Integration of Information Technologies' Dynamic Development into Academic Teaching Process

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Abstract. Modern trends in information technologies related to academic perception are looked upon in this paper. The essence of exponential growth of volumes of information relative to IoT intensification is disclosed. The place and role of higher education in the process of knowledge spread methods, collection, storage, processing and transmission of information is defined. Effective practices of working with students in the "Decision Support Systems" and "Information systems and technology in the economy" courses are shown. Elements of coherent training are implemented. The efficiency of the combination of theoretical, practical and on-line business courses within the normative study is proven.

Keywords: Information systems, self-learning, SAP UA, DSS.

Key Terms: Academia, Integration, TeachingProcess, AgentBasedSystem.

1 Introduction

Economic growth has always been based on resources. From the definition of informational society and post-industrial economy in 1973 by D. Bell., the weight of information as a resource and a factor of production has been steadily increasing. First information systems emerged as instruments serving the elements of economic activity. In 1976 SAP company launched MRP-accounting solution for businesses. Over time, similar solutions have evolved up to full support of comprehensive enterprise with much less time and material cost. At this point, information has become a driving and the main factor of production in post-industrial economy. The development of information systems was accompanied by formation of new markets and industries. Analytical solutions, knowledge management systems and artificial intelligence comprise modern trend of focusing information industries efforts. Information process moved from the stage of formation and development to the exponential growth of all items: accumulation (reproduction) and growth (processing).

In those circumstances, future training of qualified personnel depends on ability to quickly adapt to rapidly changing processes and synthesis of long trends. A steady practice of academic study is its cyclical changes in regulations and training courses. The average duration of such cycle is 5-6 years, or the period of preparation of educationally

level of "master". In such a long by modern standards time, emergence of new solutions, methods and conditions in modern market is natural. This suggests a slow nature and reduction in efficiency of academic study. At the same time employers' rankings, QS World University Rankings, Top 200 Ukraine (IREG) constantly show the need for higher education professionals in information industries. Moreover, the number of technical universities is lower compared to classical universities. This means high and growing relevance of academic study with consideration of the exponential dynamics of the environment.

The basis for this piece of work is a practical training of 3-5th year students and simultaneous training of lecturers of the Faculty of Economics of Taras Shevchenko National University of Kyiv.

Taras Shevchenko National University of Kyiv also is active participant of the global program SAP University Alliances (SAP UA). Eight-year experience of collaboration with one of leading software vendors gives an opportunity to do certain conclusions in relation to IT studies efficiency in the modern fleeting world.

The object of study - effectiveness of the learning process of dynamic IT.

Subject of research - analysis and synthesis method, quantitative method of measuring and comparing, historical method.

The aim - to create effective practices and recommendations of the study of information systems and technologies of wide application.

The goal will be revealed through the following objectives:

- Determine the conditions and trends of the environment;
- Outline the main information technology;
- Explain the internal conditions of the learning process of IT;
- Summarize the experience of forming competencies in students;
- Show effective methods of involvement in learning;
- Develop recommendations for intensification of cooperation between external and internal environments.

2 Dynamics of Products of Informational Solutions for Economy

The focus of the majority of important conferences and forums with economical and informational inclination is on discussing the topics on Internet of Things spreading technology, a new stage of scientific and technological revolution - Industry 4.0 and Artificial Intelligence. Each of these areas is self-contained and requires separate niche research. But some features are still worth noting here.

Internet of Things (IoT) - a network consisting of interconnected physical objects (things) or devices that have built-in sensors and software that allows you to transfer and exchange data between the physical world and computer systems, through standard communication protocol [1]. Information about the current state of the object in online mode is transmitted to the processing means: computers, server, smartphone, etc.

Working on data sets using intellectual systems allows to anticipate problem and improve efficiency, changing working modes of object automatically without human intervention. According to various forecasts the number of such connections by 2020 will reach 15-24 bln., and investments will amount to $2-5 trillion. Such forecasts are uplifting, but they are not decisive. Trend of the generated information growth increases exponentially. Recently, measuring information in Gigabytes was perfectly normal, but now even private users are already familiar with Terabyte, and corporate users with Peta- and Exabyte.

Huge volumes of information require processing and effective solutions [2]. Otherwise the gap is formed between the primary and processed information flow per unit of time. As a result, knowledge about the current state will not be complete. According to Moore's law the number of transistors in a processor, i.e. its' efficiency, doubles every 24 months.

