ASSESSMENT OF REQUIREMENTS OF REGULATORY DOCUMENTS ON THE USE OF ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

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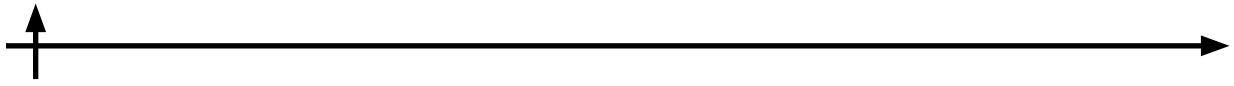Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia

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Abstract. This scientific article is devoted to the systematization of the requirements of domestic standards and other international regulatory documents in the field of application of artificial intelligence technologies in higher education. The research includes analysis of the main standardizing domestic and international documents, identification of drivers and goals of higher education institutions in the use of artificial intelligence technologies in educational processes. The article also presents a model of motivational extension within the TOGAF concept using the ArchiMate enterprise architecture modelling language, which allows to systematize both the requirements of standards and the motivations of higher education institutions to use artificial intelligence. The results of the study can contribute to a more effective integration of artificial intelligence technologies in higher education, taking into account the current standards and needs of educational institutions.

Keywords: artificial intelligence, higher education, higher education institution, standards, documents, requirements, educational processes, motivation extension, ArchiMate, TOGAF

АНАЛИЗ ТРЕБОВАНИЙ НОРМАТИВНЫХ ДОКУМЕНТОВ К ИСПОЛЬЗОВАНИЮ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В СФЕРЕ ВЫСШЕГО ОБРАЗОВАНИЯ

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Аннотация. Настоящая научная статья посвящена систематизации требований отечественных стандартов и других международных регламентирующих документов в области применения технологий искусственного интеллекта в сфере высшего образования. Исследование включает анализ основных стандартизирующих отечественных и зарубежных документов, выявление драйверов и целей высших учебных заведений в использовании технологий искусственного интеллекта в образовательных процессах, а также в статье представлена модель мотивационного расширения в рамках концепции TOGAF с использованием языка моделирования архитектуры предприятия ArchiMate, что позволяет систематизировать как требования стандартов, так и мотивы вузов к применению искусственного интеллекта. Результаты исследования могут способствовать более эффективной интеграции технологий искусственного интеллекта в высшее образование, учитывая текущие стандарты и потребности образовательных учреждений.

Ключевые слова: коэффициент корреляции, номинальные данные, коэффициент Юла, коэффициент Пирсона, корреляционные связи. искусственный интеллект, высшее образование, высшее учебное заведение, стандарты, документы, требования, образовательные процессы, мотивационное расширение, ArchiMate, TOGAF

Introduction

In today's world, when artificial intelligence (hereinafter referred to as AI) is revolutionizing many industries, higher education should also keep up with the change and implement the potential of AI to improve the educational process and increase the efficiency of administrative tasks. The possibility of increasing the efficiency of information resources use in an organization appears if a unified information space is built and an IT infrastructure is created, based on modern methods and models of building information systems, data and knowledge exchange systems and relevant information and communication technologies (Ilyin, Shirokova, 2022). Education should become multi-format and personalized (Dyatlova, 2023). This can be realized by introducing new information systems into the structure of higher education institutions (hereinafter referred to as HEI) processes.

The relevance of this research article is as follows. Standards and regulatory documents play a key role in ensuring the correct and ethical application of AI in any field, including higher education. Standards establish requirements, constraints and guidelines that help to ensure that AI technologies are used effectively, safely and for the benefit of all stakeholders. However,
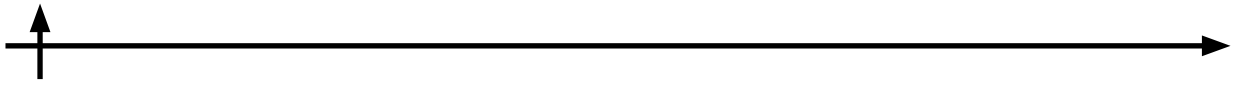
there is a challenge in that AI standards and regulations can be very numerous, complex and frequently updated due to the rapid development of AI technologies. This creates challenges for higher education institutions to understand and comply with all relevant requirements.

