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Artificial Intelligence Technologies in the Russian Arctic: The Case of the Murmansk Oblast

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Abstract. Russian Arctic is a positive example of the introduction of information technologies (Industry 4.0.) as well as artificial intelligence technologies (Industry 5.0.). In the 21st century, IT-technologies have significantly improved quality of life in the Russian Arctic — development of IT camps, access to the Internet from the tundra. Arctic projects related to the AI technologies implementation are becoming increasingly popular: the article provides a list of such Arctic AI projects. An analysis of IT and AI vacancies in all subjects of the Russian Arctic on the website of the headhunter recruitment agency showed that the largest number of IT vacancies was posted directly in the Murmansk Oblast (74 vacancies). The study also analyzed job seekers' resumes in the Murmansk Oblast, posted in the Artificial Intelligence section. The study shows that knowledge of Python programming language, SQL databases and English language is a prerequisite for all AI specialists. It was also determined that the salary of AI specialists is significantly higher than that of IT specialists. The Murmansk Oblast is becoming a leader in the development and implementation of both IT and AI technologies; this is primarily due to the development of logistics and the Northern Sea Route as an alternative to existing sea routes.

Keywords: artificial intelligence, Arctic, Murmansk Oblast, digitalization, Industry 5.0

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Introduction

Currently, the change of technological mode is taking place at a tremendous speed. In his Christmas lecture “Results of 2022 and prospects for the future”, Dmitriy Peskov emphasizes that “on the horizon of 2030, a fundamentally different model of the Internet will appear — many servers, search links and emails will disappear in the coming years, Yandex and Google understand this”¹. Digitalization is the main driver of the production development in the 21st century; prod-

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¹ Christmas lecture by D. Peskov “Results of 22 years and prospects for the future”. URL: https://vk.com/university2035?z=video-164984229_456239598%2Fbe08644ec94969df9c%2Fpl_wall_-164984229&bx_sender_conversion_id=118956348 (accessed 23 December 2022).

ucts, production processes and business models are changing. Digitalization “Industry 4.0” has become a well-established concept among politicians, business leaders and scientists [1; 2; 3]. At the same time, Chinese researchers are already writing about the development of “Industry 5.0”, which consists of using the unique creativity of human specialists in collaboration with powerful, intelligent and precise machines [4].

In July 2021, the Russian Public Opinion Research Center (VCIOM) and the National Priorities ANO presented data from a survey of Russians on the attitude towards artificial intelligence, conducted as part of the implementation of the federal project “Artificial Intelligence” of the national project “Digital Economy”². The vast majority of Russians (81%) are familiar with the term “artificial intelligence” (AI), while 32% declare that they can explain its meaning; 18% are not familiar with this term.

There is no doubt that new artificial intelligence technologies (machine learning, computer vision, speech recognition, business analytics, process automation, drones, machine translation, intelligent data analysis, etc.) are rapidly changing human life all over the world, including Russia and the Russian Arctic. It is expected that the use of artificial intelligence technologies in the Arctic will increase the volume of maritime traffic along the NSR, residents of remote Arctic villages will receive high-quality mobile communications, and constant Internet access will provide the opportunity for distance learning.

The Russian Arctic is a positive example of the implementation of IT and AI technologies. The purpose of introducing such technologies is to improve the quality of life of northerners. Thus, the IT camps of the Khanty and Mansi are known throughout the world — the indigenous peoples of the North connect to UN conferences there³. In 2022, Rostelecom announced that it had completed the construction of an underwater fiber-optic communication line in Chukotka — this region was the last one not connected by terrestrial fiber-optic lines to the general communication network of the Russian Federation. In 2022, Norilsk organized the first regular Arctic IT festival with the participation of experts from Russian and foreign companies⁴.

Projects in the Arctic related to the implementation of AI technologies are also becoming increasingly popular, with the Murmansk Oblast becoming the leader in the implementation of such projects. The impetus for such breakthrough innovative development of the region was given by the Governor of the Murmansk Oblast A. Chibis, who headed the working group of the State Council to ensure transport, logistics and socio-economic development of the Russian Arctic in November 2022. In February 2023, a meeting of the presidium of the State Commission for Arctic Development was held, at which it was decided to recognize the project for the construction of a

² *Iskusstvennyy intellekt: blago ili ugroza?* VTsIOM [Artificial intelligence: benefit or threat? RPORC]. URL: <https://wciom.ru/analytical-reviews/analiticheskii-obzor/iskusstvennyi-intellekt-blago-ili-ugroza> (accessed 13 December 2022).

