Requirements of key industries for digital technologies

S Kalyazina 1,3, E Zotova 1, I Bagaeva 1, and V Vasilenok 2

1 Peter the Great St.Petersburg Polytechnic University, St.Petersburg, Polytechnicheskaya, 29, 195251, Russia
2 Saint Petersburg National Research University of Information Technology, Mechanics and Optics (ITMO University), St.Petersburg, Russia

E-mail: kaliazina.s@gmail.com

Abstract. Key digital technologies are integral to digital transformation. Their inclusion in business processes helps to increase the efficiency and competitiveness of the company. In order to effectively incorporate technologies into the architecture of an enterprise, a set of requirements is formulated depending on the level of digital maturity of the company in order to solve the problem of digital transformation. The article discusses the issue of building a model for aligning the requirements of key sectors of Russian business to digital technologies. On this basis, it is planned to build reference models for Russian business sectors with the inclusion of selected digital technologies in the enterprise architecture.

1. Introduction

In the course of digital transformation, companies, which use digital technologies, increase their efficiency, flexibility and profitability. Due to the use of digital technologies, the development strategy and the principles of a company can be changed as a whole. Digital transformation is relevant for companies engaged in the digital business, as well as for real production enterprises [1]. At the same time, the set of digital technologies used in various industries is different. But in any case, key digital technologies help to transform business models, and create a unified system of customers and suppliers. Technologies that characterize digital transformation are cloud technologies, big data, artificial intelligence and machine learning, the Internet of Things, robots, augmented and virtual reality, horizontal and vertical integration, blockchain and others [2, 3]. Business, including Russian business, imposes certain requirements for the digital space architecture in order to include technologies that provide digital transformation. These are organizational requirements, requirements describing project implementation, documentation of implementation and operation of appropriate information technology. In this case, the depth of digital transformation depends on the level of digital maturity of the company [4].

2. Methodology

In 2020, a study was conducted to assess the key digital technologies in the Russian business environment and their importance for the Russian economy [5]. Thus, an expert survey was conducted. The experts expressed their opinion on the importance of the key digital technologies both in general and for the main sectors of the Russian economy, as well as their point of view on the impact of favorable and unfavorable factors on technology development. An expert survey is one of
the methods of qualitative research [6]. The assessment took into account the priorities of the Russian economy and the major global and Russian trends in digitalization. Accordingly, this study identified the key digital technologies and the main industries of the Russian economy by share in turnover. One of the research results includes a survey table that was elaborated to assess the role of digital technologies in the Russian economy. Some elements of augmented intellect were used in the analysis of the results. The survey results were influenced by the novelty of technologies and probable lack of understanding of the possibilities and applicability of technologies.

3. Results

Based on the results of the research, the consolidated outcomes of the expert survey were obtained on the importance of the considered digital technologies for the leading industries of the Russian economy. Among other things, the experts assessed the possible near-term implementation of technologies in the respective industries.

Thus, for agriculture, forestry, hunting, fishing and fish farming, experts identified 5G mobile communication as a key technology. They also noted the importance of the Internet of Things and augmented intelligence. In the sphere of mining, experts noted the importance of the Internet of Things, use of drones and 5G mobile communications. For the manufacturing industry experts highly valued the importance of almost all digital technologies, which is associated with the active transition of such sectors to Industry 4.0. Digital twin, peripheral analytics, augmented intelligence, the Internet of Things, 3D printing were noted as very important. In the production and distribution of electricity, gas and water, the importance of peripheral analytics, and the Internet of Things was noted. In the construction, the experts noted the importance of the 3D printing technology, which is gradually becoming one of the independent areas in this industry. The importance of the augmented reality, which is widely applied in designing, as well as the importance of the Internet of Things was emphasized. According to the experts, digital technologies are also being actively introduced in wholesale and retail trade, providing this industry with new opportunities for development. Augmented intelligence, machine learning, cloud computing are highlighted as the most important. Big data technology is also widely used in trade. In the sphere of catering and temporary residence, the importance of augmented intelligence, cloud computing and such a promising field as blockchain has been highlighted. As for transport and communications, the most attention is paid to the use of drones, the Internet of Things, the development of a common information workspace, and 5G networks. In the sphere of finance, blockchain and artificial intelligence are the most relevant technologies at the moment. As for real estate and lease, the following technologies are used: augmented reality, augmented intelligence, blockchain. In the sphere of public administration, military security and social insurance such technologies as PaaS and artificial intelligence are the most important. In the sphere of education, the application of various digital technologies is currently being expanded. The most widely-used are PaaS, augmented reality and artificial intelligence. A lot of attention is paid to machine learning too. In the field of health care and social services there are good prospects for the application of a number of digital technologies: artificial intelligence, peripheral analytics, 3D-printing, single workspace and others. In the field of public utilities and other personal services, the Internet of Things, and peripheral analytics are particularly important. The Internet of Things, 3D-printing, and 5G mobile communication are promising for household activities.

