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Digital transformation strategy: Digital competencies of a railway engineer

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Abstract

Scientific and technological progress amid the process of global digitalisation has prompted the demand for professions in relevant fields such as logistics, analytics, agriculture, industrial manufacturing, transport, and primarily for engineering and technical workers. Russian railways require not only physical infrastructure, but also digital skills of its operation by engineering and technical workers in order to integrate into the digital economy. The aim of the article is to study modern requirements for the professional competencies of railway engineers, primarily their digital literacy and the ability to work with special software. The authors mention the need for an engineer to have softskills and hardskills. The article provides a list of the main software complexes that are included in the special digital competencies of a railway engineer.

The authors of the article through the example of railway transport, describe the directions of digitalisation of railway transport, which is a link between the branches of the national and partly global economy. The emphasise the advanced development of scientific and technological progress in the transport industry – the "Digital Railway" project, which generates related tasks, one of which is the modern training of engineering personnel and the consolidation of digital competencies and metaskills in professional standards.

Keywords: professional competencies, digital engineer competencies, digital railway, railway engineer, new professional standards.

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Introduction

The advanced countries of the world today are on the border of the fourth and fifth technological modes [Uskov, 2020], but they widely use electricity, which is typical for the third mode. Some countries, such as the US, Japan, EU countries, and some countries in Southeast Asia, have already moved into the fifth technological order and are even at the beginning of the sixth.

The fifth industrial technological order uses nuclear energy as the main resource and is associated with the development of electronics and microelectronics, information technology, industrial biotechnology, genetic manipulation, the development of automated technical systems, the transfer of information by various types of technologies, non-traditional energy sources, the industrial use of space, the emergence of space communications, etc.

The main trend in the digital economy of the world is technological progress based on advanced technologies: blockchain, Internet of Things, artificial intelligence, unmanned devices, digital twins, augmented reality, virtual reality, 3D printing and robotics. Currently and in the near future, specialists in the field of big data (Data Scientist), machine learning engineers (ML-engineer), developers in the field of artificial intelligence (AI-developer), UI researchers, IT specialists in the field of biomedicine, specialists in process automation, information security, software. It is expected that the pace of technology adoption will accelerate in some areas of the economy, so cloud computing, big data, digital twins, e-commerce are becoming the most in demand.

Structural changes in the modern economy have prompted in Russia a demand for professions in areas that are relevant under sanctions: logistics, analytics, agriculture, industrial production, transport, that is, primarily for engineering and technical workers. To integrate into the digital economy, Russian railways need to have not only physical infrastructure, but also digital skills for its operation by engineering and technical workers.

1. Research methodology

The aim of the study is to analyse the current requirements for the professional competencies of railway engineers, primarily for their digital literacy and ability to work with special software. In the article, the authors clarify the list of software systems that are included in the special digital competencies of a railway engineer.

The subject of the study is the composition of the digital competencies of a railway engineer. The object of the study was a set of modern competencies that a specialist needs to work on a digital railway.

The authors briefly describe the directions of digitalisation of rail transport, which is a link between the sectors of the national and partly the world economy. Emphasis is placed on the advanced development of scientific and technological progress in the transport industry - the Digital Railway project, which generates related tasks, one of which is modern training of engineering personnel and the consolidation of digital competencies and meta-skills in professional standards.

The hypothesis of this study is the message that the following set of competencies is important for a modern railway engineer working in a digital economy: soft, hard skills (with knowledge of special software) and meta-competences that generate new skills.

In the course of the study, the following scientific methods of cognition were used: literature analysis, synthesis, comparison, induction, systematisation and classification.

As part of the federal project "Assessment and development of managerial competencies in Russian educational organisations" in 2021, pursuant to the list of instructions of the President of the Russian Federation, 41 competence centers were created on the basis of leading research universities in 21 regions of Russia. The task of the centers is to be a link between university students, employers and the state authorities of the region. At the moment more than 70 thousand students are involved in the project, and this figure is increasing every day. It is planned that by 2023, about 300,000 students will undergo competency diagnostics[1]. In 2021, only 3% of students, having shown a high level of competencies, were tested in four tools and six competencies. For this reason, the question arises of revising job profiles that do not meet modern requirements and changing the learning process in educational institutions that should offer training in accordance with new digital trends [Parkhaev et al., 2021].

