Peculiarities of training of high-tech enterprise specialists under modern conditions

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Abstract. This paper presents the transformations in the aviation industry that characterize the advent of a new industrial revolution and proposes a calculation of the complex indicator of the assessment of the effectiveness of training considering the new competences that characterizes the dynamics of modern changes. Also, it shows the results of using this model and analyzes the role of learning organizations in this era of change.

1. Introduction
The present time is characterized by an epoch of cardinal changes connected with the coming developments taking place within the framework of a new revolution in industry. The peculiarities of this revolutionary change are the fact that new information opportunities are opening up and breakthrough technologies are emerging in such areas as artificial intelligence, robotization, Internet of Things, three-dimensional printing, nanotechnology, biotechnology, etc.

2. Methodology
The year 2020 is a turning point in the foresight of the aviation industry development project, in the course of which one era, called the commercial era, is being replaced by the post-commercial era. The main indicator characterizing the change of these eras of development is the flight efficiency coefficient \( t_{\text{eff}} \), which is determined by the following formula (1):

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t_{\text{eff}} = \frac{L}{C_{\text{pass}}} \times K_{\text{saf}} \times K_{\text{comf}} \times K_{\text{ecol}}
\]

\( L \) – duration of transportation, km;
\( C_{\text{eff}} \) – cost of transportation (one passenger);
\( K_{\text{saf}} \) – coefficient of safety level;
\( K_{\text{comf}} \) – coefficient of comfort level;
\( K_{\text{ecol}} \) – coefficient of ecology level.

Metal structures do not allow to increase this performance indicator and should be gradually replaced by composite, hybrid and intelligent materials.

Composite materials are non-metallic or metallic materials with reinforcing elements that are present in the form of fibers, threads or flakes. The specific strength and rigidity of composite materials
increased in relation to traditional metal construction materials is determined by the properties of strengthening fibers/fillers. Joint work of fibers is provided by matrix/binder materials, which can be carbon fiber, fiberglass, organoplastics, etc. Compared to traditional materials under cyclic loads, composites have a different mechanism of fatigue failure and higher fatigue resistance. The sensitivity of composite materials to stress concentration is much lower than that of metals, and the durability of composite structures is provided by low rate of crack propagation in them. Composite materials in civil aviation are most often used to produce: wing mechanization units; rudders (heights and controls), keel end and nose parts and fuselage.

Thus, the changes occurring in the aviation industry have a turbulent character and require new knowledge and skills from specialists of the industry, i.e. it is necessary to develop a strategy of training and retraining of specialists. The new strategy of educational institutions should be aimed at training specialists with a wider qualification and skills required to perform a specific job, to solve the problem of shortage of IT-specialists, as well as to propose new formats for professional development of employees in the aviation industry [1].

The overall strategy of the University should be aimed at the fact that the aviation industry will have a large number of new multifunctional specialties, which will require knowledge of both information technology and production processes [18]. Many modern educational programs at all levels are aimed at training employees with very narrow specialization and provide very limited interaction between different academic disciplines [13]. Therefore, the training strategy should focus on the development of multifunctional training and interaction between universities, and should increase the number of interdisciplinary educational programs that combine training in information technology and design, and are based on existing programs of business informatics and business design of aircraft structures [24]. The traditional training programs in such subjects as management and marketing should include an additional course of training in information technology and basic design, as well as internships at the workplace, during which students will be able to get an overview of the requirements, terminology and culture of the enterprise [9]. Within the framework of this strategy, higher education institutions should pay special attention to the development of specific skills required for new professions, as well as the adaptation of their educational programs to the needs of employers in the current industrial revolution [2, 3, 25].

The proposed strategy provides an opportunity to start teaching interdisciplinary skills to students who are still secondary school students. Such courses may include, for example, training in the construction and programming of linked systems. Training and on-the-job models, which provide both theoretical knowledge and practical skills practice, can continue to be successfully applied everywhere. These hybrid models are recognized worldwide as the best practices in vocational education and training and are ideal for developing the skills needed in the fourth industrial revolution [4, 5, 6, 7, 10, 11, 15, 16].

Research conducted by the Boston Consulting Group for German companies has shown that by 2025, the labor market deficit will be of approximately 120.000 graduates in IT and computer science. Approximately the same trend is typical for Russian aviation enterprises. The acquisition of these skills requires advanced training at the university, and often the employees of the companies are not able to acquire them during on-the-job training or retraining.

At present, higher educational institutions have switched to the 3rd generation of the national learning standards (GOS) and their own models (SUOS), which are aimed not so much at the formation of knowledge and skills, as at the formation of competencies, i.e. the desire to use this knowledge and skills in practice. Competencies are considered as the main target norms in the implementation of modern standards of higher education, as well as integrating the beginning of the "model" of a young specialist.

An important component of the overall strategy for training specialists is the development of a competence-based approach. The peculiarities of the competence approach within the framework of the personnel evolution strategy are that universities should also contribute to the development of personal qualities that allow employees to be ready for continuous training, interdisciplinary cooperation and innovation [19].
On the example of the course "Strategic management" it can be shown that such competencies as business modeling of the product, studying its behavior at all stages of its life cycle and the use of information technologies should be added to the set of existing competencies. When calculating the complex indicator of evaluating the effectiveness of training in this discipline, we can use the economic and mathematical model of linear programming, developed by us earlier. The use of this model showed that the formation of these competencies is associated with the scientific work of students and the performance of work on the instructions of employers. It is also important to motivate students to use IT technologies in strategic analysis, strategy formation and evaluation of the effectiveness of strategic changes.

