

The Concept of Educational Process of Smart-Economists Training for Industry 4.0

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Abstract — The article deals with the current transition of enterprises to Industry 4.0, and new requirements which specialists should meet in a rapidly changing environment. Artificial intelligence, cloud computing, modeling are determined as instruments for providing effective activity of the enterprise. Under new conditions functional of economic and financial services will undergo changes in accordance with new requests of manufacturing and business sectors related to mass application of automation and robotization at enterprises. The paper introduces "SMART-economist" as a new term and provides the competence that he is to obtain. The authors substantiate and disclose the main elements of the concept of SMART-economist training based on project and practice-oriented approaches for his successful adaptation to digital economy. Much attention is given to role change of a higher education teacher from a knowledge transfer to tutoring. Students form, model and regulate training process in virtual environment themselves while tutor performs a coordinating, consulting and supervising role. The method of elements of the educational process is developed and partially tested on the basis of concept of SMART-economist training presented by the authors. It is reported that the method is implemented on the basis of a virtual platform as an educational virtual environment. The training process takes place in the form of project training based on the virtual enterprise in order to transform it up to level 4.0. Incoming information in its speed and volume cause to development of new concepts of training process of SMART-economist, which are becoming of great importance during transition process to Industry 4.0.

Keywords— *Industry 4.0, project training, SMART-economist, tutor, cloud technologies, training methods, virtual platform.*

INTRODUCTION

Current transformations of modern society demand new relevant methods and forms of education in higher school [1]. Nowadays the industrial concept "Industry 4.0" is considered to be the most promising one. The concept provides in particular organization and management of industrial production by means of artificial intelligence [2, 3]. At the same time, the person stays

responsible for management decisions accepted. A specialist must have a wide range of knowledge, skills and competencies to make optimal and effective decisions. It requires his constant improvement in professional activities. Its importance will increase in the long run.

Generally, the labor market requires specialists with already formed professional competences. Enterprises in turn expect minimal time of labor adaptation of the employees [4, 5].

In accordance with existing practice higher school and enterprises can not provide proper interaction with students in passing all stages and processes of production. First, lack of resources for training students of enterprises causes mostly to this. The enterprises spend almost all resources to main goals - plan execution and getting profit. Second, students do not always pay attention to the process of practice: one may not like the company, type of its activity, etc. Third, due to limited time of practice, most professional competences of the students stay not formed properly.

At present, industrial enterprises as business partners of University departments are involved in the system of internships. It allows students to get practical skills at a specific workplace, but it takes much time: 6 hours of classroom work in the university and 6 hours at the workplace. This method can not be considered as a prospective one. First, the total working day is from 12 to 18 hours causes to physical and moral exhaustion of the student. Second, the students tend to become narrow specialists.

"Industry 4.0" requires new methods and forms of training specialists. Transfer of knowledge from teacher to student in traditional manner does not meet the needs of time. Availability and diversity of information created the visibility of knowledge for modern students. The information possessed by the student has a theoretical nature and becomes applied and practical in the process of solving specific production problems. For that, it is necessary to give the student the opportunity to apply theoretical knowledge in practice. In our view, due to inefficiency of this

process in real life, it is proposed to immerse the student in the familiar environment of the Internet space [6].

Virtual enterprise enables students of Economics to improve their skills, to solve unique problems not interfering in real production operations. Industry, type of products, volume of production, industry market conditions could also be changed.

After graduating the student of Economics acquires the skills in particular:

- to set specific goals for the object;
- to determine degree of it's achievability;
- to estimate the possibilities and limitations;
- to calculate the economic benefits of the implementation;
- to set real deadlines for the tasks.

Thus, all specified stages determine the creation of a SMART-economist for Industry 4.0.

I. SCIENTIFIC SIGNIFICANCE OF THE CONCEPT FOR INDUSTRY 4.0

Digital Industry 4.0

The term "Industry 4.0" appeared in Europe in 2011. At that time, at the Industrial exhibition in Hanover, the German government announced the inevitable necessity of using information technologies in production wider. [7]. At the same time, the category "Industry 4.0" was used as a synonym for the term "Fourth industrial revolution", that is, automation of all processes and stages of production.

In his famous book "Fourth industrial revolution" C. Schwabe [8] gives a systematized overview of the expected changes, advantages and threats related to the mass application of digitalization of production. The author considers fusion of technologies and blurring of traditional borders between physical, digital and biological spheres as main current trends. It is expected, that the most significant results of Industry 4.0 will be, for instance, creation and development of drones, 3D printing technologies, robotics, "Internet of things", genetic engineering.