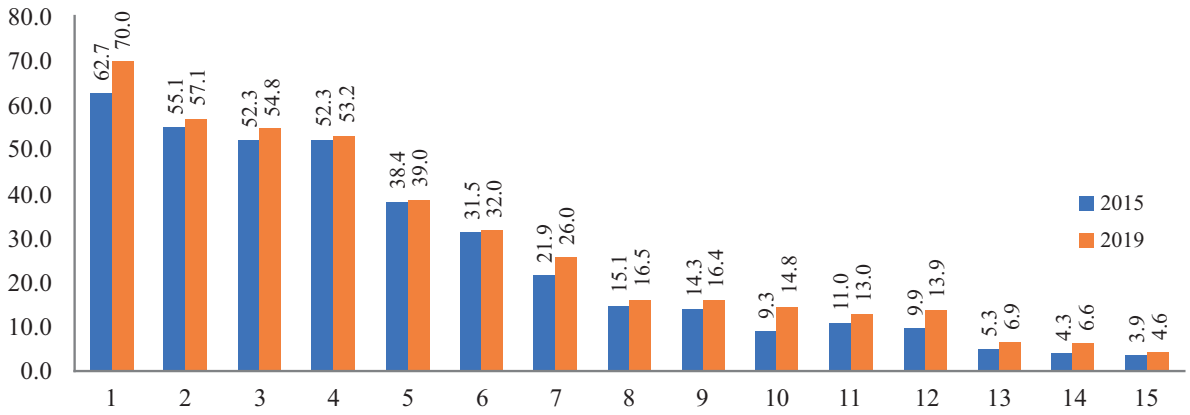
Research by the Higher School of Economics[2] and state statistics[3] on the use of specialised software that requires the staff of Russian institutions to have the appropriate skills and knowledge are shown in Fig. 1.

The data of Fig. 1 indicate a low level of use of special software compared to general computer programs for enterprise management.

The digital transformation of the railway implies the creation of innovative technical vehicles, traffic management, railway infrastructure, the creation of automated software systems for the implementation of the full cycle of business processes in rail transport, logistics, etc., to implement such a large-scale project of the country's digital economy, specially trained personnel with both a traditional set of competencies and digital industry-specific competencies. We believe that in carrying out the digital transformation of rail transport in Russia, it is extremely important to consider what is being done in Europe and China. To determine what employees are needed on a digital railway in Russia, it is necessary to understand according to what standards, technological solutions and based on what world experience this railway will be built. In this regard, it becomes important to continuously train personnel in new competencies. Online learning provides not only the opportunity to take professional training courses directly at the workplace, but also expands the network of experts and colleagues for information exchange. For example, The Engineering Institute of Technology (EIT) in Australia offers a two-year online study program to gain knowledge and skills in the latest rail technology[4]. An integral part of the distance course program is reflexivity and constant feedback, not only in terms of assessing acquired knowledge and skills, but also in terms of accompanying students with

[1] Project results for 2021. https://vk.com/@mephi_ccenter-itogi-proekta-za-2021.
[2] Information Society in the Russian Federation (2020): stat. Sat. M.: NRU HSE, 2020.
[3] Trends in the development of the information society in the Russian Federation (2020): brief stat. Sat. M.: NRU HSE, 2020.
[4] On track to becoming a railway engineer. https://www.eit.edu.au/on-track-to-becoming-a-railway-engineer/#Ancor.

Fig. 1. Share of enterprises using specialized software
(% of the total number of enterprises)



1 – Electronic document management systems
2 – Software for financial settlements in electronic form
3 – Software tools for solving organisational, managerial and economic problems
4 – Electronic legal reference systems
5 – Software for managing the procurement of goods (works, services)
6 – Software for providing access to databases via global information networks, including the Internet
7 – Software tools for product sales management
8 – Software for the management of automated production and / or individual technical means and technological processes
9 – Training programmes
10 – ERP-systems (enterprise resource management systems)
11 – Design software
12 – CRM-systems (customer relationship management)
13 – Editing and publishing systems
14 – SCM-systems (supply chain management)
15 – Scientific research software

Source: [Simarova et al., 2022].

information about events taking place in this area of study [Kamshilin et al., 2022].

2. Literature review

A feature of the theoretical premises on the issue of research is the fact of their novelty. The classification of technological structures is presented in the works of K. Schwab, an attempt to determine the contours of the new world order was made in the works of famous Russian scientists: D. Lvova, S. Glazyev, V. Kharitonova, V. Ivanova, V. Syretsky, A. Voronov and many others. A retrospective review of the digital economy development was carried out by A.N. Kozyrev.

The issues of economic development of cities with a multimodal transport system in the digital economy are disclosed in the articles by I. Bratishcheva, I. Sokolova, A. Misharina, V. Kupriyanovsky, O. Pokusaev. The problems of international logistics, where rail transportation is present, are raised by researchers O. Dunaev, A. Zazhigalkin, S. Yevtushenko and others.