³ *Proekt IT-stoybishcha okhvatit okolo 123 Territoriy Prirodopol'zovaniya v Yugre k kontsu goda.* FGBU “FIRYA” [The IT camp project will cover about 123 Nature Management Territories in Ugra by the end of the year. FSBI “FIRYA”], 22.06.2021. URL: <https://clck.ru/33KQcg> (accessed 13 December 2022).

⁴ *IT-Weekend Norilsk.* URL: <http://itweekend.ru/> (accessed 10 December 2022).

modern coal transshipment complex “Lavna” in the seaport of Murmansk as a priority for financing. Also in February 2023, it became known that the “Capital of the Arctic” TAD will be expanded to implement the project “Construction of the Western transport and logistics hub”. It is planned to build a container terminal for international transit sea freight in the Kola region. The terminal will be used for transshipment of cargo to ice-class vessels operating on the Northern Sea Route.

Literature review

The development of artificial intelligence technologies in the Arctic has received a lot of attention in the works of Russian scientists. Thus, according to the HSE “Rating of innovative development of the subjects of the Russian Federation for 2021”, prepared by the Institute for Statistical Studies and Economics of Knowledge, the leaders in the availability of ready-made technological solutions developed in-house were Moscow, St. Petersburg, Lipetsk, Penza and Murmansk oblasts. These regions turned out to be the most technologically independent. From 8 to 9% of enterprises were developing innovations independently with minimal participation of other organizations and individuals, which is more than twice higher than the all-Russian value. Most regions are characterized by a decrease in this indicator [5].

The concept of a smart sustainable city is quite popular and is used for the development of cities in the Arctic zone; it is based on the application of artificial intelligence technologies. This approach has become widespread in the Nordic countries in the context of solving socio-economic problems (cities in Denmark, Sweden, Norway, Iceland and Finland). In the article “Smart Cities in the High North: A Comparative Analysis of Arkhangelsk, Bodø, Murmansk and Tromsø”, authors I. Khodachek, K. Delva, K. Galustov note promising human-centered urban practices with the use of AI technologies — “citizen labs”, combining the possibilities of online and offline involvement, as well as gamification practices (game involvement) in transport application (practices of the city of Bodø). As the authors note, there is no universal definition of a smart city, but it is often described as a city where investments in human and social capital, as well as traditional (transport) and modern ICT infrastructure contribute to sustainable economic growth and high quality of life with smart management of natural resources through the involvement of citizens [6; 7].

The analytical review “Application of artificial intelligence systems in the conditions of a new stage of Arctic exploration”, edited by the Union of Industrialists and Entrepreneurs of the Arctic, presents the results of a survey of experts in the field of AI. Two-thirds of experts believe that artificial intelligence technologies are universal and do not depend on the areas of application. Thus, one of the experts responded that there are no Arctic specifics to the use of mathematical analysis methods or database technologies, but there are a number of tasks specific to Arctic conditions. Artificial intelligence in the Arctic can take on issues in all areas related to routine technological processes: extraction or use of natural resources, logistics, life support systems, telecommunications and information management, observation and analysis of the situation. The

review also deals with the remote assessment and correction of health of northerners in telemedicine mode using AI technologies [8].

A. Pilyasov and V. Tsukerman have defined the chronology of the new technological mode deployment in the Russian Arctic in the last three decades in their article “Development of a new technological paradigm in the Arctic regions in 1990–2021”. The authors emphasize that the Nenets Autonomous Okrug has become a pilot site for the deployment of a new technological structure in the Russian Arctic; they explain the reasons for the promotion of the Nenets Autonomous Okrug to the role of a pilot site for technological, organizational, institutional experiments and innovations for the Arctic zone. The NAO became an area of pioneering economic development in the Russian Arctic and a place for the introduction of technological, organizational, institutional innovations, methods of socially responsible and environmentally balanced environmental management, which were associated with the formation of a new technical and economic paradigm in the Arctic [9].

