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© **I. M. Gulyi, E. S. Sivertseva**  
Emperor Alexander I St. Petersburg State Transport University  
(St. Petersburg, Russia)

## MODERN TRENDS OF TRAINING SPECIALISTS FOR INNOVATIVE DIRECTIONS OF TRANSPORT DEVELOPMENT

The aim of this paper is to reveal the features of modern transformations leading to rapid obsolescence of many professions of transport branch and emergence of new ones. The article presents forecast of emergence and formation of new competences of experts as the inevitable condition for transportation management and future transport operation.

The study rests on the Autor's curve which reflects the change of employment rate depending on qualification. The graphic-analytical and statistical research methods were used.

The problem specified is acute not only for Russia, but for other countries as well facing rapid technological paradigms change. The necessity to form new competencies for transport workers for efficient functioning of transport industry.

Transport engineering higher education institutions must launch new educational programmes.

**Keywords:** transport system, "supra-professional" skills, intellectual systems, profession, digital technologies.

© **И. М. Гулый, Е. С. Сиверцева**  
Петербургский государственный университет путей сообщения  
Императора Александра I  
(Санкт-Петербург, Россия)

## СОВРЕМЕННЫЕ ТРЕНДЫ ПОДГОТОВКИ СПЕЦИАЛИСТОВ ДЛЯ ИННОВАЦИОННЫХ НАПРАВЛЕНИЙ РАЗВИТИЯ ТРАНСПОРТА

Выявить особенности современных трансформаций, которые приводят к устареванию многих профессий транспортной отрасли и появлению новых специальностей. В статье приведен прогноз появления и формирования новых компетенций специалистов как необходимое условие осуществления перевозок и управления транспортом будущего.

В основу исследования положена кривая Аутора, отражающая изменение занятости в зависимости от квалификации работников. Используются графоаналитический и статистический методы исследования.

Указанная проблема весьма актуальна не только для России, но и для других стран, где происходит быстрая смена технологических циклов. Рассматривается вопрос о необходимости формирования новых компетенций работников транспорта для эффективного его функционирования.

В транспортных вузах нужно вводить новые направления обучения.

**Ключевые слова:** транспортная система, «надпрофессиональные» навыки, интеллектуальные системы, профессия, цифровые технологии

## INTRODUCTION

The humanity of today is becoming increasingly mobile. In this regard, the role of transport branch is even more relevant, it is constantly increasing. Our travelling for both short and long distances is becoming more frequent, and we are tending to impose even more requirements to speed, safety, comfort, and economical efficiency of travelling. The intellectual systems are already replacing humanity in many ways and are becoming an integral part of transport infrastructure both in terms of traffic and transport modes operation. In Russia, ground transport provides connectivity of the vast territory, but the tempo of changes in this field has not been considerable in the past decade. However, global competitiveness will force the country to transfer to up-to-date transportation and transport operation methods and technologies [1].

## MATERIALS OF RESEARCH

Logistics management is gradually passing from human to computer control. It is not only “stuffing” that gets smart, but the materials and surfaces as well. Now, adaptive roads (equipped with sensors and solar batteries), light superdurable structures and high-tech materials are being introduced. The cartographic services will be replaced by smart mainlines, which will directly update transport on the current road situation. This will enable a more efficient route planning and faster decision making.

With the number of unmanned cars increase forecast, this solution seems ideal [2, 3].

The speed of travelling is constantly increasing, allowing, for instance, railway transport to compete with planes at short distances. The world’s fastest train is Japanese JR Maglev covering 580 km in one hour. There are other alternative projects as well.

As the age of digital transformation advances, some professions disappear. This is a natural state of things, since it is seen in any change of technology cycles: coachmen were replaced by taxi drives, postmen – by mail transfer agents. But if earlier it used to take decades or even hundreds of years for a cycle to changed, now their duration is limited to 10–15 years [4].

There are a number of peculiarities in today's tendencies of technological, social, marketing, and management-related transformations, which will cause fast-moving obsolescence of many professions, their change and spring-up of new ones. Among those peculiarities are: increasing complexity of management process systems and the necessity for high-capacity intellectual digital systems to participate more actively in decision-making processes, apart from humans; automation of operational and management-related tasks; dilution of market and competition markets, increase of life expectancy of population (Fig. 1). The factors mentioned will soon drastically change the structure of demand for some professions at job markets.

