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## Трансформация технологий профессионального образования в условиях цифровизации

Цяо Цун, Кочнева Д. И.

**Аннотация.** Цель исследования – на основе анализа проблем профессионального образования в эпоху цифровой трансформации разработать технологию эффективного взаимодействия вузов и бизнеса. В статье рассмотрены изменения, произошедшие в бизнес-процессах организаций, и выделены ключевые разрывы между уровнем квалификации выпускников и требованиями работодателя. Для решения выявленных проблем предлагается наладить системное сотрудничество бизнеса, науки и образования. Прорабатываются следующие формы взаимодействия бизнеса и университетов: технологии кейс-стади, образовательные хакатоны и научный краудсорсинг. Эти технологии могут принести взаимную выгоду всем заинтересованным сторонам. Для взаимодействия образовательной и научной составляющих университета предлагается новая концепция студенческого объединения – студенческого научного предприятия. Это объединение построено на принципах самоорганизации и самоуправления и имеет характеристики настоящего предприятия. Его основная цель – привлечение студентов к научной работе и адаптация молодежи к будущей профессиональной деятельности. Научная новизна заключается в разработке теоретической модели взаимодействия бизнеса и университетов на взаимовыгодной основе. В результате исследования были предложены формы и принципы взаимодействия науки, профессионального образования и бизнеса.

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## Transformation of professional education technologies in the digitalization context

Cong Qiao, D. I. Kochneva

**Abstract.** The aim of study is to develop a technology for effective interaction between universities and business based on the analysis of the problems of vocational education in the era of digital transformation. The article examines the changes that have occurred in the business processes of organizations and highlights the key gaps between the level of graduate qualifications and employer requirements. To solve the identified problems, it is proposed to establish a systemic collaboration between business, science and education. The following forms of interaction between business and universities are being explored: case study technologies, educational hackathons and scientific crowdsourcing. These technologies can bring mutual benefits to all stakeholders. For the interaction of the educational and scientific components of the university, a new concept of student association called student scientific enterprise is proposed. This association is built on the principles of self-organization and self-government and has the characteristics of a real enterprise. Its main goal is to involve students in scientific work and adapt young people to future professional activities. Scientific novelty: a theoretical model of collaboration between business and universities for mutual benefit has been developed. As a result of the study, forms of interaction among science, professional education and business were proposed.

### Introduction

Today no one disputes the role of science and education in the scientific and technological progress. The most important prerequisite for the development of an innovative economy is the creation of competitive universities capable of accumulating and multiplying intellectual potential, promoting the systemic integration of science, education and technology transfer into production. A relevant problem of modern professional education is the discrepancy between the level of qualifications of graduates and business requirements. This problem becomes most acute in the era of digital business transformation, since the higher education system does not have time to adapt to new requirements for graduate competencies.

Thus, the objectives of the study are as follows:

- to determine business requirements for graduates in the context of digital transformation;
- to develop a collaboration model of business and universities based on mutual benefit;
- to identify specific technologies for interaction among science, higher education and business in order to develop the necessary professional skills of graduates.

Theoretical background. The problem of interaction between universities and the business community is widely discussed (Жураховский, Шолотонов, 2021; Кулясова, Трифонов, 2020; Nsanzumuhire, Groot, 2020; Tseng, Huang, Chen, 2020; Awasthy, Flint, Sankarnarayana et al., 2020; Rossoni, De Vasconcellos, De Castilho Rossoni, 2024). In (Жураховский, Шолотонов, 2021), it is emphasized that the existing HR practices of enterprises to attract graduates do not meet the business needs for specialists with the required qualifications. The authors (Кулясова, Трифонов, 2020; Nsanzumuhire, Groot, 2020) note the high interest in cooperation between universities and business and agree with the lack of a mechanism for effective interaction. Among the main problems of higher education, the authors (Tseng, Huang, Chen, 2020; Awasthy, Flint, Sankarnarayana et al., 2020; Rossoni, De Vasconcellos, De Castilho Rossoni, 2024) note the non-compliance of the graduate's competencies with the employer's requirements. This problem has become more acute in the era of digital transformation of business processes. Thus, the development of mechanisms for interaction between universities and business is an urgent scientific problem that has not been fully resolved at present.

