# Implementation of Stakeholders' Requirements and Innovations for ICT Curriculum through Relevant Competences

Hennadiy Kravtsov[1] and Vitaliy Kobets[1]

[1] Kherson State University
27, Universitetska st., Kherson, 73000 Ukraine
kgm@ksu.ks.ua, vkobets@kse.org.ua

**Abstract.** *Research goals*: determine the requirements of employers for the competence of university graduates in the field of information systems to create the curriculum.
*Object of research*: curriculum in information systems.
*Subject of research*: modern requirements to the competences of university graduates in the field of information systems, a methodological and technological model of a unified environment of distance learning based on cloud services.
*Research methods*: review and analysis of scientific publications, modeling of complex systems, questionnaires.
*Results of the research*: the labor market requirements for the competencies of university graduates in information systems were obtained, investigated and systematized. These requirements are the basis for the formation of a new university curriculum in information systems. Based on cloud services and technologies, an innovative model of the integrated electronic learning environment has been developed. The results were obtained during the Erasmus+ project MASTIS "Establishing Modern Master-level Studies in Information Systems" (2015-2018).

**Keywords:** curriculum in information systems, requirements for the competence, cloud technology, innovations in distance learning system.

**Key Terms.** KnowledgeManagementProcess, QualityAssuranceMethodology, StandardizationProcess, TeachingMethodology, TeachingProcess, KnowledgeManagementMethodology.

## 1 Introduction

IT-outsourcing has become the third largest industry of Ukraine (Global Services Location Index, 2015): about 9% growth in 2015; 24 place in global rating, 2015; 3% of Ukraine's GDP; more than 100 IT companies and 90000 IT specialists in Ukraine. Ukraine topped the rating of the European R&D and IT-outsourcing (2015), Ukraine has the largest number of programmers among all European countries. IT-specialists

are most demanded in Ukraine ($800 is modal wage for 1st quarter of 2015). The total number of Ukrainian specialists involved in the global IT market has exceeded 100,000 people. Ukraine took the first place in Europe among the countries that hire IT-specialists (European edition IT Outsourcing News).

As a result of IT industry market research the total number of IT specialists from Ukraine will exceed 200,000 people before the end of 2020. Last year, exports of Ukrainian software brought a profit of two and a half billion dollars, approximately 80% of which came from the USA and the EU. At the end of 2015 Ukraine rose by 17 positions and took the 24th place in the global ranking of the most attractive countries for IT-outsourcing (Global Services Location Index). IT industry has shown first signs of recovery after 7% decrease in growth in 2014.

In 2015 according to estimates of the Association "IT Ukraine", the volume of IT services provided by Ukrainian programmers to foreign companies reached $2.3 billion, which accounted for 3% of GDP against 0.8% in 2012. According to the study of High Tech Ukraine, the total number of large (80 and more specialists) IT companies is 106in Ukraine. The total number of firms providing IT-services has reached more than 1,000. Nowadays IT-industry of Ukraine includes more than 90 thousand (20% more than in previous year), with 60% specialists working in outsourcing. Java or .NET-developer can expect 18-20 proposals for his service, provided he has at least 2 years experience. The average salary in the market starts at $200 at grows to $3000-5000. The difference in wages across regions in Ukraine reaches no more than 10%.

Top 5 of the largest outsourcing IT-companies in Ukraine remains unchanged, among them are EPAM (4400 employees), SoftServe (over 3800), Luxoft (3700), GlobalLogic (2600) and Ciklum (2300.). They include about 17 thousand employees (more than 18% of IT labor market). In general, according to Ukrainian community DOU.ua programmers25 largest IT companies employ 25% of Ukrainian IT-specialists.

The employers of IT companies have greatest demand for developers of senior level; while juniors want employment five times greater than seniors. By 2020 the IT industry in Ukraine has all chances to take the second place in export structure of the country, reaching a volume of $7.7 billion. In five years the number of IT specialists in Ukraine should reach 200 thousand people.

The paper goal is to develop new curriculum for master program in information system using requirements of stakeholders on international and local level.