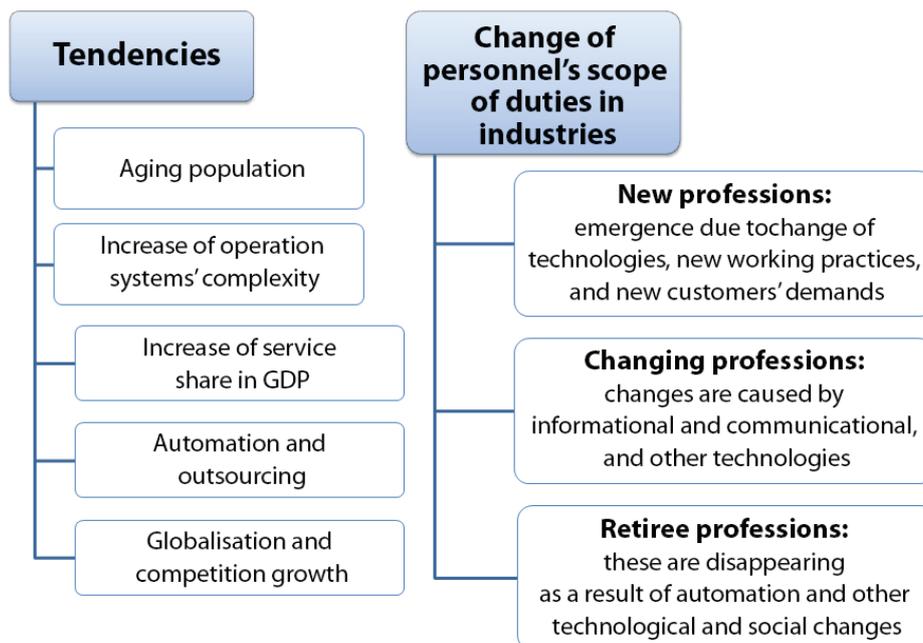


Fig. 1. Key tendencies in XXI century triggering emergence of future professions

Let us illustrate what has been mentioned above. The first example is a widespread profession of motorman. Every year unmanned control systems are improved more and more. They are expected to be first used in metro trains and freight trains. The man will participate in control only when it comes to emergency situations. By the middle of XXI century, freight train unmanned control will have become a widespread practice.

The second example is a profession in transport service sphere, namely transport hub specialist. Currently, there are information robots which help passengers orient themselves at stations, and special machines (such as cleaning and towing machines) are gradually becoming more automated. In the future, they will be controlled remotely, therefore airports and railway stations will demand fewer service personnel.

The third example is a well-known ticket seller. Transport infrastructure is becoming more sophisticated, passenger traffic is increasing, and the requirements to safety and speed are rising. The man will find it difficult to handle these tasks soon. The automated service machines and terminals are being massively introduced, whose service can be provided via mobile applications. Human involvement will be limited to control highest level decision making when it comes to incidents and complicated situations. Therefore, the profession of a ticket seller is becoming out-of-date.

Another most significant factor of XXI century professional development is that the profession gained is not static. This means that on graduating with it, a young professional is not guaranteed a full success [6]. The most sought-after professionals are those who “absorb” the so-called “supraprofessional” skills [5], required in future professions. Among these are (Fig. 2):

- a systematic way of thinking;
- intercultural communication;
- aptitude for project management, application of project-focused approach in solving professional tasks;
- lean production practice and optimal (namely, the one with the minimal resources use) option of task solving;
- aptitude for working with robots and AI systems;
- customer-focused approach;
- multicultural and multilingual skills;
- skills for work with people and employee’s integration into work with various social groups;
- skills for work in high uncertainty conditions (because of environment changes);
- creativity skills.

The supraprofessional skills are universal, since they are important for different fields of employment. Mastering these will enable an employee to increase their professional activity efficiency and pass to other fields, still being in high demand [7].