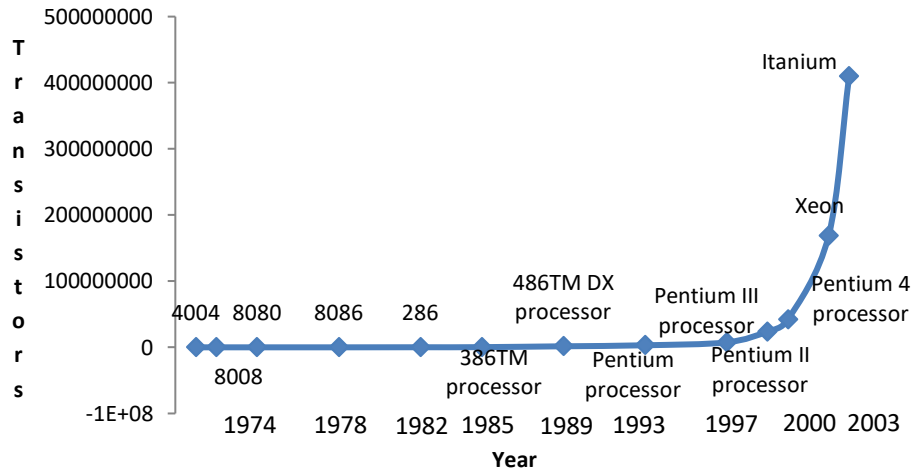

Fig. 1. Number of transistors per a chip processor

As you can see (Fig. 1.) exponential dependence clearly emerges. Popularity of the law is supported by the fact that it was formed in 1965, and receives constant empirical evidence despite the regular technological limitations. In the words of Moore himself, the law will have ceased to be functional by 2007 because of the atomic nature of matter and the speed limit of light, but the technological development of a quantum computer can continue by the said exponential curve. For convenience, changing trends in the exponentially-dynamic ranks are put into charts with a logarithmic scale.

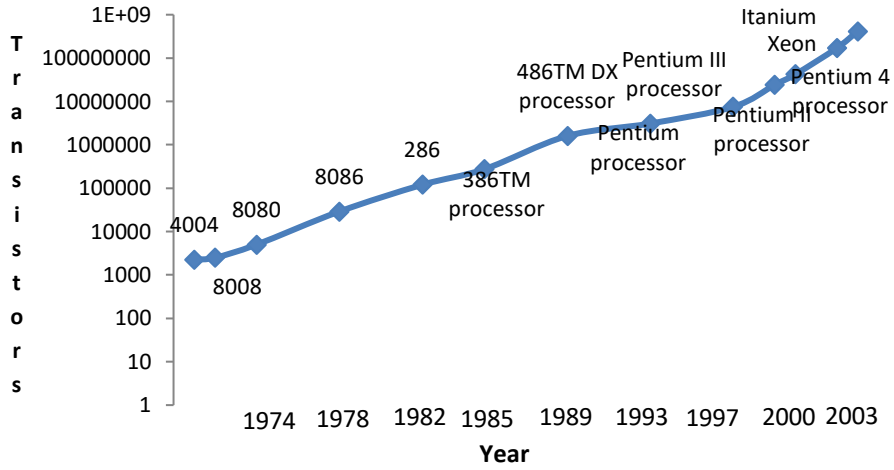

Fig. 2. Linear measurement of growth in the number of transistors

Figure 2 clearly shows that the increase in geometric progression is not an ideal constant, but still quite close to the dependence of uniform acceleration. That is, it creates a sense of confidence in long-term empirical means of processing and analyzing growing volumes of information. But in processing of primary data, new secondary information and knowledge are formed, which is also multiplied off of primary data volumes and processing speed at the k <1 coefficient. With an estimated ratio of 0.2, it means that the ways of processing and analytics should grow 20-30% faster than exponential growth of primary data sets. But production of efficient hardware and intelligent means also affect the economic, social and other spheres of public life.

This result is the transitional effect of these information industry trends into the rest of the productive sectors of social reproduction.

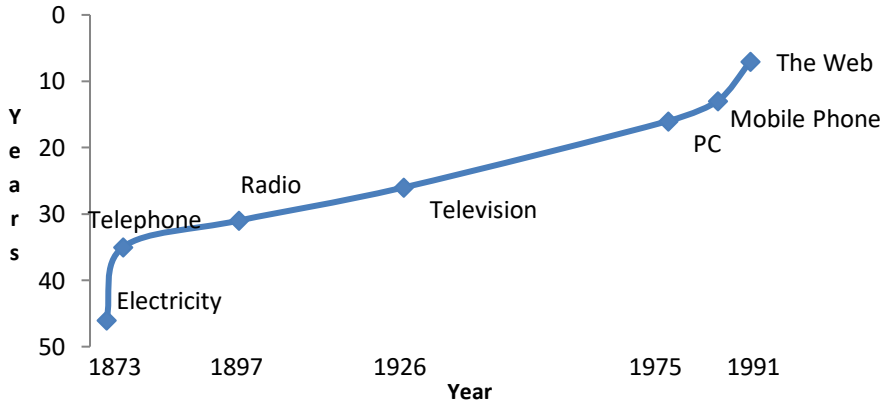

Fig. 3. Years to spread the innovations among 1/4 of the US population

Along with the effect of constant growth of innovation and its' transitive effect there is a permanent reduction of time for implementation and development of technological innovation (Fig. 3.). Current conditions in informational systems and technologies are characterized by rapid dynamics of public importance and complexity of regular instruments. This in turn may make the entry barrier in the growth of new industry professionals and slowing down the development. Therefore, training should include familiarization of students with these industry turnover and get them onto solving this problem. It is possible to implement by the team reports with creative scenarios and recommendations. Game simulative effect creates a mood of lightness and increases audiences' engagement to the problems.

