ТЕХНИЧЕСКИЕ НАУКИ
И ТЕХНОЛОГИИ

IT ЖАҢА ТРЕНДТЕРІ
НОВЫЕ ТРЕНДЫ IT
IT NEW TRENDS

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DIGITAL PLATFORM ARCHITECTURE FOR ENGINEERING EDUCATION MODEL

ИНЖЕНЕРЛІК БІЛІМ БЕРУ МОДЕЛІНІҢ ЦИФРЛЫҚ ПЛАТФОРМАСЫНЫҢ АРХИТЕКТУРАСЫ

АРХИТЕКТУРА ЦИФРОВОЙ ПЛАТФОРМЫ МОДЕЛИ ИНЖЕНЕРНОГО ОБРАЗОВАНИЯ

Abstract*. Digital platforms have become an essential part of engineering education's innovative transformation as a result of the rapid development of technology and constant changes in the field. This article examines and emphasizes the importance of developing a digital platform to provide resources and operational support for implementing the National Model of Engineering Education. The article describes the architecture of a modular digital platform. A study identifies what services are required, which user categories will use it, and which software components should be implemented. As a result of implementing a digital platform based on the proposed architecture, various categories of users will be able to access the necessary set of engineering profession-related services.*

Keywords: *digital platform, engineering education model, web application, the software implementation, multi-level architecture.*

Аңдатпа*. Технологиялардың қарқынды дамуы мен білім беру саласындағы тұрақты өзгерістерді ескере отырып, цифрлық платформаларды құру инженерлік білім беру жүйесін инновациялық трансформациялаудың аса маңызды элементіне айналады. Бұл мақала инженерлік білім берудің ұлттық моделін құру мен енгізуді ресурстық қамтамасыз етуге және операциялық қолдауға арналған цифрлық платформаны әзірлеудің маңыздылығын зерттеуге және негіздеуге арналған. Мақалада модульдік тәсілге негізделген цифрлық платформаның архитектурасы қарастырылады. Зерттеу барысында қажетті қызметтер жиынтығы, пайдаланушылардың әлеуетті санаттары, оның жұмысын қамтамасыз ету үшін іске асырылуы тиіс қажетті бағдарламалық компоненттер анықталды. Ұсынылған архитектура негізінде цифрлық платформаны іске асыру пайдаланушылардың әртүрлі санаттарына жұмыста инженерлік бейін-дегі кәсіптерді қолдауға байланысты қажетті сервистер жиынтығын пайдалануға мүмкіндік береді.*

Түйін сөздер*: цифрлық платформа, инженерлік білім беру моделі, Веб-қосымша, бағдарламалық жасақтама, көп деңгейлі архитектурасы.*

Аннотация. *В свете динамичного развития технологий и постоянных изменений в сфере образования, создание цифровых платформ становится крайне важным элементом инновационной трансформации системы инженерного образования. Данная статья посвящена исследованию и обоснованию значимости разработки цифровой платформы, предназначенной для ресурсного обеспечения и операционной поддержки создания и внедрения Национальной модели инженерного образования. В статье рассмотрена архитектура*

цифровой платформы на основе модульного подхода. В рамках исследования определены необходимые наборы сервисов, потенциальные категории пользователей, требуемые программные компоненты, которые должны быть реализованы для обеспечения её работы. Реализация цифровой платформы на основе предложенной архитектуры позволит различным категориям пользователей использовать в работе необходимый набор сервисов, связанных с поддержкой профессий инженерного профиля.

Ключевые слова: *цифровая платформа, модель инженерного образования, Веб-приложение, программная реализация, многоуровневая архитектура.*

Introduction. The rapid development of science and technology has posed many challenges to modern education. Industrial and technological progress require engineering education to adapt effectively to ever-changing requirements as an integral part of the educational system. A digital platform becomes a necessary component of ensuring high-quality specialist training in this context.

Engineering education uses a variety of IT solutions via digital platforms. The term "digital (electronic) platform" in the technical aspect has the following interpretation: building an information system that allows, using the open tools provided by the platform, to build their own products that can work and interact with other products on the same platform [1]. Platforms create a technological foundation and open up new opportunities for the implementation of various ideas. Amazon's AWS cloud platform is a classic example in the business world. [2]. A digital educational platform can be stationary (installed on the organization's server) or online (stored in the cloud). Platform choices must take into account several criteria: cross-platform support, support for the required types of content, ease of implementation, security standards compliance, support for different user streams [3]. Educational platforms are characterized by their compatibility with applications to develop distance courses based on different standards, for example: SCORM (Shared Content Object Reference Model), Common Cartridge, QTI, LTI, xAPI, Tin Can API, experience API, etc.