To solve these problems, the article uses the following research methods: analysis of scientific literature on the problem of interaction between education and production; descriptive method – to present the main technologies of interaction between the business community and universities; observation of university students – to determine their motivation to study and participate in scientific research.

Practical value of the study lies in the development of specific methods for practice-oriented teaching of students and their involvement in scientific research at the university.

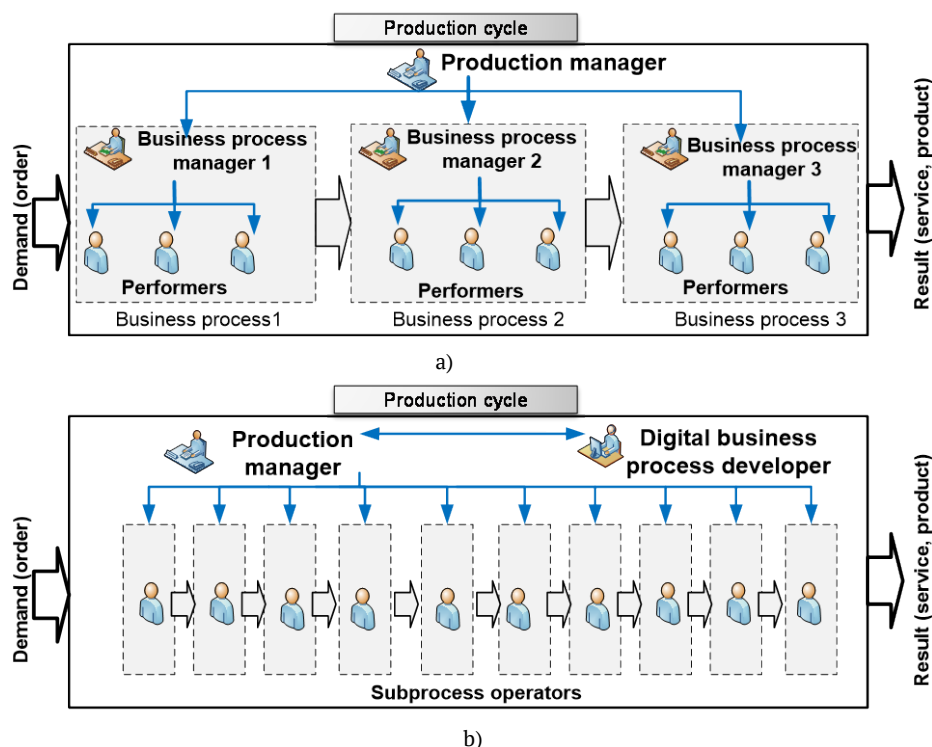
## Discussion and results

An urgent problem in higher education is the discrepancy between the competencies of graduates and the requirements of the employer. This problem has become more acute in the era of digital transformation of business processes.

The features of business processes in the context of digitalization are as follows:

- automation of routine operations;
- narrowing the range of specialist tasks;
- reduction of hierarchy levels in the process management structure;
- emergence of a new class of a highly qualified specialist – a digital business processes developer.

The named features are schematically presented in Figure 1.



**Figure 1.** Transformation of business processes in connection with digitalization:  
 a) pre-digital business process structure; b) digital business process structure

The transformation of the business process accordingly changes the requirements for specialists:

- reducing the need for unskilled personnel;
- increasing demand for mid-level specialists that are skilled in working in a digital environment;
- increasing demands on the qualification level of top management;
- big data skills and soft skills are gaining the greatest value.

These aspects are schematically presented in Figure 2.

