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Digitalization of the machine-building industry of the RK: challenges and problems in education

The purpose of the article is to consider the development of production processes in the machine-building industry of Kazakhstan in the context of integration, which makes it possible to increase the competitiveness of the industry, concentrate production, monetary and commodity capital, introduce innovations, produce high value-added products and enter world markets. Fundamental science, research infrastructure, IT industry, digital technologies are aimed at «launching large-scale system programs for the development of a new technological generation economy - the digital economy». All these strategic trends are relevant for the development of our country, they fully correlate with global economic trends.

Key words: IT industry, economics, automation, digitalization, digital technologies, Industry 5.0, programming and education systems.

Introduction

At a meeting with business representatives, the President of the Republic of Kazakhstan, K.K. Tokayev, said that in Kazakhstan it is necessary to reformat the education system and put education on a technical footing. The head of state set a task for the Government of Kazakhstan to open branches of the world's leading universities in technical specialties.

It is no secret that today Kazakh enterprises are inferior to world equipment manufacturers in a number of indicators, including the competitiveness of products and production. And this is due to the shortage of new production technologies, the lack of highly qualified personnel, the lack of certain types of competencies of industry workers for the implementation of R&D and scaling the results of innovation.

The introduction of digitalization in enterprises begins in different ways: some develop an enterprise digitalization project, others introduce digital technologies as they appear in individual business processes.

In the context of the development of the digital economy, increased interest is shown in the professions of a programmer, engineer, technical specialists, machine builder, analyst, coordinator, IT specialist, etc. To implement the Industry 5.0 concept at enterprises, a new generation of personnel with a new set of skills is required, competent to perform functions in development of innovative products, maintenance of complex computer and engineering systems, control of autonomous systems.

Industry personnel need to adapt to new tasks in a new work environment, which require analytical and communication skills, knowledge of production, knowledge of foreign languages, programming skills, the use of IT technologies, flexibility, knowledge of the market for manufactured products. Personnel is one of the main elements of transformation, a key resource of the digital economy, representing a multifunctional complex subject of development, production and commercialization of products, a source of generating competitive ideas.

A modern highly qualified engineer must have an up-to-date set of digital competencies that are essential for successful professional activity in the era of digitalization. One of the characteristic features of digitalization is the integration of sciences, which is especially evident in the application of digital technologies, the development of digital competence of students, using the potential of interdisciplinary and interprofessional integration.

Today, digital technologies are changing the operating model of production management, increasing profitability and identifying new market opportunities. Robotization and artificial intelligence of labor are gradually becoming a cost-effective alternative to human labor in an expanding range of industries.

Automation and artificial intelligence make it possible to abandon human labor where routine adherence to algorithms or mediation between systems is required. However, job cuts are not the only consequence of the development of technology that companies face in their personnel policy. As part of traditional professions, the set of tasks related to the realities of the digital world is rapidly expanding: working with big data, online communication, programming, website and application development.

The World Economic Forum's The Future of Jobs 2020 report states that the rapid development of technology and the automation of business operations are driving up to the loss of 85 million jobs in 26 significant countries by 2025. At the same time, about 97 million jobs could arise over the same period, more adapted to the new division of groups between people, machines and algorithms.

Allur is a group of automotive companies engaged in the production and sale of cars, components and spare parts, as well as car service in Kazakhstan [1].

As a result, the gap between business needs and the qualifications of the available workforce is becoming a key challenge for Allur Group.

Allur Group, like other companies, is interested in technological developments using artificial intelligence, which will optimize costs, use an individual approach to customers, and minimize the risks and costs of the company.

One of the tasks of Allur Group of Companies is the training and development of employees, the training of highly qualified personnel, students.

In 2013, a base was created for vocational training of existing employees in the skills necessary for working in production and launching new production projects, introducing new technologies.

In May of this year, Allur Group of Companies opened the Higher Engineering School to develop relevant programs for universities and colleges with the introduction of national content, to facilitate the opening of new departments, internships for students, undergraduates and doctoral students.

