Production of Indicators for Evaluation of Digital Transformation of Modern University

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*Abstract***:** *The article describes the main threats and opportunities for the use of digital technology by universities. We considered the features of the functioning of universities in the digital economy.*

In the study, we applied the method of a balanced scorecard, which allows integrating estimates of diverse activities to assess the overall result of the university's socio-economic system in the development of digital technologies.

Achieved results. An original balanced system of indicators of the digital transformation of the university has been formed.

The study will improve the effectiveness of tactical and strategic management of a university due to the authors' recommendations for the formation of indicators for assessing and regulating the digitalization processes at the university.

Keywords: digital economy, digitalization of university activities, indicators of digital transformation.

I. INTRODUCTION

The evolution of university models is complex and occurs under the influence of a change in the technological structure, the development of industry and society [1]. The first models of the university are associated with the pedagogical process and work in the teacher-student format. The second model includes a customer-employer, and the pedagogical process acquires a practice-oriented focus. The third model of the university is characterized by the transfer of technology and the increasing role of commercialization of the university research activities results. The modern fourth model operates in the digitalization of educational, scientific, innovative, entrepreneurial activities of the university [2].

Each new model is characterized by an increase in complexity and uncertainty in the university management system. There is an urgent and practically significant task of developing indicators of the digital transformation of a university as an effective tool for the analysis of current and strategic management.

The process of evolution and transformation of university education is accompanied by the emergence of new forms and types of universities:

- open university. The main purpose of the functioning of open universities is the implementation of distance education programs [3]. Despite the fact that such universities already exist in many countries, the development of distance education will not be limited to this. Many universities in the USA and Europe develop Massive Open Online Courses and

Small Private Online Courses [4], and the Massachusetts Institute of Technology, Stanford University and Harvard purposefully develop free LMS distance learning platforms [5]. Outside-the-Box strategies have undoubtedly been successful, because MOOCs courses allow the universities to compete globally [6-8].

- network university - an association of individual universities from around the world that implement one educational program [7-9].

- multiversity - a form of organization of the university's activities when the university grows into more than a hundred campuses, many of which begin to form independent educational institutions [7, 8, 10].

- educational hub - a Knowledge Village or Education City, which presents educational programs of various universities in the world. The leaders in this direction are Qatar, the United Arab Emirates, Singapore, Malaysia, Hong Kong and Botswana [7, 8, 11].

The process of digital transformation of a university is the creation of a unique university information system that will provide unified asset data for users [12]. This includes information about students, personnel, teachers and researchers, their publications and patents, the courses they teach and the research projects they conduct. This will improve the interaction with the external environment and increase the accuracy and efficiency of various tasks [13, 14].

In general, a review of the literature has shown high relevance of the research topic stated in this article on the digital transformation of the university [15, 16]. In the studied literature, the issue of indicators of the digitalization level of a university is not sufficiently developed. This question is complicated when considering these indicators in the context of changes in the educational, research and entrepreneurial functions of a university in the modern economy. Accordingly, there arises a new field for research.

II. METHODS

In the study, we have applied the balanced scorecard method, which allows integrating estimates of diverse activities to assess the overall result of the university's socio-economic system in the development of digital technologies.

III. RESULTS AND DISCUSSION

Indicators are the basis of any strategic management and management in general. The movement of the socio-economic system along the evolutionary spiral of development can be evaluated only by specific quantitative indicators [17].

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We have a different set of indicators for each university model. Also, a different set of indicators will characterize various areas of the university. Certain indicators shall also be developed for the digital transformation of the university, to measure the success and effectiveness of such a transition. It is clear that the indicators shall meet certain requirements: objectivity, universality, updatability, consistency, scalability. It will be possible to manage the process of digital transformation, taking into account the progressive expected results, only after developing a system of university digitalization indicators.

Let us examine, in succession, the opportunities and threats that arise in various sections of the socio-economic activity of a university, the things to be done to increase the effectiveness of the digital transformation of a modern university, and most importantly, the indicators to be used to measure the digitalization of university activities.

1. Firstly, educational activity is the basis of any educational organization, especially in the field of higher education. Sub-subject competencies, such as leadership, teamwork, vision, initiative, project approach, work for the result, stress resistance and conflict resistance come to the fore. A modern university teacher shall teach the students not only professional knowledge, but also subject-specific skills. It is important to teach a future specialist not only to generate new ideas and successfully master existing technologies, but also organizational, entrepreneurial abilities, ability to keep his/her word, to lead people along, honesty, justice and other moral standards. Modern digital education should become highly moral with a high level of trust and empathy. This will significantly reduce the costs of protecting property rights and information security.

The indicators of digital transformation in this area should reflect the educational activities of the university implemented through digital technology.

Another group of indicators should reflect the presence, depth, scale, geography and effectiveness of using the MOOCs and SPOC courses implemented by the university both nationally and abroad [18]. Also necessary are the indicators characterizing the digitalization degree of the processes of enrolling students at the university, the implementation of individual educational paths and the success of their employment. The following indicators shall assess the quality of digital literacy of students and teachers [19-27], the activity and motivation of taking advanced training courses using the distance learning technologies.

2. Secondly, the scientific and innovative activity is the basis of the modern economy, especially in the face of fierce global competition for markets and economic resources. Innovations are an engine of any national economy in the modern world. Innovations are a product of the intellectual work of human, implementation of his/her creative potential [20, 21, 22]. Accordingly, the conditions at the university shall correspond to the disclosure of the creative potential of students, the support of talented youth and gifted children. Learning of subjects should be mixed. This means that along with common knowledge, students shall participate in obtaining new knowledge in the subject under study guided by their teachers. Joint research should be encouraged by a group of teachers and students (scientific collaborations). Foreign and national internships shall have both an educational and a scientific implementation plan. In this regard, the competencies of a teacher of a modern university shall take into account the challenges of the innovative economy. A modern teacher shall learn to understand the modern trends of scientific research and technology. Only after that it is possible to transfer scientific and innovative activities to digital technologies and vice versa; in such conditions, digital technologies can ensure the effectiveness of scientific and innovative activities of the university.