# 2 Concepts and Related Works

## 2.1 Specification of Stakeholders

Needs and objectives related to MASTIS: expected results

- improvement of Master Program in Information Systems according to the requirements of business (IT companies and IT departments in Kherson (Ukraine) were asked to fill questionnaire)

- modernization of the current Degree Profile and curricula in Information Systems (using existing experience from previous Tempus project and project of US Department of State Freedom);
- development of innovative academic environment for Master program in Information Systems as a platform for training/retraining, PhD, LLL (distance learning platforms, e.g. Kherson Virtual University and KSU-online);
- proposition/modernization of labs infrastructure for Information Systems (according to expected competencies).

Kherson State University (KSU)was founded in 1917. Chair of Informatics, Software Engineering and Economic Cybernetics (CISEEC) of KSU was organized in 1987 and now includes 4 bachelor programs and 2 master programs. The Chair continues to work in the following areas: improvement of curricula, activation of students' individual work, and increase of the number of qualification projects, including the extensive usage of computer technologies, vocational guidance (especially of rural students), computerization of educational process.

Since 2009 our students have participated in International training programs at the universities of Nice-Sophia Antipolis (France), Glasgow Caledonia (Scotland) and Scientific Research Institute of symbolic computation (Austria).Scientific research complexes based on the department of major disciplines were created and located on the distant learning systems: Kherson Virtual University and KSU Online, providing efficient instruction of students.

Such leading companies as DataArt, Logicify, Wezom, Autoplaneta, PrivatBank, Raiffeisen Bank Aval are the largest employers for our graduates. International relations of CISEEC include Alpen-Adria University, Austria (Klagenfurt), Akademia Pomorska (Poland, Slupsk), University of Nice-Sophia Antipolis (France). CISEEC has established close cooperation with relevant stakeholders in Ukraine:

- IT companies;
- IT departments of banks and enterprises;
- Ministry of Science and Education.

For establishing close cooperation between students and IT companies and IT departments, CISEEC combines different methods:

- QA talk, Java School, QA School http://www.dataart.ua/contacts/kherson/
- IT NonStop (http://it-nonstop.net/city/lviv)
- IT talk (industrial experience): http://www.icteri.org/
- outside IT specialists teaching optional disciplines for students
- awards, bonuses and sponsoring of students taking part in contests.

Participation of IT companies in educational process of CISEEC of KSU (Ukraine) consists of

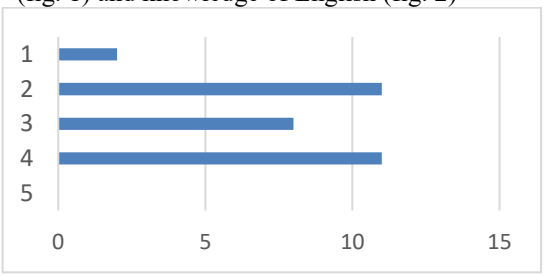
- Start-up competition from education fund «OSEF» (http://spivakovsky.info/fund/);
- Training programs (work practice) (http://www.dataart.ua/contacts/kherson/);
- Free courses from companies for students' training (http://wezom.com.ua/);
- Open online courses and online practice followed by entering in personnel reserve of company (http://practice.privatbank.ua/).

Students of CISEEC of KSU take part in these programs along with learning process. These events facilitate close cooperation with about 10 relevant stakeholders (IT companies, IT departments of firms and banks, public sector etc.) in Kherson (Ukraine).