Examples of futuristic scenarios are supplemented with reflections of listeners. One of these scenarios is the invention of artificial intelligence during 2050-2060 (Fig. 4.) and its' consequences. Such a scenario is called "technological singularity".

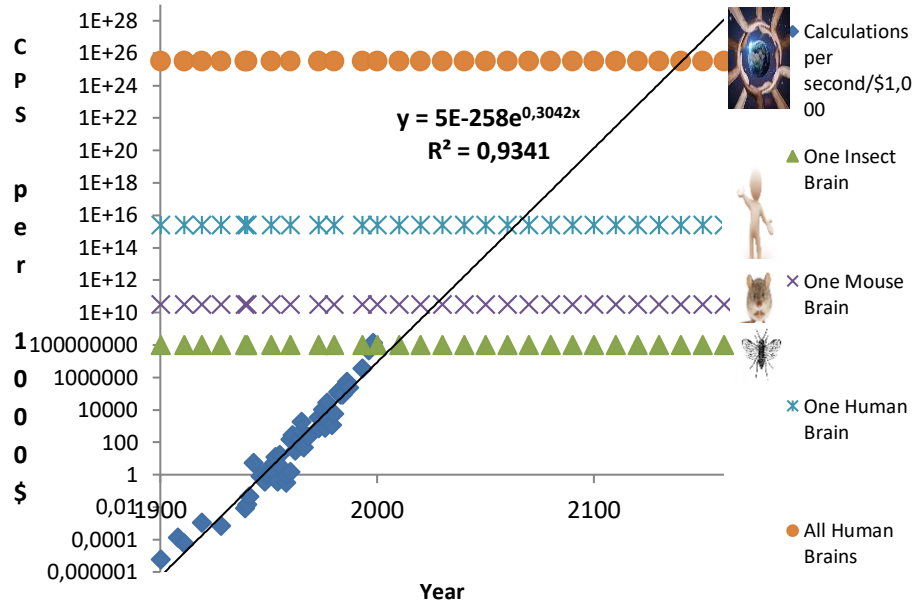

Fig. 4. Alignment of calculation abilities of PC, man and society [3]

Technological singularity in futurology - hypothetical explosive growth rate of scientific and technological progress, which is likely to come as a result of creation of artificial intelligence and machines capable of reproduction [4]. One of the expected consequences is the impossibility of understanding the human brain processes that will complicate significantly.

Another direction of case tasks and reports is the Industry 4.0. It deals with the influence on contemporary forms of production of automated technology, development

of market of weak buyer as well as close formation of market of week seller. In this situation, the most powerful driving force of the market is analytical system containing information on consumer preferences, which provides for their needs, knows the possibilities and sellers know how to achieve optimum performance. Also considered are hypothetical new forms of business with the possibility of immediate product configuration for individual order.

3 Proactivity, Cognition and Agent-Based Technologies

Perceived necessity to ensure stability in the functioning of the socio-economic systems and the ability to implement it in terms not only of present moment, but also the future, makes imperative of proactivity. Proactivity claims to constantly examine the changing boundaries of the possible, and within that framework, you attain your goals, including goals of growth and development.

The pace of social development in the information period requires a proactive way of thinking, proactive decision-making [5]. The basis of mechanism proactive management decisions' ideology is continuous automation, integration of all information flows and management functions into one strong unit. Modern DSS [6; 7] must be able to process large volumes of structured and unstructured data; maintain rational and irrational approach to decision-making; organically combine the two types of intelligence - human and artificial; use formal and informal techniques of cognitive analysis; support of proactive production, storage and subsequent use for systematic control cognitive information - knowledge.

Prospects of effectivization in management information systems (IS) are considered only if they will be intellectual. Moreover, now talking not just about intellectual IS, but the cognitive systems - the systems in which the internal mechanisms of cognitive information processing integrated with process of natural intelligence modeling through artificial intelligence and collective intelligence. Modern DSS should decide together the classical analytical tasks and the new cognitive tasks connected with proactive search of knowledge.

A survey conducted among managers about 6 thousand companies from around the world (including 129 from Ukraine and CIS) shows that the implementation of cognitive computing and development on this basis of intelligent information systems relate to technologies that foremost will transform business in the next 3-5 years (Fig. 5).