Another important tendency of the past decades cannot be omitted. Today, the highest impact of digitalisation and automation is made on blue-collar and



Fig. 2. Required supraprofessional skills for future professions

middle specialists. To confirm this, let us consider the Autor's curve (presented by American economist David Autor), which reflects alterations in employment rate in USA industry from 1980 until 2005, depending on an employee's qualification (Fig. 3).

It is seen that, for a period of 25 years in USA the employment degree of low and highly-qualified employees increased, and the number of middle qualification workers decreased. This was caused by widespread use of automated solutions for medium-level tasks. The automation in any industry always starts with middle qualification works, since they contain a sufficient volume of template operations which are easy to automate, and they are paid good enough to make this process attractive for business owners.

Let us pass on to description of some future professions, expected to emerge within the following decades.

The emergence of new professions will be accompanied by setting the following transport tasks:

- design and operation of transport systems (unmanned ones);
- design of automated transport control systems;
- transport safety provision;
- design of cross-logistics systems;
- design of intermodal transport hubs;

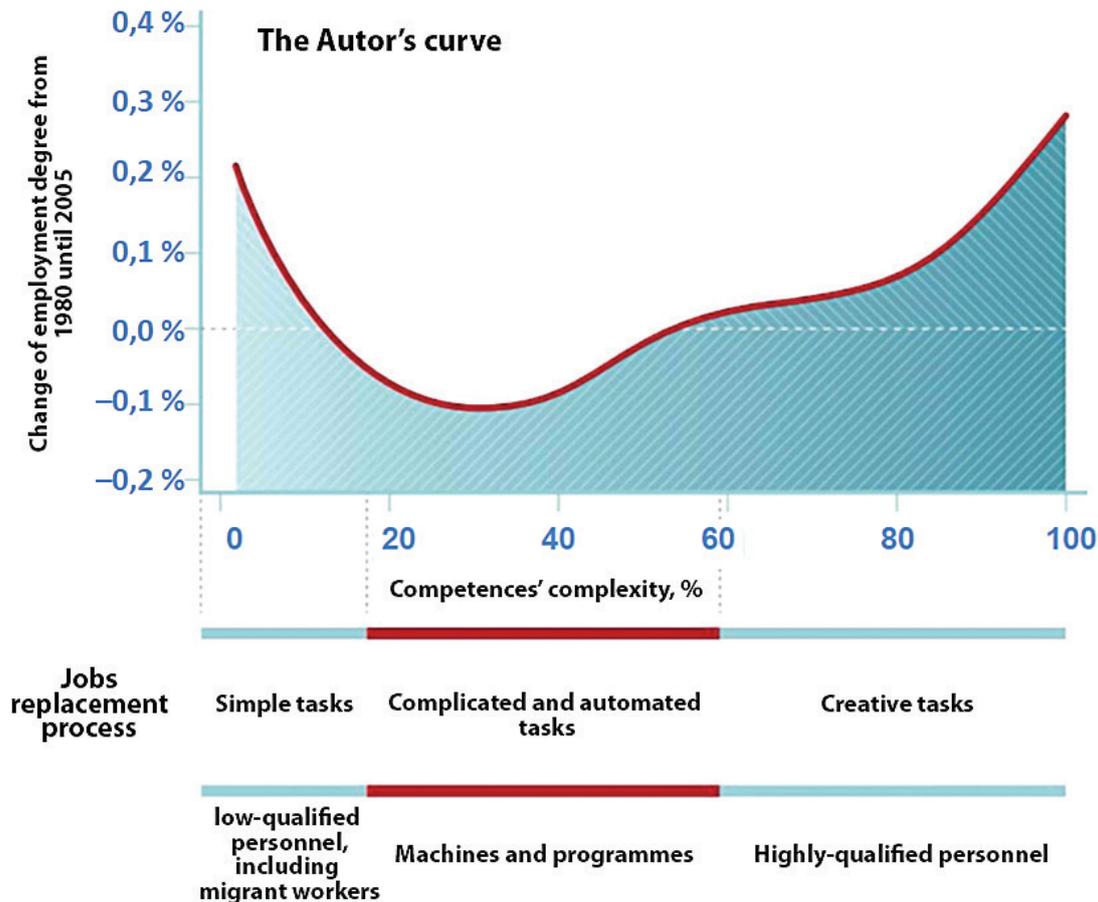


Fig. 3. The Autor's curve [5]

- design of smart roads;
- application of new materials for ground transport;
- design of HSR projects.