3. Thirdly, the entrepreneurial activity is a tool for integrating a modern university into the real sector of the economy. The university can conduct entrepreneurial activities in several areas. It is possible to organize student production and undergraduate practices at the enterprises in the territory and region. This can lead to contractual work when the university can provide scientific and technical services and advice on the order of the enterprise. In this regard, digitalization can become an additional tool for finding the necessary technologies and selecting the necessary and qualified performers. Entrepreneurship is also possible the in the field of educational services. By organizing advanced training courses with the wide use of digital technologies, the university can become a translator of advanced knowledge in the external environment, and in return receive not only appropriate extra-budgetary funding, but also the opportunity to adjust its educational and research programs depending on the development trends of the real sector of economy. And another direction for the implementation of the entrepreneurial function by the university and the most demanded now is small innovative business. Already, many large universities are surrounded by a belt of small innovative enterprises. On their basis, the integration of educational and scientific activities takes place. The students undergo training and industrial practices, conduct advanced scientific research. The university receives royalties from its intellectual property [23-26], since the patents received at the university get an economic assessment and are added to the registered capital of the small innovative enterprises.

The indicators of digital transformation in this area shall reflect the success of the university's entrepreneurial activity, achieved, inter alia, using digital technologies [24-25-28].

To assess the digital transformation of the university, it is advisable to use a certain system of indicators characterizing various types of activities presented in Table 1.

Table 1: University digital transformation scorecard

No.	Indicator name
1.	**Educational digitalization indicators**
1.1.	number of links to the university website available on the pages of websites of national and foreign educational domains
1.2	university website ranking in search engines (Google, Yandex)
1.3	number of MOOCs and SPOC courses implemented by the university
1.4	number of international students enrolled at the MOOCs and SPOC of the university
1.5	number of the KFU students enrolled at the MOOCs and SPOC of foreign universities
1.6	number of MOOCs and SPOC in foreign languages
1.7	number of applications for applicant enrollment processed using digital technology
1.8	number of optional or compulsory modules in the framework of training programs aimed at improving digital literacy among students
1.9	number of academic personnel trained in digital skills development course
1.10	degree of digital integration of online classrooms in the university management process
2.	**Indicators of digitalization of scientific and innovative activities**
2.1	number of PDF files published on the official website of the university on the employee/unit page
2.2	number of university publications in journals included in 10% of the most cited works of the corresponding scientific direction
2.3	number of new generation innovative educational technologies introduced into the university (Internet of things, big data, cognitive technologies, cloud technologies)
2.4	number of intra-university incentive and support programs for research and teaching staff, setting trends in the development of digital skills
2.5	collaboration with foreign researchers using digital technologies: online research, online sharing of results
2.6	number of virtual laboratories shared with foreign partners
2.7	presence of a digital bank (online database) of innovative solutions and requests for innovation (the number of user requests to this database)
2.8	number of new digital technologies developed and implemented by MIPs and the university as a whole.
3.	**Entrepreneurial activity digitalization indicators**
3.1	number of IP addresses that refer to the university website
3.2	number of external backlinks to the university website
3.3	number of registered users of the university website
3.4	number of downloads of the university's mobile application on PlayMarket and AppStore
3.5	amount of extra-budgetary funds raised from the use of MOOCs and SPOC, number of agreements with other online educational sites on the offsetting of courses taken by the students during their transition
3.6	number of introduced new technologies in the basic business processes of the university
3.7	number of introduced digital services that significantly facilitate the activities of students and university research work
3.8	number of new digital technological innovations found that can be used in the university activities to achieve the goals set for the university
3.9	number of university enterprises and MIPs using digital technologies for production and sale of products and services
3.10	number of digital services created through budget and extra-budget sources, amount of funds received through the use of digital services

The indicators summarized in this form, presented in Table 1, will make it possible to assess the digital transformation of the university, compare the achieved indicators with the previous period or with reference universities, identify problems in the functioning of the educational organization and in the use of digital technologies, make a decision on further tactical and strategic development of the higher educational institution.

IV. SUMMARY

Table 1 presents indicators for assessing the degree of digitalization of the educational, scientific, innovative and entrepreneurial activities of the university. These basic types of university activities are changing under the influence of digital technologies in the modern conditions. A new scientific and technological structure and a new wave of scientific and technological progress expand the educational, scientific, innovative and entrepreneurial functions of the university. At the same time, the university management is complicated and uncertainty is increasing. To solve this problem, a system of indicators for the digital transformation of the university is formulated in Table 1 according to the research results. By adopting this system of indicators and improving it, the leadership of a modern university will be able to more effectively manage digitalization processes to solve tactical and strategic tasks.

V. CONCLUSION

In our opinion, the main problem of a university's digitalization in the modern world lies in the barriers that are not yet overcome between the university and other market participants and the public sector.

A certain mechanism is needed to overcome the existing barriers Digitalization is not capable of doing this alone. A transition mechanism is needed that would make the processes external to the university its internal processes, while maintaining existing institutions (property rights, market mechanism, laws of value, supply and demand, public-private partnerships, innovative infrastructure, monetary system and other public initiatives). In other words, a "skeleton" is needed that can direct the positive effects of digitalization to the benefit of the university and the economy as a whole. Without the development and establishment of an appropriate mechanism (a system of transition institutes), it will not be possible to switch to model 4.0 using digital technologies.

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