The problems of economic partnership for the economic development of the EAEU countries were covered in the publications of S. Glazyev, A. Petrova, V. Kupriyanovsky, Yu. Kupriyanovskaya, I. Sokolova, A. Stepanenko and O. Pokusaev. From the point of view of technical means and technologies of cargo transportation, the works of S. Vinogradova, M. Mekhedov and A. Khomova.

In recent years, researchers I. Simarova, Yu. Alekseevicheva, D. Zhigin, V. Vasina, I. Chernenko, E. Sysoeva, A. Shevyakova, E. Petrenko and many others deal with the professional competencies of digital economy specialists, their role in the modern labor market, and the impact of digital skills on wage formation.

The role of human capital in the digital economy is fundamental, and foreign scientists and researchers paid attention to this fact: S. Carpitella, F. Carpitella, A. Certa, J. Benítez, J. Izquierdo, Sh. Guoa, J. Lia, J. Heb, W. Luoa, B. Chenc - and their Russian colleagues: E. Leven, A. Suslov, S. Dyatlov, M. Dobrokhotov, O. Roman.

With regard to railway transport, in particular in matters of higher education and continuous training of engineering and technical workers on the digital railway, one can note the works of A. Khabarov, V. Radchenko, A. Vylegzhanina, S. Tsybukova, N. Toivonen.

The methodology for integrating digital technologies into professional standards was described by O. Spiridonov, M. Shklyaruk, N. Garkusha.

To conduct this study, the authors used statistical data from world surveys, The Future of Jobs (2020) and others, analytical collections of the Higher School of Economics and other reference literature.

3. Research tools

The railway is a connecting network of the country's economy, therefore, the creation of a strong national capital that dominates all sectors of the digital economy, including the railway industry, can become one of the priority areas of national policy. The digital economy and rapid technological development put forward demands on the professional competencies of railway technicians. What modern professional competencies and personal qualities should technical specialists, primarily railway engineers, have in the 21st century?

Technologies such as 3D printing, remote sensing of the Earth, the Internet of Things, artificial intelligence, digital twins, avant-garde biotechnologies, nanomedicine, the digital footprint, the digital human shadow, as well as the development of modern vehicles and communications will require trained professionals with digital competencies. Workers with relevant information competencies, programmers and engineers will always be in demand in the digital economy, including on the digital railway.

Russian railways have already implemented information services that manage the train fleet, assess the technical condition of train sets, build a transportation plan in order to reduce wagon downtime and unproductive empty runs, plan optimal routes, increase the level of customer service, and make an instant calculation of the cost of transportation. The concept of digital twins, adopted by Russian Railways, is part of the fourth industrial revolution and is designed to improve the quality of products through predictive detection of possible problems and modeling of results. The concept defines four areas - static objects (the superstructure of the railway), dynamic (locomotives), processes (management) and parameters of the external environment (marketing and macroeconomic data)[5]. The digital twin is becoming an integral attribute of every transport enterprise due to large-scale digitalisation [Rimskaya, Anokhov, 2021].

The digital transformation strategy of Russian Railways until 2025[6] contains included projects for the development and implementation of digital technologies and platforms in the holding. The comprehensive innovative development program of the Russian Railways holding for 2016–2020 is considered a priority for the implementation of the Digital Railway project, the purpose of which is to significantly reduce operating costs and improve the safety and reliability of rolling stock.

The scientific and technical project "Digital Railway" is associated with the knowledge economy, knowledge management and knowledge technologies, which determines many features of the transformation of the industry, which entailed new requirements for the professional competence of railway industry workers [Khabarov, Volegzhanina, 2020]. The Digital Railways project will significantly change the composition of positions, the content of the activities of the employees employed in it and the methods of work, requiring new competencies.

Rail transport, like other modes of transport, is changing significantly under the influence of digital transformation. Global trends are associated with the unification of signaling and control systems, the digitalisation of rolling stock, modernisation, traffic management and train automation. An important advantage of digitalisation should be noted - the possibility of increasing throughput without increasing the physical infrastructure. Constant monitoring of railway loading and identification of bottlenecks allows you to reorganise processes to make the most efficient use of physical facilities.

The Digital Railway project was initiated as part of the implementation of the Development Strategy of the Russian Railways holding for the period up to 2030, approved by the Board of Directors of Russian Railways on December 23, 2013. One of the main objectives of the project can be declared to improve the quality of logistics and transport services provided using digital technologies, and the fundamental goals are:

1) creation of a single information space for freight traffic;
2) creation of a single information space for passenger traffic;
3) formation of end-to-end digital technologies for organizing the transportation process;
4) creation of a unified integrated automated management system to increase the efficiency of corporate governance and the social sphere.