The digital transport transformation is expected to give rise to:

- high-speed railway transport represented as a complex in each territory [8];
- development of global freight logistics (on the basis of Radio Frequency Identification, the system now used in metro tickets);
- unmanned cars and lorries;
- smart roads with adaptive surface;
- electrical cars in cities;
- беспилотных легковых и грузовых автомобилей;
- «умных» дорог с адаптивным покрытием;
- электромобилей в городах;
- freight screening without unpacking.

What are exactly these future professions in transportation sphere?

This is, for instance, *cross-logistics operator*, a professional engaged in selecting the best methods of freight and passenger delivery using different modes of transportation; control and adjustment of traffic throughout a multimodal network; monitoring of the throughput capacity of transportation hubs; redistribution of traffic flows in transportation networks.

*Intermodal transport hub designer*, a professional to be engaged in designing intermodal transportation hubs (transport modes changing system), calculating their capacity, durability, and assessing their development potential.

*Intermodal transport technician*, engaged in servicing technologically heterogeneous transport structure, intermodal freight and transport hubs, infrastructure, and railway stations premises.

The new profession is also considered *a high-speed railway designer*. This professional designs railway tracks, junctions and stations for high-speed travelling, considering area features and climate conditions.

Due to development of alternative types of materials and structures, *designer of composite structures for transport* will emerge. This professional will design structures (framework, liners, details) using composite materials with the set weight, durability, and wear resistance, etc.

Another much sought-after profession will be *smart road builder*, who will choose and install adaptive road surface, marks, and road signs with RFID, surveillance systems, and road state control sensors.

Due to mass automation, the Fourth Industrial Revolution, the companies will face demand for *automated transport systems operator*, who will operate robotised transport systems, configure computer programmes for robotised mechanisms and transport modes (unmanned ones in the first place).

As the digitalisation develops, the transport industry will need *smart management systems architect*, who will design software for unmanned vehicles and traffic management systems, and control smart management systems. Various solutions exist today to monitor complex shipments, though shipments are managed by people. The future will require automated traffic management systems [9].

The age that requires public security will see emergence of *transport network safety engineer*. Among his duties there will be analysing and monitoring information, environmental and technological threats to transportation networks. Unlike traffic safety experts, these engineers analyze and prevent problems connected with the functioning of whole transportation networks. With the increasing speed of data transmission, demand is growing for faster riding and higher speed of transportation, which means more stringent requirements for network infrastructure and safety [10–12].

It is beyond any doubt that the professions mentioned will require mastering supraprofessional skills, covered earlier in this work. Fig. 4 shows as a matrix the key cross-competences to be possessed by a transport professional of the future.

	Systematic way of thinking	Inter-industry communication	Project management	Lean production practice	Programming/working with robots and AI systems	Customer-focused approach	Multicultural and multilingual skills	Working with people	Working in uncertainty conditions	Creativity skills
Automated transport systems operator	✓		✓	✓						✓
Transport network safety engineer	✓	✓	✓		✓	✓	✓	✓		
Cross-logistics operator	✓		✓	✓	✓	✓	✓	✓		
Intermodal transport hub designer	✓	✓	✓	✓		✓				
Intermodal transport technician				✓	✓	✓		✓		
Smart road builder			✓	✓	✓					
Designer of composite structures for transport	✓	✓	✓	✓	✓					
High-speed railway designer	✓	✓	✓	✓	✓					
Smart management systems architect	✓	✓	✓	✓	✓					

Fig. 4. Supraprofessional skills for transport professionals of tomorrow [5]

It needs to be pointed out that JSC “Russian Railways” today are actively implementing pilot projects using new digital technologies. As an example, the following can be pointed out [13]:

- unmanned traffic control on Moscow Railway;
- unmanned operation of marshalling locomotive on October Railway;
- development and implementation of integrated automated rolling stock receiving and diagnosis station at stations – the Bataysk station of North Caucasus Railway;
- expansion of functional capabilities of complex electronic system of updating data at Moscow-Uzunovo section of Moscow Railway;
- expansion of functional capabilities of the interval traffic control system using automated locomotive signalling with data transmission by digital radio

channel without using rail circuits at Bolshevo-Fryazino section of Moscow Railway;

– establishment of the Centre for automated monitoring of traffic parameters [13].