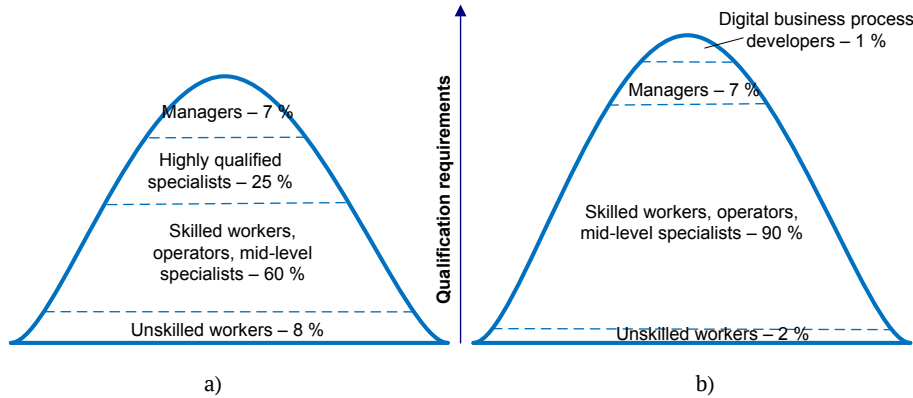


Figure 2. Pyramid of needs for qualification: a) pre-digital era; b) digital era

In the context of digital transformation, a gap arises between education and business. Most enterprises are not satisfied with the level of qualifications of graduates and have high costs associated with retraining personnel. At the same time, university teachers do not understand what and how to teach students so that a specialist meets the modern needs of production.

An equally significant gap has arisen between business and the other side of the university – science. University scientists are not sufficiently involved in the business processes of the real sector of the economy, have no idea about the real problems of business and data for testing and verifying their scientific hypotheses.

Enterprises, in turn, regularly face new problems. They solve them intuitively using administrative methods, since financial investments in project development are often economically ineffective.

Moreover, the burden of current activities does not even allow enterprises to formulate the problem and determine a business development strategy. In recent years, production has also faced the challenges of the times: global competition leads to the need for rapid deployment of scientific and technical projects and their implementation with high quality. Such projects can be quite large and be beyond the capabilities of one organization, which requires the involvement of a large number of researchers.

The solution to these problems is possible on the basis of systemic interaction between education, science and business on mutual benefit. The collaboration model of the named parties is presented in the Figure 3.

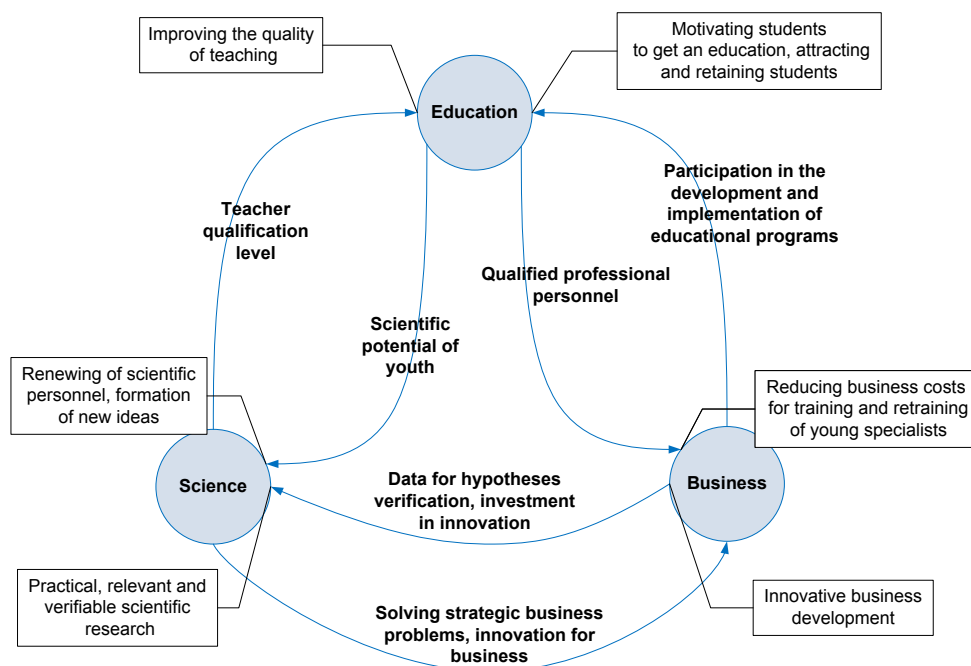


Figure 3. The collaboration model of science, education and business

Each party receives mutual benefit from the interaction.

