SMART UNIVERSITY: GLOBAL CHALLENGES OR LOCAL TASKS?

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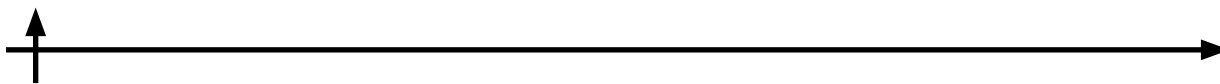
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Abstract. The article discusses the concept of "Smart Universities": prerequisites for development, innovative breakthroughs and subsequent results, the change of educational paradigms in society and the impact on industrial and post-industrial societies. The main smart processes taking place at a Smart university are also considered, and the main smart infrastructure for providing activities is described. As a result, e-information and educational environments are considered in the example of Peter the Great St. Petersburg Polytechnic University and MIT OpenCourseWare and edX.

Keywords: smart university, digital education, industry 4.0, digital economy, educational technologies

УМНЫЙ УНИВЕРСИТЕТ:
ГЛОБАЛЬНЫЕ ВЫЗОВЫ ИЛИ ЛОКАЛЬНЫЕ ЗАДАЧИ?

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Аннотация. В статье рассматривается концепция "Умных университетов": понятие, предпосылки создания, инновационные прорывы и последующие результаты, изменение образовательных парадигм общества и влияние на индустриальное и постиндустриальное общества. Также, рассмотрены основные смарт-процессы, происходящие в умном университете, и описана основная смарт-инфраструктура для обеспечения деятельности. В итоге, электронные информационно-образовательные среды рассматриваются на примере Санкт-Петербургского политехнического университета Петра Великого и MIT OpenCourseWare и edX.

Ключевые слова: умный университет, цифровое образование, индустрия 4.0, цифровая экономика, образовательные технологии

Introduction

The object of this research is a concept of Smart universities in the education system. It implies a change in the approach in the learning process: education should become multi-format and personalized. It is possible to implement this by introducing new information systems into the management structure of universities. Such changes concern not only the educational process, but also the organizational structure of universities as a whole.

The subject of this research is scientific articles by Russian and foreign authors on the topic of the introduction of digitalization (Industry 4.0) in the education system. In the course of research, theoretical and practical methods were applied, including: analysis, generalization, comparison.

The purpose of writing this paper is to examine the current set of concepts that should build up the basis for a Smart University to function properly. This research aims to analyze the current state of digitalization implementation in the process of Smart Education, identify the basic concepts and show the relationship between them by analyzing existing practices.

The research is aimed at:
1. analysis of "Smart University" as an education-related concept;
2. identification of prerequisites for the emergence of the "Smart University" concept;
3. assessment of necessary elements for launching the "Smart University" concept;
4. examination of changes that take place in the educational paradigms during the society's transfer from industrial to post-industrial mode.

In the recent years, the issue of digitalization of the economy has been discussed vastly. In
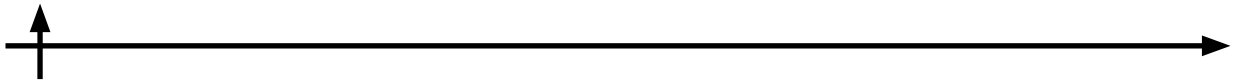
particular, a lot is said about the concepts with the prefix "Smart", and "Digital". Under these concepts, a lot of funding is being allocated on a competitive basis, even ministries of digitalization have appeared at all levels. Accordingly, concepts such as Smart university have appeared, alongside the concepts of Smart City, Smart Home, Smart Transport, and much more "smart" or "digital" entities. "Smart" is a property of an object that characterizes the integration of two or more elements that were not previously connected. This sort of connection is established thanks to the Internet. "Smart" technologies contribute to the expansion of mobility in various fields: education, public service, production, etc. Vast coverage of this trend determines the relevance of this research (Wiesmeth, 2016).