For successful realisation of “the Programme of Semi-High-Speed and High-Speed Railway Communication in the Russian Federation”, it is obligatory to have qualified personnel of the highest level [14]. In the conditions of global digital development, JSC “RZD” should prove that it is capable of fulfilling the tasks of a national railway freight and passenger transportation operator not only now, but in the future as well, by fostering breakthrough researches [15].

For realisation of pilot projects and subsequent work, professionals are demanded that would possess all mentioned cross-competences. Emperor Alexander I St. Petersburg State Transport University is already using these competences both in education and compiling new education programmes in order to fulfill the following functions:

***project and economic activity:***

- ability to assess efficiency of the projects considering uncertainty factors;
- ability to form a project team and efficiently organise work in groups.

***analytical activity:***

– ability to analyse and use various information sources to perform economic calculations;

– ability to make forecast of major social and economic indicators of activity of a company, branch, region, and economy as a whole;

– ability to design varieties of decision-making solutions and justify their choice building on social and economic efficiency criteria.

***informational and analytical activity:***

– ability to evaluate influence of macroeconomic environment on functioning of organisations, and state and municipal governmental bodies, to identify and analyse market-based and specific risks, and analyse customers’ behaviour and form demand using knowledge of economic principles of organisations’ behaviour, market structure and competitive environment of the industry;

– eagerness to act in unusual situations, bear social and ethical responsibility for decisions made;

– eagerness for self-development, self-realisation, and use of creative potential;

– eagerness to lead the team in one’s professional area, tolerating social, ethical, confessional, and cultural differences;

– ability to make organisational decisions;

– ability to independently prepare tasks and develop project decisions including uncertainty factor, develop relative methodical and normative documents as well as propositions and activities on realisation of the designed projects and programmes, and other competences of no less importance.

## CONCLUSION

Thus, emergence of new professions is not a predetermined scenario of the future, which can come with a certain degree of certainty, but a prerequisite for development and maintaining of competitiveness of transport system and national economy.

Currently in education process the institutions are governed by Federal State Educational Standard (FGOS) and must use them as the basis for methodological guidance in training specialists, considering new requirements which are constantly updated by legislation. The competences fixed in FGOS of this generation are divided into universal competences, which comprise general scientific, instrumental, general cultural, general professional, and special competences.

The use of these instruments in the process of education means planning each class in the form the required competences, which are demanded in a professional's activities. The results of mastering these competences should become: knowledge and skills to be demonstrated by a person on completion of lectures, practical trainings, laboratory practices, etc. Since realisation of competences takes place during fulfillment of various kinds of activity associated with solving of theoretical and practical tasks, the structure of the competences should include (apart from standard knowledge and skills) motivational, and emotional and volitional spheres. And we must understand that the competence formed is not abstract, it should demonstrate itself in a person's behaviour in a certain situation. In order to fix and describe a competence, we need to solve a task of assessing competences. The assessment and control procedures are undertaken both at training stage and by employer, having many approaches and various viewpoints. And educational institutions undertake training in accordance with FGOS, whereas employers during hiring process assess graduates by professional standards, developed by Ministry of Labour and Social Protection of Russia, and entry questionnaires. As matter of fact, it is extremely difficult to combine different legislation requirements in training sphere and employers' eagerness to have highly professional personnel. It is exactly therefore the above-mentioned supraprofessional skills are sought-after in today's reality and are a prerequisite for development and retaining of competitiveness of transport.

Emperor Alexander I St. Petersburg State Transport University is one of the first universities in Russia to realise in its education process new training

programmes for future transport. On completion, graduates possess knowledge, skills, and other significant competences required for promotion of innovative management on high-speed transport [14].