Some authors assume that about 9-15% of professions will disappear by 2025 [9, 10, 11]. However, not all experts share this point of view. According to S.Yu. Glazyev's research specialists in the field of creating digital economy infrastructure will be widely in demand in the foreseeable future [12]. Training of such specialists in turn requires new educational technologies [13, 14, 15]. Wolfgang Grundinger in his book "Alte Scke Politik. Wie wir unsere Zukunft verspielen" raised the problem of changing the education system according to objectives of Industry 4.0[16].

He proposed to start by changing the educational process in the school. At the moment, the plan for the modernization of the German education system is called "School 4.0" (similar to the term "Industry 4.0"). The concept is based on the features of the fourth industrial revolution and the Internet of things. Insufficient material resources and low qualification of teaching staff do not allow to implement the project in full [17].

Thus, the fourth industrial revolution sets the tasks for society, Industry 4.0 in it's elements shows solutions for some of them. An economist for Industry 4.0 should have the competencies to interact with artificial intelligence and the ability to work with cloud technologies [18]. At the same time, the concept of training such personnel has not been developed yet at the moment.

It demands new requirements to the competencies of students, teachers and to the educational environment as a whole.

SMART- economist for Industry 4.0

Smart Economics involves digitized physical assets and production processes that can be used to train a SMART economist. Economists should be able to count quickly and correctly as well as choose the most optimal financial solutions. SMART-economists should possess a wide number of skills in all areas of production, for instance, to set the task to the technologists and programmers, to write a technical task, etc. For this purpose, the economist of the new generation must have skills of extracting necessary information, it's sorting and analyzing and justifying the most rational decisions based on it from the economic, industrial and social points of view. SMART-economist is a specialist of a new format with synergetic knowledge and team work skills. SMART - economist's skills of interaction with artificial intelligence will help him to make optimal economic and management decisions under conditions of uncertainty and big data [19].

Tutor-supervisor for economist of Industry 4.0

Tutoring as a method of interaction between the teacher and the student has a long history [20]. In all time periods, tutoring meet the needs of society in the organization of the educational process [21]. Currently, the researchers identify three main components of the modern understanding of the term "tutoring" [22]:

1. Tutoring is a type of pedagogical activity aimed at the formation of independence of the individual in solving educational problem.
2. Tutoring-assistance aimed at the implementation of individual educational programs, project work, research activities.
3. Tutoring-facilitation-activities aimed at helping in professional, cultural and personal self-determination.

Tutorship, as a specialty, was included in the "Unified Qualification Handbook of the Positions of Executives, Specialists and Employees" and approved by the order of the Ministry of Health and Social Development of the Russian Federation (5 of May, 2008, №216). However, tutorship does not yet have a standardized description of the specifics of both professional pedagogical activity and the process of preparation for implementation.

Kobzeva L.V. considers [23] the following tutor functions, in particular,

1. Flow management. Flow management. The teacher and the student learn how to manage information flows and arrays of

knowledge. Quality education is impossible avoiding this process.

2. Exploring new space

The need to rethink the educational process as technological development concepts to specific techniques. The most effective format for the implementation of the function of opening a new space is the student’s participation in the projects of industrial enterprises as business partners of University departments [24]. The tutor’s role is to form technological teams.

3. Path engineering

Tutoring assumes determination the direction and importance of working with space in theory and practice. The tutor changes the methods and methodology of the training group management, leads the group to solving the corresponding tasks.

Technological development in the field of training an economist is limited by two limits. First, the economist’s lacks of knowledge in the field of production and IT-technologies. Second, there is no correlation between the departments of the enterprise in the educational process: financial, production, supply-marketing and others. Students are trained by narrows directions, they do not see the picture of the enterprise’s activity as a whole.

Education has missed the synergy aspect. There is no way of adequate and rational interaction between the departments of the enterprise within digital space under conditions of shifting of technological paradigms. The task of the tutor-supervisor is to manage the information flows of different areas of production.

II. METHODOLOGY OF IMPLEMENTATION OF THE EDUCATIONAL PROCESS CONCEPT

The concept of the educational process of training SMART-economist for Industry 4.0 involves step-by-step mastering by the students of all stages of production under conditions of resource and information restriction. The concept is, that SMART-economist is trained from “elementary” to “advanced” throughout the period of study (4 years). The basis of the educational process concept for SMART -economist is project training.