Materials and Methods

Smart technologies are changing the education system, which is manifested by:

1) introduction of the "life-long learning" principles;

2) application of the latest distance and e-learning technologies;

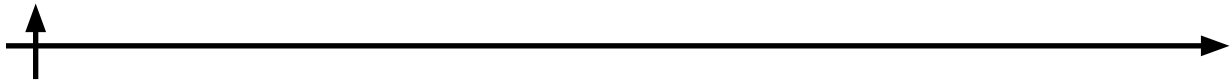3) facilitated licensing and accreditation procedures.

Smart universities, acting as centers of scientific and innovative development of each region and stimulating interest in the intensive development of all sectors of the Russian economy, shape the basis of Smart cities. A smart university is a model for creating a unified environment of digital services that are adaptive to the processes and goals of the university and suitable for replication (Borisenko, 2015). The main goal of creating a Smart University is to transform the basic and management processes at the university with the help of digital technologies. The "Smart University" model involves the introduction of the most modern technologies in the educational process, widespread use of online platforms, personalized educational trajectories and courses, new space opportunities and modes.

A smart university is not just about online courses. Neither the e-timetable, nor the elements of online education by themselves, make universities digital. The transformation should affect the essence of the educational process, improve the quality of the final educational result and the motivation of students and faculty (Bochkareva, Danilova, 2021).

In the scientific work "Organization of management in a smart university", Grishin V.I., Kalinina I.A., Karasev P.A., Kulapov M.N. and Shklyaev A.E. consider a Smart University as an information space with intellectual products of a special kind (Grishin, Kalinina ,et. al., 2018). In the concept, the authors propose to integrate digitized processes in the educational, scientific and financial activities. In this case, the university's structure consists of seven main components: leadership, personnel, resource infrastructure, educational products and scientific products, education and scientific activity, strategy − making the vision of the future (Grishin, Shevchenko, 2022).

New opportunities for "University 2.1" are not only an increase in the number of students, but also their quality. In recent years, this has been typical for universities and faculty, but first of all, achieving strategic development goals with minimal resources. For now it is possible to say that we have almost reached the limits of the size of university education in the traditional format, in terms of the number of students and the volume of academic hours. This led to a decrease in the reputation and image component of university education, and a growing share of the "entertainment" part of education (Glukhov, 2017).

In order to make a "smart" university, it is necessary to look for and implement mechanisms for concentrating resources on breakthrough areas, as well as to abandon inefficient activities. Therefore, it is very important to change the structure of the university, which ceases to dominate in the process of creating educational products. Projects aimed at creating new scientific and educational products at a smart university are changing the organization of university activ-

ities. They require a transition to network or cluster types of interaction with partners to create an out-of-system education. And in the education system, which is based on the principles of "lego" - assemble your education yourself. This also leads to an increase in the market of educational services for "competent customers" - parents, employers and students. These organizations activate the formation of the student's environment in order to influence the change in the development of competence under control of an interested party (Walter, 2014).

It is impossible to dispute against the facts put forward by N.V. Dneprovskaya, E.A. Yankovskaya, I.V. Shevtsova in their article "Conceptual foundations of the concept of smart education". According to this paper, modern smart universities are very different from average students in terms of development. Firstly, the faculty for a Smart University should be comprehensively trained and able to quickly navigate in modern life. These changes set new vectors of the educational process, and contribute to realizing the potential of teaching staff and students in creating new technologies (Dneprovskaya, Yankovskaya, 2015).

A virtual campus is advisable to be created in a smart universities, so that all students and faculty could freely use resources in accordance with their role in education. This requires the availability of technical infrastructure (computer network, computers, telecommunication and communication devices, presentation equipment, access control systems for educational content, information security system) (Stepanova, 2019). Another important component is information infrastructure, that includes a set of digital resources, applications and services of the intra-university information environment, personal IDs for access to Smart campus resources.