It is becoming increasingly common to use the term "ecosystem" in this stage of technology development, one that allows IP-based interaction using an agreed-upon data transfer protocol. A good example of an ecosystem abroad is Apple, and Yandex and Beber are good examples of ecosystems in Russia.

Digital products used in education primarily include LMSs (Learning Management Systems) [5], ICOSs (Modular Digital Educational Environments), and MOEs (Massive Open Online Courses).

Creating a specific architecture for an information system is a crucial step in its design. It describes the main functional elements of the system and their grouping in order to display the relationship between groups of elements and the environment. There is currently a non-architectural approach to designing, which involves building a system from separate low-level modules, but architectural solutions are considered more conceptual, affecting higher-level structures and aiming to meet all of the system's goals.

An analysis of the requirements [6-7] imposed on corporate web applications, such as completeness, clarity, the absence of redundancy, and scalability, while providing integration with other applications at the same time. In order to provide an API (Application Programming Interface), to handle a large number of requests without compromising data access speed, new approaches need to be implemented in the development of the system architecture. We should pay particular attention to the increasing need for corporate web applications to be more flexible and scalable, the weak connectivity of their software components, and the ability to integrate services from a variety of manufacturers, regardless of the programming languages and technologies used [7, p.150].

It is proposed to develop an architecture based on modular design in order to resolve the above-mentioned issues. This approach offers the advantage of expanding the platform by

adding new services if necessary [8].

This digital platform should offer the following services:

1. Registration of platform users - the registration of users on a digital platform allows them to access its resources.

2. Engineering education standards registry - this service involves maintaining a database (creation, update, termination, etc.) of engineering education standards. This database provides information about education standards for various types of users, based on the collected information.

3. Atlas of engineering professions – this service involves maintaining a database of engineering professions (creation, updating, terminating, etc.) and providing information about their professional characteristics and requirements. Its purpose is to provide information about current education standards for different categories of users based on the information contained in this database.

4. Information about engineering personnel needs - this service involves maintaining a database, collecting data about the needs for personnel in engineering professions in response to business requests for personnel of certain professions, as well as forecasts of economic development requiring the training of engineering personnel. The collected personnel needs data will be used for employment and for developing and implementing educational programs for training the required professional personnel.

5. Personnel information - this service involves gathering and analyzing information on students who graduated from higher and postgraduate education institutions, as well as technical and vocational schools. Employers are supposed to use the information collected as part of this service to find the necessary personnel, as well as analyze and forecast training volumes.

6. Register of educational programs - a digital platform that provides a central repository for educational programs developed based on educational standards. The register will include a variety of educational programs, including technical, vocational, and undergraduate and graduate programs. This educational program register is intended to assist in the selection of a study program in educational institutions that provide appropriate training programs.

7. Personnel training course register - this service maintains a database for engineering professionals on advanced training courses. There are several ways in which advanced training courses can be conducted, including by educational institutions with a license, and by enterprises with the necessary equipment and authority. Information from this service is intended for both individuals who want to improve their skills as well as business representatives who need to improve their employees' skills.

8. Register of training courses for advanced training of teaching staff – this service consists of maintaining a database on the proposed training courses for advanced training of teachers in engineering profile programs for organizations of higher and secondary special education. It serves as a resource for teachers seeking advanced training as well as educational institutions requiring advanced training of their staff.

9 Registries of certification centers and professional certificates issued by them - a database of certification centers, certification programs, and information about certification is maintained. The purpose of this register is to provide information about the possibility of passing professional certification according to the required programs, and to confirm that certification has been completed.

10. Digital platform Participants Interaction service - this service organizes interaction between system participants in the following areas:

– developing, modifying, and excluding education standards

– developing, modifying, and excluding professions from the atlas of professions

– developing, modifying, and excluding education standards educational programs, etc.

11. Integration service - this service automates the receipt and transmission of data from participants' information systems.

12. Management services - these services handle the general operation of the digital platform, including directory management, access control, and registration of users.

Category-based capabilities should define what users can do on the digital platform. The digital platform could be used by the following categories of users:

1. Companies that require engineering specialists who have the appropriate skills and knowledge or who are certified as required by their organizations.