According to this project, it is planned to create at least eight platforms, and each will become the basic element of the IT infrastructure for the key areas of activity of Russian Railways: e-commerce, intermodal freight and multimodal passenger transportation, management of the transportation process and traction rolling stock, organisation of transport and logistics nodes and interaction of linear infrastructure operators[7].

The implementation of the Digital Railway project is carried out using the tools available at Russian Railways: an informatisation program, investment projects, a plan for scientific and technological development and the creation of new software systems. Today, the digital railway consists of key subprojects:

1. "Digital rails" are used by the railway infrastructure and provide the movement of freight and passenger

[5] Russian Railways wants to create "digital twins" of technological processes for the modernization of stations. https://company.rzd.ru/ru/9401/page/78314?id=190657.
[6] Russian Railways Digital Transformation Strategy. https://www.tadviser.ru/index.php.
[7] Id.

trains. IT systems are actively used to work out routes and schedules for trains throughout the network, set the interval for the operation of arrows and traffic lights. They also allow you to make the necessary changes quickly[8].

2. "Digital Wagon"[9], or "Smart Wagon", is a project developed by JSC VNIIZHT and allows to build predictive analytics based on data on the state of wheel sets. Work on the digital twin of a freight car requires synergy from all participants in the transportation process.
3. "Digital railway station"[10] - a project to create an energy-efficient railway station is being developed at JSC NIIAS. The creation of this project requires the use of an interdisciplinary approach and is a complex of interrelated technical means and devices that provide the calculation and execution of technological operations with minimal human participation.
4. In the field of freight transportation, it is planned to create an integrated CRM system for interacting with customers, introduce smart contracts on a blockchain platform, and develop an electronic trading platform[11]. The CRM system contains information about about 300 different products and services of the Russian Railways holding and its subsidiaries.
5. Based on the analysis of world experience and trends in its development, Russian Railways determines the range for regular piggyback trains. The technology of transportation using piggybackers is developing towards making them mobile: they are equipped with wheels, and in the future they can be equipped with an autopilot capable of independently building a route and moving short distances without human intervention.
6. Currently, it is proposed to use navigation seals, that is, seals equipped with navigation devices (trackers)[12]. Electronic seals[13] for wagons operate on the basis of the GLONASS navigation system. The technology was launched in 2021 and helps in tracking the transportation of goods by controlling the location of wagons, the integrity of the cargo and the route of the train.
7. Another development in the field of unmanned technology is the “machine vision” complex. The device can detect any obstacle on the railway track and signal it to the dispatcher. This technology makes it possible to introduce a new specialty - the driver-operator, who is able to control several locomotives from the office.
8. Russia can enter the top three countries producing trains with a speed of 400 km/h. Now the task is to create a high-speed digital train by 2028, which will have a digital filling.

Developments related to unmanned trains began in 2015, and now unmanned trains are a reality. At the Experimental Ring of JSC VNIIZhT, the largest test site in the country, in 2022, the unmanned Lastochka, an intellectual product of JSC NIIAS, successfully passed the test complex. In the medium term, unmanned cargo trains can also be expected.

When working in a digital environment, the security of information transmission is important, so the development of quantum communication technologies has been launched in parallel. If we consider long distances, then the most secure technology for transmitting information and messages are quantum technologies. The importance of interoperability for the digital transformation of railway transport is beginning to be discussed in the professional community [Rozenberg et al., 2021].

The main issue of the competitiveness of companies that operate in the transportation market and are interested in increasing the income of commodity producers, developing non-commodity exports and increasing the volume of movement of goods is the digitalisation of the transport and logistics industry. To achieve this goal, the Strategy for the Digital Transformation of the Transport Industry of the Russian Federation until 2030 was adopted, the main directions of transport development of which are:

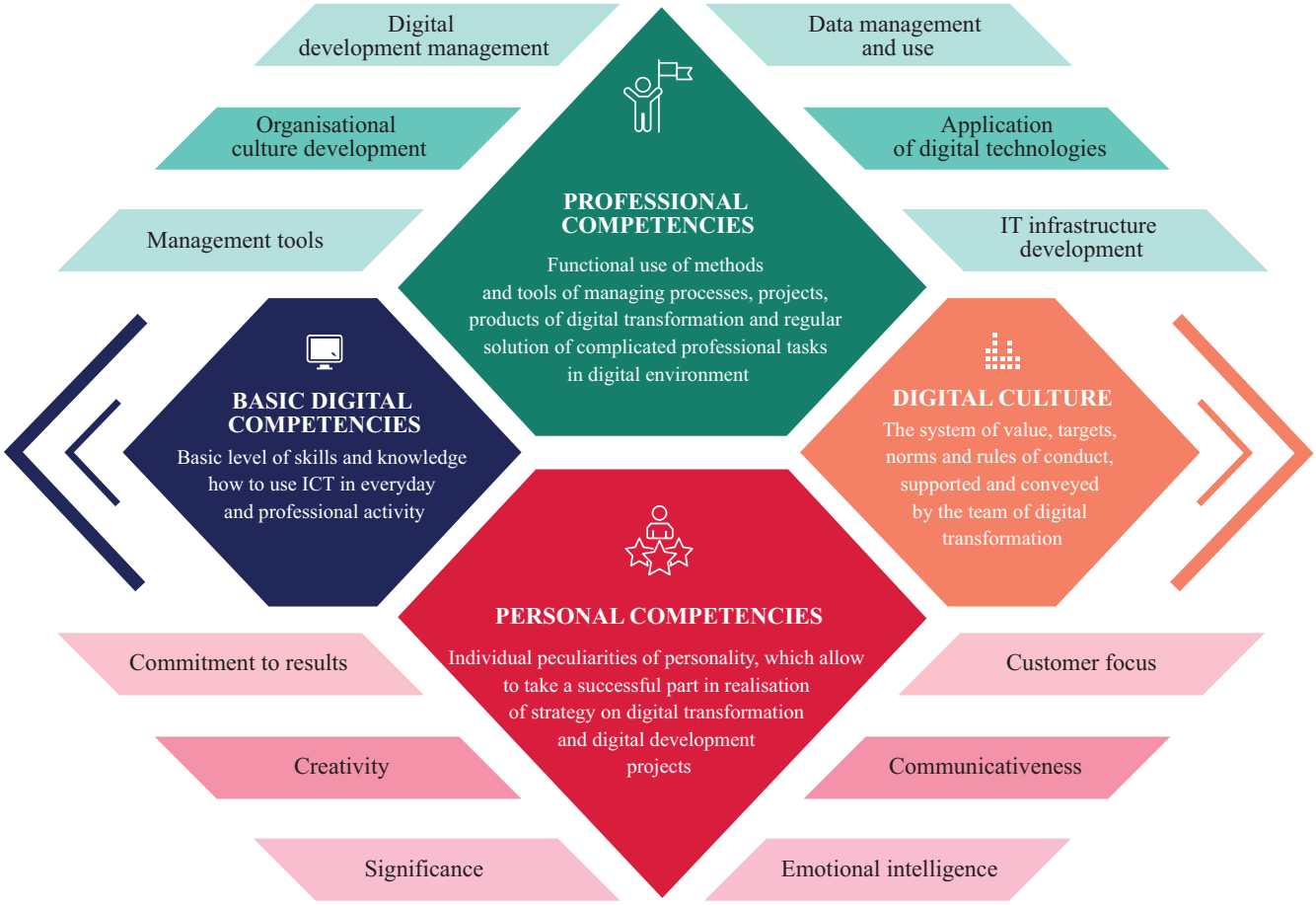
- digital control of the transport system of the Russian Federation;
- digital twins of transport infrastructure facilities;
- drones for passengers and cargo;
- seamless cargo logistics;
- green digital passenger corridor;
- digitalisation for transport security.

The transport industry, which provides the opportunity for the interaction of all types of transport and is the life support link of the digital economy, is already in dire need of qualified engineering personnel. To prepare them, the transport education system needs modernisation[14], so that by 2024 all graduates of transport universities will have the necessary digital competencies. It is obvious that universities cannot cope with the task on their own; close cooperation is needed with specialised companies and research institutes that have modern testing and laboratory facilities and use digital tools in practice.

Some universities quickly responded to the requirements for specialists in the digital economy. Thus, the Higher School of Economics has developed a procedure for conducting independent examinations in digital competencies, which are built into the Regulations on the organisation of intermediate

[8] Digital or railway? What to expect in the future? https://vc.ru/transport/215389-cifrovaya-ili-zheleznaya-doroga-chto-zhdat-v-budushchem.
[9] JSC VNIIZhT passed tests of the Digital Freight Car system. https://itsjournal.ru/news/v-ao-vniizht-proshli-ispytaniya-sistemy-tsifrovoy-gruzovoy-vagon/.
[10] JSC NIIAS is working on the digital transformation of railways. https://nvdaily.ru/info/176913.html.
[11] Russian Railways considers the program of "digital transformation" up to 2025 to pay off. https://company.rzd.ru/ru/9401/page/78314?id=182738.
[12] Electronic sealing: new concepts and reality. https://www.rzd-partner.ru/zhd-transport/comments/elektronnoe-plombirovanie-novye-ponyatiya-i-realnost/.
[13] Electronic navigation seals GLONASS. https://gpscool.ru/sistemy-gps-slezheniya/elektronnye-navigatsionnye-plomby-glonass.
[14] Digital competencies. https://company.rzd.ru/ru/9401/page/78314?id=145125.