In the article "Smart University", V.V. Meshkov and I.A. Suslova argue that for successful a integration of the system, it is necessary for the university to meet the following requirements: to use the best practices in creating smart infrastructure; to ensure communication between students, teachers and staff through information technology; to invite innovative technologies that improve the quality of information services, while saving money. The authors also note that the intellectual infrastructure of the university has multiple facets: management of the material and technical complex, management of educational activities, and supporting processes (Meshkov, Suslova, 2019).

The article by G. Sidorov "Digital University: Application of digital technologies in modern educational institutions" examines five levels of the conceptual model of a digital university, formed for successful collaboration between Russian and foreign universities. The first level is represented by researchers (NPR), students, industry and university partners of the university, graduates of the university. The external and internal stakeholders of the university are also based here. At the second level, there are basic information services that determine the information support for digital communication within the university. Examples include services, such as: video screens for lectures and seminars, wireless communication throughout the university (including dormitories), and cloud data storage (Glukhova, Kaziev, et.al., 2021).

The third level implies a number of services that significantly facilitate the work of students and faculty of a modern university. The fourth level is the most resource-intensive in terms of implementation, but at the same time, allows the university to get the greatest added value. It consists of services, such as digital marketing, research project management, procurement management, interaction with applicants and students (Nesterov, 2015). The fifth level consists of digital technologies, which are highly likely to be widely used in the university environment from 2018-2019. Such technologies, for example, include drones (unmanned aerial vehicles).

There is no universal solution that ensures the achievement of concrete results through the use of digital technologies. But by listening to the opinion of end users, it is possible to acquire the most valuable information and use it as a basis for further actions (Rabenatulutra, 2022).

The prerequisite for the emergence of the concept of Smart universities was Industry 4.0.
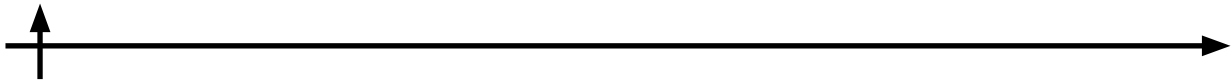
Tarasov I.V., in his article "Industry 4.0: Concept and Development Trends", builds his research around the concept of "Industry 4.0", which was first introduced by the German Federal government as a strategic plan for the development of German industry, based on the unification of industrial equipment and information systems in a single information space, allowing them to interact on their own, without human involvement (Tarasov, 2017).

Another work "The concept of a "Smart University", published in the journal "Automation and Software Engineering", V.A. Zhmud describes the development of a model of a "Digital University" and its replication to the higher education system. According to the author, based on the data of the Ministry of Education, a conditional framework has already been defined for the model of a "Digital University" to be built. The framework will consist of four blocks - university management information systems and online support of the educational process.

V.A. Zhmud claims that the "Digital Transformation Center" is needed in order to transform the formation and content of education. The author uses this example to show that the form can be changed using digital services and technologies (Zhmud, 2019). The Ministry of Communications will create highly-effective platforms that are necessary for obtaining public services online. The student will be able to receive certificates and register at the military enlistment office online. Changes in the content of education are also planned, and along with the already developing segment of online courses, courses using AR and VR will be introduced. Today, thanks to modern technologies, it will be easier for students to study their profession hands-on (Sidorov, 2017).

A. Schwindt, in his turn, mentions that in addition to the "Digital University", emphasis will be placed on the individual trajectory of education, that is, collecting information not only according to the teacher's assessments, but also according to the results of online courses. Such information will be collected, processed and personalized based with the help of AI, which would be time-saving for both, students and faculty.
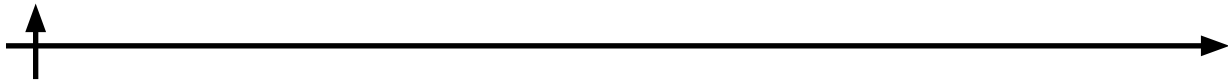
Results and Discussion

All of the above mentioned works also provide arguments that relate to the specifics of the transition from an industrial to a post-industrial society in education. Not all participants of the educational process are ready to change educational paradigms. Without this change in education, it is impossible to achieve the concept of Smart Universities, but society and the state are doing everything possible to implement this concept into education.

