

# Impact of critically relevant factors on human resourcing in the transportation industry

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**Abstract.** The article deals with the most significant aspects of developing human resourcing at transport enterprises. The transportation industry is one of the most important both from the point of view of the national economy and the life support of an individual. The success of the transportation industry depends largely on human resources. Currently, there are two models of staff training for the transportation industry around the world: in narrowly focused specialized educational organizations or in classical universities at specialized transport faculties, departments and schools. Both models are subject to the same influence of external factors. Structural transformation of the global economy, as well as processes of sustainable development and digitalization play a special role. The article attempts to reflect the impact of a number of factors on the staffing of the transportation industry, as well as to consider ways to reduce their negative impact.

## 1 Introduction

At present, global competition is actively developing in many markets. Because of this, many companies set the speed of the production system's response to customer requests as a criterion for the effectiveness of the enterprise's operation. Only those enterprises whose production system has a high degree of flexibility and adaptability, and whose finished products are largely customized, have the opportunity to take the leading positions among manufacturers [9].

The same patterns persist for the educational system: stakeholders in the educational services market make similar demands on educational organizations:

- employers expect graduates of the university to have acquired skills to innovate in the industry;
- graduates are expected to master the competencies that will be in demand by the time of completion of the training process;
- the state assumes that all graduates will be employed, and the need for existing vacancies is provided.

In addition, the quality of education is becoming more and more important for all interested parties, since people are the most valuable asset for most companies [16]. The authors V. Juščius and E. Adaškevičiūtė have the same opinion. Their position indicates that

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human resources have a significant impact on the company's operations, operating results, product quality and competitiveness [12]. It is the level of competence development at the university that will be a decisive factor in the re-sale of goods, works, and services that the company produces or provides in its market niche. This is especially true for life-supporting industries that result in services: transport, medicine. Here, customer dissatisfaction may be the most innocuous result of the actions of unskilled workers in these industries. The greatest probability of accidents is inherent in transport, as a source of increased danger. In their large-scale research based on data from the Czech In-depth Accident Study (CzIDAS) project, the authors [6] prove the significant influence of the human factor on the occurrence of accidents and road accidents.

The transportation industry today is one of the most dynamically changing and one of the most pronounced applied Sciences. In recent years, the complexity of transportation systems has become more and more apparent. In this regard, intelligent approaches are being introduced to the design of rolling stock and infrastructure, as well as to the construction of logistics chains. The specifics of educational organizations are more evident in the sphere of transportation.

The policy in the field of human resourcing of educational institutions in the transportation sector of education should be built in such a way as to meet modern challenges: globalization, digitalization, national security. The transition to the new University 3.0 format has become the educational mainstream in universities. This trend is typical for the entire world education system. The third generation of universities trains professionals, scientists and entrepreneurs on a global scale in a recognized international language. The main units within such universities are institutes within universities. For example, at the Siberian State University of Water Transport, there was a merger of faculties whose main educational programs are implemented in accordance with the STCW Convention. The newly created structural division was named the Marine Institute.

The challenge for the transportation industry is also the transition to a global knowledge economy, where the key unit is not an individual, but a team that is capable of implementing projects of large-scale changes [1]. In transport, this team is the rolling-stock crew, where team building is a critical competence for the normal functioning of the entire transport system.

## **2 Research methods**

The methods of bibliographic description, analysis, comparison, classification, as well as the graphical method were used. When compiling models of transportation education, the sites of 40 universities were examined, of which 18 were Russian and 22 were foreign. The analysis was based on data from educational organizations in more than 10 countries. Articles in scientific peer-reviewed journals were used in forming the list of competencies that are most important for transport companies, as well as methods for their formation. The authors of the articles are representatives of such countries as the Republic of Lithuania, the Republic of Poland, the Czech Republic, Italy, Australia, Russia, etc.

The logic of the article is as follows: at the beginning, the prerequisites for establishing a focus on personnel in the transportation industry are defined. Then we consider the challenges facing humanity today. The transportation industry is also forced to adapt to new conditions. There are defined models of implementing transportation education in Russia and in the world. There are identified some universities and countries that provide training on a similar principle. An attempt is made to determine the reasons for the existing territorial placement of the transport university framework. It turns out that the principles of its construction are similar.