Teachers need to cooperate with state employment centers so that they can include in their courses the use of information technologies, which in the future will be required for all types of work, and not only for specialties that emerged as a result of this revolution in the aviation industry [14]. In line with the goal of training more broadly qualified staff, universities should continue to include components of their computer training programs in other training courses, especially in design and business. These elements will include mandatory IT infrastructure design, user interface programming, electronic measurement and control principles, and programming for data processing.

Having a basic knowledge of IT technologies within each discipline, it is necessary to use applications that allow to automatize the process of solving problems of the discipline. So, if you continue our example with the course "Strategic management", then within the framework of this course it is possible to use such software products as Project Expert within the framework of strategy development and COMFAR III Expert and Alt-Invest for financial and economic evaluation of the efficiency of investments made in the strategic development of the enterprise.

The leaders of the scientific community should change the education system in such a way that it provides an opportunity for continuous professional development of the personnel employed in the industry and training in different places, not only in traditional places outside the territory of the enterprises. To this end, it is possible to create distance learning platforms, provide free courses at "open" universities where there are no entry requirements, and use mobile applications for training and expertise. As part of this strategy, universities can also offer all citizens a free but high quality "mass outdoor distance learning" course in information technology and 3D modeling. Academic community leaders should discuss the specific training needs of companies with their CEOs. Such cooperation will allow to develop new educational models for business, for example, training programs aimed at the development of creative and strategic thinking abilities, rather than at obtaining specific professions [17, 20].

In order to maximize the number of vacancies created by this revolution and to help companies retain as many employees as possible, government agencies should promote better interaction between stakeholders in the business environment and the scientific community. In many cases, the focus of this activity should be on promoting the successful implementation of innovation and new technologies, which is a prerequisite for the effective development of the aviation industry [21].

Creativity and strategic thinking as well as learning organization are important in this regard. The peculiarity of a learning organization is its continuous adaptation and growth in the conditions of rapidly changing external environment, which is typical for aviation enterprises within the current revolution in industry. The most significant features of a learning organization are, firstly, a special role assigned to intellectual capital; secondly, respect for individuality, thirdly, the climate of trust, openness and tolerance; and fourthly, the translation of knowledge into action [22]. Knowledge will be dead and hopelessly outdated, and people will lose interest in acquiring it if the conditions for transforming knowledge into action are not created. The lack of such conditions is the main reason why the organization's acquisition of the ability to "learn" remains an unrealistic dream for many companies. This means that, first of all, it is necessary to direct resources to increase the organization's susceptibility to innovation, to develop its adaptive capacity.

In Russia, the Ministry of Economy and the Ministry of Education and Research have created a coordinating organization where stakeholders discuss a long-term strategy for the current industrial
revolution [23]. However, some experts want the government to play a more active role in coordination and funding, using the best practices of some other countries. A more influential central coordinating organization could play a leading role in the process of developing a national strategy for this revolution and thus help industries to realize the full potential of new technologies. Through this organization, for example, the government could finance critical modernization projects and formulate skills-based requirements for professionals. Such support would be key for many small and medium-sized organizations. These organizations are currently unable to carry out the necessary research, make investments and make high-level decisions related to the results of the industrial revolution. These studies could improve the effectiveness of their activities in the long run and thus contribute to job creation.

Although the subject of our research is the development of a training strategy for the aviation industry that will be able to work within the framework of this revolution, CEOs and educational institutions should anticipate the development of the situation in order to take into account the changes that may take place at the end of the next decade. Advances in the use of artificial intelligence and machine learning such as "deep learning" must be carefully monitored. Experts predict that artificial intelligence technologies will be used to perform some cognitive functions, such as supervising people and robots, ensuring regulatory compliance and the responsibilities of human resources professionals [8]. More free use of artificial intelligence and robotics can lead to the elimination of many more groups of other positions. Trial programs in which computers act as managers (e.g. work assignments and scheduling) are already in use and have been unexpectedly well received by the workers involved in these projects. Because of the fact that the base used by artificial intelligence contains more extensive and detailed data than any human knowledge, it creates incredible opportunities for the technology to be applied in the workplace.

If robots can ever use the principles of human brain thinking, they will be able to perform all the functions, such as machine operator or even robot coordinator [12].

3. Results
Successful realization of the technology potential of this industrial revolution depends on whether companies are able to retain their employees, whether educational institutions will be able to solve the problem of shortage of creative specialists and whether government agencies are ready to provide more active support. This will require a thorough understanding of the technological processes and their impact (both quantitative and qualitative) on different groups of related professions. Effective action based on this knowledge will contribute to the growth of the countries’ economy and increase the arbitrariness and responsibility of staff.

4. Conclusions
The industrial revolution creates incredible opportunities for the development of production and the countries as a whole. While some categories of work, such as assembly and production planning, are expected to see a significant reduction in the number of specialists, others, especially in information technology, will create a significant number of new jobs. The extent to which this industrial revolution will drive employment growth depends on how effectively companies use these technological innovations to develop new products, services and business models. The business model is an important tool for assessing the competitiveness of an aviation company and the unique competencies of profit centers. The new business models will provide an opportunity to assess the company’s ability to reduce costs and create new value for its stakeholders.

Thus, the proposed training strategy for aviation industry specialists includes the following components:

- multifunctionality and interdisciplinarity of educational programs, which would include training in information technology and design;
• adaptation of training programs to the needs of employers, introduction of professional training and in-service training models;
• wide introduction of competency-based approach to develop personal qualities that allow employees to be ready for continuous training, interdisciplinary cooperation and implementation of innovations;
• continuous professional development of specialists and teachers, including distance learning platforms, creation of learning organizations;
• use of artificial intelligence and machine learning techniques such as "deep learning";
• creation of new educational models together with the heads of aviation enterprises;
• state policy on financing education modernization projects and setting requirements for specialists.

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