O. Pichkov, A. Ulanov and K. Patrulina in their work “Digitalization of the Arctic” note that the digital transformation of the Arctic in Russia is a strategic priority of the state; it should contribute to the development of the Far North, which remains partially cut off from broadband connections and basic Internet services. Another role of digitalization is the development of logistics and the Northern Sea Route as an alternative to existing sea routes [10]. A number of initiatives have been introduced in recent years, such as the “Capitan” system, which uses various data sources such as oil production volumes and reserves, ship locations, ice and weather conditions. The capabilities of the Capitan AI system allow real-time analysis of operational efficiency, speed, loading volumes and fuel consumption ⁵.

A. Fedotovskikh writes about the creation of conditions, development and implementation of ready-made artificial intelligence systems for their practical use in the activities of AZRF economic entities. In the context of the ongoing outflow of population from the regions of the Far North and the Arctic, artificial intelligence and the introduction of robotics can partially replace (in some cases completely eliminate) humans in economic processes. The author believes that it is necessary to create automated industrial complexes in the Arctic that will eliminate the need for a significant part of human labor [11].

Methods and results

The Murmansk Oblast was chosen for the analysis for a number of reasons. Firstly, this region is the most populated in the Arctic zone of the Russian Federation, so the number of vacancies in the field of IT and AI is significantly higher there than in other regions of the Russian Arctic, as shown by the analysis of vacancies by the leading Russian recruiting agency “HeadHunter”. Murmansk is the center of socio-economic, cultural and intellectual life of the Murmansk Oblast; it

⁵ Sistema tsifrovoy logistiki «Gazprom nefti» vyigrala prestizhnyuyu premiyu IoT Awards 2022 [Gazprom Neft's digital logistics system wins the prestigious IoT Awards 2022]. URL: <https://www.gazprom-neft.ru/press-center/news/sistema-tsifrovoy-logistiki-gazprom-nefti-vyigrala-prestizhnyuyu-premiyu-iot-awards-2022/> (accessed 03 December 2022).

is no coincidence that there are only 2 registered TADs in the Russian Federation — “Capital of the Arctic” in the Murmansk Oblast and “Chukotka”. Murmansk has several regional universities, health care and cultural institutions. The city is an important logistics center of the Far North. The Northern Sea Route of Russia, or more precisely, its Pomor sector, begins in Murmansk [12]. The administration of seaports of the Western Arctic is located in Murmansk ⁶. The largest international airports in the Far North are also located in Apatity and Murmansk. The peculiarities of the Murmansk Oblast also include its favorable territorial location in the Arctic Zone of the Russian Federation, a relatively warm climate and favorable transport accessibility.

Table 1 presents a list of the most popular projects in the Russian Arctic, where AI technologies are being actively introduced. The range of these AI technologies is quite extensive and includes process automation, drones, machine translation, and intelligent data analysis. Some of the projects include several areas of AI technologies at once, for example, Botkin.AI is a platform based on artificial intelligence technologies, such as computer vision, process automation, intellectual analysis of data and processes, and pattern understanding ⁷.

Table 1

List of projects in the Russian Arctic using artificial intelligence technologies

Region	Project name	AI technology	Impact on regional economy
Murmansk Oblast	Smart Drilling Rig ⁸	Process automation	Monitoring and transmission of data from hard-to-reach subsoil
	Machine Vision at Kola MMC ⁹	Predictive analytics	Forecast of the technological process at the enterprise
	Methodology of three-dimensional mapping of mineral deposits ¹⁰	Data mining, Process Mining	Forecast of the mineral composition of rocks by chemical composition
	Data centre ¹¹	Process automation	Data processing, storage and distribution
	Botkin.AI platform ¹²	Computer vision	Detecting cancer in the early stages
Arkhangelsk Oblast	Technological IT “Digital Arctic” ¹³	Process automation	Unmanned aerial vehicles and vessels along the NSR

⁶ Federal State Budgetary Institution Administration of Sea Ports of the Western Arctic. URL: <https://www.mapm.ru/> (accessed 18 December 2022).