As a result of the analysis of the expert survey, the model was built for equalizing the requirements of the key industries of Russian business for digital technologies that provide an effective digital space for specific industries (Figure 1).
Figure 1. End-to-end technologies for key industries of Russian business.

These data provide an idea about technologies that are the most promising for the specific industry and can bring the fastest and most significant results. At the same time, there are examples of successful implementation of the above technologies in the leading sectors of the Russian economy.

For example, in agriculture there are already examples of 5G farms, and it is possible to combine the organization of production in an agricultural enterprise with environmental control and conservation activities, including remote monitoring of animals and soil [7]. On 5G farms, 5G technology, big data, artificial intelligence, cloud platforms are included into integrated management systems in order to automate the different phases of agricultural production and transit to autonomous, environmentally friendly, energy efficient farming [8].
In the field of mining the Internet of Things is used in equipment and modular mining systems solutions to ensure safety, increase productivity, and monitor the environment [9].

Manufacturers already take the advantage of digital twins, which can be used to model and predict situations taking into account various factors: from the location of equipment, movement of workers and repair operations to the reaction of devices to changes in solar lighting or emergency situations. A digital twin can be used to identify in advance the most critical stages of the production process, reduce the time needed for product development and cut production costs [10].

In the sphere of production and distribution of electricity, gas and water, the application of the Internet of Things in smart meters of resource consumption seems very promising. Such devices, when combined into smart grids, make the use of resources more efficient, reduce the cost of suppliers and consumers of resources, automatically calculate payment and billing. In addition, the IoT technology helps to constantly monitor resources, identify and minimize losses, and ensure network management in order to forecast consumption and possible emergencies [11].

The 3D printing technology has been applied in construction for a while. Using 3D printers you can print buildings both in parts and as a whole. The use of the technology to restore buildings after various emergencies seems to be promising [12].

In trading big data is extremely important for different purposes. Further analytics of demand and personalized supply are based on the processing of the collected data (taking into account economic, geographical, sociological considerations). On the basis of big data a scheme of goods layout is generated, with due regard of the properties of trade equipment, customer preferences, sales history of certain categories of goods and other factors so that the trade space can be used effectively [13].

In the hospitality and tourism industry, artificial intelligence is already used to provide personalized recommendations, when connecting chat bots, in the design of applications to optimize search and provide the best user experience [14].

In the field of transport and communications, they started to apply such a promising technology as various types of unmanned vehicles (unmanned aerial vehicles (UAVs), unmanned vehicles). For example, unmanned vehicles are used in port logistics. UAVs are used to deliver to hard-to-reach areas to diagnose and repair transmission lines, to monitor various indicators [15]. At present, Russia is only in the process of developing the regulations that govern the possibility of using unmanned vehicles on public roads [16]. A legal framework has already been developed for civilian UAVs with a maximum take-off weight of up to 30 kg.

Blockchain technology shows promise in the sphere of finance. Its application in Russia has not been legally regulated yet. Nevertheless, this technology is developing. It provides acceleration of financial operations, their transparency and reliability. For example, banks use blockchain in interbank and client-bank communications, financial engineering, and in product optimization [17].

In the sphere of real estate there are interesting examples of the application of augmented reality, for example, when choosing apartments with the possibility to get a full picture of the object without real inspection. In this case, augmented reality can be used as early as at the planning stage of the building to the developer and in the construction process, so that a potential buyer from the very beginning could have an idea of the final product [18].

One of the promising technologies for state administration and military security is a border computing. The use of appropriate algorithms and the use of a wide structure of big data, data from IoT sensors, other resources and applications allow for a complex multifactor analysis that provides a fairly accurate forecast of the analyzed parameters. This prediction is used in decision making, ensuring its accuracy and reducing the time for decision making. At the same time, the device is capable of making its own decisions [19].

In education, with the growing share of educational services provided online, the role of advanced technologies such as PaaS and SaaS is growing. For example, the service uses Google Apps Engine, which helps to develop and install your own user applications on the cloud platform. In education, cloud platforms provided by Microsoft, Google, 1C and cloud services based on them are very popular [20].
Health care is very promising in terms of digital technologies. Solutions based on machine learning play an important role at the moment. They can be used to analyze X-ray and computer images on the basis of loaded and constantly updated semantics, to form assumptions about the diagnosis and prognosis of the patient's further condition. Machine learning technologies are also used in the transition to personalized medicine [21, 22].

The use of the Internet of Things is expanding in the household segment. The main example is a "Smart House". The inclusion of a Smart House into the overall ecosystem of a Smart City is upcoming.

4. Discussion
In the course of further research it is planned to develop reference models for the main Russian business sectors discussed above, including the relevant key digital technologies mentioned in this article. The model developed for the oil refining industry can be cited as an example. Here, digital technologies contribute to the formation of a single business information space. Figure 2 shows the architecture of services of the upper level of the end-to-end technologies.

Figure 2. Upper level service model of end-to-end technologies.