Table 1 describes the components of paradigms that change, as does the way of our society and the economy: from industrial to post-industrial society.

Table 1. Changing educational paradigms

Components of paradigms	Industrial Society	Post-industrial society
Values	1. public education is realized in special educational institutions; 2. education for industries – professional training.	1. personal career and fulfillment are prioritized before public interests; 2. personalized approach to teaching; 3. creative education, life-long learning.
Motives	1. training = duty; 2. activity of a teacher is observed as fulfillment of one's professional duty; 3. the optimal educational unit is a group.	1. students' interest in education; 2. joy of achieving results; 3. teachers are interested in the development of students, find reward communicating with them; 4. the optimal educational unit is an online network team.
Norms	1. the teacher is responsible for the training; 2. the authority of the teacher is maintained by keeping distance, and requiring discipline from students.	1. students take responsibility for their learning; 2. the authority of the teacher is created by his personal qualities and professional merits.

Components of paradigms	Industrial Society	Post-industrial society
Goals	1. training is focused on the acquisition of scientific knowledge; 2. learning while young makes a "life's main asset".	1. training is focused on mastering the basics of human culture and competencies; 2. life-long learning.
Roles of participants in the educational process	1. teacher = knowledge transmitter; 2. teacher's position is higher.	1. the teacher creates space for developing personal educational environment, and encourages independent learning; 2. efficient learning rests on cooperation and co-authorship between teachers, students, practitioners and international PPP communities.
Forms and methods	1. hierarchical and authoritarian methods, stable structure of academic subjects; 2. stable forms of organization of the educational process; 3. emphasis on classroom work under the guidance of a teacher.	1. individual educational trajectory; 2. modular open world intellectual resources; 3. emphasis on planned education itself.
Tools	1. textbook makes the main means of teaching; training stands and laboratory work.	1. the textbook is complemented by the world's open educational resources, potential of online expert communities, and the opportunities provided by social networks and the media.
Control and quality of education	1. monitoring and evaluation are carried out mainly by the teacher.	1. shifting the emphasis on self-control and self-management in students; 2. participation in the assessment of the quality of education of professional communities; 3. education becomes open to criticism.

A smart university cannot exist without a well-functioning smart infrastructure and smart processes. Smart processes are based on trained people, digital literacy, innovative approaches, continuous updating, active use of Information and Communication Technologies, dynamic interaction and a high level of motivation (Tuluzakova, 2022). They should occur and be supported in all areas of the educational process and the organization as a whole: in smart education, science, and management (Kaptur, 2019; Bolchek, 2023).

In smart education, these are: innovative teaching materials, a dynamic interaction between teachers, technical support and students, updating information about the educational process: schedules, personal accounts of students, resources for teachers and etc. (Krishtal, 2019)

In the management system, these are: the educational process, scientific work and management and finance. Scientific work is intertwined with the educational process and the management system. The smart infrastructure includes a well-established corporate network, IoT, smart-learning, and a management system (Sarsembayeva, 2017).