Understanding current state of information and analytical decision-making support in the national economy can to create options for improvement and modernization, which will provide a necessary integration into the global information and economic space, and to create competitive advantages of the national economy. The search for such options is one of the important tasks of the study course DSS at the Economics Faculty of University. So preparation of case-studies for implementation in the classroom as well as the formation of tasks for individual work of students concerns such basic provisions.

Firstly, to solve the task of proactive solutions support we need to develop DSS model, which combines the latest technological achievements such as technology of

information management; data mining technology; modeling technology in real time; mobile technology; technology of decision support in real time.

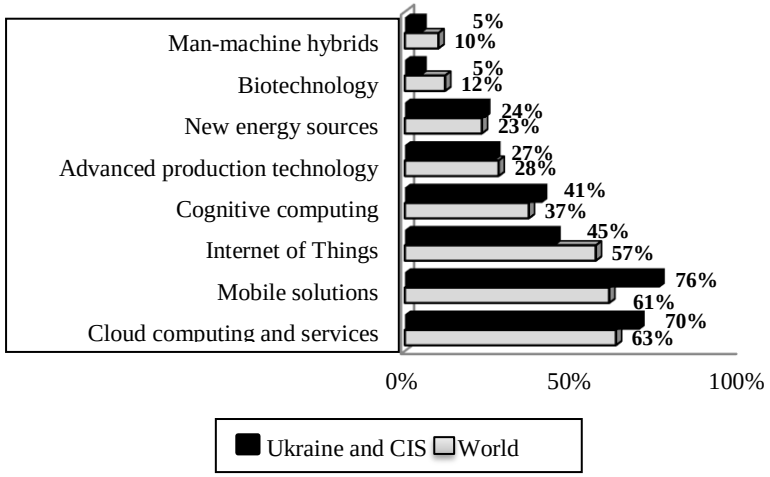

Fig. 5. Results of the survey of CEOs on the impact of technology on business transformation (IBM, 2016)

Secondly, the basis for the development of cognitive DSS is set to put a hybrid approach which combines the advantages of accumulated decision support software, efficiently synthesizes various approaches to the collection and processing of data, combines various intellectual methods and models, actively involves the hybrid algorithms.

Thirdly, the need to combine in one model a significant number of tools to collect, prepare and analyze data and provide with parallel operations, negotiations, distribution solutions, knowledge management requires the decentralization and the use of network structure in the DSS.

A promising direction for implementation of DSS is distributed intelligent systems based on agent-oriented approach. Multi-agent systems (MAS) are a radical concept that opens an era of networked organizations with the collective interaction of software agents, providing powerful replace centralized structure completely decentralized, which gives way the network instead of the hierarchical structure. Chronology of the concept of agent-oriented approach and the MAS is presented in [8; 9]. Practical implementation of MAS in industries, information and telecommunications, in public and organizational management presented in [10; 11; 12] and other sources.

The agent-based approach leads to a multilevel combination of hardware, software, conceptual entities that form the heterogeneous structure of the global information space, allows you to build very large open, flexible, reliable, productive cognitive systems, each component of which is completely autonomous, but if necessary coordinates activity with other systems.

On the bases of great prospects of this approach students are invited to divide in teams of 7-8 people for realization of the individual projects and to develop the concept

of agent-oriented DSS, which monitors and analyzes the situation in certain particular socio-economic system and provides for implementation of data mining models.

As a result of this project the students, firstly, get to know the concepts of multi-agent and agent-oriented systems, and secondly, they involved in the study of the various agent platforms - specialized software systems containing a set of software tools and describing the behavior of agents and the state of the environment.

Due to the fact that agent-oriented approach has great demand both in scientific research as well as for business process management, a lot of agent platforms are developed, for instance, ABLE, Altreva Adaptive Modeler, AgentBuilder, AgentSheets, Aglobe, AnyLogic, Ascape, Brahms, Breve, Construct, Cormas, Cougaar, DeX, D-OMAR, ECHO, ECJ, Eclipse AMP, FAMOJA, Framsticks, GPU Agents, GROWlab, iGen, JADE, JAS, JASA, Jason, JCA-Sim, jES, jEcho, JESS, LSD, MacStarLogo, Madkit, MAGSY, MAML, MASON, MAS-SOC, MATLAB, MIMOSE, Moduleco, MOOSE, NetLogo, OBEUS, Omonia, OpenStarLogo, oRIS, PS-I, Repast, SDML, SEAS, SeSAm, SimPlusPlus, SimAgent, SimBioSys, SimPack, SME, Soar, StarLogo, StarLogoT, StarLogoTNG, Sugarscape, Swarm, VisualBots, VSEit, ZEUS.

The students found that almost half of the listed platforms (31 of 65) makes it possible to simulate MAS for general purpose, but there are special platforms developed for environmental and biocommunity modeling (Cormas, ECHO, jEcho, SME), social modeling (MAML, MAS- SOC, MIMOSE, VSEit), organizational processes' modeling (Brahms, Construct), economic processes (Altreva Adaptive Modeler).