⁷ Botkin A.I. URL: <https://botkin.ai/> (accessed 24 December 2022).

⁸ «Messoyakhaneftegaz» vnedryaet iskusstvennyy intellekt v burenie skvazhin [Messoyakhaneftegaz is introducing artificial intelligence into well drilling], 19.10.2022. URL: <https://mesng.ru/press-center/news/messoyakhaneftegaz-vnedryaet-iskusstvennyy-intellekt-v-burenie-skvazhin> (accessed 24 December 2022).

⁹ Kol'skaya GMK vnedryaet iskusstvennyy intellekt [Kola MMC is introducing artificial intelligence]. URL: <https://www.nornickel.ru/news-and-media/press-releases-and-news/kolskaya-gmk-vnedryaet-iskusstvennyy-intellekt/> (accessed 24 December 2022).

¹⁰ Iskusstvennyy intellekt budet stroit' karty mestorozhdeniy vmesto geologov. Rossiyskiy nauchnyy fond [Artificial intelligence will build maps of deposits instead of geologists. Russian Science Foundation]. URL: https://rscf.ru/news/media/iskusstvennyy_intellekt_budet_stroit_karty_mestorozhdeniy_vmesto_geologov/ (accessed 24 December 2022).

¹¹ «Nornikel'» moderniziroval sobstvennye data-tsenry [Norilsk Nickel has modernized its own data centers], 03.12.2018. URL: <https://www.nornickel.ru/news-and-media/press-releases-and-news/nornikel-moderniziroval-sobstvennye-data-tsenry/> (accessed 24 December 2022).

¹² Murmanskaya oblast' vnedryaet rossiyskuyu sistemu iskusstvennogo intellekta dlya vrachey [The Murmansk region is implementing a Russian artificial intelligence system for doctors]. URL: <https://zdrav.expert/a/404017> (accessed 24 December 2022).

Republic of Sakha (Yakutia)	Online machine translators from indigenous languages of the North ¹⁴	Machine translation, natural language dialogue	Online machine translator among the languages of the peoples of the North in the Dolgan language
	ArcticXpert ¹⁵	Predictive analytics	Modeling the behavior of foundations taking into account changing climatic conditions (NEFU)
	AITA digital assistant ¹⁶	Software agents	Building feedback with the population
Yamalo-Nenets Autonomous Okrug	Botkin. AI ¹⁷	Computer vision	Detecting cancer in the early stages
Republic of Karelia	Data centre ¹⁸	Process automation	Data processing, storage and distribution
Krasnoyarsk Krai	ArcticZone platform ¹⁹	Process automation	Single platform for tourists and management platform of the Arctic tourist cluster
	Digital Nornickel ²⁰	Human-Machine Interaction, recommender systems	Training program for employees of Norilsk Nickel MMC in the field of digitalization
	Nornickel's digital laboratory ²¹	Process automation	Study of the applicability and testing of new technologies in production processes
	Data centre ²²	Process automation	Data processing, storage and distribution
AZRF	Captain system ²³	Data mining, Process Mining	Selecting the optimal route for ships from more than 66.5 million options
	Polar Express ²⁴	Process automation	Ensuring year-round navigation along the NSR

¹³ IT-park Digital Arctic URL: <https://arctic.narf.ru/main/news/1641-proekt-digital-arctic-predstavili-gubernatoru-arkhangelskoj-oblasti> (accessed 24 December 2022).

¹⁴ Eksperty sozdayut onlayn-perevodchik dlya korennykh malochislennykh narodov [Experts are creating an online translator for indigenous peoples]. URL: <https://tass.ru/obschestvo/10909651> (accessed 24 December 2022).

¹⁵ Programma ArcticXpert rasschitaet ustoychivost' fundamentov v Arktike [ArcticXpert program will calculate the stability of foundations in the Arctic]. URL: <https://ru.arctic.ru/infrastructure/20220412/1000547.html> (accessed 15 March 2023).

¹⁶ Kak rabotaet tsifrovoy pomoshchnik AITA [How the AITA digital assistant works]. URL: <https://yakutia-daily.ru/kak-rabotaet-czifrovoy-pomoshchnik-aita/> (accessed 15 March 2022).