The needs of IT companies diversified among many types of IT specialists:

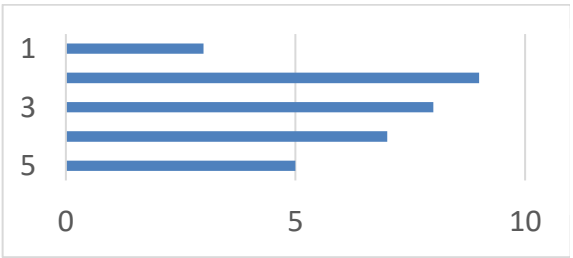
- Architect
- Software engineer
- Business Analyst
- Developer (.NET, Java, Python, etc.)
- QA Engineer
- Automation QA
- Project Manager
- SEO-specialist
- Technical support

Demand of employers is characterized of requirements on IT specialists who can work on different positions for different projects. Feedback from all participants of the project revealed 2 types of unsatisfied requirements, such as practical skills (fig. 1) and knowledge of English (fig. 2)




| | | |
|---|---|---|
| 1 (strongly disagree) | **2** | 6.3% |
| 2 | **11** | 34.4% |
| 3 (neutral) | **8** | 25% |
| 4 | **11** | 34.4% |
| 5 (strongly agree) | **0** | 0% |

**Fig. 1.**Graduates are well trained practically; they know how to apply theoretical knowledge in practice.




| | | |
|---|---|---|
| 1 (strongly disagree) | **5** | 15.6% |
| 2 | **7** | 21.9% |
| 3 (neutral) | **8** | 25% |
| 4 | **9** | 28.1% |
| 5 (strongly agree) | **3** | 9.4% |

**Fig. 2.** The knowledge of English is good.

The reason for creation of new curriculum is new insights and the strategic view of our university on future IT education [1] where uses simulation business model for different information systems will be used [2]. We conclude that at each company all vacancies are different so requirements of employers are different too. Good analytical skills and open mind are great results of completed master degree

education. Actually, companies don't need ALL these competences of employees; it depends on their position in the company. While students who lack motivation for personal and professional growth will not possess all necessary competencies.

### 2.2 Stakeholders requirements

Stakeholders requirements to MASTER in Information Systems include:

1) Pre-research – analysis of official reports, research and strategies in order to create an overview of Kherson IT sector. We have used data and references available from official data of Ukrainian statistics, Ministry of Science and Education, Reports of IT Industry 2015. KSU has been engaged in collecting and maintaining lists of IT companies and IT departments, with CEO & Heads' names, phone numbers, e-mail and web addresses, etc.
2) Online questionnaire of IT companies (https://goo.gl/N7QbFp)
3) Interviews and meetings with stakeholders. CISEEC of KSU organized separate interviews with different stakeholders.
4) Collection and analysis of information obtained from pre-research, online questionnaire and meetings with stakeholders to assess the courses according to the requirements to specialists training in the field of information systems. CISEEC of KSU is engaged in the analysis of the results.

Among our stakeholders were representatives of small, medium and large companies and IT departments of SME (table 1). The method of questioning was applied, the studies are relevant.

**Table 1.** Stakeholders of CISEEC

| Company name | Company main activities | Number of employees | Contact |
|---|---|---|---|
| Logicify | IT services | 65 | http://logicify.com/en/ |
| Wezom | Digital services | 208 | http://wezom.com.ua/ |
| IT company DataArt | IT services | 150 | http://www.dataart.com.ua/ |
| Raiffeisen Bank Aval (Kherson branch) | Bank services | 1000 | https://www.aval.ua/en/ |
| Autoplaneta | Car business | 350 | http://autoplaneta.com.ua/ |
| LAPEK Ltd | Hardware services | 10 | sharplaks@gmail.com |
| PrivatBank (Kherson office) | Finance services, banking | 340 | https://privatbank.ua/ |

We analyze e-Competence Framework 3.0 as global requirements of employers for master program for information system (MPIS) [3]. We reveal the following main groups of competences of MPIS graduates (table 2).