If a business takes part in the development and implementation of practice-oriented educational programs, it receives qualified specialists in return. Thus, companies reduce the costs of selection, training and retraining of young specialists, and the university increases students' motivation to study.

When business provides the scientific community with factual data to verify hypotheses and invests in research, it receives a solution to strategic development problems. At the same time, scientists can conduct practically significant and verifiable research based on real business data.

The interaction of scientific and educational activities within universities allows for the improvement of the qualifications of teachers and the use of the creative potential of students to find innovative solutions. This allows us to update scientific personnel and improve the quality of teaching.

One of the most effective forms of interaction between education and business, in our opinion, is case technology.

Case technology is an innovative approach to learning based on real situations and problems. The researchers (Martinez-Garcia, Morris, Tscholl et al., 2011; Иванова, Малетин, Мутагаров, 2023) are devoted to analyzing case study technologies in education. With the active support of the business community, case studies based on real business problems can be introduced into the educational process. This will allow students to develop the following skills:

1. Working with information:
  - look for the information;
  - analyze and process large amounts of data in a short time;
  - form hypotheses;
  - present research results in a logical and structured manner.
2. Business management skills:
  - look for creative and non-standard solutions;
  - act effectively under stress;
  - make decisions quickly in conditions of limited time and conflicting information.
3. Soft skills:
  - organize teamwork;
  - competently formulate one's opinion, convince, seek compromises;
  - present one's solution to the public.

Case study technologies will provide the following benefits to the business community:

- generating new ideas;
- systematization of existing problem-solving experience;
- participation in implementation of education in accordance with one's goals (reducing the costs of retraining and training young employees);
- possibility of selecting the most promising personnel.

For the educational process, the advantages are as follows:

- improving the quality of education;
- increasing students' interest;
- formation of competition among students, increasing motivation of study;
- opportunity to test scientific ideas in practice.

Another form of case technology that is currently popular is a hackathon.

A hackathon is a competition between teams that solve a specific problem in a limited amount of time. The term "hackathon" is derived from the words *hacker* and *marathon*. *Hacker* is because the competitions are usually held in the IT sphere, *marathon* is because the teams work intensively for several days without a break. Despite the fact that hackathons initially involve competitions between IT projects, today this format is also used in other areas (Гречушкина, Арефьева, 2023; Rys, 2023).

In order to develop the relationship between science and business, it is proposed to introduce scientific crowdsourcing technology into universities.

The concept of "crowdsourcing" has become quite widespread at present. In a general sense, it is the involvement of many performers in the implementation of projects, usually via the Internet. In scientific research, crowdsourcing technology involves the process of accumulation and exchange of knowledge with the voluntary involvement of a large number of scientists (Ланщикова, Позднякова, 2023; Lenart-Gansiniec, Czakon, Sułkowski et al., 2023).

The idea of scientific crowdsourcing can be implemented in various forms.

For example, it can be implemented on the basis of a jointly established scientific and technical partnership between a university and business structures, as a knowledge exchange center. Problems and ideas are discussed within the partnership and formulated by the joint efforts of scientists and business. On this basis, the concept of a scientific and technical project and a list of the necessary initial data for its implementation are substantiated. Enterprises transfer data to the university on the basis of a bilateral agreement on confidentiality of information. The university involves research teams in the implementation of the project. The results obtained within the partnership are used in the economic activities of enterprises, but are not necessarily published for the general scientific community. In this case, scientists are faced with the goal of not so much developing a theory as obtaining results that can be used in business activities.