### Библиографический список / References

1. Казанская Л.Ф., Палкина Е.С. Императивы инновационного развития транспортной системы в условиях глобализации // Экон. жел. дорог. – 2016. – № 12. – С. 52–58. [Kazanskaya LF, Palkina ES. Imperativy innovacionnogo razvitiya transportnoi systemy v usloviyakh globalizatsii. *Ekonomika zheleznykh dorog*. 2016;(12):52-58. (In Russ.)].
2. Цифровой бизнес: учебник / под науч. ред. О.В. Китовой. – М.: ИНФРА-М, 2018. – 418 с. [Kitivii OV, editor. *Tsifrovoy biznes: uchebnik*. Moscow, INFRA-M, 2018. (In Russ.)].
3. Казанская Л.Ф., Савицкая Н.В., Камзол П.П. Перспективы развития беспилотного транспорта в России // Бюл. результатов науч. исслед. – 2018. – № 2. – С. 18–28. [Kazanskaya LF, Savitskaya NV, Kamzol PP. Perspektivy razvitiya bespilotnogo transporta v Rossii. *Bulletin of research results*. 2018;(2):18-28. (In Russ.)].
4. Журавлева Н.А. Цифровая экономика как основа экономики высоких скоростей // Транспортные системы и технологии – 2017. – Т. 3. – № 2. – С. 47–49. [Zhuravleva NA. Digital economy as the basic of high-speed economy. *Transportation Systems and Technology*. 2017;3(2):47-49]. doi: 10.17816/transsyst20173247-49
5. Атлас новых профессий. АНО «Агентство стратегических инициатив по разработке новых проектов». Доступно по: <https://asi.ru/reports/16344>. Ссылка активна на: 02.09.2018. [Atlas novykh professii. ANO “Agentstvo strategicheskikh iniciativ po razrabotke novykh projektov”. Available from: <https://asi.ru/reports/16344>. (In Russ.) Accessed September 2, 2018.].
6. Гулый И.М., Петухов В.В. Анализ баланса спроса и предложения на рынке труда молодых специалистов // Новая экон. – новое об-во. – 2011. – № 6. – С. 72–75. [Guliy IM, Petukhov VV. Analiz sprosa i predlozheniya na rynke truda molodykh specialistov. *Novaya ekonomika – novoye obshchestvo*. 2011;(6):72-75. (In Russ.)].
7. Казанская Л.Ф. Качество системы образования как индикатор развития транспортной системы в условиях глобализации. Сб. тр. X С.-Петербур. конгр. «Профессиональное образование, наука и инновации в XXI веке». Доступно по: <https://elibrary.ru/item.asp?id=27436546>. Ссылка активна на 12.11.2018. [Kazanskaya LF. Kachestvo systemy obrazovaniya kak indikator razvitiya transportnoi systemy v usloviyakh globalizatsii. (Congress proceedigs) (In Russ.) Available at: <https://elibrary.ru/item.asp?id=27436546>. Accessed November 12, 2018].
8. Казанская Л.Ф. Развитие высокоскоростного железнодорожного транспорта как фактор повышения конкурентоспособности национальной экономики страны // Экономика и управление в XXI веке: актуальные вопросы, достижения и инновации. Пенза: Наука и просвещение, 2017. – С. 55–63. [Kazanskaya LF. Razvitiye vysokoskorostnogo zheleznodorozhnogo transporta kak factor povysheniya konkurentosposobnosti natsionalnoi ekonomiki strany. In: *Ekonomika i upravleniye v XXI veke: aktualniye voprosy, dostizheniya i innovacii: monografiya*. Penza: 2017. P. 55-63. (In Russ.)].