**Table 2.** e-Competence Framework 3.0 for master program in IS

| Level | Competences | Group of competences |
|---|---|---|
| **A-Plan** | A.1. IS and Business Strategy Alignment<br>A.2. Service Level Management<br>A.3. Business Plan Development<br>A.4. Product / Service Planning<br>A.5. Architecture Design<br>A.7. Technology Trend Monitoring<br>A.8. Sustainable Development<br>A.9. Innovating | Programming competencies<br><br>Business processes competencies |
| **B-Build** | B.2. Component Integration<br>B.3. Testing<br>B.6. Systems Engineering | Programming competencies |
| **C-Run** | C.4. Problem Management | Business processes competencies |
| **D-Enable** | D.1. Information Security Strategy Development<br>D.2. ICT Quality Strategy Development<br>D.4. Purchasing<br>D.5. Sales Proposal Development<br>D.6. Channel Management<br>D.7. Sales Management<br>D.8. Contract Management<br>D.9. Personnel Development<br>D.10. Information and Knowledge Management<br>D.11. Needs Identification<br>D.12. Digital Marketing | Business processes competencies |
| **E-Manage** | E.1. Forecast Development<br>E.2. Project and Portfolio Management<br>E.3. Risk Management<br>E.4. Relationship Management<br>E.5. Process Improvement<br>E.6. ICT Quality Management<br>E.7. Business Change Management<br>E.8. Information Security Management<br>E.9. IS Governance | Competences in Information systems |

Following fig. 3 and fig. 4 present the average result of CISEEC stakeholders' grades for competences specification defined in MASTIS online questionnaire.

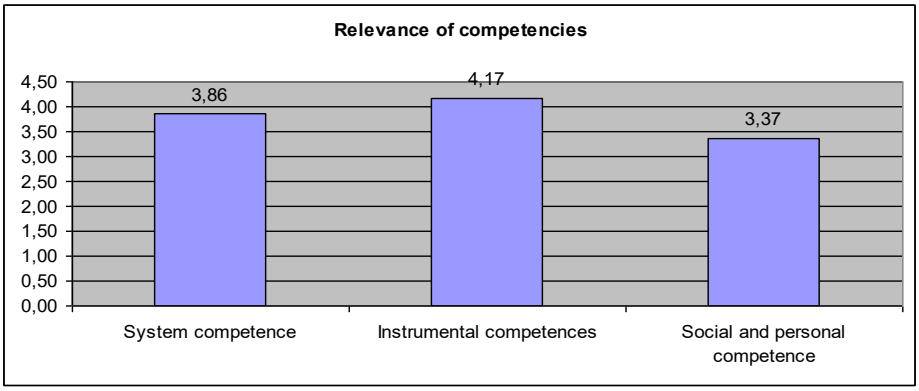



**Fig. 3.** Estimation of generic competences by employers (1-min, 5-max)

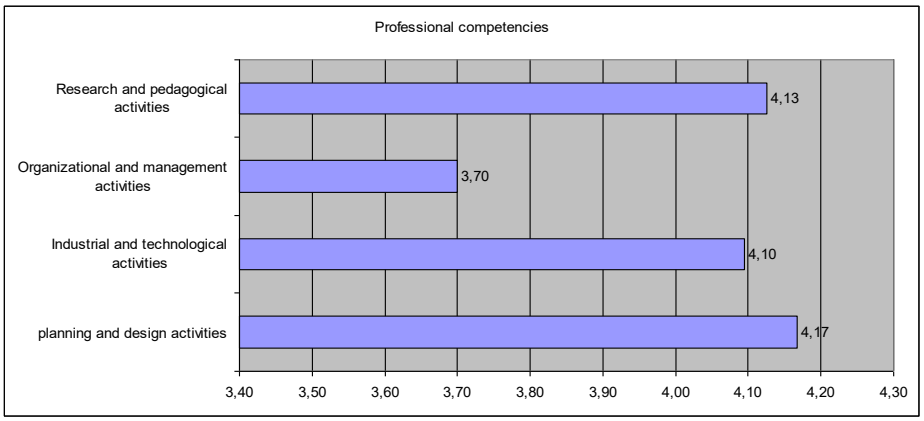



**Fig. 4.** Estimation of professional competences by employers (1-min, 5-max)

We can see that generic competences (such as scientific researches and foreign language) are no less significant than professional competences (e.g., instrumental competences).

After processing the data of online questionnaire for employers we invited these employers for interview 6 months later. We redesigned our list of competences using experience of EU and Ukrainian partners (table 3).