A more promising way to implement scientific crowdsourcing involves creating a digital Internet interaction environment. Enterprises publish problems and tasks on the platform, scientists generate their ideas for solutions, join

the discussion, supplement and expand ideas (wiki technology as a possible implementation). Thus, a digital knowledge base is formed according to the voicing of many ideas. Business has the opportunity to hear the opinions of a large number of scientists on ways to solve the problem and to choose the option that suits them. When the task is sufficiently detailed and ideas for its solution are selected, a scientific and technical project is formulated, which is transferred to the scientific team. This method of implementing crowdsourcing is preferable, since it allows for an increase in the efficiency of knowledge exchange and the involvement of a large number of scientists from various fields in the solution.

For the university, crowdsourcing is effective in achieving two goals: firstly, the realization of scientific potential and receiving orders for the development of scientific projects from business; secondly, the educational aspect: by joining the discussion of the idea, scientists expand their knowledge base about business and the industry, which they then use in teaching and generating new ideas.

And the third side of the collaboration model is the interaction of science and education. We propose a new concept of student community called “student scientific enterprise”. It increases students’ involvement in university research and develops their soft skills.

Student Scientific Enterprise (SSE) is a voluntary association of students created to assist in the implementation of scientific research works of students and the possible implementation of the results of activities into production, using the educational and scientific potential of the relevant departments and faculties of a university.

The activities of the SSE are aimed at realizing the scientific potential of young people, as well as preparing students for practical activities during the educational process in order to reduce the period of adaptation of young specialists in the workplace.

The key differences between the SSE and traditional scientific circles are as follows:

1. Self-organization and self-government of students, i.e. the student association independently makes decisions, chooses projects of interest, organizes scientific events, selects members for its ranks. And the supervising teacher only provides organizational and methodological assistance.

2. The presence of attributes of a real enterprise: management structure, distribution of functionality, currency, income, salaries.

3. Personal responsibility for the results, i.e. the SSE takes responsibility for the results of its work, learns from mistakes, makes efforts to resolve emerging problems.

The objectives of the establishment of the SSE are:

- creation of an effective mechanism for conducting research and development by involving students and postgraduates in scientific and technical creativity;

- integration of science and industry by intensifying the activities of the University’s leading departments to attract young people to the development and synthesis of new technical solutions;

- concentration and support of promising innovative solutions and technologies;

- coordination of scientific research and development of University’s departments in the field of creation of new technical solutions and technologies;

- development of young people’s interest in scientific research and development, implementation of the results of scientific activity in production;

- preparing students for practical activities during the educational process in order to reduce the period of adaptation of young specialists in the workplace.

In order to stimulate the activities of students as part of the SSE, the students understand the responsibility for the results of the SSE activities, the internal currency of the student scientific enterprises introduced. The income of the SSE in the “SSE currency” is formed through the implementation of research projects, presentation of the results of research activities, including the publication of articles, organization and participation in conferences and other types of scientific research. Salaries for members of the SSE are calculated in the “SSE currency” and can be exchanged for additional educational services of the University: organization of excursions to enterprises, lectures by business representatives outside the main educational program, other types of goods and services as part of stimulating the research activities of students.

The organizational structure of the SSE is proposed on the matrix principle and includes a functional block and a project block. An example of the organizational structure of the SSE is shown in Figure 4.

The Board of Directors consists of the directors of the functional divisions of the SSE and the project managers of the SSE. They are selected from among the members of the SSE by a general vote.

The functional block of the organizational structure of the management of the SSE can include the following positions:

