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Influence of Scientific and Technical Progress on Change Management in Business and Education

The problem of scientific and technical progress influence on spheres of business and education, and also on their interaction is revealed in the article. Dynamics of development of management as a field of knowledge and professional activity is described. Technological tendencies, their influence on labor market and functioning of the organizations in the present and the future are analyzed.

Keywords: change management, scientific and technical progress, business and education, enterprises and universities, the turquoise of the organization, the relevance of professions

Management as a field of knowledge and professional activity constantly evolves. If we study bases of management, it is important to know its history, as well as in what conditions each of managerial schools was developed. It allows to trace dynamics of changes and to make the approximate forecast for the future, considering the current realities.

The school of scientific management (1885–1920, F. Taylor, F. and L. Gilbert, H. Gantt) is classical. The excessive amount of time and efforts was spent on manufacturing of each product. Researchers and engineers found it when they began to make observations, measurements, including logic, analysis and timing. The conclusion was that it was possible to improve many operations of manual skills, having removed superfluous ones and having revealed an optimum way of their execution. Actions of each worker were analyzed and systematized in a

certain standard in the way that made possible to transfer work to any person, using cards with instructions. There was a differentiated system of compensation and scientific approach to workers' selection and training.

When organizations began to grow in the number of workers, there was a problem of effective management of big groups of people. The classical administrative school in management (1920–1950, A. Fayol, L. Urvik, J. D. Muni) became the solution of this problem. Management was referred to administrative type of operations. The principles of management were created, including job specialization, powers and responsibility, one-man management, subordination of private interests by general, centralization, hierarchy of heads, stability of a workplace for personnel.

At development of the administrative resource it was found out that money reward is not enough for motivation and for maintenance of the healthy atmosphere in a team. This problem was solved by representatives of the school of the human relations (1930–1950, M. P. Follett and G. E. Mayo. A. Maslow. C. Argyris, R. Laykert, D. McGregor, F. Herzberg). The attention began to be paid to social interaction, relationship of workers among themselves and relationship administration with subordinated. The great value was attached to a ratio of formal and informal leadership, the pyramid of requirements was studied. It gave an essential impetus to labor productivity growth.

With the advent of large corporations, the new problem appeared – organizational structures and solvable tasks became complicated, document flow grew exponentially. Representatives of the school of management science (since 1950 until the present, L. Bertalanfi, A. G. Rappaport, R. Ackoff, A. Goldberger, V. Leontyev) were engaged in the solution of this problem [1]. There were a cybernetics, modeling, the theory of decision-making, process, system, situational, customer-oriented and competence-based approaches. When planning business processes and reengineering, the effect of synergy is actively applied. Public

management essentially changed interaction of the state and citizens, especially in services industry [2]. ERP and CRM systems allow to automate and simplify the internal accounting, interaction of functional divisions and work with clients. Decisions began to be made quicker due to use of the automation equipment.

Each new stage of management development was caused largely by technical progress. But in the second decade of the 21st century extent of technological influence on the market reached unprecedented scales: every year more and more technological companies fill up the rating of the most expensive public companies of the world. In 2016 their quantity in the TOP-100 passed 12 [3]. Speed of updating of technologies and speed of exchange of information changes environmental conditions in such way that the companies should review completely long-term plans, and sometimes they have to react to market changes, making decisions in several hours.

Till 1990th the general tendency of scientific and technical progress led to replacement of a manual work by human-managed machine's work. For instance: production of cars, construction cranes, driving, piloting.

Till 2010th development of technologies stimulated implementation of the automated work of robots on the scripts which are in advance programmed by the human. Examples: robot vacuum cleaner, autopilot, washing machine, climate control.

One of the main trends of 2017 – replacement of manual programming of machine work by the automated programming due to implementation of artificial intelligence and neural networks.

The technologies associated with "Big Data" in detail analyze behavior of big mass of people. As a result, becomes possible to foresee actions and needs of people for different conditions. For example, for suppression of violations of law and order or display of a certain advertizing to only very precisely chosen target audience.

"The Internet of things" – allows to unite household appliances, the real estate and even goods in single network for interaction with them at distance. For instance: decisions for "the smart house", "the smart city", monitoring of traffic circulation and people, control of distribution of drugs and weapon, identification of a product in a production or logistics chain.

Autopiloting comes today to a stage when the robot can distinguish an area or a route in details, and, for example, to conduct the car more effectively and more safely than human. It is especially urgent in transit freights and transportation of people.

Drones (pilotless flying vehicles) allow to effective observing, exploration, surveying, to simplify logistics, they are used for irrigation, protection of objects and distribution of the Internet in remote places.

Decentral production and the fused deposition modeling (3D-printing) allows to make products of any form of different materials, including metal, plastic and even organic compounds. In the future probably the printing of organs will become possible.

The augmented reality and the virtual reality (AR and VR) open for people the new interoperability layer with the environmental and virtual world. First of all, it is in the game industry, and also in medicine, design, simulation and design.