**Table 3.** Stakeholders grades of AIS MSIS 2016 competences [4]

| Competency Areas | **Average grade (1-min, 5-max)** |
|---|---|
| Business Continuity and Information Assurance | 2,45 |
| Systems Development and Deployment | 2,96 |
| Data, Information and Content Management | 3,16 |
| Ethics, Impacts and Sustainability | 3,40 |
| Enterprise Architecture | 3,50 |

| | |
|---|---|
| IS Strategy and Governance | 3,58 |
| Innovation, Organizational Change and Entrepreneurship | 3,70 |
| IS Management and Operations | 2,64 |
| IT Infrastructure | 2,50 |

Comparative analysis of pre-requirement analysis and after-requirement analysis demonstrates substantially revised opinion of employers for some types of competences (table 4).

**Table 4.** Comparative analysis of stakeholders' requirements to competences of graduates in MPIS

| **Online questionnaire competence specification grades** | **(1 - min; 5 - max)** | **Average result of stakeholders grades for AIS MSIS 2016 competences** | **(1 - min; 5 - max)** | **Inter-dependence («-» means revised opinion)** |
|---|---|---|---|---|
| Systematic competences | 3,86 | 6. IS Strategy and Governance | 3,58 | + |
| | | 8. IS Management and Operations | 2,64 | - |
| Methodological competences | 4,17 | 3. Data, Information and Content Management | 3,16 | ? |
| Social/personal competences | 3,37 | 4. Ethics, Impacts and Sustainability | 3,40 | + |
| | | 9. IT Infrastructure | 2,50 | - |
| Professional competences: analysis, design, and project management | 4,17 | 2. Systems Development and Deployment | 2,96 | - |
| Professional competences: implementation and systems administration | 4,10 | 1.Business Continuity and Information Assurance | 2,45 | - |
| | | 5. Enterprise Architecture | 3,50 | + |
| Research and academic/analytical competences | 4,13 | 7. Innovation, Organizational Change and Entrepreneurship | 3,70 | + |

Considering competencies proposed by our employers we created the following courses for Curriculum Master of Information System (table 5), which take into account global and regional requirements to alumni of MPIS. These requirements are presented in the European e-Competence Framework (e-CF 3.0), which contains a reference to 40 competencies as applied at the Information and Communication Technology (ICT) workplace, using a common language for competencies, skills, knowledge and proficiency levels that can be understood throughout Europe [3].

**Table 5.** Developed Curriculum Master of Information System

| Course | E-CF 3.0 Competences |
|---|---|
| Methodology and organization of scientific researches with basics of intellectual property | D.9. Personnel Development |
| Foreign language for professional purposes | D.9. Personnel Development |
| Project Management | E.5. Process Improvement<br>E.6. ICT Quality Management |
| Data stores organization | A.9. Innovating<br>D.10. Information and Knowledge Management<br>E.9. IS Governance |
| Global Information Resources | A.7. Technology Trend Monitoring<br>A.8. Sustainable Development<br>A.9. Innovating<br>D.10. Information and Knowledge Management<br>E.5. Process Improvement<br>E.9. IS Governance |
| Business Analytics for Information Systems | A.1. IS and Business Strategy Alignment<br>A.3. Business Plan Development<br>A.4.Product / Service Planning<br>D.11. Needs Identification<br>E.1. Forecast Development<br>E.2. Project and Portfolio Management<br>E.3. Risk Management |
| Mathematical modeling of systems and processes | A.9. Innovating |
| Software systems support | B.3. Testing<br>E.5. Process Improvement<br>E.6. ICT Quality Management |
| Modeling and design of information systems | A.5. Architecture Design<br>B.2. Component Integration<br>B.3. Testing<br>E.5. Process Improvement<br>E.6. ICT Quality Management |
| E-commerce and e-business systems | A.2. Service Level Management<br>C.4. Problem Management<br>D.4. Purchasing<br>D.6. Channel Management<br>D.7. Sales Management<br>D.8. Contract Management<br>D.9. Personnel Development<br>D.12. Digital Marketing<br>E.2. Project and Portfolio Management<br>E.3. Risk Management<br>E.4. Relationship Management<br>E.7. Business Change Management |
| Business processes modeling | C.4. Problem Management<br>D.5. Sales Proposal Development<br>E.1. Forecast Development<br>E.5. Process Improvement |