Next, the most important competencies for employers in different countries are determined. Competencies that are critical for some of them are compared. In general, it is concluded that the set of competencies was subjected to a significant revision, on the way to entering the fourth industrial revolution. At this point, employers felt a noticeable gap between theory and practice, as university graduates were not ready for the new conditions of functioning in transport. The changes taking place in the industry are dynamic, which is not true of the educational environment, which is one of the most conservative. This is confirmed by the academic culture – the number of defended thesis with the word "transport" in the title in Russia has decreased by almost 40% over the eight-year period. In the Republic of Lithuania, the situation is more favorable, not least because of differences in the organization of the system of training highly qualified personnel. The participation of a number of foreign universities in the Erasmus+ and Erasmus Staff programs also has a positive impact. At the end of the work, all the considered aspects are examined from the point of view of their impact on the transportation industry, as well as ways to reduce possible risks and their consequences are determined.

### 3 Research results

Transportation education has different implementation models all over the world. In the Russian Federation, transportation education is represented by branch universities, which are located in the Department of the Ministry of transport of the Russian Federation. Each individual university specializes in specific types of transport – for example, the Siberian State University of Water Transport, the Siberian State University of Railways, and the Saint Petersburg State University of Civil Aviation.

Transportation education is based on a similar model in a number of other countries:

- People's Republic Of China: East China Transport University (<https://www.ecjtu.jx.cn>), Dalian Transport University (<https://www.syu.edu.cn>);

- Democratic People's Republic of Korea: Pyongyang Railway Institute;

- Republic of Korea: Korean Railroad Research Institute (<https://www.krri.re.kr>), Korea National University of Transportation (<https://www.ut.ac.kr>);

- Vietnam: Ho Chi Minh City University of Transportation(<https://ut.edu.vn/en/>);

- United States Of America: U.S. U.S. Merchant Marine Academy (<https://www.usmma.edu/>), Great Lakes Maritime Academy (<https://www.nmc.edu/maritime/>), Maine Maritime Academy, Massachusetts Maritime Academy, Texas A and M Maritime Academy, the California State University Maritime Academy, State University of New York Maritime College;

- France: Airways Aviation Academy (<https://airwaysaviation.com/>);

- Republic of Kazakhstan: M. Tynyshbayev Kazakh Academy of Transport and Communications (<https://www.kazatk.kz>), Kazakh University of Railway Transport (<http://kuwc.kz>);

- Republic of Belarus: Belarusian State University of Transport (<https://www.bsut.by>), Belarusian State Aviation Academy (<https://bgaa.by>).

Most of the European world system of transportation education is based on the principle of classical universities with the allocation of transport faculties in their structure. For example:

- Federal Republic of Germany: Technical Dresden University of Technology (<https://tu-dresden.de>) ("Friedrich List" Faculty of Transport and Traffic Sciences), TU Berlin ([www.tu-berlin.de](http://www.tu-berlin.de)) - Faculty of Transport and Mechanical Engineering;

- Poland: Warsaw University of Technology (<https://www.wt.pw.edu.pl/>) - Department of Transport.

Historically, transport universities have emerged as a form of transport has developed. For example, in Russia, as the construction of the TRANS-Siberian railway progressed, universities of railway communication were established in Moscow and Omsk. The expansion of the railway network required the training of specialists for the South of Russia (Rostov-on-don), the Far East (Khabarovsk), and the creation of another university in Siberia (Novosibirsk).

In other countries of the world, the network of transport universities was formed on the same principle. After the restoration of Lithuania's independence, the strengthening of the country's economy led to the emergence of the Lithuanian transport sector as an important factor in the development of the economic foundations of the state. The emergence of a new transport system gave an impetus to the training of highly qualified specialists in air and rail transport. Vilnius Gediminas Technical University has allocated a structural unit-the Department of Transport Engineering, where training programs in Aviation mechanics, Railway transport engineering and Economics were implemented. Later in 1994, as the demand for specialists in the transportation industry increased, it became necessary to create an aviation Institute, a Department of railway transport, and a faculty of transport engineering, together with four specialized departments [2].

Poland, using its favorable geographical location, effectively uses its transit potential - two out of ten TRANS-European corridors intersect in the Silesian province. These are Corridor III (Berlin-Wroclaw-Katowice-Krakov-Lviv) and Corridor VI (Gdansk-Katowice-Zilina). This state of affairs is an attractive factor for securing large logistics companies in the country [13]. It meets the needs of the transport services market at the International University of Logistics and Transport in Wroclaw. With the support of the Society of Road Hauliers "Lower Silesia", the Polish Union of Motor Transport Employers, the Polish Logistics Community, the Logistics company GEFKO Polska, as well as the Chamber of Commerce and Industry of Lower Silesia, the training is practice-oriented, providing a base for internships and practices. The close connection between theory and practice has a positive effect on the balance of supply and demand in the labor market of the region [4].