¹⁷ Botkin.AI. Yamalo-Nenets Autonomous Okrug. URL: <https://botkin.ai/yamal> (accessed 24 December 2022).

¹⁸ Novyy data-tsentr v Nadvoitsakh nachnet rabotu v noyabre [The new data center in Nadvoitsy will begin operation in November]. URL: <https://gov.karelia.ru/news/16-10-2020-novyy-data-tsentr-v-nadvoitsakh-nachnet-rabotu-v-noyabre/> (accessed 24 December 2022).

¹⁹ Agentstvo razvitiya Noril'ska prezentovalo tsifrovuyu platformu Arctic Zone na mezhdunarodnoy konferentsii [The Norilsk Development Agency presented the Arctic Zone digital platform at an international conference]. URL: <https://24rus.ru/news/society/189657.html> (accessed 15 March 2022).

²⁰ Tsifrovoy Nornikel' [Digital Nornickel]. URL: <https://nornickel.digital/> (accessed 15 March 2022).

²¹ Tsifrovaya laboratoriya [Digital laboratory]. URL: <https://www.nornickel.ru/innovation/laboratory/> (accessed 15 March 2022).

²² Samyy severnyy v mire data-tsentr otkryli v Noril'ske [The world's northernmost data center was opened in Norilsk]. URL: <https://www.ttelegraf.ru/news/samiy-severnyiy-v-mire-data-tsentr-otkryli-v-noril'ske/> (accessed 15 March 2022).

²³ Tsifrovaya sistema «Kapitan» pomogla «Gazprom nefti» na 12% sokratit' raskhody na morskuyu logistiku arkticheskoy nefti [The Captain digital system helped Gazprom Neft reduce costs for maritime logistics of Arctic oil by 12%]. URL: https://www.gazprom-neft.ru/press-center/news/tsifrovaya_sistema_kapitan_pomogla_gazprom_nefti_na_12_sokratit_raskhody_na_morskuyu_logistiku_ar

kti/ (accessed 18 December 2022).

²⁴ Polar Express. URL: <https://xn--e1ahdckegffejda6k5a1a.xn--p1ai/> (accessed 24 December 2022).

	Unmanned cargo delivery to hard-to-reach areas of the Arctic and the Far East ²⁵	Uncrewed (unmanned) vehicle and autonomous robot, Swarm intelligence	Delivery of cargo to remote villages by unmanned aerial vehicle
	Northern Zavoz ²⁶	Data mining, Process Mining	Optimal logistics solutions for entrepreneurs and cost reduction
	Supercomputer of the Russian Ministry of Emergency Situations ²⁷	Predictive analytics	Forecast of possible disasters – floods and fires
	Oculus small spacecraft ²⁸	Predictive analytics	Forecast of the NSR ice conditions
	Russian autonomous unmanned underwater vehicle Sarma ²⁹	Uncrewed (unmanned) vehicle and autonomous robot, Swarm intelligence	Search, inspection and maintenance of underwater objects in the Arctic

It is worth noting that the Murmansk Oblast is becoming the main Arctic territory for the implementation of AI projects. The analysis of IT and AI vacancies in all regions of the Russian Arctic, which are posted on the website of the recruiting agency HeadHunter ³⁰, showed that the largest number of vacancies in the IT field are posted in the most populated territories of the Russian Arctic: Murmansk Oblast (74 vacancies), Arkhangelsk Oblast (60 vacancies), Yamalo-Nenets Autonomous Okrug (53 vacancies), in the Arctic territories of the Krasnoyarsk Krai (38 vacancies) (Table 2). There are practically no posted AI vacancies in the Russian Arctic; they are concentrated mainly in large Russian cities — Moscow and St. Petersburg.

Table 2

Top 5 IT vacancies in the Murmansk Oblast, 2023

Vacancy	Number of vacancies	Average salary
Engineer	8	~ 49 000
System Administrator	6	~ 80 000
Software Engineer	5	~ 52 500
IT Specialist	5	~ 79 200
Technical Support Engineer	4	~ 50 000

²⁵ Zasedanie Soveta po strategicheskomu razvitiyu i natsional'nym proektam [Meeting of the Council for Strategic Development and National Projects]. URL: <http://www.kremlin.ru/events/president/news/66217> (accessed 24 December 2022).