| | |
|---|---|
| | E.7. Business Change Management |
| Mathematical methods in information systems of artificial intelligence | A.9. Innovating |
| Standardization and certification of information technologies | D.2. ICT Quality Strategy Development<br>E.6. ICT Quality Management |
| Formal methods of software engineering | B.2. Component Integration<br>B.6. Systems Engineering<br>E.6. ICT Quality Management |
| Safety of information and communication systems | D.1. Information Security Strategy Development<br>E.8. Information Security Management<br>E.9. IS Governance |
| Data mining | A.9. Innovating |
| Formal methods of specification and verification of information systems | D.2. ICT Quality Strategy Development<br>E.6. ICT Quality Management |
| Information systems in education | D.10. Information and Knowledge Management<br>E.9. IS Governance |
| Information systems reengineering | E.6. ICT Quality Management |
| WEB-services of information systems in education | D.10. Information and Knowledge Management |

So, the curriculum is specified using the competencies as its foundational element, rather than courses or knowledge areas, units, and topics.

## 3 Innovations in ICT Support for IS Learning Process

Platforms of Distance Learning (DL) are innovative and important resources support IS Education process [5]. A wide variety of DL platforms and many more formats of electronic educational resources (EER) create difficulties in the organization of educational process in a general educational standard. These challenges define the requirements for the unification of EER formats and service access.

Cloud services and technology are to solve these problems.

### 3.1 Tools and Platforms for e-Learning in IS Education

Among the DL platforms we can identify commercial learning management systems (LMS) (Blackboard, Learning Space, Lotus, WebCT, and others), Open Source (Moodle, ATutor, Sacai, and others) and authoring platforms (in Kherson State University: Kherson Virtual University [6], KSU Online [7]). These platforms are widely used in certain universities. A common drawback is the relative closeness of these systems. Restricting access to educational resources is an obstacle to the development of e-Learning. The solution is to open access to distance learning resources. Open platforms and open access resources will enhance the e-Learning mobility of students [8].

An important example of open EER is a massive open online course (MOOC). MOOC is an online learning resource designed for open use over the Internet. MOOC

is a form of distance learning that has evolved over the past decade.

Open academic information environment of universities is the basis for the creation of a common European Academic information environment in the Computer Science and Software Engineering. Unification of the formats for storage and use of the EEP is a necessary requirement for the creation of a unified academic information environment of universities.

The task of creating a common European academic information environment in the field of Computer Science and Software Engineering requires unification of EER formats and services access to those resources. Unification of EER formats defined standards IMS and SCORM (EER software exchange between different LMS). The problem of the unification of the EER storage structures in the clouds requires solutions. It will also require the decision of the task of unification of educational process management.

Unification of Computer Science and Software Engineering curriculum will allow to organize the educational process in the IS Education with the participation of several universities.

### 3.2 Cloud Services and Data Processing Technology

Cloud services are widely used in education. According to research (M. Shishkina and Yu. Nosenko), novelty and relevance of existing approaches, rapid development of technology, the need to develop models, methods most appropriate for using and implementation of cloud tools and services which are factors that encourage further development of this issue [9]. Main tasks:

- Creation of an open cloud platform
- Unification of cloud data processing tools
- Highlighting the main cloud services.

**Cloud services and data processing technologies (SaaS, PaaS, IaaS).**

SaaS – Software as a Service. This type of cloud services allows using the Internet software in education. In e-Learning, it provides access to email, various training sites, blogs, video and audio materials in the Internet. For example, the service Google Apps for Education provides Internet technologies and tools to create information-educational environment of the institution; Microsoft Live@edu is used to equip students with the necessary tools of online interaction without additional costs for software, hardware and support.