Review

The education system creates human capital as a key factor in the development of the economy in the 21st century; it is itself a growing sector of the economy. Providing Kazakhstan with the necessary high-quality capital is becoming a state priority, and this task must be solved with the help of a modern high-quality education system. To succeed in the digital economy, it is necessary to regularly update the acquired knowledge base.

Drivers for creating an expanded supply of digital workforce by the education system include:

– a large-scale transformation of the Kazakh education system into the paradigm of «continuous education» – which implies the flexibility of educational trajectories;

– development of interaction between educational organizations and the business community in order to ensure the relevance and importance of educational programs;

– ensuring professional development by improving digital learning platforms.

– To this end, Allur Group of Companies is working on the integration of education through joint work on the development of educational programs, strengthening career guidance with schools, colleges, universities, creating dual education; using the potential of interprofessional integration.

– The growth of stimulation and development of the engineering industry in the Republic of Kazakhstan started after the approval of the State Program for Industrial and Innovative Development of the Republic of Kazakhstan for 2015–and consisted of two stages2019 [2]:

– The first stage of the industrialization of Kazakhstan was focused on the approval and implementation of the Industrialization Map of Kazakhstan for 2010 – 2014 [3] and the Scheme for the Rational Allocation of Production Capacities until 2015 [4];

– The second stage of the country's industrialization was based on sectoral programs to overcome fragmentation, which reformulated the goals of industrial policy and were focused on innovation and cluster development.

Materials and methods

Allur Group launched the first initiative to integrate business and science at the national level. On the basis of the ENU. L.N. Gumilev opened the MBA program «Sociologist-analyst in the field of economics and marketing». The program will be available to top managers of the company in the field of trade and production, structural heads in the field of sales, marketing and data analysis, as well as analysts in the field of economics and marketing.

The MBA program aims to train highly qualified managers with practical sociological research skills to develop business strategy and policy both on a daily and long-term basis, as well as the skills to manage human, financial and material resources to achieve the goals of the organization.

The project partners were: St. Petersburg State University (St. Petersburg), Istanbul University (Turkey), Peoples' Friendship University of Russia (Moscow), Belarusian State University (Ufa), Tomsk State Pedagogical University (Tomsk), All-Russian Public Opinion Research Center, Sofia University. K. Ohridsky (Bulgaria), Otto von Guericke University (Germany), Warsaw University of Social Sciences and Humanities (Poland), Opole University (Poland), Scandinavian Institute for Academic Mobility (Finland), Gazi University (Turkey) and University of California (USA).

Work is underway to integrate science and production through the commercialization of scientific projects, participation in the development and proposal of topical topics for diploma and master's theses. Allur Group has joined the Science Foundation's Business Partners Club. Work continues to study relevant business cases.

On April 12, the Forum-exhibition "Commercialization of the results of scientific and scientific and technical activities" was held, dedicated to the Day of Science Workers, where the Higher Engineering School of Allur Group of Companies was presented to the scientific community.

After this event, SpaceLab entered the Allur Group through JSC Science Foundation with the development of a large-sized industrial 3D printer that prints with high-strength plastics.

The Space3D printer allows you to produce a wide range of plastic parts ranging in size from 1 cm to 2 meters. For example, this company has already learned how to produce car parts: FordRanger, BMW transfer gear, Toyota RAV4 heater damper control, Xiaomi electric scooter repair kits, Infinity QX50 headlight washer cover. The use of an industrial 3D printer in the automotive industry will significantly increase the production of components for the domestic automotive industry, and in the future completely replace foreign analogues with them.

On June 9, the SpaceLab company, represented by the director Arman Bekembaev, presented its product at the Saryarka Avtoprom LLP.

After the presentation, our engineers showed interest in this product and agreed with SpaceLab to make a trial version of printing plastic parts.