Moreover, the goals and needs of HEIs in the context of AI application may differ depending on the specific institution, educational programs and administrative processes. It is important to identify the drivers and motivations that encourage HEIs to apply AI, as well as to understand the constraints and requirements that set standards to ensure successful integration of AI into the educational environment. The realization of the strategic goals of the enterprise should be ensured by a flexible and effective management system (Ilin, 2022).

The article aims to help higher education institutions understand the complex landscape of standards, identify drivers and constraints in the context of AI applications, and ultimately successfully integrate AI technologies into educational and administrative processes.

Purpose of the study: systematization of the requirements of domestic standards and other foreign regulatory documents in the field of application of artificial intelligence technologies in higher education.

Objectives:

− to analyze the main standardizing domestic standards and foreign regulatory documents in the field of application of AI technologies in higher education;

− to identify the drivers and goals of higher education institutions in the context of the application of AI technologies in educational processes/processes of organization and support of the educational process, as well as to identify the limitations and requirements of standards and other regulatory documents in the field of application of AI technologies in higher education;

− to create a model of motivation extension within the TOGAF methodology to systematize the requirements of domestic standards and other foreign regulatory documents in higher education, as well as to systematize the drivers and motives that encourage HEIs to apply AI technologies.

Subject of the research: regulating, standardizing, normative and other documentation in the field of implementation of artificial intelligence technologies in educational processes and processes of support and organization of educational process in higher education institution.

Object of the research: educational processes and processes of support and organization of educational process in higher education institution.

Materials and Methods

The following materials and methods were used to fulfil the aim and objectives of this research article:
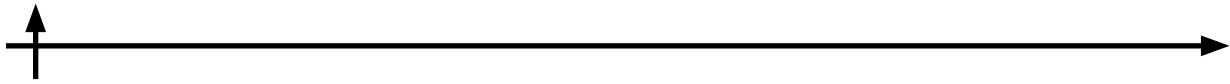
1. Analyzing standards and regulatory documents.

First, the main domestic standards, such as 'GOST R 59895-2021' and 'GOST R 70946-2023', as well as foreign regulatory documents, such as guidelines from the UNESCO Institute, were analyzed.

The general provisions, terminology, functional subsystem of learner performance management, test methodology and other aspects related to the application of AI technologies in education were studied.

2. Identification of drivers, goals and constraints of higher education institutions.

For this purpose, research was conducted into the motives that may encourage universities to apply AI technologies in educational processes.

The goals and drivers in the context of using AI in the organization and support of the educational process were identified, as well as the limitations and requirements established by

standards and other documents.

3. Modelling a model of motivation extension within the TOGAF methodology.

To systematize the requirements of standards and other regulatory documents, the modeling of the motivation extension model was used.

TOGAF methodology was used to organize and classify drivers and motives that stimulate higher education institutions to use AI technologies.

Thus, the paper used analytical methods to analyze the standards, exploratory methods to identify the drivers and goals of universities, and modelling within the TOGAF methodology to systematize the requirements and motivations for the application of AI technologies in higher education.

Results and Discussion

The introduction of AI technologies into educational processes requires the use of unified concepts and definitions to ensure a uniform understanding and exchange of information between specialists in the field. One of the breakthrough technologies in solving automation challenges is artificial intelligence (Abdukhalilova, 2023). A digital strategy requires IT tools capable of supporting its development, implementation and evaluation (Maidanova, 2023).

Standard GOST R 59895-2021 «Artificial Intelligence Technologies in Education. "General provisions and terminology" is a fundamental standard that defines key terms and concepts in the field of AI use in education. Thanks to the standardization of terminology, it becomes possible to effectively implement new technologies, as well as to exchange experience and transfer knowledge between participants of the educational process.