PaaS – Platform as a Service. It is provided by a set of software services and libraries that you can use to develop your own electronic educational resources (EER). It provides an integrated platform for development, testing and support of web applications that are based on cloud computing. In education, the service is used to develop integrated applications that are used "in the cloud" for managing educational projects, implementation of joint researches, such as designing the virtual laboratories of share access. Learning Management System (LMS) can be represented "in the cloud" through this type of service.

HaaS (Hardware as a Service) is provided by the hardware capabilities, such as a certain amount of memory, processor time, bandwidth and so on.

IaaS (Infrastructure as a Service) may be seen as HaaS technology development that provides certain systems underlying in the construction of other systems, such as

virtualization tools, load distribution etc. IaaS may include hardware (servers, storage, client systems and equipment); operating systems and system software (virtualization, resource management); communication software between systems (e.g. integration into network, management equipment). The use of the technology in education provides an opportunity to get rid of the need to support complex data infrastructures, client and network infrastructures.

**Model of integrated academic information environment**. Methods and forms of practical implementation of cloud technology in education are highlighted in [10]. In particular, the following propositions are considered:

- Cloud services are the technological basis for the creation of an open cloud-based distance learning platform.
- This should solve the problem of unification of cloud processing tools.
- The common European academic information environment can be designed as an element of cloud infrastructure (fig. 5).

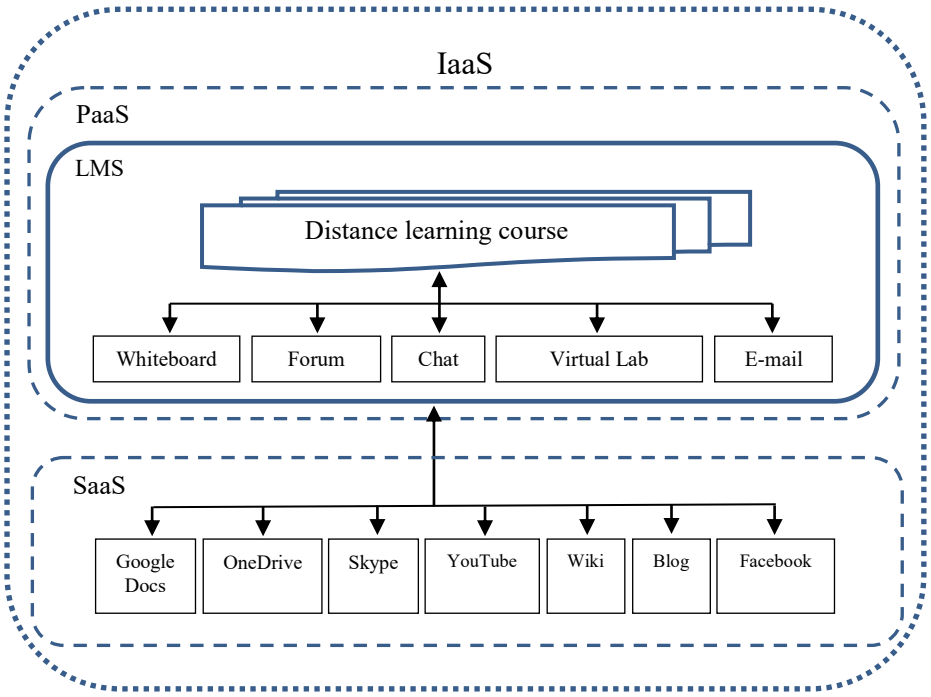



**Fig. 5.** The model of interaction between LMS and SaaS cloud services.

The developed model of interaction of distance learning platforms with cloud services can be used to build a united electronic educational system. In accordance with the developed model, the interaction of LMS with open resources of cloud services SaaS ensures the functioning of such educational environment.