Method of implementation

Training takes place on the platform of a virtual industrial enterprise using cloud technologies [26]. During the first and second terms students study the place of the enterprise on the foreign market. According to the programs developed by the authors, students estimate the market share, choose the product, the volume of its output, carry out SWOT and PEST analyzes. The work is carried out in the form of projects under tutor supervision.

During the educational pro-cess, tasks from professional module become more complicated. The concept of “production task” is introduced into the educational process. (Fig. 1).

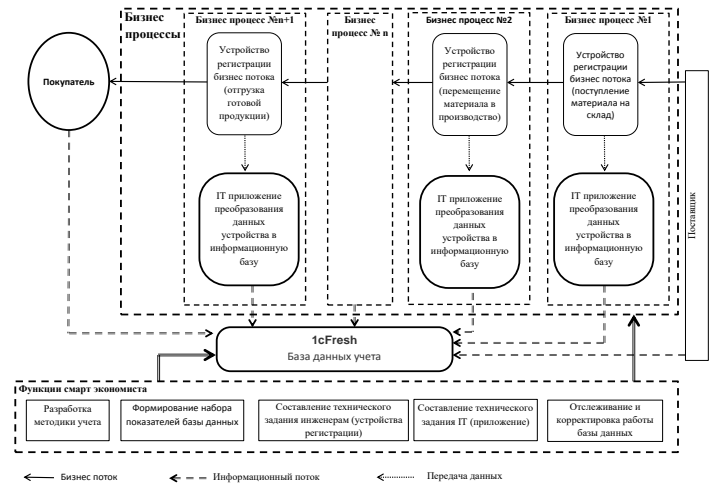


Fig.1. Model of the algorithm of project training SMART-economist

Description of the Model for the implementation of the educational process for SMART economist training for Industry 4.0:

Online services and IT-programs are involved in the educational process and allow conduction business processes in electronic form. Integration of Internet services allows to remove internal and external information ones. Integration of cloud systems provides the training enterprise with automation of the accounting of the production process, personnel management, formation of various reporting [28]. Technical support and software automatize the process of accounting for actual costs and resources of the enterprise by types of activi-ties, accounting for actual balances, calculating the actual cost of the output for any period of activity [28].

To realize the automation of business processes of an enterprise, students consider the generated flows, in particular information and production (business flow), material flow.

During digitization of material flow the aggregate of inventories is considered over a time interval while carrying out various business operations. When studying the information flow, students consider a set of data circulating in the enterprise system and the external environment, necessary for the management and control of operations with material flows. Information and material flows must be the same [29]. The educational process of SMART economist training is carried out on the basis of the construction of a simple virtual enterprise model and the subsequent modernization of the enterprise according to Industry 4.0.

The virtual model of an industrial enterprise is based on the software product “1C: Enterprise 8 via the Internet”. The product is based on 1cFresh technology. This technology allows to create “cloud”services, pro-vides subscribers access via the Internet to application solutions and applications through a data exchange file. To exchange data between device for business flows registration and “1C”, an IT application in the EnterpriseData format, based on XML, is used. The format is business-oriented.

The data structures described correspond to business entities (documents and elements of reference books) presented in the "1C" program. Data exchange takes place via web services. External application initiates a data exchange session by invoking the corresponding web methods of 1C application. The configuration received the file in the EnterpriseData format will react, namely, it will create new objects and delete those that are marked as deleted in the file.

The format can be used to exchange data with any other information systems. Scanners, cameras and other recording devices can be used for registration of business flows.

Some elements of the Concept of educational process of training SMART-economist for Industry 4.0 were implemented in 2017-2018 academic year in elite training group of the Higher School of Economics (South Ural State University). Future SMART-economists were involved into the project called "the production task". The device for registering business flows was the bar code scanner terminal. Information and business flows were registered from the suppliers. Business flow "materials" was registered by the enterprise automatically. Each business process generated data flows, placed in the 1C database. Information flow of the supplier reached the enterprise database for registration in accounting planned and actual deliveries. The number of business processes depends on the industry and the type of enterprise chosen.

Thus, the information environment in the form of artificial intelligence affecting suppliers, producers and buyers was formed.

It was established that information flows of participants affect accounting methodology as well as technological process of the enterprise, and the system of artificial intelligence provides managers with a tool for making decisions.

The implementation of the elements of the Concept of the educational process under the guidance of a tutor in the 2017-2018 academic year revealed the need for additional competencies of a SMART economist, in particular:

- conducting accounting transactions in digital economy;
- registration of accounting operations in the automated system;
- skills of developing algorithms for data transfer from applications to the database.