The document consists of three main sections:
1. "Scope of application".
2. "Terms and definition": terms related to artificial intelligence; terms related to the educational process; terms related to the use of artificial intelligence technologies in education.
3. "Use of artificial intelligence technologies in education": computer vision technologies; technologies of natural language processing, speech recognition and synthesis; technologies of intellectual decision-making support; promising artificial intelligence technologies; use of the totality of described artificial intelligence technologies.

The document introduces specialized terms that apply exclusively in the context of the use of AI in education, which distinguishes it from other standards. While most standards cover a wide range of applications of AI without reference to a specific subject area or domain, this document focuses exclusively on the educational domain.

It is worth mentioning important advantages of GOST R 59895-2021 standard, which can be taken into account when implementing AI technologies in the system of support and organization of the educational process:

1. Standardization and unification of terminology in the field of application of AI technologies in higher education helps to ensure a common understanding of AI concepts among all participants of the educational process.

2. Clarity of terminology provides developers with clear criteria for creating educational AI systems.

3. The possibility to avoid misunderstandings and legal disputes related to the use of AI technologies in education.

The digitalization of activities generates an increasing amount of data that requires further processing. It is data that is at the heart of digital transformation (Morozevich, 2022). In this regard, it is necessary to have some document prescribing the requirements for testing this data.

The next document for analysis is the standard GOST R 70946-2023 «Artificial Intelligence
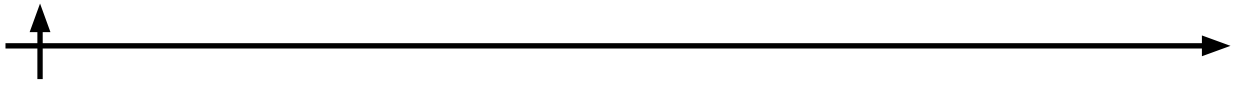
Technologies in Education. Functional subsystem for managing the progress of students on bachelor's and specialist's programs. General provisions and test methodology». This standard defines the general provisions and test methodology of AI technologies used in the management of learning achievement of students on undergraduate and specialist programs within the framework of the relevant functional subsystem of a higher education institution.

The document is organized into seven main sections:

1. "Scope of application".
2. "Normative references".
3. "Terms and definitions".
4. "General Provisions". It is important to note that this section states that in order to ensure confidence in artificial intelligence systems (hereinafter referred to as AIS) used to implement learning progress management, the test methodology set out in this standard should be applied. For the realization of other functions arising within the functional subsystem under consideration, the test methodology set out in this standard is also applicable, provided that it is transformed to take into account the peculiarities of the applied AI technologies. In other words, it means that the test methodology described in this standard can also be applied to other modules of the system, including those mentioned earlier, but it needs to be adapted to the specific AI technologies. This means that it is possible to scale and use it not only for testing the module of learning progress accounting with the help of AI technologies, but also for testing any different functions of organization and support of the educational process of HEI.
5. "Test Methodology". It is one of the main sections. This section describes the following points: who are the participants of the tests, the responsibilities of the customer and the test laboratory during the tests, the essential conditions of operation, the formation of the test data set, as well as the formulas for calculating the classification and approximation indicator (the choice of one of the indicators is set by the customer), which will be subsequently calculated by the test laboratory and recorded in the test report.
6. "Examples of intelligent systems and tasks for managing the progress of students on bachelor's and specialist programs".
7. "Description of the basic demonstration dataset".

Let us describe the advantages of using the GOST R 70946-2023 standard when implementing AI technology in the system of support and organization of the educational process:

1. Providing a unified approach to testing of the AI system when implementing it in the processes of support and organization of the educational process in the sphere of higher education;
2. Ensuring consistency in the assessment of compliance of the stated requirements to the system with the actual functions of the system and identification of inconsistencies for their subsequent elimination.

The economy, which had started to recover, was again caught in the crucible of another crisis - COVID-19 (Vinichenko, 2020). Educational organizations were forced to restructure the system of personnel training, switch to distance learning and, in general, completely restructure their business processes in the shortest possible time. In this regard, there was no doubt that sooner or later higher education institutions would need to integrate artificial intelligence into their processes.

