

Regular Article

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Key competences for Transport 4.0 – Educators’ and Practitioners’ opinions

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Abstract: This study deals with the subject of the Fourth Industrial Revolution; that is, Industry 4.0 or Revolution 4.0 discusses its impact on contemporary road transport and the development of Transport 4.0. The needs of the industry as well as the transport industry change diametrically with the correspondingly sudden and rapid development of technology, as well as the requirements of companies hiring new employees. To meet the future requirements of Revolution 4.0, the vocational training program should undergo a major overhaul. Therefore, it is important to determine what skills and qualifications of employees of transport companies should be currently developed. The study presents fragments of analyses performed as part of the F2J – “Future-Ready Ed Right Skills To Right Job” project, financed by the European Commission under the Erasmus + Program. The main goal of this article is to identify the skills and characteristics of transport companies’ employees that are most required from the point of view of the Revolution 4.0. Both technical and soft skills to be imparted into the human workforce for Transport 4.0 were reported. Study shows the need to address the integration of the concept of Revolution 4.0 into the current education system. The article is based on the analysis of data from highly qualified employees who work in transport companies (practitioners), as well as people involved in education and comprehensive preparation of people for work in the transport industry (educators). A total of 63 people participated in the study.

Keywords: revolution 4.0, transport 4.0, future competences, industry 4.0, industrial revolution, human resources

1 Introduction

The fourth industrial revolution, or Industry 4.0, is a complex process of technological and organizational transformation of enterprises, based on automation, digitization of products and services, integration of information systems, and the introduction of new business models. The changes that take place under the influence of new technologies do not apply only to manufacturing companies. The scope of the revolution is much more extensive. The use of the Industry 4.0 concept can also be observed in transport and logistics.

This article shows the impact of Revolution 4.0 on the most popular branch of transport – road transport, and in this context, points to the changes already taking place in it, leading to the formation of Transport 4.0. Revolution 4.0 has created new areas that today’s specialists in the transport industry must face. For this reason, the main goal of the article is to show what technologies seem to be important for Transport 4.0, as well as to show the key skills of an employee in this industry. This issue is extremely important for research and teaching centers whose aim is to educate future employees of specific skills at the highest possible level.

The article is divided into three parts. The first part is a theoretical introduction to Transport 4.0, summarizing innovations in road transport, the introduction of which will involve a change in the requirements for employees and their range of skills. The second is a theoretical introduction to the identification of the employee’s key competences. It presents two basic categories of competences: technical and soft. The last part presents the methodology of the conducted research and shows and interprets the results.

2 Transport 4.0

Transport 4.0 is defined as an increasingly autonomous transport because it is strongly based on automation and autonomization, and at the same time, focused on

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a gradually decreasing negative impact on the environment, the process of movement along with all accompanying activities, taking place in a networked environment [1,2]. In present world increasingly dependent on safe, economical, and environmentally friendly transport, companies have to face many new challenges related to technological progress. According to the results of the PwC “21st CEO Survey,” presented in the report “Transport of the Future” (PwC), “As much as 68% of CEOs of global transport and logistics companies expect changes in key service delivery technologies to have a breakthrough impact on their business” [3].

Innovative technologies are necessary to improve the efficiency and profitability of activities carried out by companies. An example is truck platooning, that is, integrated truck convoys that follow one another at a distance shorter than is possible under uncontrolled automatic conditions (approx. 10 m compared to 50 m for manual steering). The concept is based on vehicle-to-vehicle communication, and each vehicle in the convoy is equipped with advanced driving assistance systems and connectivity technologies. Integrated convoys will contribute to reducing fuel consumption and, consequently, will reduce the negative impact of human activity on climate change, that is, reduce CO₂ emissions. They are also intended to increase the level of security, eliminating the risk of human error. The currently used technology assumes that each vehicle has a driver responsible for steering and, if necessary, correcting the speed of the car, but as the system develops, the driver will only be necessary in the leading vehicle.