SMART-economist, while developing accounting technology, should have knowledge in the field of technological process of production, that in turn will ensure a rational approach to cost accounting and product costing.

III. PRACTICAL SIGNIFICANCE AND THE RESULTS OF IMPLEMENTATION

The practical significance of the developed Concept of educational process of smart-economists training for industry 4.0 is in its synergetic effect. Industry 4.0 places high demands on engineers, IT specialists, economists, accountants, technologists, managers, etc. Each specialist has his own unique knowledge. The information and time for making informed decisions under conditions of real production frequently is not enough. SMART-

economist works out as much as possible number of scenarios on the simulator. At the same time, he sets tasks for specialists from non-financial departments and collaborate with them. A constant learning process takes place.

A set of competences in the field of information technology allows an economist to form a technical tasks for an IT specialist justified and accurate. The functional of the economist includes also the solution of integration problems. To solve some of them the usage of interactive data exchange is often enough. For more complex tasks, the data exchange could be fully automated. A specialist could be forced to address the business processes of the external systems.

They also could have specialized nature of integration with external equipment, for instance, commercial equipment, mobile scanners, etc., or highly specialized systems (RFID tag recognition systems). It is highly important to choose the optimal integration mechanism for each type of tasks.

SMART-economist creates requirements for a set of data of various documents (reference books). To solve this problem, he needs to offer an extension that unloads the reference book "Nomenclature" to a file of a certain format (text, XML, JSON, ...) and reads this format.

SMART-economist needs to obtain knowledge in the fields of engineering and automated systems construction in order to be successful in transfer the enterprise to Industry 4.0. The authors consider selection of functional devices for business flows registration (barcode scanner) as the main problem of that process. SMART-economist must also possess competences of forming of technical specification to engineers and electronic engineers and determine what data will form and transmit a particular device. Knowledge of automatic control theory of production process become of great importance.

CONCLUSION

The developed Concept of educational process of smart-economists training for industry 4.0 has confirmed its relevance for the industry 4.0. Business partners of the Higher School of Economics and Management (South Ural State University) put forward requirements for graduates of economic departments that could be implemented under conditions of the Concept.

The methodology of project training at a virtual enterprise is considered by the authors as a practical tool for the implementation of the Concept. The methodology will be useful for students training as well as retraining of personnel of various enterprises. The method of training at a virtual enterprise can be in demand when carrying out psychological training for compatibility, the team working ability. This model could also be used when choosing the optimal investment project.

At the moment, the Concept has been partially tested in project training process of the elite group of students from the Higher School of Economics and Management (South Ural State University). Due to the positive results, the research is expected to be continued.