According to software implementation, agent-based platform can be a complete development environment (AnyLogic, NetLogo), as well as built-in modules (Repast Simphony), pluggable libraries (JADE). 40 platforms require knowledge of programming languages (C, C ++, C #, Java), while others use specially developed agents modeling language (Logo in NetLogo, AgentSpeak in Jason). Only 9 platforms come with open source, another 17 have free license (with different limitations).

Comparative analysis of capabilities of platforms for general purpose with a free license and low requirements for programming skills, leads to the fact that in most cases for their further studies students choose software environment NetLogo.

In addition to agent-based platforms, students explore the possibilities and specific features of the intellectual data analysis software, selecting some tools in one or more systems, presented in Table 1.

Finally, students learn how to integrate various types of software efficiently for management based on the existing IT infrastructure through the use of software agents. Agents are created and destroyed in accordance with the needs of specific tasks, network architecture MAS allows new agents to connect to the "on the fly" (or existing switched off) without stopping and restarting other structural elements of the system.

Thus students create a conceptual model of a system that can be a part of a global network environment, its structural link. The requirements imposed on modern DSS: a high level of flexibility, efficiency and productivity; adaptability to changes in environmental conditions; high potential of integration and interaction with other systems are specific to agent systems.

Table 1. Samples of Data Mining software

Methods of Mining, groups of IS		Samples of software
Data Mining	DBMS	Microsoft SQL Server Data Mining, IBM DB2 Intelligent Miner, Oracle Data Mining, SAP HANA (in-memory analytics)
	Analytical platforms	Oracle Advanced Analytics, IBM SPSS Modeler; PolyAnalyst, IBM SPSS Predictive Analytics Enterprise, SAP Predictive Analysis, SAS Enterprise Miner, Deductor; Systems that implement in-memory analytics: SAP InfiniteInsight, Oracle Exalytics In-Memory Software
	Statistical packages	SAS/STAT, SAS Visual Analytics, STATISTICA Data Miner, The R Project for Statistical Computing, Weka
	Special packages	Neural networks: Neuro Pro, NeuralWorks Professional II Plus, NeuroShell 2, Neuro Office, NeuralWorks Professional, BrainMaker Pro; Genetic algorithms: GeneHunter, Auto2Fit3, KnowledgeMiner ; Fuzzy logic: FuziCalc CubiCalc, Fuzzy Logic Toolbox
Visual Mining		Oracle Data Miner, Oracle Endeca Information Discovery, IBM Cognos Insight, SAP Lumira, SAS Visual Analytics
Text Mining		SAS Text Miner, STATISTICA Text Miner, TextAnalyst, Textalytics, SAP BusinessObjects Text Analitycs, Salience Engine, WordStat, KnowledgeREADER, DiscoverText, NetOwl, TextMiner

Students develop the systems composed of many modules connected through information and intellectual integration of the various levels of management. Among the components of such systems can be the situational centers that provide fast and deep "immersion" into situation for decision-maker and getting of reasonable solution; local DSS; BI platform; subsystems of corporate information system for local strategic decision support; local systems operational decisions; analytical platforms and various software applications.

Developing a system that creates a proactive solution, each student had hones skills of effective teamwork and his own competence of proactivity, passes from adaptive flexible adaptation to environmental conditions to an active, proactive impact on the environment, to the model of proactive behavior. Collective interaction of software agents in the created agent-based DSS, along with rational integration of different types of software and the ability to solve cognitive tasks generates system proactivity competence of the information system because proactivity is the basic property of each agent, which it gives for a functioning system.

The main advantages of this approach to self-learning, is that it gives a theoretical possibility to simulate without simplifying decisions of the complex practical problems that constantly occur the economy; leads to the creation of social self-organizing models, each element of which is developing, getting information and knowledge from other elements. The value of this approach is that it allows to create and experiment with many techniques that adapt to the continuous changes in the composition and structure of heterogeneous tasks, directs evolution methods of storage, processing, modeling in a channel defined by the laws of nature, of society and science. It opens the way for

students to synthesize IS capable of solving problems not only today but also those that provide opportunities for the future to include the most relevant elements and methods that appear through continuous identification of new, unknown up to this time of the fundamental laws of development and behavior of socio-economic systems, which are closely related to nature, man and created equipment and technology.

4 Thinking as Innovation

As an active participant in global program SAP University Alliances, in practical training, students freely use SAP ERP solution. Besides, those wishing, participate in the regular activities of SAP InnoJam, where "Design Thinking" technology of innovation is presented. Elements of this way of creative design space of innovative solutions development is implemented in the "Information systems and technology in the economy" course.