Fig. 2. The structure of the competency model



Source: Competence Model of the Digital Transformation Team in the Public Administration System. https://hr.cdto.ranepa.ru/model-kompetencij-komandy-cifrovoj-transformacii.

certification and ongoing monitoring of students' progress at the Higher School of Economics[15].

Specialists of the Center for Training Leaders and Digital Transformation Teams of the RANEPA have developed a methodology for assessing the competencies of participants in digital transformation. The general structure of the competency model is shown in Fig. 2. The competency model correlates with the new professional standards of the Ministry of Labor for Transport.

A new concept of "meta-competencies" (metaskills) has appeared, which is understood as "competencies that allow the formation of new knowledge and competencies" [Mikhailichenko et al., 2016]. The main meta-competences form the foundation for the qualitative growth of an employee at the organisational, social and personal levels. A person will be able to develop other competencies faster and achieve results by owning metaskills.

In Russia, there is a need to develop unified professional standards that will allow linking and adjusting existing educational standards to the necessary qualification requirements, taking into account digital competencies.

Digital competencies, which are currently needed by employees of modern production, are understood as knowledge of communication and digital technologies, as well as a set of skills, knowledge and skills in algorithmic thinking, programming and data analysis. In a broad sense, digital competencies can be called the use of digital technologies in professional activities, training and social communications [Vuorikari et al., 2016], which will ultimately affect the economic development of the country.

Work in this direction is carried out by an advisory body - the National Council for Professional Qualifications under the President of the Russian Federation. Digital competency levels have been defined and professional standards are being prepared for publication[16]:

1. Information and data management.
2. Conscious acquisition of skills or self-development in the face of uncertainty.

[15] The procedure for organising and conducting independent examinations on digital competencies. https://www.hse.ru/dataculture/exams.
[16] Minutes of the NSPK dated June 25, 2020 No. 45. https://nspkrf.ru/documents/materialy-natsionalnogo-soveta/2020-ns/2296-45-25062020/file.html.

3. The ability of a person to build a logical conclusion, evaluate and credibility of information or critical thinking in a digital environment.
4. The process of information transfer and communication or communication and cooperation in the digital environment.
5. The ability to create something new or creative thinking.

Four levels of competencies were selected for employees and workers according to the level of complexity and type of tasks[17] to be solved:

1. Competencies for working with computers, skills and knowledge necessary to view textual and graphic information or basic.
2. Competencies for working with universal text and graphic editors and global networks or universal.
3. Competencies to work with programs for computer-aided design, programs for the development of technological documentation, programs for the finite element method or general professional.
4. Competencies that are in demand by a narrow range of specialties of workers and professions or professional ones.

It is assumed that a significant part of the digital core competencies in professional standards will remain, since the training of engineers for railways is impossible without knowledge about the means of transportation and railway infrastructure. At the same time, there will be fundamentally new requirements for the level of training of engineers - digital competencies necessary for intelligent traffic control and digital railway infrastructure.

To acquire modern digital competencies of railway transport employees, a multimedia communication platform was created on the basis of the Sochi branch of the Sirius Center to integrate new research practices and methods for developing digital products into corporate development programs of companies[18]. The prerequisites for the creation of the center were the lack of digital transformation leaders and teams, as well as employees with advanced competencies for working with data, digital technologies and devices, software, including with colleagues (soft skills).

The set of competencies that an employee should possess depending on their role is traditionally divided into two groups: soft skills and hard skills. Soft skills, or soft skills, are super-professional, universal skills that are not important for a particular job, but without them it is impossible to achieve success. These personal qualities and skills of an engineer include: critical thinking, creativity, persuasiveness, self-motivation, responsibility, time management, adapting to changes in the work environment, the ability to build communications, emotional intelligence. Hard skills, or professional skills, are technical abilities and skills that can be measured and that can be obtained in the learning process. They are often associated with a specific profession: working with technology, programming, working with equipment, knowledge of special industry software, etc.

For example, leadership and communication are interpersonal skills that help engineers be more successful because they complement their job skills. As a rule, the right hemisphere of the brain is involved in the formation of soft skills, and the left hemisphere is involved in the formation of hard skills.