²⁶ Edinyy operator sevzavoza pomozhet predprinimatel'nyam regionov optimizirovat' logistiku [A single sowing truck operator will help regional entrepreneurs optimize logistics], 22.11.2022. URL: <https://tass.ru/ekonomika/16395549> (accessed 24 December 2022).

²⁷ Iskusstvennyy intellekt pomog MChS smodelirovat' vozmozhnye stikhiynye bedstviya [Artificial intelligence helped the Ministry of Emergency Situations simulate possible natural disasters]. URL: https://rg.ru/2022/11/10/stihii-po-prognozu.html?utm_source=yxnews&utm_medium=mobile&utm_referrer=https%3A%2F%2Fdzen.ru%2Fnews%2Fsearch%3Ftext%3D (accessed 24 December 2022).

²⁸ Pobeditel' «Liderov Rossii» proektiruet pervyy otechestvennyy sputnik dlya monitoringa Sevmorputi i Arktiki [The winner of “Leaders of Russia” is designing the first domestic satellite for monitoring the Northern Sea Route and the Arctic]. URL: <https://xn--d1achcanykala0j.xn--p1ai/tpost/s2ol7a0f61-pobeditel-liderov-rossii-proektiruet-per> (accessed 24 December 2022).

²⁹ Zhen'min' zhibao (KNR): Rossiya prodolzhaet prodvigat' strategiyu razvitiya Arkticheskoy zony posredstvom razrabotki podvodnykh bespilotnikov. Fond perspektivnykh issledovaniy [People's Daily (PRC): Russia continues to promote its strategy for the development of the Arctic zone through the development of underwater drones. Advanced Research Foundation]. URL: https://fpi.gov.ru/press/media/zhenmin-zhibao-rossiya-prodolzhaet-prodvigat-strategiyu-razvitiya-arkticheskoy-zony-posredstvom-razr/?sphrase_id=131285 (accessed 24 December 2022).

³⁰ HeadHunter. URL: <https://hh.ru/> (accessed 20 December 2022).

In addition to vacancies, we also analyzed the number of CVs posted in the Murmansk Oblast on the HeadHunter portal — 70 CVs in the Artificial Intelligence section. Basically, these resumes were posted by applicants within the framework of one AI technology — “Intellectual analysis of data and processes, understanding of patterns / Data mining, Process Mining”. The study showed that the salary of AI specialists is significantly higher than that of IT specialists. The average salary for a specialist in the Murmansk Oblast in the field of AI is 87.500 rubles.

Table 3

Number of CVs for AI specializations in the Murmansk Oblast, 2023

AI specialization	Number of CVs	Requested salary	AI competencies
BI Analyst, Data Analyst	2	100 000	PowerQuery; English at level B2 (Upper-Intermediate); experience in analytical research; Power BI; jupyter; pandas; Visual Studio, OOP; C#; C++; .NET Framework; MS Visual Studio; MS SQL Server; ASP.NET; MySQL; JavaScript
Data scientist	1	105 000	Python 3; Microsoft SQL; libraries and frameworks: Pandas, Numpy, Matplotlib, Tensorflow, Keras; knowledge: Pytorch, LightGBM, XGBoost, CatBoost, Scikit-learn, Seaborn, SciPy, BS4, MongoDB, SQL, Scrapy, Xpath, Git, Java, Linux, Airflow
Python Developer	2	120 000	Python; SQL; ClickHouse; Hadoop; Apache Spark; airflow; SparkML; BI; Git; HTML; Linux; MySQL; PostgreSQL; OOP; English language; XML; SQLAlchemy; Docker; Flask; FastAPI; Alembic; Cassandra; Architecture; Development; PyCord; JavaScript

Research shows that knowledge of the Python programming language, SQL databases and English is a requirement for all AI professionals. The Murmansk Oblast is becoming a leader in the development and implementation of IT and AI technologies. This is primarily due to the development of logistics and the Northern Sea Route as an alternative to existing sea routes.