The use of international standards in the implementation of AI technologies in the system of support and organization of the educational process in higher education is of great importance. AI technologies have a serious potential for implementation in the field of science and higher education and nowadays successful results are already observed in the international practice. For successful implementation of new technologies, it is necessary to take into account possible and available international experience (Alexandrov, 2021). Modern education is impossible without
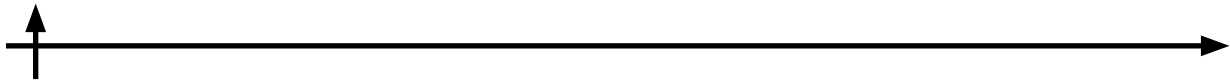
the use of digital technologies (Kolesnikova, 2021), in particular, without the evaluation and application of international best practices in the field of implementation of AI technologies in the educational process.

"Guidance for Generative AI in Education and Research" is a document developed by the UNESCO Institute to provide guidance on the use of generative AI in education and research. The document covers issues such as the ethical, social and educational aspects of the use of generative AI and offers recommendations for its application in teaching and research environments. It also analyses the existing problems and challenges associated with the use of generative AI in education and research and suggests ways to address them. In addition, the document provides recommendations and best practices for integrating generative AI into curricula, research projects and other educational and research activities. The importance of this approach to organizational development is now understood by almost everyone (Mokaeva, 2021).

The document is organized into six main sections:

1. "What is generative AI and how does it work?".
2. "Controversies about generative AI and their implications for education".
3. "Regulating the use of generative AI in education".
4. "Towards a policy framework for the use of generative AI in education and research".
5. "Promoting the creative use of generative AI in education and research".
6. "Generative AI and the future of education and research".

AI co-operates with humans in various fields of activity, including education (Petrova, 2021). The report of the UNESCO Institute for Information Technologies in Education, reveals the main provisions of the application of AI systems in the field of education. The report focuses on the advances in technology in the educational environment, the capabilities of AI systems at the moment, as well as some prospects for this technology in the future (Chagilov, 2021). Artificial intelligence is a huge resource that opens up rich opportunities for improving the educational process (Radugin, 2021).

The document "Guidance for Generative AI in Education and Research" provides valuable recommendations on the use of generative AI in education and research. These recommendations may be particularly useful for Russian higher education institutions that are seeking to introduce AI technologies into the educational process. The main recommendations include the following:

1. Ethical principles. The UNESCO guidelines emphasize the need for ethical standards in the use of AI, which helps Russian HEIs to develop and implement AI technologies that respect the rights and freedoms of students and teachers.

2. Transparency and accountability. The UNESCO guidelines emphasize the need for transparency of algorithms and accountability for their results, which is important for building trust in AI systems in the academic environment.

3. Quality of education and educational process organization. By providing methodologies for integrating AI into the educational process, the UNESCO guidelines contribute to improving the quality of education, allowing students to have a personalized and adaptive learning experience and university staff to organize their work more efficiently.

In the period of digital transformation, artificial intelligence technologies are being actively developed and implemented in the processes of various organizations (Blinnikova, 2020). This trend extends to the educational and administrative processes of higher education institutions.

As a result of the analysis of the selected documents that can help IT specialists in the possible implementation of artificial intelligence technologies in the system of support and organization of the educational process in higher education institution, it is possible to compile and
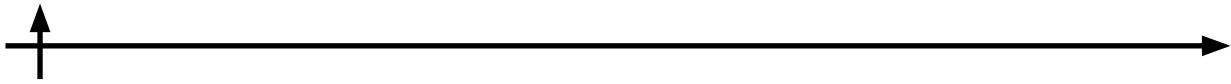
systematize the main requirements that each of them puts forward:

1. Standard GOST R 59895-2021 "Artificial Intelligence Technologies in Education. General provisions and terminology". The main requirement put forward by the standard: Application of standardized and unified terminology in the field of implementation of AI technologies in educational processes/processes of organization and support of educational process in higher education institution.

