Education management to prepare the specialists for the industrial companies Industry 4.0

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Abstract. The task is to organize specialists training for working in the industrial companies Industry 4.0. The companies have technological equipment (cyber and physical system) and informative technologies which future specialists will use. To work in the Industry 4.0 company the personnel must highly-qualified and have knowledge and skills in the field of new professions. The specialists must be trained at educational institutes having practical programs. There is a scheme of infrastructure ecosystem of production and educative components to prepare the specialists for the Industry 4.0 companies. There is a scheme how educative program components interact after the education projection and when the students have taken the programs. The ecosystem for preparation of specialists of the Industry 4.0 company has some professional and educative standards where the student competence is in accordance with workers of industrial companies.

1. Introduction
To implement new informative technologies in project and production activity, the industrial companies have created the fourth industrial revolution. The fourth industrial revolution of the Industry 4.0 [1, 2] is a set of organization and technical, technological, material and other measures to unite infrastructure of the new company type (digital factory, smart factory, virtual factory) to develop the technologies of unmanned and paperless production. To work in the high-tech companies of new type, good specialists are required [3, 4] which are capable to know and to solve the difficult tasks which require some knowledge and skills in some subject fields of the industrial economy sector.

Practical experience implies [5, 6] that in order to prepare a student in engineering specialty [7], it must deal with practical educative programs and some requirements put forward by high-tech companies [8, 9]. The base of practical educative programs is professional and variable lessons, which gives the student the necessary competence.

The high-tech company workers competence is closely related to project and production technologies of the company. The primary component of the Industry 4.0 company is a cyber and physical system [10] which is the base of robotized automatic production. Implementation of robotized machines in production has created new occupations:

- specialist of cyber and physical system maintenance;
- specialist to control cyber and physical production;
- specialist to create digital twins of cyber and physical systems and others;
They are still not available today. To prepare the specialists of future (to work in the Industry 4.0 companies) they need [11, 12] to unite educative companies resources and industrial companies with cyber and physical systems. Educative companies create the educative programs components and prepare the specialists. Industrial companies will give the students the necessary competence giving the students some real tasks of actual production in their education.

2. How to organize specialists preparation for the Industry 4.0 company

The infrastructure ecosystem of production and educative components to prepare the specialists for the Industry 4.0 company is given in figure 1.

![Figure 1. Infrastructure ecosystem of production and educative components to prepare the specialists.](image)

The ecosystem production component of digital economy includes the following branches:
- aviation industry;
- maritime industry;
- rocket and space industry;
- railroad industry;
- automobile industry and other.

Each branch of the Industry 4.0 company can be specialized in the following activity: item designing, car designing, machine designing and others. The company specialty gives its personnel the competence (company personnel) according to the requirements of professional standards. Professional standards are norm and technical documents to define for each occupation the job description and personnel activity. Job description and personnel activity depend on the personnel education level and the
occupation position which the worker has in a company. So professional standards define the requirements (criteria) for each worker and also for worker’s activity.

Requirements of professional standards are competence which the specialist receives in the education program. The education level of the specialist in the Industry 4.0 company could be a bachelor, a magistrate and an aspirant. Work activity students consists in professional education. The specialist competence educative programs have a resource provision (laboratory base) and are made according to the educative standards.

So professional and educative standards are two primary components for norm base to train the qualified personnel for the Industry 4.0 companies. And educative standards are educative competence to be received. Professional standards are «expectations» of an employer for the future employee. Those two standards are interconnected.

3. Structure and specialty of educative program for the Industry 4.0
Structure components to form the educative program to train specialists for the Industry 4.0 industrial companies are given in figure 2.

![Figure 2. Structure and specialty components of the Industry 4.0 educative program.](image)

The educative program core is the educative plan. It is a list of disciplines, practices, inter and final types of checks for the students and value of academic hours for each type of activity.

Unlike educative plans of the Industry 3.0 which has the fixed list of disciplines for the whole period of education educative plans, the Industry 4.0 gives the students a chance to prepare their own trajectory. An individual trajectory of preparation means that a student chooses a set of disciplines to be studied (educative program modules) or some disciplines which together forms the necessary number of academic hours. The student chooses the competence for future development from what is available.

An educative plan for the students is formed with educative standards of the company and according to the educative standards requirements which are now available in the State. Standards of educative organizations may be full (100%) or partial when student fill the sections of the educative plan. Partial filling of educative plan sections gives the student some basic knowledge (competence) the list of which is given by the educative company and a set of knowledge which the student chooses. Full filling of the educative plan sections means that the student chooses all the disciplines available which can be received.
in the educative company.

An educative plan option, one of two, defines the program to train the student for the specialty. Within one direction like item designing, some technical occupations can be done which differ in their educative plan.

4. Experience of practical educative program

An interaction component scheme after the projection of educative programs for the Industry 4.0 is given in figure 3.

![Component interaction scheme after the projection of educative programs](image)

**Figure 3.** Component interaction scheme after the projection of educative programs.

The projection of educative programs trains specialists (teachers) of educative organizations. Projection results are:

- work programs of theoretical disciplines;
- work programs of practices;
- work programs of student checks for each stage of education and other educative documents which compose the educative plan of preparation and the student competitive model with a table for each work program and the competences inside.

The components of the educative program must have a check stage. It is verified with the industrial company personnel where the future specialists will be employed. The main objective of this check is to evaluate the competences of the future specialists and check out that they are close to the requirements of the industrial company. This must be done for professional and educative standards.

Having analyzed figure 3, the most effective interaction of educative and industrial companies is to conclude an educative contract in the electronic form. This form means maximum engagement of the industrial company resources in the educative space (laboratory base for practical tasks and research activity of the students and others). Industrial company personnel in this case are experts in analysis of the educative process documents, they are members of commission checking the quality of education at all stages.

The net form of companies’ interaction may annul the centers of independent check of the students to check the student competence in the professional standards constantly controlling the quality of the educative process from the potential employer during the whole time of studying.
5. Conclusion
The main thing to prepare the specialists for working in the company Industry 4.0 is introduce the ploy-
technical character of the items being produced and means of industrial production. It is necessary to
organize educative process where individual trajectories of studying are permitted.

The item being produced could be item designing components or machine designing components
which may have a new composite and nano-materials or new alloys, optical components with nano-
coverage and others. To project such components and technologies, it is required that the specialist
knows some competence in many fields where some of them are new today.

Industrial production means (cyber and physical systems) are also a combination of physical devices
and cloud components. To work with such systems, a worker must know the production technology and
informative technology.

To form new educative, the technical students must have (base competence) competence in
informative technologies (cloud technologies, Internet of Things technology, the security of cyber and
physical system, technology of BigData and others) and some variable special disciplines (material
study, optics, item designing, etc.). The specialist of such competence may work successfully in
automatic cyber and physical production with wide nomenclature of the item being produced.

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