Students are encouraged to split into teams of 3 people and develop software to optimize the pressing problems: for example, queues in the student cafeteria, urban traffic jams, etc. Then during class 2 teams report their results under the "Tournament of young inventors (physics / mathematics)." The reports are presented by teams one by one.

The average attendance rate of students of 4th year is 53%, but during the report sessions mentioned above, attendance increases. All the attending students, except those that were reporting, are involved into evaluating the reports. Results are ranking in nature, subject to normal distribution, and therefore can be considered objective. Only 10% of the total participants failed to perform a full report of their own decisions (Fig. 6).

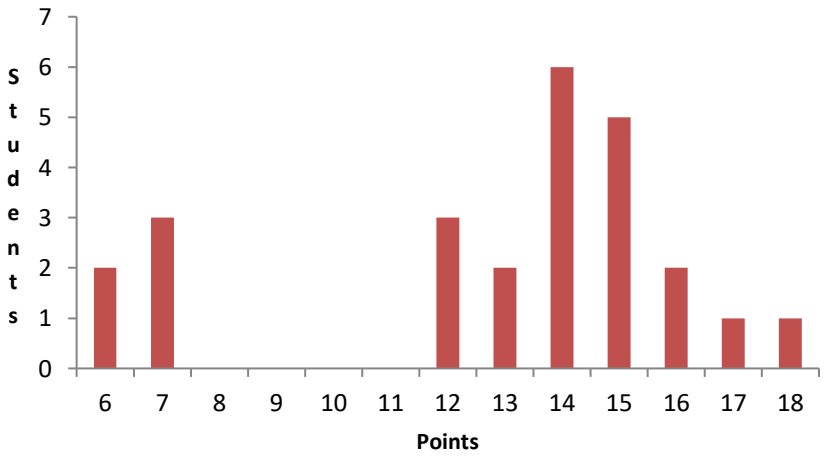

Fig. 6. Students' score distribution for "Design Thinking"

The results developed during the presentations of reports can be used by students in further research and practice.

5 Cloud Technologies and Self-Learning Opportunities

As described in Section 2, the number of tools, solutions and information systems is increasing, the students were offered to individually study a certain information system from the list in Table 2.

Table 2. List of IS for the personal study

Microsoft Dynamics CRM	ARIS Express
Salesforce (CRM)	StarUML 2
NetSuite CRM	SmartDraw
SAP CRM	Oracle ERP Cloud
Oracle CRM	Decision Lens
SAP Business Objects	Cogito
Microsoft SharePoint	Microsoft Power BI
Sisense	Hyperion Solutions Corporation
IBM Cognos Business Intelligence	Business Intelligence and Reporting Tools (BIRT) Project
iDashboards	FreeCBR
SAS Visual Analytics	ManageEngine ServiceDesk Plus
QlikView	

After personal study of one of these systems the students delivered their presentations. Obligatory elements were: to specify a product demo, describe the main functions and develop a detailed business case and solve it with the use of the product.

According to the results of the final presentation, only 8% of students were unable to cope with the task. The work was not assessed by rank but as to the availability of finished assignments and therefore it is not of a normal distribution. 52% of students completed the task very efficiently and showed great interest.

This form of training allowed to dramatically expand the list of products in which the students received basic skills. In addition to SAP ERP-solutions, students can study other modern systems up to the level 10+ user, like Oracle, Microsoft as a part of a standard course.

The second part of this self-learning program is getting a certificate from any online course of choice from open.sap.com portal. 96% of students completed the task thanks to its' availability and mobility. Of these, 60% did it efficiently (Fig. 7). Compared with last year's results, the involvement of students in tasks completion increased dynamically by 10-12% on average.

More than 10 online courses for the listeners' registration were accessible during studies. But students have demonstrated relative stationarity in a choice. On the whole only 4 courses studied of own free will by students.

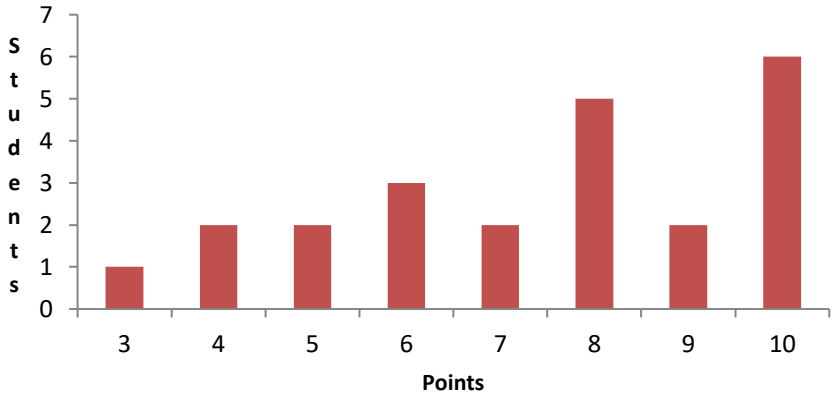

Fig. 7. The score distribution for individual independent study of ISs

Also on Fig.8 we see a result (achievement) got students. Within the framework of our course the "Information systems and technology in the economy" a student got points in any case, regardless of online course passing quality. The important fact was receiving at least a certificate of participation.