A detailed diagram describing the processes at a smart university is presented in Figures 1-3.
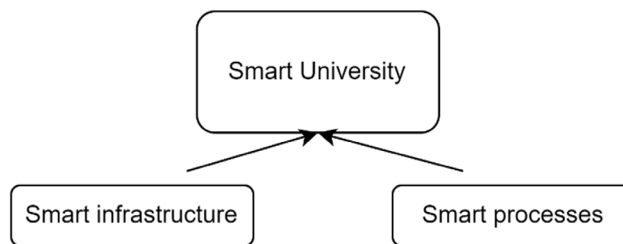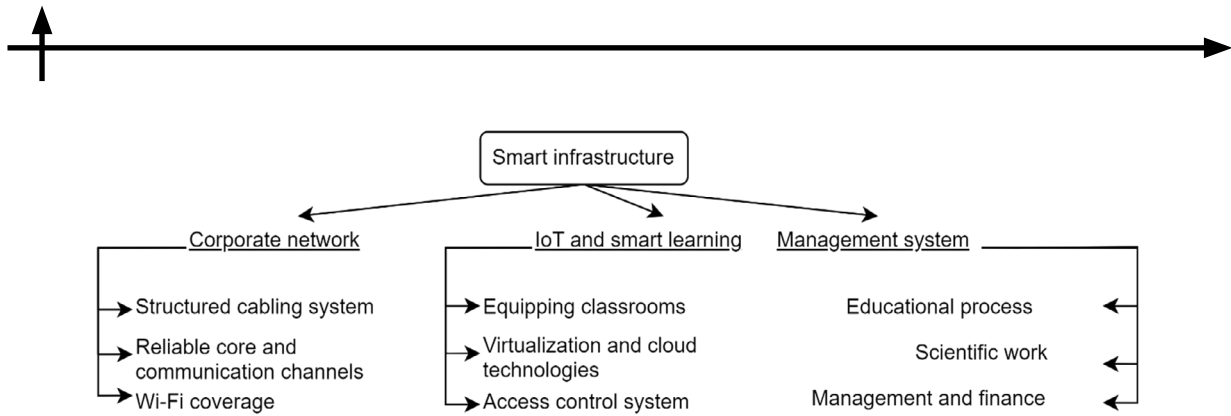

Fig. 1. Processes in a Smart University
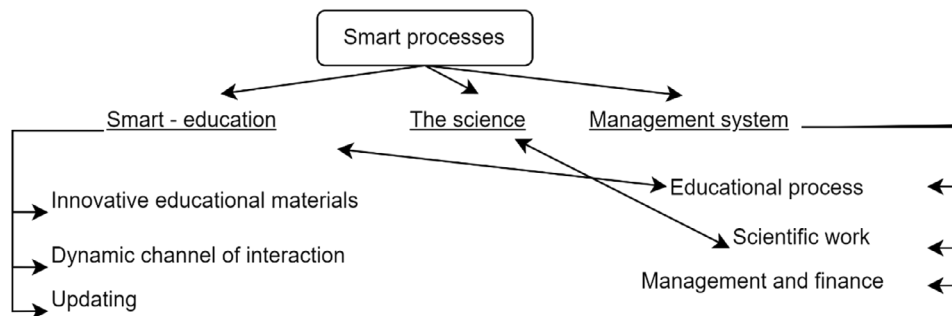
Fig. 2. Processes in a Smart University

Fig. 3. Processes in a Smart University

Conclusions

Overall, the major reasons why it is difficult to digitalize universities include the following:

− The second most conservative social institution is a university;

− The professor always knows how and what to teach;

− It is possible to fulfill all formal indicators requested by the system without changing anything in real activity;

− The professor does not want to be evaluated by the students, importance of student feedback is neglected;

− Employers do not know who they will hire in 4-6 years, clarity in this regard is absent.

− Students and graduates are not ready to take responsibility for their career choice and education;

− It is necessary to significantly change the space and infrastructure of the campus;

− For now, there is no model of effective higher education;

− The concept of "average" university in the country is a myth.

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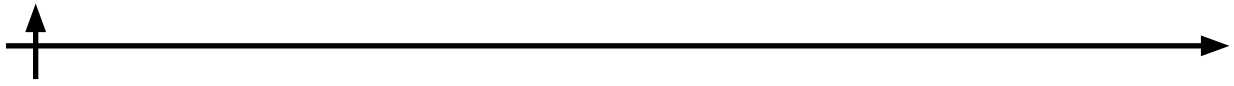
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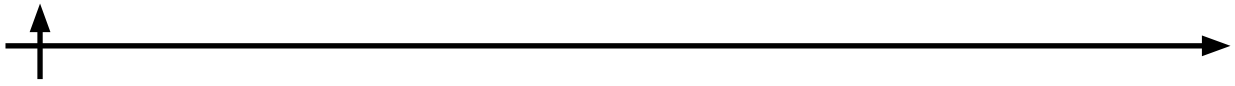
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