The modern business world is rapidly changing, so it is important for universities not only to develop the competencies that are in demand in the market at the moment, but also to identify and try to predict the necessary competencies in the future [19].

For example, managers of logistics companies impose a number of requirements for the availability of competencies on potential candidates for the position of logistician. The significance of the level of possessing a particular competence in Poland and Lithuania was determined empirically in the study of authors from the countries under consideration [17]. The results of the study are presented in Table 1.

**Table 1.** Significance of the level of competence of a specialist in the position of a logistician in Poland and Lithuania [17].

Competence	Significance of the competence depending on the country, %	
	Poland	Lithuania
Planning, coordinating and controlling the order fulfillment process	84	68
Maintaining long - term relationships with clients	68	57
Calculating the cost of services	44	48

Search for new customers and carriers	68	36
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As a result of the research [17], the authors concluded that a professional in the field of logistics in Poland should have some developed leadership qualities, a driver's license, be able to work in a team and delegate authority. At the same time, Lithuanian logistics company managers only require a specialist in a similar position to have knowledge of Russian and other foreign languages.

Knowledge of languages becomes a very important criterion when passing the test selection for a position in any company in the transport industry. At present, borders are being blurred for transport companies operating in global markets, business models are changing, logistics supply chains are changing, and skills and relationships with stakeholders in the transport services market are being transformed. Taking into account the increasing penetration of technologies, we can talk about the diffusion of the "Industry 4.0" phenomenon into the transportation industry.

The expression "Fourth Industrial Revolution" was the first used in 1988 to refer to the processes of turning inventions into innovations thanks to scientists in production teams [15]. In 2011, the term "Industry 4.0" was assigned to this phenomenon [5]. Other countries use different names to refer to the current stage of technological development:

- in the Federal Republic of Germany: "Industrie 4.0»
- in the United States: «Industrial Internet» or «Advanced Manufacturing»;
- in the European Commission, it sounds like "Factories of the Future".

Terms such as "Digital Factory", "Digital Manufacturing", "Smart Factory", "Interconnected Factory", "Integrated Industry", "Production 4.0", and "Human-Machine Cooperation" are also used to denote the new industrial paradigm [5].

One way or another, all these terms imply one thing – industry will not be the same, and technology cannot continue to be ignored. The collaboration of man and machine becomes a creative alliance that will increase labor productivity and create additional value for the final consumer.

The authors from Italy [7] after the analysis indicate that the new industrial paradigm industry 4.0 will be expressed in two evolutionary aspects in transport:

- the operator is replaced with technology for performing certain tasks;
- the operator uses new technologies to perform additional tasks and increase productivity.

It is very likely that human resources will be replaced in transport with technologies (artificial intelligence, robotic technologies, automatic machines) for those types of work that involve physical labor and frequently repeated operations. These include loading and unloading operations, a set of cargo presented for transportation in a warehouse, packaging, etc. [10].

Teaching concepts and methods to prepare students for learning Industry 4.0, i.e. the use of digital and virtualized objects in transport, has been successfully applied at the University of Applied Sciences Emden / Leer, Germany since 2010. Transport systems are viewed through the prism of the life cycle of processes based on digitized data, information, and services (for example, computing, modeling, analysis, decision-making, communication, and so on). [8]. This university implements the main educational programs in the field of transport at the faculty of Marine Sciences.

Special attention is paid to teaching methods based on four principles [18]:

- connecting theoretical training with the concept of "industry 4.0" through research results published in scientific journals, applications for industrial patents and analysis of industry requirements performed by students themselves;
- transferring the obtained knowledge to the prototype of the innovation, performed by teams of students consisting of 2-3 people at the university «process factories»;

- bringing some prototypes to an industrial design with the launch of production;
- replicating research and innovation results performed by students at international conferences [11].

According to this perspective, the new generation of transport engineers should be able to integrate interdisciplinary knowledge. That is, the ship's captain must not only understand how to use the electronic map navigation and information system (ECDIS, that is Electronic Chart Display and Information System) and a radar station (RS), but also have the competence of a Manager, since he/she manages the team, decides on the life support of the team on the ship and is responsible for the property entrusted to them in the form of the ship and cargo presented for transportation.

The author from Australia [14] in his research on the analysis of the best pedagogical practices of training transport specialists in an interdisciplinary approach points to the need to adapt pedagogy to work in constantly changing conditions of functioning in the field of transport.

The author sees a positive aspect of the interdisciplinary approach in transportation education as reflection in the work of practitioners, since during training a deeper understanding of the issues under consideration is formed.