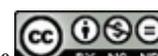
9. Давыдов С.С. Использование компетентностного подхода к обучению для обеспечения реализации стратегии развития железнодорожного транспорта // Роль образования в формировании экономической, социальной и правовой культуры. СПб, 2014. – С. 382–386. [Davydov SS. Ispolzovanie kompetentnostnogo podkhoda k obucheniu dlya obespecheniya realizatsii strategii razvitiya zheleznodorozhnogo transporta. *Rol obrazovaniya v formirovaniy ekonomicheskoi, sotsialnoi i pravovoi kultury. Sbornik nauchnikh trudov. Government of St. Petersburg, Committee on Science and Higher Education*. 2014:382-386. (In Russ.)].
10. Казанская Л.Ф. Оптимизация критериев эффективного управления безопасностью движения в железнодорожной компании // Уч. зап. Межд. банк. ин-та. – 2017. – № 21. – С. 146–158. [Kazanskaya LF. Optimization of Criteria for Effective Traffic Safety Management in Railway Company. *Proceedings of the International Banking Institute*. 2017;(21):146-158. (In Russ.)].
11. Казанская Л.Ф., Ризакулов Ш.Ш., Артимович В.М. Направления повышения экономической эффективности управления движением в железнодорожной компании // Уч. зап. Межд. банк. ин-та. – 2017. – № 22. – С. 115–129. [Kazanskaya LF, Rizakulov ShSh, Artimovich VM. Directions of Increase of Economic Efficiency of Traffic Safety Management in Railway Companies. *Proceedings of the International Banking Institute*. 2017;(22):115-129 (In Russ.)].
12. Казанская Л.Ф., Ризакулов Ш.Ш. Построение системы управления в железнодорожной компании с учетом экономических факторов // Бюл. результатов науч. исслед. – 2017. – № 2. – С. 15–25. [Kazanskaya LF, Rizakulov ShSh. Postroyeniye systemy upravleniya v zheleznodorozhnoi kompanii s uchetom ekonomicheskikh factorov. *Bulletin of research results*. 2017;(2):15-25. (In Russ.)].
13. Российские железные дороги (ОАО): офиц. сайт. Доступно по: <http://www.rzd.ru>. Ссылка активна на 02.09.2018. [Russian railways OJSC: Available from: <http://www.rzd.ru>. (In Russ.) Accessed September 02, 2018].
14. Сиверцева Е.С. Новые направления подготовки кадров для решения современных задач развития сети ВСМ в РФ // Матер. межд. науч.-практ. конф. «Августин Бетанкур: от традиций к будущему инженерного образования». СПб, 2018. – С. 193–196. Доступно по: <https://elibrary.ru/item.asp?id=34854822>. Ссылка активна на 12.11.2018. [Sivertceva ES. Novye napravleniya podgotovki kadrov dlya resheniya sovremennykh zadach razvitiya seti VSM v RF. (Conference proceedings) Materialy mezhdunarodnoi nauchno-prakticheskoi konferentsii “Avgustin Betankur ot traditsii k budushchemu inzhenerного obrazovaniia”; 2018 Feb 01-02; St. Petersburg; 2018. P. 193-196. (In Russ.) Available from: <https://elibrary.ru/item.asp?id=34854822>. (In Russ.) Accessed November 12, 2018.].
15. Давыдов С.С. Экономические аспекты цифровой железной дороги // Транспортные системы и технол. – 2017. – Т. 3. – № 2. – С. 39–41. [Davydov SS. Economic features of digital railway. *Transportation Systems and Technology*. 2017;3(2):39-41]. doi: 10.17816/transsyst20173239-41

### Information about authors:

**Ilya M. Gulyi**, Candidate of Economic Science (PhD)

eLibrary SPIN: 1788-1967, ORCID 0000-0001-8676-1561

E-mail: [ilya.guliy@mail.ru](mailto:ilya.guliy@mail.ru)



**Elena S. Sivertseva,**  
eLibrary SPIN:2917-1809; ORCID 0000-0002-2087-0260  
E-mail: sivlen@mail.ru

**Сведения об авторах:**

**Гулый Илья Михайлович,** кандидат экономических наук  
eLibrary SPIN: 1788-1967, ORCID 0000-0001-8676-1561;  
E-mail: ilya.guliy@mail.ru

**Сиверцева Елена Сергеевна,**  
eLibrary SPIN:2917-1809; ORCID 0000-0002-2087-0260;  
E-mail: sivlen@mail.ru

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