2. Organizations that provide training, advanced training, or professional certification This category includes: higher education and postgraduate education organizations; organizations that provide technical and vocational education; training centers, etc.

3. Government entity to assess the need for engineering personnel and the possibility of training and advanced training for them.

4. Persons interested in pursuing advanced engineering training and education: applicants to choose an educational program for training; persons seeking advanced training; persons seeking professional certification etc.

The relationship between platform services and users needs to be determined based on the above services and possible users of the digital platform. This use case diagram shows which groups of users will use which services (Figure 1).

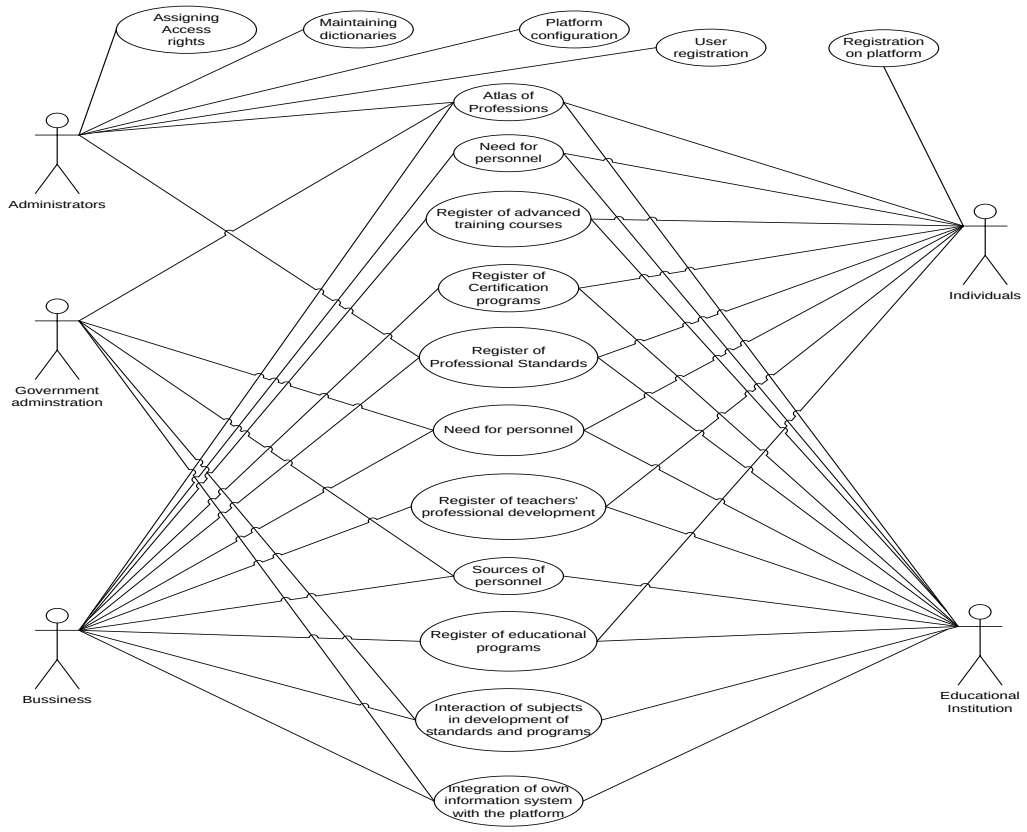

Figure 1. Digital platform services usage diagram

Next, software components must be determined to ensure the operation of a digital platform's

architecture. This component has been divided into three levels for ease of design:

1. Data layer. This group includes components that provide work with databases based on the PostgreSQL database management system and a file storage system

2. The level of basic services. It includes components that interact with data layer components, provide security, and support integration with other information systems.

3. The level of user services. This group includes components that users of the digital platform interact directly with. These services were previously listed.

Figure 2 shows a diagram illustrating how the components of the digital platform are distributed and interact.