For example, a specialist in the formation of a logistics supply chain should possess not only technical knowledge of theoretical aspects for scientific justification of the decisions made, but also promote open communication between all stakeholders of the transport services market [3].

In this regard, teachers in transport universities (or transport departments in classical universities) have a dilemma: hone their practical skills or immerse themselves in scientific research. If we take into account that in most cases, teachers of special transport disciplines are graduates of the same universities (faculties), who, after entering the MA or Doctorate courses, remained to teach in the scientific direction of their thesis. In other words, such a teacher is a theorist and cannot fully cover applied issues. This is confirmed by the work of the author [3], who mentions the widening gap between the theory and practice of transport education. Theoretical aspects of research are also reflected in the results of the activities of transport departments. For example, the team of Vilnius Gediminas Technical University participated in the development of the Lithuanian transport system strategy, but only theoretical and methodological parameters.

## **4 Discussion of results**

It should also be noted that the emphasis on the development of theoretical competencies among teachers is also stimulated by the state and the employer: almost all employment contracts with teachers contain a KPI, such as the number of publications in indexed and peer-reviewed scientific journals. From the point of view of increasing material remuneration for labor, teachers are willing to publish articles, often at the expense of internships at transport and engineering enterprises. Thus, there is an increasing gap between academic culture and practice.

At the same time, if we talk about academic culture in the field of transport, it often explores technologies that are currently losing their relevance. The time of completing a Doctoral dissertation in Russia is measured in years, and sometimes in tens of years. Therefore, research scientists approach the subject and object of research with caution. For example, after examining the website of the Higher Attestation Commission of the Russian Federation, we can conclude that the number of defended theses for a nine-year period, the name of which contains the word root "transport", barely exceeds 1% of the total number of defended theses (Table 2), and the authors are not always employees of transport universities.

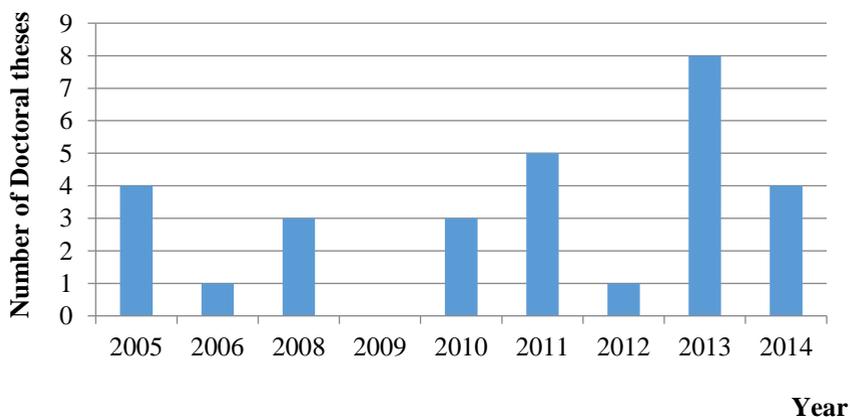
**Table 2.** Number of defended Ph. D. theses in the Russian Federation [17].

Period	Total number of defended Ph.D. theses, units.	Number of Ph.D. theses with the word root "transport" in the title	
		the total number of units.	percentage of the total number of defended Ph.D. theses, %
2012	15730	188	1.2
2013	24054	290	1.2
2014	13038	168	1.3
2015	16016	221	1.4
2016	13190	152	1.2
2017	11043	135	1.2
2018	10094	104	1.0
2019	9038	117	1.3
2020*	747	30	0.4

\* - data presented as of 13.06.2020

Source: compiled by the author based on the site <https://vak.minobrnauki.gov.ru>

In the European Union, the Doctoral program is the third stage of education and in most cases ends with the defense of the final work and the assignment of a scientific degree (PhD). For example, in Vilnius Gediminas Technical University (VGTU), the Faculty of Transport had only one year without defending Doctoral thesis in the period from 2005 to 2014. The dynamics of defended Doctoral theses (2005-2014) in the field of transport is shown in Figure 1.

**Fig. 1.** The number of defended theses for the Doctor's degree in the field of transport at VGTU for the period 2005-2014 [2].

The final work of VGТУ is a collaboration of science and practice and necessarily brings a positive effect for the industry. In addition to the mandatory research conducted at the third stage of education, students in many countries have the opportunity to take foreign internships in organizations that are included in the Erasmus+ system. These internships last six months in the sixth and eighth semesters of the first stage of education (Bachelor's degree). The opportunity to study best practices and learn from the experience of other countries has a positive impact on the development of practical skills of future specialists in the transport industry. At the same time, the general trend of the world educational system is programs focused on the export of education. As part of this concept, the "Visiting Professor" program is actively used. For example, the already mentioned VGТУ attracts experts from Israel, Malaysia, Kazakhstan, Russia, Switzerland, Iran, Jordan, the Netherlands and many other countries as visiting professors.