As predicted by the European Automobile Manufacturers Association, ACEA, it should be possible to use motorways (and thus crossing state borders) in convoys across Europe without the need to apply special exemptions until 2023. The forecast applies to heavy goods vehicles in which drivers are ready to intervene in any situation [4]. It is estimated that trucks can move without a driver from 2027. This may contribute to reducing the operating costs of transport enterprises by as much as 45% [5].

Another example of innovation in road transport is alternative drives. Due to the increasingly restrictive regulations on greenhouse gas emissions, it becomes necessary to introduce new solutions, such as zero-emission vehicles with electric drive (battery electric vehicle [BEV]) and hydrogen (fuel cell electric [FCEV]). Although hydrogen-powered fuel cell vehicles are currently being tested, many experts say they are the future of truck and bus transport. It is estimated that the total cost of ownership of commercial hydrogen vehicles will decline by more than 50% over the next 10 years. Breakeven for FCEVs and BEVs will be in 2024, and for FCEVs and ICEVs (Internal Combustion Engine Vehicles) in 2028 [6].

According to the report of the E-mobility Meter [7], according to data from the end of November 2020, 757 electric vans and trucks were driving on Polish roads, which is a 40% increase compared to January 2020. Along with the increase in the number of electric vehicles, the charging infrastructure is also developing. The network of publicly accessible charging stations has grown by as much as 36% year-to-year. The importance of vehicles powered by natural gas – compressed – CNG and liquid – LNG is also growing. This gas is considered to be one of the most ecological and economical engine fuels.

Digitization also has a huge potential to increase the efficiency of the services provided by companies and reduce costs. The first area of transport digitization is the computerization of transport companies and process automation. Digitization manifests itself mainly in transport management systems, customer relationship management, and enterprise resource planning systems that allow for the automation of administrative processes. Robotic process automation is also a technology that is gaining in importance. It is an advanced software-based technology used to automate repetitive activities, for example, preparation of transport documentation. Among the representatives of global transport and logistics companies, as many as 78% plan to take action to automate tasks and positions to ensure the effective realization of the company's goals [3].

The second area of transport digitization is the platformization of the sale of transport services. Examples of this can be found both among taxi and haulage services, as well as freight services, such as online freight exchanges, which create platforms for short-distance and long-distance transport in real time. The phenomenon related to platformization is the sharing economy. It assumes the sharing of specific resources, not only platformization of the purchase of services. The solutions created on their basis can solve the issue of unused cargo space, which is a big problem for the transport industry. A study by Frost and Sullivan shows that one in four trucks on the road in the United States and Europe is driving empty and, among the loaded trucks, typically only just over 50% loaded [8,9].

On the basis of digitization, it will be possible to implement more advanced digital solutions, such as, for example, intelligent transport systems (IST) or blockchain solutions (after 2023) [3]. IST will enable transport operators to better manage their vehicle fleet and loads remotely. The solution will support companies in collecting and reporting information on vehicle traffic and even in securing vehicles against unauthorized use of the fuel card. However, blockchain-based software solutions will enable the transport industry to locate, identify the product, and allow for privacy auditing. The technology

will make it easier to track shipments, create documentation, and register payments. It will allow for more effective real-time temperature monitoring from anywhere. The World Health Organization reports that up to 50% of vaccines are damaged in the world every year. One of the reasons given is inadequate transport conditions and temperature fluctuations during transport [10].

Another technology that will be used by entrepreneurs providing road transport services is artificial intelligence (AI). Solutions based on AI will allow, among others, better management of the fleet and the flow of passengers/goods as well as better planning of activities. Applications created with the use of AI will help choose the best combinations of vehicles with orders, considering the available vehicles and routes, estimate the value and reject less profitable orders, as well as support drivers, for example, by managing working time.

3 Challenges of future employees

Modern technologies are becoming a key element of competitive advantage for transport companies. They allow to increase the effectiveness of the company. However, the development of technology raises concerns about the role of the employee in modern enterprises. The view that increased digitization in companies is likely to lead to a reduction in workforce is quite popular. This is a misconception because the goal of the concept of Revolution 4.0 is to create networks by integrating the work of people and machines. Although the share of technology and automation will increase, and digitization will cover almost every aspect of the company's operations, the employee will still remain its greatest value. It can be predicted that the role of an employee will be significantly transformed, as computerization and automation of work generate the demand for a completely new employee model [11,12].