Conclusion

Currently, trends in economic development are shifting in the Russian Arctic. On February 21, 2023, the President of the Russian Federation introduced long-awaited changes to the “Fundamentals of state policy of the Russian Federation in the Arctic for the period up to 2035”³¹, in the new edition of which the concept of “innovative development” appeared. The necessary skills in the field of artificial intelligence and intelligent information systems are becoming in demand to solve technological problems specifically in the Arctic territories of the Russian Federation, and therefore the state policy of the Arctic is reoriented towards innovative development.

³¹ Vneseny izmeneniya v Osnovy gosudarstvennoy politiki v Arktike na period do 2035 goda [Changes have been made to the Fundamentals of State Policy in the Arctic for the period up to 2035], 21.03.2023. URL: <http://www.kremlin.ru/acts/news/70570> (accessed 15 March 2023).

The “Atlas of future professions”, developed by the National Research University Higher School of Economics in 2021, presents 50 promising professions using AI, identified on the basis of an analysis of global trends in technological development, forecasts, and assessments of employers and experts. Researchers predict that the key factor will soon be the widespread implementation of the Internet of Things (smart containers, unmanned vehicles, etc.) [13]. In practice, it turns out (Table 1) that the list of various AI projects in the Russian Arctic is constantly being improved, expanded and already includes not only new developments in the field of mining and optimization of production costs, but also process automation, drones, machine translation, intelligent data analysis, machine learning, computer vision, etc. Our research shows that about 50 projects in the field of artificial intelligence technologies have already been launched in the Russian Arctic. New projects are at the stage of creation and design: creating digital twins of territories and enterprises, introducing neural networks on board drones, creating smart cities (Murmansk and Norilsk), transportation along the NSR using blockchain, etc.

An analysis of vacancies in the IT and AI fields in all regions of the Russian Arctic on the website of the HeadHunter recruiting agency showed that the largest number of vacancies in the IT field are posted directly in the Murmansk Oblast (74 vacancies). The study analyzed not only vacancies, but also CVs of applicants in the Murmansk Oblast, posted in the Artificial Intelligence section (subsection “Intellectual analysis of data and processes, understanding patterns / Data mining, Process Mining”). It was determined that the salary of AI specialists is significantly higher than that of IT specialists. The experience of the Murmansk Oblast as a positive example of the development of artificial intelligence in the Arctic is extremely important in the context of understanding the current trends in the Russian high-tech segment in the labor market, as well as the prospects for the socio-economic development of the entire Arctic macroregion and the Murmansk Oblast as its driver.

It is noteworthy that in 2023, the master’s program “Artificial Intelligence and Data Science” was launched at St. Petersburg State University. A distinctive feature of the program is the block of disciplines “Artificial Intelligence for the Arctic Region”³². Graduates of the program can choose a wide range of areas, for example, analytics, architecture and development of special systems for the global transport industry and mobile telemedicine in remote communities in the Arctic; implementation of digital solutions in metallurgy, oil, gas and chemical industries; creation of control systems for electrical grid and generating infrastructure; formation of the basis for “smart houses” and “smart cities” in the field of construction and housing and communal services; automated processing of information from satellite sensing and technological video surveillance. The launch of such an educational program once again proves

³² Artificial intelligence and data science: new master's program at St. Petersburg State University. URL: <https://spbu.ru/news-events/novosti/iskusstvennyy-intellekt-i-nauka-o-dannyh-novaya-programma-magistratury-spbgu> (accessed 15 March 2023).

the fact that skills in the field of artificial intelligence are becoming extremely in demand for solving technological problems in the Arctic territories of the Russian Federation.

Based on the analysis of vacancies in the IT and AI areas, as well as the list of AI projects of the AZRF, it can be emphasized that AI technologies in the Murmansk Oblast will be developed in the following key areas: intelligent computer vision, analysis and processing of texts in natural language and images, transport infrastructure management, data processing of large industrial enterprises, data-based health technologies in the Far North, software development technologies for applied tasks.

