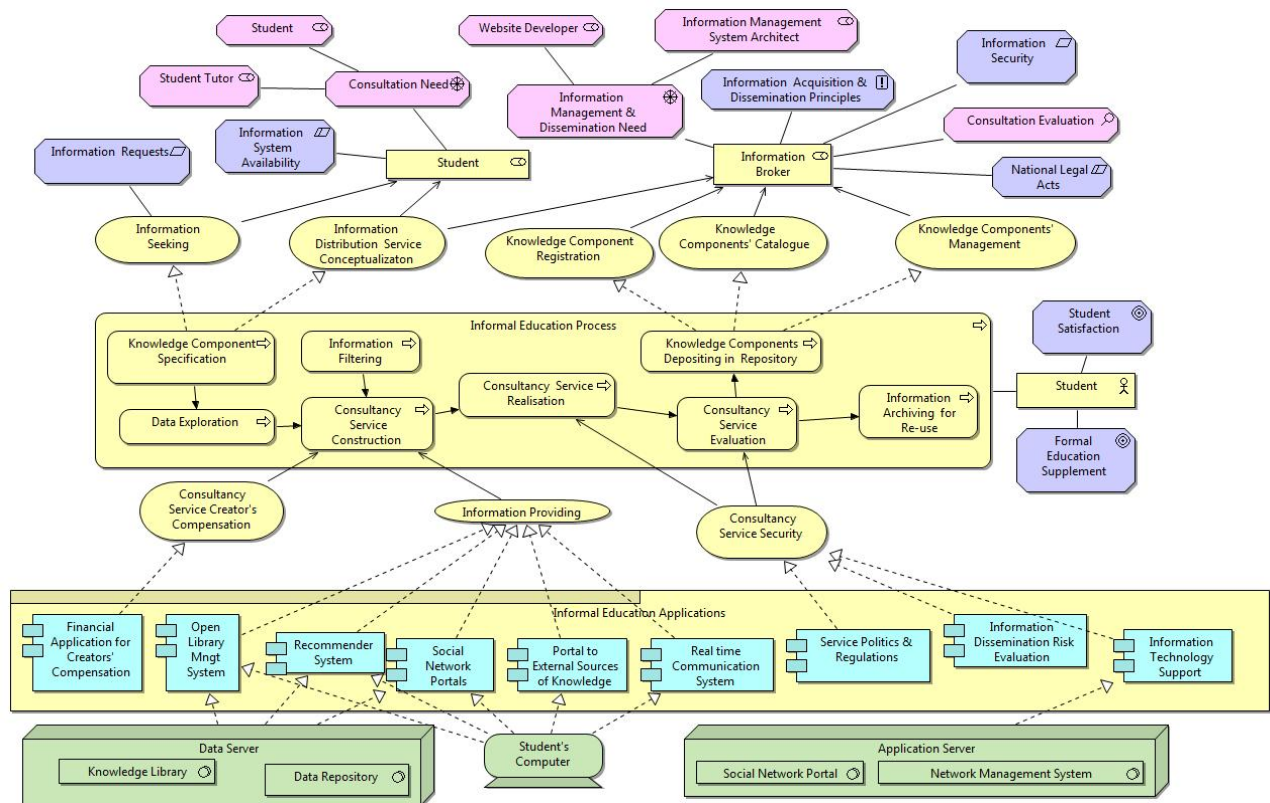


Fig. 4 Informal education architecture model

VI. CONCLUSIONS

Although traditional formal education has still a very important position for teachers and learners, nowadays there is evidence that informal educational processes are supplementary to the traditional knowledge acquisition and dissemination. The paper includes discussion on university formal education fundamentals, which cover Student Learning Outcomes, ECTS system, and student competence management. The traditional approach to educational assessment has relied on indirect evidence pertaining to student's self-perceptions of their learning and their perspectives on program structure and curricular contents. Nowadays, the student learning outcomes, student portfolio, departmental evaluations of students' projects and diploma theses, apprenticeship reports, and institutional and individual certificates are accepted as university identity constructive evidence. Beyond that and independently of that, informal education has been developed. The second way of learning is strongly based on Web 2.0 approach and easy access to mobile devices. The information communication technologies (ICT) support informal education on academic level and easy access to them encourages students to use them as supplementary to the formal educational process. Nowadays, at universities, because of security reasons those two learning environments are working separately. The formal learning environment is under control of the university boards. The informal learning environment is managed by the student community. The formal learning is well regulated and designed, but the other learning environment is constantly changing, however in the interest of students it should be developed under supervision of experts or knowledge brokers, who would help in the peer-to-peer consultancy process.

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