This approach allows to expand the concept of student mobility from physical mobility to knowledge mobility. Standards help to transmit different EER between

different DP platforms. It is a first step for integration of different DL platforms. For example, KSU has two different DL platforms, such as Kherson Virtual University (KVU) and KSU-online. Both systems are developed according to IMS and SCORM standards. Technologically it allows to exchange of all distance courses. But in realty such exchange is absent due to resistance of lectures to disclosure their e-courses for the other teachers. Within KVU is realized the possibility to use elements (e.g., tests, presentations, labs etc.) of one course in the other ones.

The question is that the requirements to exchange of elements of DL courses between different DL platforms does not realized yet. This approach has following advantages:

- individual learning trajectory for students;
- increasing of course quality;
- increasing of students' motivation through educational content diversification;
- expanding the number of languages.

Future step is to create new learning management system instead of creating of new DL platforms with educational resources. We believe that this task can be solved only in cloud services and technologies.

## 4 Conclusions and Outlook

Thus, we have designed and developed conceptual proposals for improving the system of training university graduates in the area of information systems, which includes the following propositions:

1. Analysis of the results of the questioning of stakeholders from the labor market shows that there is a gap between the qualifications of IT graduates and the requirements of employers.
2. To decrease this gap, we propose the following:
   - to develop a unified approach to the creation of curricula in information technology disciplines;
   - to approach unified standards of qualification requirements for graduates' competencies in the fields of computer science and software;
   - to apply unified requirements to graduates' competencies according to e-CF v.3.0.
3. In cooperation with leading European universities to design and develop a common European academic information environment as a cloud infrastructure. This environment will create such benefits as an individual way of learning, high quality of courses and the motivation of students through the diversification of educational content.

## References


1. Moergestel, L., Keijzer, A., Stappen, E. Tips and pitfalls for blended learning: Redesigning a CS curriculum using IT. In: Ermolayev, V. et al. (eds.) Proc. 12-th Int. Conf. ICTERI 2016, Kyiv June 21-24, 2016, CEUR-WS.org/Vol-1614, ISSN 1613-0073, P.273--283, online CEUR-WS.org/Vol-1614/ICTERI-2016-CEUR-WS-Volume.pdf
2. Kobets, V., Yatsenko, V. Adjusting business processes by the means of an autoregressive model using BPMN 2.0 (2016), CEUR Workshop Proceedings, vol. 1614, P. 518-533 (Indexed by: Sci Verse Scopus, DBLP, Google Scholar). Available: CEUR-WS.org/Vol-1614/ICTERI-2016-CEUR-WS-Volume.pdf
3. e-Competence Framework 3.0, E.: A common European Framework for ICT Professionals in all industry sectors (2014). Mode of access: http://www.ecompetences.eu.
4. Revising the MSIS Curriculum: Specifying Graduate Competencies. Mode of access: http://cis.bentley.edu/htopi/MSIS2016_Draft_03-21-2016_Part1.pdf
5. Bykov V. Models of Organizational Systems of Open Education / V. Bykov. – Kyiv: Atika, 2009. (in Ukrainian).
6. LMS “Kherson State University”. Mode of access: http://dls.ksu.kherson.ua/dls.
7. LMS “KSU Online”. Mode of access: http://ksuonline.kspu.edu.
8. Carnwell, R. Distance education and the need for dialogue. Open Learning 14 (I). – 1999. – P. 50 – 55.
9. Shishkina M.P., Nosenko J.G. Recent Areas of Cloud-based Educational and Scientific Environment Education System // Scientific Journal of NPU of M.P. Dragomanov. Series №2. Computer-oriented education system: Coll. of scientific articles. / Pedrada. – K .: NPU of M.P. Dragomanov, 2015. – № 16 (23). – p.153 –158.
10. Kravtsov H., Gnedkova O. The Use of Cloud Services for Learning Foreign Language (English). In: Ermolayev, V. et al. (eds.) Proc. 12-th Int. Conf. ICTERI 2016, Kyiv, Ukraine, June 21-24, 2016, CEUR-WS.org/Vol-1614, ISSN 1613-0073, P.620-631, online http://ceur-ws.org/Vol-1614/paper_87.pdf