References

1. Barzotto M., Corradini C., Fai F., Labory S., Tomlinson P.R. Smart Specialisation, Industry 4.0 and Lagging Regions: Some Directions for Policy. *Regional Studies, Regional Science*, 2020, vol. 7, no. 1, pp. 318–332. DOI: 10.1080/21681376.2020.1803124
2. Hanna N. A Role for the State in the Digital Age. *Journal of Innovation and Entrepreneurship*, 2018, vol. 7, no. 1, pp. 1–16. DOI: 10.1186/s13731-018-0086-3
3. Lund H.B., Vildåsen S.S. The Influence of Industry 4.0 Narratives on Regional Path Development. *Regional Studies, Regional Science*, 2022, vol. 9, no. 1, pp. 82–92. DOI: 10.1080/21681376.2022.2029552
4. Lv Z., Wang N., Ma X., Sun Y., Meng Y., Tian Y. Evaluation Standards of Intelligent Technology Based on Financial Alternative Data. *Journal of Innovation & Knowledge*, 2022, vol. 7, no. 4. DOI: 10.1016/j.jik.2022.100229
5. Gokhberg L.M., ed. *Reyting innovatsionnogo razvitiya sub"ektov Rossiyskoy Federatsii* [Russian Regional Innovation Development Rating]. Moscow, HSE University Publ., 2021, iss. 7, 274 p. (In Russ.)
6. Khodachek I.A., Delva K.I., Galustov K.A. Umnye goroda na Kraynem Severe: sravnitel'nyy analiz Arkhangel'ska, Bude, Murmanska i Tromse [Smart Cities in the High North: A Comparative Analysis of Arkhangel'sk, Bodø, Murmansk and Tromsø]. *Gorodskie issledovaniya i praktiki* [Urban Studies and Practices], 2020, vol. 5, no. 1, pp. 57–79. DOI: 10.17323/usp51202057-79
7. Khodachek I., Aleksandrov E., Nazarova N., Grossi G., Bourmistrov A. Smartocracy: Context Entanglement of the Smart City Idea and Bureaucracy in Russia. *Organization Studies*, 2022, pp. 1–3. DOI: 10.1177/01708406221123373
8. Fedotovskikh A.V. *Primenenie sistem iskusstvennogo intellekta v usloviyakh novogo etapa osvoeniya Arktiki. Analiticheskiy obzor* [Application of Artificial Intelligence Systems in the Conditions of a New Stage of Arctic Exploration. Analytical Review]. Moscow, Soyuz promyshlennikov i predprinimateley zapolyar'ya Publ., 2018, 52 p. (In Russ.)
9. Pilyasov A.N., Tsukerman V.A. Stanovlenie novogo tekhnologicheskogo uklada v Arktike za period 1990–2021 gg.: regional'nyy razrez [Development of a New Technological Paradigm in the Arctic Regions In 1990-2021]. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz* [Economic and Social Changes: Facts, Trends, Forecast], 2022, vol. 15, no. 5, pp. 95–117. DOI: 10.15838/esc.2022.5.83.5
10. Pichkov O.B., Ulanov A.A., Patrunina K.A. Digitalization of the Arctic. In: *The Handbook of the Arctic: A Broad and Comprehensive Overview*. Singapore, Springer Nature Singapore, 2022, pp. 1–21. DOI: 10.1007/978-981-16-9250-5_22-1
11. Fedotovskikh A.V. Ispol'zovanie robototekhniki i iskusstvennogo intellekta na Kraynem Severe i v Arkticheskoy zone RF [Use of Robotics and Artificial Intelligence in the Far North and Arctic Zone of Russia]. *Rossiya: tendentsii i perspektivy razvitiya* [Russia: Trends and Prospects for Development], 2019, no. 14–1, pp. 560–563.
12. Grigoryev M.N. Rzvitiye tranzitnogo potentsiala Severnogo Morskogo Puti [Development of Transit Potential of the Northern Sea Route]. *Kontury global'nykh transformatsiy: politika, ekonomika, pravo* [Outlines of Global Transformations: Politics, Economics, Law], 2019, vol. 12, no. 5, pp. 109–129. DOI: 10.23932/2542-0240-2019-12-5-109-129

13. *Atlas professiy budushchego* [Atlas of Professions of the Future]. Moscow, HSE Publ., 2021, iss. 2, 240 p. (In Russ.)

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