On July 28, JSC Fund of Science held a meeting with representatives of Allur Group, where the products of grantees in the field of production and maintenance of vehicles were presented: carbon nanostructured materials (fullerenes), catalytic converters for gas emissions, safe washer fluids for vehicles and more.

During the meeting, readiness for cooperation was expressed, an agreement was reached to search for joint scientific and technological solutions in the transport industry. In particular, the catholic neutralizers agreed with the project grantee to start testing in the near future.

At the end of the event, an agreement was signed on the entry of Allur Group into the Club of Business Partners of the Science Foundation [5]. Work continues on the development of national content through the translation of professional literature, the opening of training groups in the Kazakh language, the development of teaching aids, the holding of conferences and round tables.

The discussion of the results

A project has been developed to automate the mechanical process of the functioning of the lifting mechanism on the car assembly line.

The main idea of the project is to eliminate the human factor represented by the GPM operator. All operations that the operator previously performed for him are performed in the project by the industrial controller PLC. For the PLC, a program code is written from scratch in the form of a ladder diagram in a special application on a computer, after which the finished program code is uploaded to a preconfigured controller. The written program exactly repeats the assembly process. Before writing the program code for the PLC, circuit and power electrical diagrams are drawn up, reflecting all connections, electrical components and including a description of the general process (table-1).

Description of original equipment	***The current build process***
LM - lifting mechanism, a device for moving the car body in the assembly process. The movement takes place linearly using a beam crane. Functional actions of the LM: raising and lowering the body at the assembly posts and moving between them. The main components of the LM: monorail, hoist, crab, control panel. The assembly line consists of 5 LM maintenance	The control of the LM is mechanical, i.e. a special person - the operator of the LM carries out the process of controlling the electric motors responsible for the vertical movement (1st engine), horizontal movement (2nd engine).

Description of original equipment	*The current build process*
posts and 2 ground ones. At each of the 5 posts, the LM raises and lowers the body, after which assembly operations are carried out. Lowering is carried out on special assembly columns, but the LM remains to support the body or completely to the ground. On this assembly line there are 4 telphers and 4 winches attached to them (a winch is a device for gripping a car body), in the future the combination of a hoist and a winch will be called a generalized winch. A wired control panel is connected to each winch.	The engines are located on the monorail. The operator determines when to raise, move and lower the body and to what height.

Table 1. Description of original equipment

Automated assembly process: A control cabinet with PLC and electrical components is installed on the ground next to the assembly line. Process control buttons are displayed on the cabinet doors. Next to each assembly post, a control unit is installed, on which control buttons are also located. A control cabinet is installed on each winch.

1) Starting the process: the responsible specialist for the assembly line presses the Start button on the door of the control cabinet – which means the start of the engines of the first winch and the beginning of its movement to the first assembly post according to the program prescribed in the PLC.

2) The first crab stops at the first assembly post and stays on it until the completion of the assembly operations of this post.

3) After the workers of the post have completed their work, one of them approaches the control unit of this post and presses the Complete button - after which the first winch continues to move to the next post according to the program.

4) As soon as the first winch leaves the first assembly post, the second winch moves to the first assembly post and repeats the same operations as the first one, also with the other two winches and the other 4 posts.

5) The next winch does not move to the next post until the previous winch leaves it.

The project can be implemented in two formats, the choice of which depends on the funding budget

1) A more budget option includes:

• 1 PLC Mitsubishi Q02YCPO and expansion units;

• Signal transmission between the controller and control cabinets on each crab is carried out through signal trolleys in large numbers;

• This option is feasible, but less safe, as it is usually not used in such projects and therefore little studied.

2) More expensive implementation option:

• 5 Mitsubishi Q02UCPU PLCs and expansion units (1 PLC located in the main control cabinet on the ground and 4 others in the cabinet of each crab);

• The transmission of signals between the controller on the ground and the controllers from the crabs is carried out through signal trolls in a much smaller number than in the first option;

• This option is used everywhere in similar projects of foreign specialists, but requires serious cash injections, the estimated cost of one PLC is about 20 million tenge.