According to the results of a survey on the website of the Russian Railways Digital Competence Center[19] 42% of respondents noted the importance of combining hard skills and soft skills. 25% of survey participants voted for the development of soft skills, believing that it is impossible to build a successful career without soft skills; 14% of the votes were given for the development of hard professional competencies. It should be noted that in different companies the list of soft and hard skills may differ, as well as their interpretation by recruiters.

The Ministry of Labor of the Russian Federation responded to the request of employers in the transport industry and developed a number of professional standards for railway specialists in 2022:

1. Engineer for the operation of technical means of railway transport.
2. Specialist in the operational and dispatching management of railway transportation.
3. An employee for the maintenance and repair of railway traction and transformer substations, linear devices of the traction power supply system.
4. An employee for fencing work sites and securing rolling stock on railway transport.
5. Specialist in organising the work of the railway station and ensuring traffic safety.
6. Specialist in operational management of ensuring the issuance of traction rolling stock for trains, locomotive crews for work.

For example, in professional standard 17.063 "Engineer for the operation of technical equipment of railway transport" in the list of labor actions of an engineer it is prescribed:

1. Registration of documentation in an automated system using application software.
2. Accounting for technological violations and monitoring of failures of technical means using integrated automated systems.

Among the necessary skills of an engineer are mentioned:

1. Ability to use application software in the process of repair and maintenance of technical devices of railway transport.
2. Ability to work with electronic databases and information and analytical systems.

And among the necessary knowledge to perform a labor function, an engineer will need knowledge of a professional

[17] Spiridonov O.A. (2020). Accounting for digital technologies in professional standards. https://profstandart.rosmintrud.ru/upload/medialibrary/ff9/12.11.2020.pdf.
[18] http://cckrzd.ru/.
[19] Digital Competence Center of Russian Railways. https://cckrzd.ru/questions.

Table 1
Automated systems of “Russian Railways” JSC

№	ACS	Name
1	PC GIP JSC Russian Railways	Geographic information platform JSC Russian Railways
2	АСУ ПРИГ	Automated control system for the motor-carriage complex of Russian Railways
3	АСУ НБД – 2 (СВПС)	Rolling Stock Interaction System
4	ПМ ЭТСО	Driver's electronic route
5	"Topomatic Robur - Railways"	The software package is intended for use in railway design and construction organisations
6	AS ETRAN	Platform for issuing railway documents for cargo transportation
7	АКС ФТО	Complex for sales blog - branded transport service systems
8	АС АПВО	System for analysing the planning and execution of "possessions"
9	АС БНУиО	Automated system of accounting and tax accounting and reporting
10	AS OTD	Automated system of operational and technical documentation
11	АСДК	Automated supervisory control system
12	АСНТИ	Automated research and development information system
13	АСОВ	Automated system for organising car traffic
14	ATCS	Automated Tariff Control System
15	АСУ ВОП	Automated management system for issuing and canceling warnings
16	ACS S	Shipper's automated control system
17	ACS “Freight Express”	Automated control system "Freight Express"
18	ACS RT	Automated railway transport control system
19	ACS SS	Automated control system for marshalling yard
20	ACS SSP	Automated control system for shift-daily planning of cargo work
21	ACSST	Automated control system of the railway station
22	ACST-T	Controlling regional information and signal system of the locomotive economy
23	APCS	Automated process control system
24	ACS E	Automated management system for the economy of electrification and power supply and many other complexes

Source: compiled by the authors.

standard for organizing the technical operation and repair of technical equipment of railway transport.

The content of all the above standards mentions the requirement to own special software, the ability to work with analytical automated systems, databases. Thus, the use of industry software is part of the special digital competencies of an engineering worker, which are enshrined in professional standards.

In the foreseeable future, digitalisation will affect all technological processes on the railway without exception. Among the software complexes of Russian Railways, developed at research institutes and specialized companies and implemented in production activities, one can list a lot of software for special industry purposes.

The leading scientific institute of the industry - the Research Institute of Railway Transport (JSC VNIIZhT) has developed and put into operation several well-known software systems on the railway:

- ACS "Express" - a new generation is a system for managing passenger traffic, the prototype of which began work half a century ago;
- "Elbrus M" - predictive macro model of train traffic;
- "SADKO" - system for monitoring the work of special rolling stock "SADKO";

- subsystem "PAUK" - a subsystem of acoustic ultrasonic control of the undercarriage of the rolling stock;
- system of prescriptive diagnostics of an electric train;
- automatic train guidance system;
- technology of accelerated cargo transportation;
- guide "Ural-VNIIZhT" - a program for automating the management of operational work.

JSC VNIIZhT also develops educational solutions. In 2021, a new interactive full-format educational program "Transport Logistics" was announced, presented in two versions: advanced training (96 hours) and professional retraining (256 and 512 hours). The program has received recognition among participants in the transportation market.