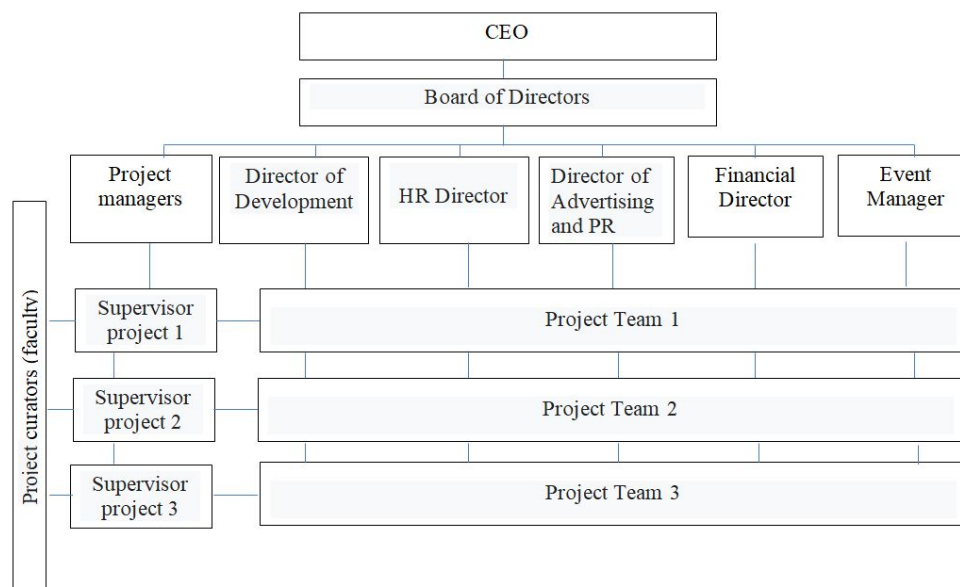
- the Director of Development searches for and selects priority projects for implementation in the SSE: student work contests, student conferences, case championships;

- the HR Director holds meetings with potential participants of the enterprise, brings information to students, motivates them to join the SSE, keeps records of employees of the enterprise, maintains electronic workbooks, draws up employment contracts with members of the SSE;

- the Director of Advertising and PR covers information about the SSE, current projects and events of the SSE in the university press, on the website, social networks;

- the Financial Director manages the financial flows of the SSE in the “SSE currency”, conducts payroll, organizes settlements with the University for services provided in the “SSE currency”, forms financial statements;

- the Event Manager organizes the SSE events: student conferences based on the results of work on projects, visits to third-party conferences, exhibitions, forums.



**Figure 4.** The organizational structure of the Student Scientific Enterprise

Thus, by “playing” the enterprise, students prepare for real practical activities, learn to work in a team and be responsible for the success of this team. In addition, this form of student association contributes to the renewal of the university’s scientific personnel and the generation of new ideas.

In this sense, it is appropriate to quote Bernard Shaw: “If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas.”

## Conclusion

Thus, the collaboration of universities and businesses is the most important direction of economic development in the context of digital transformation.

This study showed that the digitalization of business has changed the requirements for specialists: the requirements for digital skills of graduates have increased as well as big data skills and soft skills are gained the greatest value.

To bridge the gap among education, science and production, a model of university-business collaboration is proposed. This contributes to improving the quality of education, on the one hand, and innovative development of business, on the other hand.

It is proposed to build a collaboration among the educational and business components on the basis of case study and educational hackathons technologies. The interaction between the scientific and business communities is proposed to be carried out through scientific crowdsourcing.

For the development of student science and the inclusion of research in the educational process, a new form of student community, called a student scientific enterprise, has been proposed. This concept is aimed at realizing the scientific potential of young people, as well as preparing students for practical activities during the educational process.

Research prospects. Further research into business-universities collaboration is aimed at quantifying the benefits of interaction in order to justify the potential economic efficiency of business investments in vocational education.

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### Информация об авторах | Author information

**RU****Цяо Цун<sup>1</sup>**, к. техн. н.**Кочнева Дарья Ивановна<sup>2</sup>**, к. техн. н.<sup>1</sup> Чжэнчжоуский железнодорожный профессионально-технический колледж, Китайская Народная Республика<sup>2</sup> Уральский государственный университет путей сообщения, г. Екатеринбург**EN****Cong Qiao<sup>1</sup>**, PhD**Daria Ivanovna Kochneva<sup>2</sup>**, PhD<sup>1</sup> Zhengzhou Railway Professional & Technical College, The People's Republic of China<sup>2</sup> Ural State University of Railway Transport, Ekaterinburg<sup>1</sup> [qiaocong@mail.ru](mailto:qiaocong@mail.ru), <sup>2</sup> [DKochneva@usurt.ru](mailto:DKochneva@usurt.ru)

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