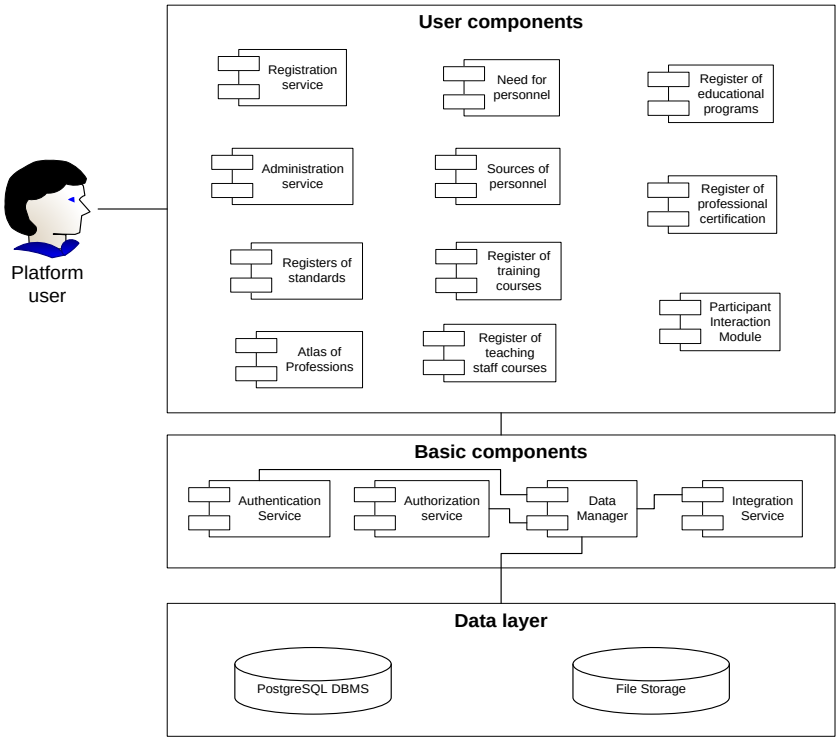

Figure 2. Digital platform components

Figure 2 shows the proposed architecture's modularity, which allows parallel development, testing, and debugging of platform components.

Our final consideration will be the physical implementation of the digital platform's proposed architecture. Digital platform will be implemented through a web-based solution since different categories of users will interact with it.

Figure 3 shows the general layout of the elements of the physical implementation of the proposed architecture of the digital platform.

Figure 3 illustrates the elements of the proposed digital platform's physical implementation. The specified elements include:

1. A data storage system that contains a database and file storage of a digital platform.

2. A digital platform web application that interacts with the data storage system and provides data to users over HTTP. This web application will be hosted on the Microsoft Internet Information Services web server. A web application can be implemented in a number of ways using the Microsoft technology.NET Framework [13-14], which offers all the services required

for both the basic components and the user components seen in Figure 2.

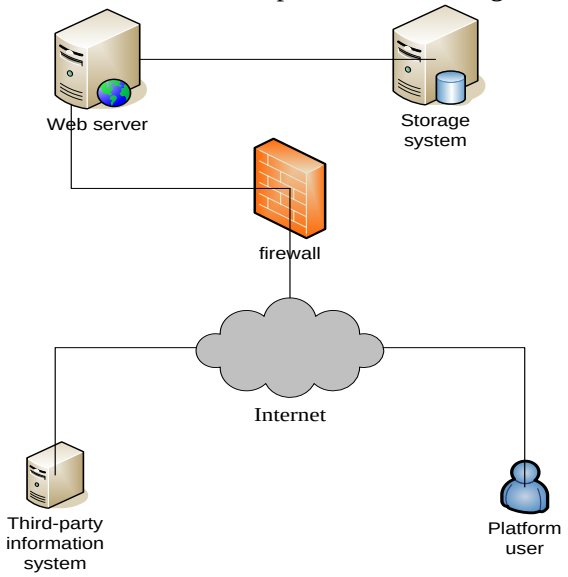

Figure 3. General layout of physical implementation elements

3. The client part consists of the following components

- Web browser - this element will be used by users to access the resources of the digital platform via the Internet.

- Special software for receiving and transmitting data to a digital platform when interacting with other information systems. A REST-based interaction technology is assumed to ensure interaction with other information systems.

Conclusions. This study examines the architecture for a digital platform to support resource provision and operational support as part of the creation and implementation of a National Model of Engineering Education. A specific set of services related to the support of engineering professions are provided on this platform to various categories of users (educational institutions, businesses, government agencies, etc.). Model construction included identifying the required platform modules, their interaction with other components, and the physical implementation of this digital platform.

The implementation of the proposed digital platform will provide the necessary level of services and ensure their safe use to provide support and resources for engineering education model in the Republic of Kazakhstan.

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