According to the General Director of JSC "VNIIZhT" S.A. Vinogradov[20], today the institute has many different projects in the field of infrastructure development, transportation process technologies, digitalisation and transformation programs using modern IT technologies. The Institute takes an active part in at least 14 major technological and digital development projects of Russian Railways.

Award-winning software solutions from another major scientific institute of the railway industry - JSC NIIAS[21]:

- system of technical and commercial control of the state of trains;
- system of interval regulation of train traffic;
- a way to control the technological process of a railway station.

Some of the software solutions used on the railway, which are the foundation for the digital competencies of a railway engineer, are listed in Table 1.

To improve the management of the production activities of Russian Railways on the railways, as part of the development of the digital environment, it is planned to create completely new car and train models, as well as a sales module for the branded transport service system. As noted in the article [Anokhov, Rimskaya, 2021], “digitised routine processes will automatically cease to be a source of profit and the basis of competitiveness.”

In the ACS of Russian Railways today there are about a thousand subtasks and applications[22], that operate in the areas of the holding's activities. The automated system integrates the following subtasks:

1) transportation process management, including the transportation process model;
2) marketing and organisation of freight and passenger transportation, including the system of centralised preparation and execution of transportation documents;
3) corporate infrastructure;
4) rolling stock, including an automated data bank of freight cars;
5) economics and budgeting;
6) investment activity and finance;
7) strategic development;
8) investment activity and security in the field of information technology.

Among the professions of the future on the digital railway[23] one can already name those based on the digital competencies of an engineer:

- operator of unmanned transport systems;
- engineer of artificial intelligence and machine vision systems;
- specialist in cybersecurity of railway transport control systems;
- specialist in the modernisation of the transport system;
- architect of intelligent control systems;
- designer of digital commercial services..

The development of the digital economy is a strategic task that cannot be solved without the availability of digital competencies among workers in various sectors of the economy, primarily high-tech ones. The final results of the implementation of the federal project "Personnel for the Digital Economy" is the achievement by 2024 of the planned performance indicators, in particular, 120 thousand university graduates per year in areas related to information and communication technologies, and 800 thousand university and college graduates per year with digital competencies[24].

Following the Strategy for the Development of the National Qualifications System until 2030, priority areas for the development of the qualifications system until 2024 were identified, in which the emphasis is on harmonising the procedures for the state final certification of a university graduate with an independent assessment of his qualifications, creating conditions for confirming the results of self-education using the qualification assessment procedure , as well as expanding its use in industrial enterprises.

Conclusion

In the era of the rapid development of digitalisation, it is necessary to restructure the system of internal corporate training in terms of the development of digital competencies in connection with the development of informatisation. This process should be implemented starting from the very first stage of training future specialists and continuing continuously throughout their careers.

For the foreseeable future, engineering professions will need the following qualities:

- attention to detail;
- flexibility and stress resistance;
- critical thinking;
- initiative;
- ability to negotiate;

[20] Breakthrough results on the horizon of 5-10 years. Interview with S.A. Vinogradov to the newspaper "Gudok". https://gudok.ru/content/first_person/1611677/.
[21] NIIAS presented new traffic control technologies. http://niias.ru/news/smi/niias-predstavili-novye-tekhnologii-upravleniya-dvizheniem/.
[22] Informatisation in railway transport. History and modernity. https://company.rzd.ru/ru/9401/page/78314?id=22800.
[23] Professions of the future. https://cckrzd.ru/professions_of_the_future.
[24] Personnel for the digital economy. https://data-economy.ru/education.

- possession of information technologies and special software for performing specific activities;
- creativity.

Undoubtedly, leadership qualities and emotional intelligence will remain among the important competencies. Skills related to innovative technologies will become more in demand: quick learner, analytical thinking and deep immersion in a specific area.

All of these skills are the basis, a kind of superstructure that is necessary for the development and formation of new competencies (metaskills).

Scientists from the Carnegie Institution for Science conducted research and made conclusions that proved that people with emotional intelligence, networking and leadership qualities have an 85% chance to achieve financial success, and people with only technical knowledge, - no more than 15%[25].

What kind of meta-competences does a modern engineer of a high-tech industry need in a digital economy? Among the meta-skills[26] that are not currently taught in a university, school or college are: mentoring and mentoring, critical thinking, communication, project management competencies, problem solving and emotional intelligence.

In order for our country to take a leading position in the global economy, ensure economic security and preserve its national borders, it is necessary to continue development in the development of new, non-traditional energy sources, follow the scenario of advanced technical modernisation, raise the level of training of specialists involved in the digital economy, in particular in the digital railroad.

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