The profession of a driver is a good example to illustrate the depth of a shift. Currently, a professional driver can be seen as an operator of systems of interconnected devices. When full automation will be possible in the transport sector, the profession of "truck driver" will gradually disappear. The driver who was the operator of the device system will become the supervisor of autonomous device systems controlled by AI. Instead of driving a vehicle, human responsibilities will include managing a fleet of autonomous vehicles. This work will be much more difficult, and the driver will have to demonstrate specific competences to be able to supervise autonomous decisions. At this point, it should also be noted that even

fully autonomous unmanned trucks will still need the participation of not only the supervisor but also many other employees: analyst, engineer, programmer, tester, and service technician [12,13].

The transformation of the work environment will change the job profiles and therefore requires employees to be outfitted with a wide range of competencies. The following will be particularly important: cooperation skills and teamwork [14–18], openness to changes [11,14,16,19], and problem-solving [17,18,20–22]. Various authors underline that cognitive ability [14,23], positive attitude [15], and creativity [17,18,24,25] are the key competencies required from employees. Others go further highlighting skills such as cross-cultural competency [15,26–28], adaptability [21,29], and flexibility [17,18,29,30], which will play a key role in Industry 4.0 as they also play an important aspect in teamwork and work in interdisciplinary environments.

To be able to coordinate these competencies, being able to manage complexity [14,30], abstraction ability [31,32], critical thinking [17,18,25,33], leadership skills [17,18,26,34], and respecting ethics [23,35] may be crucial.

Apart from all the competencies mentioned above, employees must also bring domain-related competencies as well as the ability to apply expertise and use technology. In this area, all graduates need to bring IT and technology affinity [11,17,18,20,25,36,37]. In most new jobs, knowledge of the Internet of Things (IoT) solutions will be expected [11,38,39]. Knowledge about cloud computing and cloud architectures [11,29,30,33,37,40] as well as robotics and AI [12,24,41] will be of key importance. Big data and data analysis and interpretation will also be of big importance [29,33,37,40].

4 Required competences for Transport 4.0

The question is what competencies seem to be necessary for future employees of Transport 4.0. To define the skills requirements, in this study, based on the literature on the subject, the key competences were identified and categorized into two groups: digital and technical competences (equated with hard, professional skills) and soft competences. Technical skills are required for highly technical tasks, whereas soft skills are essential, *inter alia*, for teamwork and communication [42].

Technical skills are acquired through practice and learning [43]. They include knowledge and skills related to work, for example, knowledge of cloud segments

(network services), cooperative IST and vehicle to everything (V2X) interfaces, autonomous systems, or knowledge of cybersecurity. Due to the fact that the fourth industrial revolution will affect every industry, and digital tools will become common, almost all employees, in every position will need technical skills [11,17,18,44].

Soft competences are divided into two subcategories – cognitive and social competences. Cognitive skills, commonly known as thinking competences, include problem-solving and decision-making skills, creativity and innovation, critical thinking, and the ability to deal with cognitive overload. Social skills, however, include the ability to work in a group, leadership skills, and intercultural competences [17,18].

The research focuses on verifying the importance of technical, cognitive, and social competences of Transport 4.0 employees. Based on the existing research and analyzes [11,12,14–30,33–42,45,46], a total of 21 competences were identified. The competences selected for the analysis are discussed below.

4.1 Technical competences

Big data and analytics – understood as the ability to analyze large data sets in transport applications, that is, to manage the supply chain, optimize transport routes, plan operational capabilities, and perform comprehensive risk analyzes. With the help of Big Data analysis, the employees managing the team could assess which employees, for example, drivers, are the most effective and identify competency gaps. Thanks to this, it would be easier to train current and future employees to increase the efficiency of their work.

Knowledge of autonomous robots or autonomous systems – knowledge and ability to operate devices, processes, and systems (controlled automatically by means of mechanical or electronic devices). This competence is extremely important because, as analyzes show, transport is the industry with the greatest automation potential [12]. Calculations of the automation potential of individual activities show that in the transport industry, the percentage of working time that can be automated using the technologies available today is as high as 65% [12].