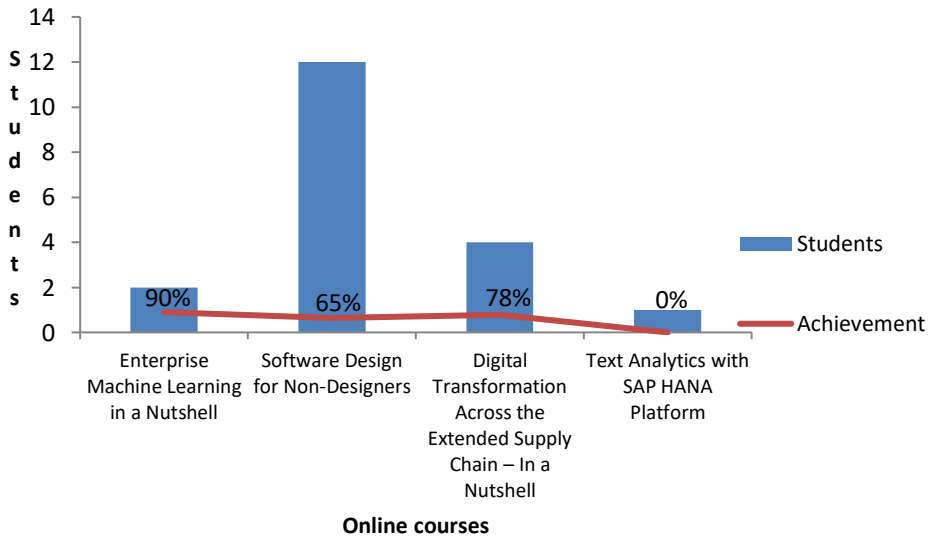

Fig. 8. Student distribution among online courses

As students passed studies on online-courses independently, then results within one type of course between different students had a stationary result also. It testifies for command work or transitive transfer of correct answers to on-line-tests.

This is seen in Fig.9. A student received a certificate of successful achievement if the results exceed 50%. In the opposite case - only a certificate of participation. Among the nine students successfully passing the test, there are three levels of results - 58%, 67% and 72%. To improve the quality and independence of online learning can limit the student's free choice by setting a proposed courses range.

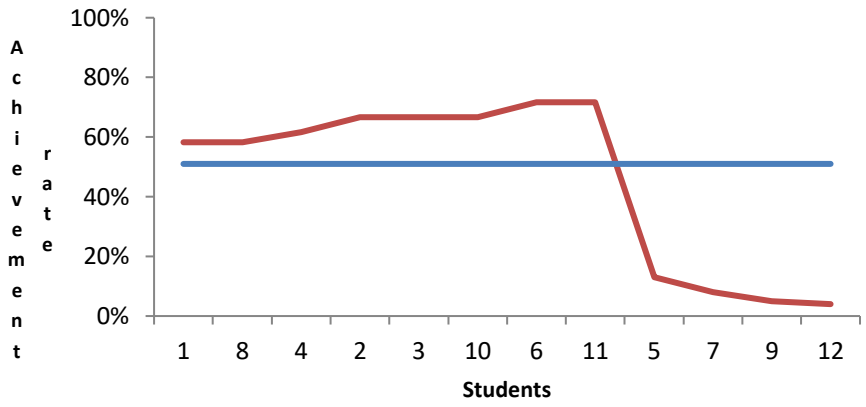

Fig. 9. Student's result distribution for online-course "Software Design for Non-Designers"

In the future it is planned to expand the list portals of quality online education of information systems issues and practices. It is also planned to attach a simulation of software industry tasks to the practical tasks.

6 Enhancement of Cooperation with Leading Software Vendors

As the information society imposes significant requirements for level of information technologies and appropriate training is a necessary condition for the adequacy of the realities of life, Taras Shevchenko National University of Kyiv has been developing programs of cooperation with world leaders in the IT sector.

One of cooperation forms is participation in the global program of company SAP – SAP University Alliances (more than 3,100 member institutions in over 106 countries). The program exposes students and faculty to the latest SAP technologies and enables universities to integrate SAP software into their teaching by partnering to build technology skills [13].

During 8 years of participating in this program such basic possibilities of the program were implemented on Faculty of Economics: the teaching of academic disciplines using SAP ERP, support projects and theses, regular presentations of experts of SAP

and partner company on the latest trends in IT, training in the partner companies of SAP.