Such reference models make it possible to use the potential of dedicated digital technologies quickly and efficiently.

5. Conclusion
Based on the requirements of business for the architecture of the digital space, identification of key digital technologies and the main sectors of the economy we formulated a model of equalization of the requirements of key industries of Russian business for digital technologies that provide an effective digital space for certain industries. This model can serve as a basis for building reference models that reflect the inclusion of digital technologies in the architecture of enterprises of the industries.
considered. It is assumed that these models will reflect the variability depending on the level of digital maturity of the company.

Acknowledgment
The reported study was funded by RSCF according to the research project № 19-18-00452.

References
[1] Maydanova S, Ilin I 2019 Strategic approach to global company digital transformation. In Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020 pp 8818-8833
[2] Prokhorov A, Konik L 2019 ‘Tsifrovaya transformatsiya. Analiz, trendy, mirovoy opyt’ Litres,
[3] Dubgorn A, Borremans A, Zaychenko I, Abdelwahab M N 2019 Analysis of digital business transformation tools. In Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020 pp 9677-9682
[4] Ilin I, Levina A, Borremans A, Kalyazina S 2019 Enterprise Architecture Modeling in Digital Transformation Era. In Energy Management of Municipal Transportation Facilities and Transport pp 124-142
[5] Pavlov N, Kalyazina S, Bagaeva I, Iliashenko V 2019 Key Digital Technologies for National Business Environment. In Energy Management of Municipal Transportation Facilities and Transport pp 143-157
[6] Döringer S 2020 ‘The problem-centred expert interview’. Combining qualitative interviewing approaches for investigating implicit expert knowledge. International Journal of Social Research Methodology, 1-14.
[7] ‘Where and why the first 5G networks will appear in Russia’ https://www.cnews.ru/news/top/2019-01-24_gde_i_pochemu_poyavyatsya_v_rossii_pervye_seti_5g
[8] ‘5G for Smart Farms, a Step Further towards Agricultural Modernization’ https://carrier.huawei.com/en/success-stories/Industries-5G/Agriculture
[9] ‘Mining IoT Connections to Reach 1.2 Million in 2023’ https://iot.ru/promyshlennost/obem-podklyuchennych-gornodobyayushchey-promyshlennosti-k-iot-dostignet-v-2023-godu-1-2-mln-edinit
[10] ‘How digital twins help Russian industry’ https://rb.ru/longread/digital-twin/
[11] ‘The Russian market of smart meters in the resource distribution industries - electricity, heat, water, gas - until 2020’ https://json.tv/ict_telecom_analytics_view/rossiyskiy-rynok-intellektualnyh-schetchikov-v-otraslyah-raspredeleniya-ressursov-elektroenergii-tepla-vody-i-gaza-do-2020-goda-20160218023751
[12] ‘3D printing in construction: how it works, technology and 3D printers’ https://top3dshop.ru/blog/3d-printing-of-buildings-technologies-and-3d-printers.html
[13] ‘Big Data for retail’ https://trends.rbc.ru/trends/innovation/5d66c23c9a79476e7d9aff95
[14] ‘Artificial intelligence in the hotel business’ https://www.frontdesk.ru/article/iskusstvennyy-intellekt-v-gostinichnom-biznese
[15] ‘Drone in production: how the industry uses unmanned vehicles’ https://www.comnews.ru/digital-economy/content/204389/2020-02-03/2020-w06/dron-proizvodstve-kak-promyshlennost-ispolzuet-bespilotnyy-transport
[16] ‘Drones VS Trucks: How Will Drones Change the Market?’ https://sovzond.ru/press-center/news/bpla/6041/
[17] Lipnitsky D V 2019 ‘Blocheyv v finansakh i bankovskom sektore: problemy sta-novleniya i perspektivy’, Ekonomika promyshlennosti, 3 (87)
[18] ‘Augmented reality in the real estate sector’ https://www.pwc.ru/ru/industries/real-estate/digital-real-estate/augmented-reality-in-real-estate.html

[19] ‘Will Edge Computing Change How Government Operates?’ https://www.govtech.com/computing/Will-Edge-Computing-Change-How-Government-Operates.html

[20] Avksentyeva E Yu 2014 ‘Migratsiya elektronnogo obrazovaniya v oblachnuyu sredu’ in Russian Journal of Education and Psychology, 10 (42)

[21] ‘How AI and machine learning will affect healthcare’ https://iot.ru/meditsina/kak-ii-i-mashinnoe-obuchenie-povliyayut-na-zdravookhranenie

[22] Iliashenko O Y, Iliashenko V M, Dubgorn A 2019 IT-Architecture Development Approach in Implementing BI-Systems in Medicine. In International Conference Cyber-Physical Systems and Control pp 692-700

[23] Gorodnichev M, Marsova E, Gematudinov R, Dzhabrailov K 2020 Technical vision for monitoring and diagnostics of the road surface quality in the smart city program E3S Web of Conferences 164 03013 doi:10.1051/e3sconf/202016403013