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REFERENCES

- [1] J. Raven, "Competence in modern society. Identification, development and implementation", Moscow: Kogito-Center, 2012.
- [2] Stuart Russell, and Peter Norvig, "Artificial intelligence: a modern approach (AIMA)", 2nd edition., translation from English, Moscow: Publishing house "Williams", 2016, p. 1424.
- [3] A.V. Gavrilov, "Artificial intelligence Systems", Uch. a Handbook, part 1, Novosibirsk, NSTU, 2010.
- [4] A.N. Antamoshkin, O.V. Bliznova, A.V. Bobov, and A.A. Bolshak, "Intelligent control systems organizational and technical systems", Moscow: R&S, 2016, p. 160.
- [5] E.A. Sharoyan, and T.N. Myznikova, "Transformation of the principles of training of modern managers", in the collection "Innovations with the personnel management system", Chelyabinsk, 2014, pp. 30-32.
- [6] T.N. Myznikova, "Innovative development of economy and education at the present stage of development of Russia", in monograph, Chelyabinsk, 2013, p. 396.
- [7] I. Hel, "Industry 4.0: what is the fourth industrial revolution?" High-tech news Hi-News [electronic resource]. URL: www.hi-news.ru/business-analitics/industria-4-0-cto-takoe-chetvertaya-promyshlennaya-revolyucia.html (accessed 07.08.2016).
- [8] K. Shvab, "The Fourth industrial revolution", Moscow: Eksmo, 2016, p. 208.
- [9] "Russia 2025: from personnel to talent", Moscow: The Boston Consulting Group, 2017, p. 72.
- [10] E.A. Yumaev, "Innovation and industrial policy in the light of the transition to Industry 4.0: foreign trends and conclusions", journal of economic theory, № 2, 2017, <http://www.uiec.ru/content/zhurnal2017/JET/02i2017i19iUmaev.pdf>.
- [11] Migration and remittances: recent developments and outlook, World Bank Group [Electronic resource]. URL: www.siteresources.worldbank.org/INTPROSPECTS/Resources/334934-1288990760745/MigrationandDevelopmentBrief22.pdf (accessed 12.07.2018).
- [12] S.Y. Glazyev, "Great digital economy (challenges and prospects for the economy of the XXI century)", <http://nlr.ru/news/20171130/glazjev.pdf> (accessed 16.07.2018).
- [13] K.E. Romanova, "Theory and methods of technology training", Moscow: RSUH, 2009, p. 200.
- [14] V.A. Skakun, "Organization and methods of professional education: study guide", Moscow: Forum, SIC INFRA-M, 2013, p. 336.
- [15] T.N. Myznikova, "Modern educational technologies in higher education", in the collection "Innovations in the system of higher education", materials of the I all-Russian scientific-methodical conference, Responsible editors: A. L. Khudoborodov, G. I. Ladoshina, 2010, pp. 190-192.
- [16] https://news.rambler.ru/education/38450688/?utm_content=news&utm_medium=read_more&utm_source=copylink (accessed 16.07.2018).
- [17] https://news.rambler.ru/education/38450688/?utm_content=news&utm_medium=read_more&utm_source=copylink (accessed 16.07.2018).
- [18] S.V. Emelyanov, "Artificial intelligence and decision-making: methods of reasoning and knowledge representation. Cognitive research. Intelligent system", vol.3, Moscow: Lenand, 2014, p. 120.
- [19] [B.Y. Sovetov, V. V. Tsekhanovsky, and V. D. Chertovsky, "Intelligent systems and technology", textbook for students of institutions of higher education, Moscow: EC Academy, 2013, p. 320.
- [20] "Historical origins and theoretical foundations of tutoring", [Electronic resource]: Educational and practical publication: textbook on the discipline "Historical sources and theoretical foundations of tutoring", Far Eastern Federal University, School of pedagogy; [comp. A. V. Medvedev, I. B. Clubina], Vladivostok: Far Eastern Federal University, 2014, 243 p., http://uss.dvfu.ru/struct/publish_center/index.php?p=epublications (accessed 16.07.2018).
- [21] M.A. Dyachkova, and O.N. Tomuk, "Tutor support of educational activity", textbook, Ekaterinburg: FGBOU VO "Ural state pedagogical University", 2016, p. 184, URL: http://elar.urfu.ru/bitstream/10995/44244/1/978-5-7186-0774-1_2016.pdf (accessed 16.07.2018).
- [22] E. Gordon, "The Revolution in tutoring", Moscow: ERGO, 2010, p. 821.
- [23] [Y.D. Cocambo, and O.V.Skorobogatova, "Tutoring as a new form of interaction of participants of educational process", Bulletin of the Amur State University, 2013, vol. 60, ser.: The Humanities sciences, p. 110-115, <http://si-sv.com/publ/1/tjutor/14-1-0-371> (accessed 16.07.2018).
- [24] L.V. Kobzeva, "Tutoring in higher professional education. Frontier tutor corps", part 2, journal "Tutor support", № 3, 2012 [Electronic version] <http://www.thetutor.ru/biblioteka/biblioteka/tyutorstvo-v-vysshem-professionalnom-obrazovanii/146-frontir-tyutorskogo-korpusa-chast-2.html>
- [25] A.V. Antukhov, "Project training in higher education: problems and prospects", journal "Higher education in Russia", 2010, № 10, pp. 26-29.
- [26] George F. Luger, "Artificial intelligence: strategies and methods of solving complex problems", 4th edition, transl. from English, Moscow: Publishing house "Williams", 2013, p. 864.
- [27] M.Y. Gvozdev, and A.Y. Ozhegova, "Formation of accounting policy of a small enterprise in an automated system", Bulletin of South Ural State University, series: "Economics and management", 2016, vol. 10, № 2, pp. 177-181.
- [28] A.S. Malkova, and M.Y. Gvozdev, "Automation of interaction of economic agents on the basis of cloud technologies", in the collection "Contemporary economy and society through the eyes of young researchers", the International scientific-practical conference V Ural Vernissage of science and business, in 3 volumes, under the General editorship of E.P. Velikhov, 2018, pp. 233-237/
- [29] E.M. Fedosihina, and M.Y. Gvozdev, "Management of material and information flows in the enterprise. Implementation of automated management accounting system", in the collection "Economics and business. Look young", 2013, № 1, p. 293.