Brief project effectiveness:

• The human factor is excluded from the assembly process in which the LM is involved, in the mechanical process, 1 person monitors the entire movement of the winch. There is a high probability of situations when the operator can hit a winch with a body in front of another hanging winch with a body – automation will reduce possible damage to products and equipment; the operator can hit a person in his blind zone with a winch.

• Electricity is saved and the wear of electric motors is reduced by reducing starting currents: with the mechanical control of the LM, the operator repeatedly turns on the motors in a short period of time to perform one or another action, since before the winch captures the body, the workers level the trolley with the body and adjust the winch under the body, its height and location relative to the body, capturing the body "by eye". In the automated control, the winch sank 1 time to the post, where the body is already in the established position (the project also provides for the installation of special «skis» for the wheels of the bogie with the body, which will allow you to immediately set the body in the desired position for the winch), captured the body and 1 once it has risen - as a result, for one post for horizontal movement, the engines are switched on 1 time and for vertical movement 2 times.

Conclusion

Having studied the features of the development of the manufacturing industry in Kazakhstan on the example of the engineering market, we can draw conclusions about its dependence on external macroeconomic influences, low localization of manufactured products, and strong dependence on state support.

In order for the drivers of digital development of human capital to work in a strategic perspective, it is necessary to purposefully systematically influence all subjects of management and investment in human capital, namely, the education system, enterprises, and the state.

The desired goal can be achieved only if all the subjects of the presented institutional model play ahead of the curve and develop response measures in a strategic perspective.

This strategic model for managing the digital development of the human capital of enterprises through new management drivers will reveal the most important methodological principles of management, ensure a balance of interests of all subjects of the labor market, and determine long-term strategies in managing human capital.

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Цифровизация машиностроительной отрасли РК: вызовы и проблемы в образовании

Цель статьи – рассмотреть вопросы и проблемы развития производственных процессов в машиностроительной отрасли в Республике Казахстан в условиях интеграции, которое позволяет существенно повысить конкурентоспособность отрасли, сконцентрировать производственный, денежный и товарный капитал, внедрить инновации, производить продукты с высокой добавленной стоимостью и выходить на мировые рынки. Фундаментальная наука, исследовательская инфраструктура, IT-индустрия, цифровые технологии направленына «запуск масштабных и системных программ развития экономики нового технологического поколения – цифровой экономики». Все эти стратегические тренды являются актуальными для развития нашей страны, они полностью коррелируют с мировыми тенденциями в экономике.

Ключевые слова: IT-индустрия, экономика, автоматизация, цифровизация, цифровые технологии, «Индустрия 5.0», программирования и системы образования.

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ҚР машина жасау саласын цифрландыру: білім берудегі қиындықтар мен мәселелер

Мақаланың мақсаты-интеграция жағдайында Қазақстанның машина жасау саласындағы өндірістік процестерді дамыту мәселелерін қарастыру, бұл саланың бәсекеге қабілеттілігін арттыруға, өндірістік, ақша және тауар капиталын шоғырландыруға, инновацияларды енгізуге, қосылған құны жоғары өнімдер шығаруға және әлемдік нарықтарға шығуға

мүмкіндік беру.Іргелі ғылым, зерттеу инфрақұрылымы, IT-индустрия, цифрлық технологиялар «жаңа технологиялық буын экономикасын дамытудың ауқымды жүйелік бағдарламаларын іске қосуғабағытталған – сандық экономика».Осы стратегиялық трендтердің барлығы біздің еліміздің дамуы үшін өзекті болып табылады, олар экономикадағы әлемдік үрдістермен толық корреляцияланады.

Кілт сөздер: IT-индустрия, экономика, автоматтандыру, цифрландыру, цифрлық технологиялар, "Индустрия 5.0", бағдарламалау және білім беру жүйелері.

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