2. Standard GOST R 70946-2023 "Artificial Intelligence Technologies in Education. Functional subsystem for managing the progress of students on bachelor's and specialist's programs. general provisions and test methodology". The main requirement put forward by the standard: Application of a unified approach to testing of functional modules of the AI system when it is implemented in educational processes/processes of organization and support of the educational process in higher education institution.

3. "Guidance for Generative AI in Education and Research". The main requirement of the standard: Compliance with international practices and trends in the field of implementation of AI technologies in educational processes/processes of organization and support of educational process in higher education institutions.

Now, with a clear systematized set of document requirements, it seems possible to generate a motivation extension model within the TOGAF methodology using the ArchiMate modelling language, which will achieve the following objectives:

− identify the drivers and goals that higher education institutions have in implementing AI technologies in their processes;

− identify the constraints and requirements that standards and other regulatory documents impose on the application of AI technologies in higher education.

In the description of enterprise architecture, one of the most popular tools is ArchiMate - a tool for integrated high-level modelling and analysis of various enterprise domains and dependencies between domains. Within the discipline of Enterprise Architecture, the concept of motivation extension is used, which is understood as a model of external forces (stakeholders, drivers of situations, constraints, requirements, assessments) that influence the emerging business architecture (Ilyin, Levina, 2019). Motivation extension is an extremely important feature of ArchiMate because it is an effective tool for describing goals, drivers, interaction principles, business requirements and business constraints (Voronova, 2021).

Let us describe in more detail each of the components of motivation extension: stakeholders, drivers, driver evaluations, goals, outcomes, constraints and requirements.

The main stakeholder is the higher education institution. It is also the customer.

Drivers are the main interests of the stakeholder in the system (Mapping methodological concepts using the ArchiMate language).

Drivers:

1. The need for the HEI's IT infrastructure to keep up with the latest cutting-edge technologies in higher education.

2. The need to support the competitiveness of HEI IT support in the market of educational services.

3. Growing volume of information and the need of educational and support staff to quickly process and analyze it.

Assessment is the result of analyzing the state of affairs in an enterprise in relation to a driver (Elements of motivation).

Assessments:

1. The existing IT infrastructure of the HEI does not meet the latest advanced technologies
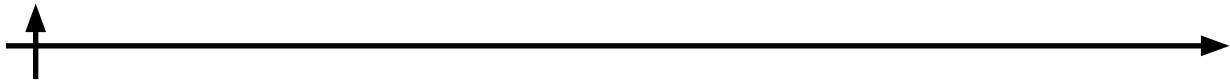
in higher education.

2. Low competitiveness of HEI on the market of educational services.

3. Low current speed of analyzing and processing information by the teaching and support staff.

A goal is a high-level statement about the intentions, direction of development, or desired end state of an organization and its stakeholders (ArchiMate 3.1 Specification).

Goals:

1. Update and modernize IT infrastructure, implement new technologies and IT solutions.

2. High competitiveness in the market of educational services due to effective IT support of the educational process.

3. Development of IT infrastructure to ensure high speed and efficiency of information processing.

The overall goal is «Introduction of AI technologies into educational processes/system of support and organization of educational process in HEI».

An outcome is a desired or achieved result that affects the motivation of stakeholders and determines the strategic goals of the organization (ArchiMate. Motivation Layer).

Outcome:

1. Improving the efficiency of the educational process and formation of the modern image of the HEI.

2. Increasing the attractiveness of HEI for future and current students and potential partners.

3. Improving the efficiency of decision-making processes of the teaching and support staff and responsiveness to students' requests.

Constraints:

1. Standard GOST R 59895-2021 «AI technologies in education. General provisions and terminology».

2. Standard GOST R 70946-2023 «AI Technologies in Education. Functional subsystem for managing the progress of students in undergraduate and specialist programs. General provisions and test methodology».