Awareness that a high level of IT training can be achieved only through continuous professional development of lecturers, lies in the basic pillars of the program. 18 university lecturers have been training in SAP Ukraine, SAP Academic Competence Centre, the Regional Academic SAP Certification Center in Taras Shevchenko National University of Kyiv. 8 lecturers have international certificates SAP Certified Business Associate with SAP ERP 6.0 and SAP Certified - Associate Business Foundation & Integration with SAP ERP 6.0 EHP5, 2 lecturers have certificates SAP Certified Application Associate - Human Capital Management with SAP ERP 6.0 EHP4 and SAP Certified Application Associate - Financial Accounting with SAP ERP 6.0 EHP4.

32 trainees passed the international certification in the Regional Academic SAP Certification Center in Taras Shevchenko National University of Kyiv, including 15 students (SAP Certified - Associate Business Foundation & Integration with SAP ERP 6.0 EHP5).

As noted in Sections 4 and 5, students take part in the intelligent crosses InnoJam and self-learning programs through free massive open online courses on the SAP HANA platform, SAP Mobile Platform, design thinking, business network, Industry 4.0, Internet of Things, and more.

Thus the program provides empowerment of the university community on the latest, most innovative topics from SAP, including to leverage massive open online courses available on the openSAP platform and running operations in the cloud.

However, in our opinion, the program possibilities are not yet fully implemented in Ukraine. Our university initiates extension of the program in Ukraine and suggests a series of actions that will provide improvements in this area.

1. Extension of Ukrainian universities' representation in the SAP UA.

Nowadays, there are only 3 Ukrainian universities which are the active members of the SAP UA. Considering the possibilities for development that SAP UA gives to universities and the fact that average of universities from developed countries are 50-150 institutions, it is necessary to intensify efforts to raise awareness about the program and reduce entry barriers. It is also necessary to develop a minimum set of steps to upload Ukrainian universities to the program and to perform adaptation of norms and requirements of global program to Ukrainian realities.

2. The development of scientific and industrial cooperation between the academic and business institutions.

It is necessary to define the annual needs of companies in trainees and capacity of Ukrainian universities - participants of the SAP UA, to develop a set of required competencies of students for effective practical training.

Consistent improvement of educational materials and learning methods creates conditions for scientific outsourcing. We must create a mechanism for coordination between universities and partner companies for clear delineation of the issues of integration and development of information systems in economics.

3. Creation of grants for specialized SAP courses’ student training.

The main competences of students on information systems generate during academic courses according to the curriculum. But the advanced knowledge with subsequent international certification is possible only for a fee. A permanent interest of the students to specialized courses exists, but there is no objective possibility of incurring such costs simultaneously. It should intensify communication and cooperation with international grant agencies.

4. Creating of Innovative Research SAP Center in Ukraine.

Full performing of paragraph 2 will formulate a request for the establishment of institutional cooperation and communication among the market leaders in information systems and universities in Ukraine.

5. International research cooperation.

The current active academic environment on information systems will allow participants to intensify cooperation with the joint work of graduate and doctoral students from universities in different countries. Mechanisms such studies have been realized on the basis of several universities in the EU and the US.

6. The functioning of database 'the competent students - reliable employers'.

All students, who were trained on information systems in the universities, which are participants of the SAP UA, will be entered into a database, showing the existing competencies and grades. The program partners can upload vacancies or projected needs with a set of required competencies. It is necessary to develop a software mechanism of division of qualified students between vacancies.

These actions are important not just for the development of the program SAP UA in Ukraine, they are typical for cooperation with any of the leading software vendors. Without enhancement of cooperation, successful IT training cannot be provided in the conditions of dynamic development of technology.

7 Conclusions

Information technology market is growing rapidly, it is a subject to sectorial dichotomy and it transitively distributes its effects on other markets and spheres of public life. In the next 5-10 years processing of IoT will become the most promising sector, alongside with analytical systems market and modeling of artificial intelligence.

Academic teaching process should give possibilities to experiment with a lot of methods that appear due to the constant discovery of new laws of systems' development, create social models, self-organizing, each element of which is developing, getting information and knowledge from other elements.

For quality training in information technology, students’ initiatives should be encouraged and the exchange of experience between academic and business spheres should be intensified. Now when technology is evolving faster than we can adapt for it, there is an urgent need to enhance cooperation between universities and vendors of software solutions that allows to keep up with the times both teachers and students. Therefore, there is necessity of extension of Ukrainian universities' representation in the programs of cooperation, for example, SAP University Alliances.

Combining classical theoretical learning with practical innovative approaches shows the effectiveness and focuses students on common features of software solutions and architectures. Permanent research on the changing boundaries of the possible allows to develop proactivity competence of student without which today person cannot effectively move forward and achieve goals.

The extent of involvement of business representatives and solution providers to the cases and tasks is the basis for effective growth of studying. Through a blended learning model, university should access software, bringing hands-on learning with world-class enterprise software solutions into the classroom.

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