Of course, first of all, giants of the IT industry, such as Alphabet or Microsoft are engaged in such developments. But Russia is also famous for the programmers. The Sberbank (including The Sberbank-Technology) can be an example where, for instance, a part of routine tasks of lawyers on preparation and sending legal claims and other documents is already being completed by robots, and the relevant employees are reprofiled.

The listed technologies in the next 5-10 years will change functioning of one and all industries. Each commercial and non-profit organization needs to

understand how its internal and external environment will change. A part of professions will cease to exist.

Perhaps, in the next 10 years these professions will stop being urgent: the driver, the librarian, the stenographer, the lecturer, the mail carrier, the call center operator, the seamstress, the travel agent, the guide, the copywriter, the translator, the hairdresser, the cashier, the seller in a shop, the janitor, the cleaner, the worker on the pipeline and on house building. But a lot of things will depend on needs of people and the market. For example, professions of the cultural and art spheres will unlikely become outdated. Already now the computer can draw patterns, write verses, music and songs, but such "creativity" isn't in great demand. Manual, authoring skills will still be appreciated more, than machine.

Possibly, there will be a large number of the new professions associated with management of groups of robots. Most of people will become managers in a varying degree. Besides, it is possible to expect, for example, emergence of next professions: designer of the virtual worlds, programmer of electronic recipes of clothes, producer of the semantic field of media streams.

It is important to be ready to the fact that the whole functional divisions in connection with replacement of human work by machine will be reconstructed or be reduced. It is necessary to carry out retraining and re-profiling of staff in time.

Not only the organizational structure and ways of interaction between employees, but also the fundamental principles of work, value will change towards low hierarchy and the most expeditious adaptability under environmental conditions. F. Laloux calls such organizations “turquoise” [4].

For decades teachers in higher educational institutions teach students to the imperatives of strategic and organizational management which already have become traditional. But rapid updating of technologies causes a gap between an education system and business. Standards, tools and form of studying during education in university significantly become outdated. Especially it concerns the

sphere of information technologies and the related, and also technical science, but not only. For example, students who study geology in a number of higher education institutions draw maps manually or using the outdated software and when they get a job in a company – there are absolutely different, new program complexes are applied in it, so they should be learned anew from the beginning. Firstly, it is an educational system problem in the country. Secondly, a problem of higher education institution which does not allocate funds for updating of instruments of training. Thirdly, it is a problem of employees, teachers who do not show an initiative and not always monitor the development of their field of knowledge in practice.

In favor of the old educational concept it is possible to tell that, as a rule, new technology solutions are evolution of old. For example, having studied "HTML4" in higher education institution, certainly, it is possible to master "HTML5" much quicker in case of having got a job in a websites creation studio. In this sense, training in higher education institution will not be useless. But why to spend so much time for studying of excess, outdated information when it is possible to begin with "HTML5" at once? Time is the most valuable resource of mankind since it is irretrievable.

Training in bases of the subject and a technique of expeditious obtaining the latest detailed information on the subject can be one of decisions. The logic is following: if knowledge becomes outdated, then students, having necessary basic skills, will always be able quickly to find urgent data on a subject. Not only studying of ways of information search, but also training in how to interpret information what to pay attention to is supposed.

Professional development of workers can be made not internally, and online, at full visual interaction. At the same time, it is possible to use technologies of virtual reality which actually are available to the mass consumer.

Updating of content of the taught disciplines has to happen constantly – in close contact with the real enterprises and without excess of formal procedures. On the first place there has to be a compliance of knowledge gained by students, to requirements of business. Involvement of representatives of the enterprises in educational process is necessary. Teachers have to be a link between the theory and practice.

Perhaps, the education system will essentially be reconstructed in the next 10 years under the influence of the changing structure of labor market. In conditions when the market changes for several months, in some directions long-term training will stop being urgent owing to the inflexibility. People centrally will study only profession bases within 2 years after leaving school, and all narrowly targeted disciplines will be studied within short courses with the minimum expenses of time. Such courses will be constantly updated by teachers depending on requirements of the market and will be last even from several hours. At the same time the person will be able to study different disciplines in different higher education institutions. That is the binding to educational institution will remain only at the teacher, and also at the student at a stage of the 2-years basic centralized training. The higher education as a concept can become outdated in view of strong fragmentation of modules which studying is not limited on human lifetime. The most part of objects will move to a level which is called postgraduate (or after university, refresher courses) education now. And use of the gained knowledge in practice will be the most important indicator of learning of the educational program. Perhaps, control of progress will be carried out by self-training robots with artificial intelligence. The most part of documents will pass into an electronic form, including diplomas and certificates. The unified register of all diplomas and certificates will be created.

In fact, refresher (postgraduate) courses, trainings and webinars which provide quick assimilation of high concentrated knowledge and abilities are

provided already today, assuming their practical application for the purpose of obtaining skills.

The future changes will concern each person and each organization. The main problem is adaptation to the changing conditions, flexible rearrangement of the organizations under needs of the market. Competence "change management" is aimed at it. First of all, change management is the task for managers who have to be trained for new conditions already today.

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