3. Guidance for Generative AI in Education and Research.

Requirements:

1. Application of standardized and unified terminology in the field of implementation of AI technologies in educational processes/processes of organization and support of educational process in higher education institution.

2. Applying a unified approach to testing the functional modules of the AI system during its implementation in educational processes/processes of organization and support of educational process in higher education institution.

3. Compliance with international practices and trends in the field of implementation of AI technologies in educational processes/processes of organization and support of educational process in higher education institution.

The model of motivation extension for higher education institutions when introducing artificial intelligence technologies in educational processes and processes of support and organization of educational process in higher education institution is presented in figure 1.
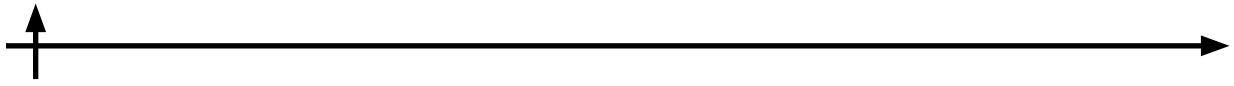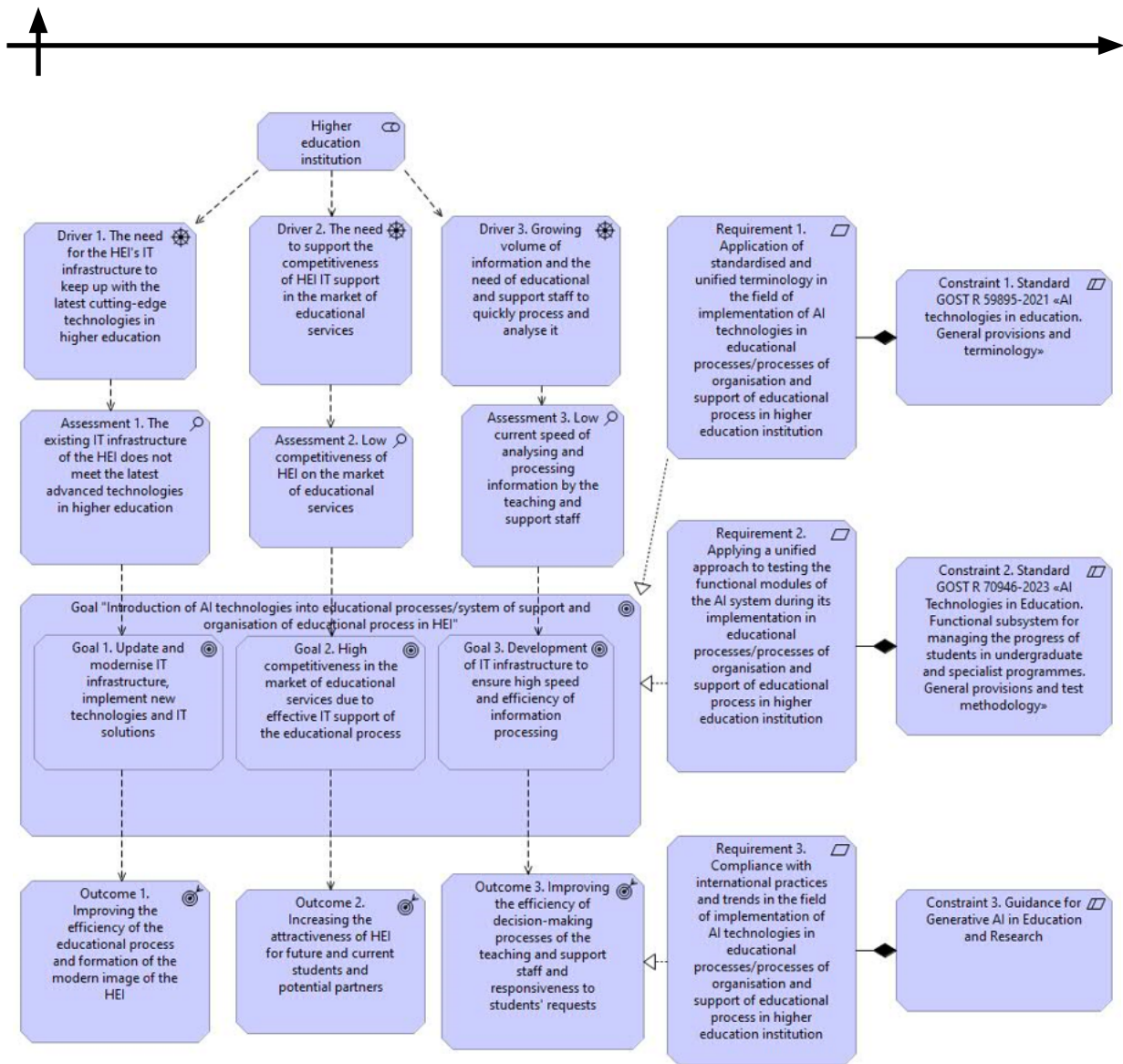
Fig. 1. Model of motivation extension for higher education institutions when introducing artificial intelligence technologies in educational processes and processes of support and organization of the educational process