In Russia, there is a special feature in attracting practical teachers to give lectures and practice to students of transport and other universities. In Russia there is a Unified Job Evaluation Catalogue of Posts of Top Managers, Experts and Employees (UCP), where qualification characteristics of managers and specialists of higher professional and additional professional education are approved by the Order of the Ministry of Health of the Russian Federation of 11.01.2011 No. 1H. This is a restriction on both the positions held and the functions performed. For example, if an employee of an existing transport company with extensive experience in the industry, but without a degree, will be employed at a university, they can count on the position of assistant. In accordance with the UCP, an employee in the position of assistant does not have the right to give lectures and supervise final qualifying works. In this regard, the employee gets a minimum wage, which reduces their motivation to work. It is not possible to replicate information to a wide audience. Project work that could be carried out as part of the final qualification work is also not available. It is obvious that practical skills can be honed during practice. For example, this may be the practice of a major shipping company, but they enter into contracts for all navigation, which most often lasts from April to November. The school year ends in June and begins in September. In other words, the student is likely to experience academic failure and has to make a choice between attending classes and practicing. Not always in favor of practice. In this case, the practice takes place at the Department.

## 5 Conclusion

Thus, summing up the results of the work, we can highlight the specifics of training personnel for the transport industry (Table 3).

**Table 3.** Specificity of personnel training for the transport industry.

Aspect	The manifestation of the transportation	Risks to industry- based education	Ways to reduce negative impact
1. Transition to University 3.0	The emergence of new specialties that combine entrepreneur and technical specialist. Emergence of institutes as part of universities	Loss of contingent	Building flexible adaptive programs with an individual learning trajectory
2. A key unit of the global knowledge economy - team	Allocation of responsibility for decision-making to all members of the team / crew / flight crew. The results of the entire system will	The degree of manifestation of academic science decreases, the association of stronger individuals in strong teams and weak in weak	Building training programs in such a way that classical forms of learning (lectures and seminars) are

	depend on the actions of each individual	ones-there is a risk of the Matthew effect, where the principle works : "the more, the more»	combined with active and interactive ones (case studies, brainstorming, role-playing games, trainings)
3. Different implementation models: industry - based universities or transport divisions based on classical universities	Specialists who graduate from general universities have great opportunities during their studies. However, employers, all other things being equal, choose a graduate of an industrial transport university	Universities that have a stronger reputation in the market will "absorb" a large number of applicants, while industry universities will get those applicants who were not able to enter the leading universities	Increasing the number of target places for admission to transport universities
4. Language barrier is also a barrier to the transport industry	Global channels for the movement of material resources are international transport corridors, domestic transport is an object of international tourism, vacancies in international companies are possible only if you have a certificate confirming the level of language proficiency	A large loss of transport teachers may leave the industry due to the need to overcome the language barrier. At the same time, teachers who speak the language will not be able to fully convey the industry subtleties of the discipline being studied	Teachers' training is centralized in universities at the expense of the employer, internships, Erasmus Staff programs
5. Deep penetration of the fourth industrial revolution in the transport industry	The emergence of unmanned vehicles for cargo and passenger transport, automation of logistics processes, warehouse robotization, the use of drones for document delivery, cleaning cars, etc.	An increase in the share of unemployed in the industry, a failure in automated systems leads to paralysis of the functioning of the transport enterprise	Use of released human resources for " training " robots, prescribing them various algorithms of actions, maintenance
6. Significant gap between theory and practice. Difficulties in attracting production workers to the educational process	Graduates take a long time to adapt to the profession, they need additional training in the workplace	Reduction of the university's reputation capital	Changing the procedure for attracting industry specialists to the educational process
7. Integration of soft skills and hard skills and an interdisciplinary approach	It often happens that the carrier becomes an entrepreneur, growing due to the established client base. The heads of production divisions of transport enterprises are not ship captains and drivers,	"Blurring" of industry disciplines, reducing the level of professional knowledge	Training in special disciplines through methods that develop team building, increasing activities in extracurricular activities, project activities at the

	but people who have managerial competencies		intersection of sciences
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As it can be seen from the presented analysis, this list of specific aspects for transport education is far from complete. The analysis of the studied literature showed the need for further research.

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