The proposed model of motivation extension will allow further qualitative modelling of the model of the current state of the organization 'AS-IS', identify bottlenecks in the work of the organization and model the model of the target state of the organization 'TO-BE', which, ultimately, will help IT specialists in understanding the complex landscape of processes of higher education institutions and will contribute to the successful integration of artificial intelligence technologies into the educational and administrative processes of higher education institutions.

Conclusion

In conclusion, it should be noted that the systematization of the requirements of standards and other regulatory documents in the field of application of AI technologies in higher education is an important and urgent task. Proper and effective application of AI technologies in the educational process can bring significant benefits and improve the quality of higher education.

In the course of this study, the main standardizing domestic standards and foreign regulatory documents concerning the application of AI technologies in higher education have been analyzed, namely the standard GOST R 59895-2021 «Artificial Intelligence Technologies in Education. General provisions and terminology», standard GOST R 70946-2023 «Artificial Intelli-

gence Technologies in Education. Functional subsystem for managing the progress of students on bachelor's and specialist's programs. general provisions and test methodology», the guidelines from the UNESCO Institute «Guidance for generative AI in education and research». This made it possible to identify general trends, requirements and limitations that should be taken into account by higher education institutions when implementing AI technologies.

One of the key aspects of the study was to identify the drivers and goals of higher education institutions in the context of the application of AI in educational processes and their relationship to the requirements of standards. It was found that HEIs are interested in using AI to improve the quality of education, personalize learning, increase the efficiency of administrative tasks and many other goals. These drivers and goals play an important role in motivating HEIs to implement AI technologies.

In addition, a motivation extension model within the TOGAF methodology was modelled using the ArchiMate modelling language to systematize the requirements of standards and other regulatory documents and visualize the link between them and the drivers and goals of higher education institutions when implementing AI technologies. This model provides a structured approach to understanding and complying with the requirements of the standards, ensuring successful integration of AI into educational processes and processes of organization and support of the educational process. The result of the formation of a motivation extension to update and modernize the IT infrastructure, increase competitiveness through effective IT support of the learning process and develop the speed and efficiency of information processing can be the transformation of a higher education institution into a modern educational institution with an attractive offer for students and partners.

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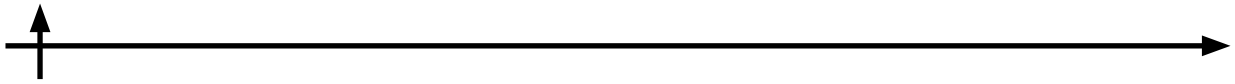
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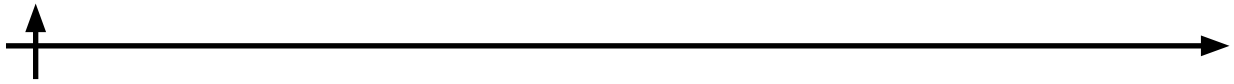
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