Simulation – knowledge of simulation tools that enable optimization of current and planned processes, identification and reduction of losses, and cost reduction. A Transport 4.0 employee could use simulations to plan vehicle routes considering the limitations indicated by the decision-maker, analyze capacity and design routes, or optimize transshipment processes.

Knowledge of horizontal and vertical system integration – understanding the issues of vertical and horizontal integration. Industry 4.0 horizontally transforms and integrates processes throughout the organization, from purchasing and product development, through production, logistics to services. Vertical integration goes beyond the company's internal operations, from suppliers to customers, and includes all key partners. It is based on technologies enabling identification and tracking as well as integrated planning and implementation of tasks in real time [47].

Knowledge of IoT solutions – understood as knowledge about IoT solutions and systems that allow the implementation of new methods of monitoring goods and shipping management. A Transport 4.0 worker could use IoT technology to track, monitor, and manage connected vehicles, transported loads, and other assets in real time.

Cybersecurity knowledge – knowledge about activities that reduce the risk of cybersecurity violation and the ability to react in the event of an incident. Supply chain participants, including transport companies, have access to sensitive data on the value of cargo and its location. Due to the development of IoT devices, which are equipment of modern vehicles, the risk of attacks consisting, for example, in immobilizing a car with a valuable cargo in a selected location or sending false information to the driver about a change of destination point increases.

Understanding cloud computing – knowledge, ability to analyze and supervise processes using cloud technologies. Knowledge of this technology allows to communicate with all participants of the supply chain, business partners, and customers within a consistent interface and from any device.

Knowledge of augmented reality – knowledge of the technology could allow you to optimize transport operations in areas such as completeness checks, international trade, driver navigation, and loading of goods. Mastering the technology could enable managers to conduct much faster training introducing a new employee to the tasks at his workplace, training in the use of specialized equipment or in the implementation of specific procedures [48].

Knowledge of information technologies and informatics applications – mass computerization of processes translates into a huge amount of data provided by systems. This competence is understood as having analytical skills that will allow to extract the most important information from the point of view of the conducted activity.

Knowledge of cooperative systems and V2X interfaces – understood as specialist knowledge and skills in

the field of traffic control and management in transport systems using Cooperative Intelligent Transport Systems solutions. Technologies are closely related to progressive automation and solutions such as truck platooning. Due to them, vehicles will be able to communicate with other vehicles, elements of road infrastructure and elements of the transport network. The systems are intended to be helpful, for example, in emergency braking situations. The leading vehicle sends a braking message to other vehicles in the vicinity, which prevents a collision or limits its consequences [49].

4.2 Soft competences

4.2.1 Social competences

Collaboration and team work – understood as the ability to adapt actions in relation to the actions of others, the ability to compromise to achieve a common goal and to accept the perspective of other employees and business partners. This skill also applies to working in virtual teams – more and more tasks will require the cooperation of people who are far away from each other [18].

Leadership – activities aimed at motivating, inspiring others, the ability to influence the behavior of an individual or a group to achieve specific effects [15].

Positive attitude – a mental attitude that focuses on the positive aspects of what surrounds the individual.

Work ethic – understood as high commitment to work and focusing on the compliance of activity results with the company's standards. As well as focusing on work activities in line with moral, job-related, and social norms.

Cross-cultural competency – the ability to work in a diverse cultural environment. They are manifested in the ability to respect, accept, and use the views and actions of others (resulting from culture) to create conditions for integration, adaptation, and development of cooperation [27,28].

4.2.2 Cognitive competences

Problem solving (decision-making ability) – competency based on both analytical and creative skills. Analytical thinking provides a logical framework for problem solving. It includes skills such as comparing, judging, and selecting. Creative thinking is a divergent process, using the imagination to create a large range of ideas for solutions [15].

Creativity and innovation – the ability to go beyond the routine way of acting or reasoning, the ability to find

hidden patterns, and generate solutions. According to research, 70% of Industry 4.0 employees declare that in the companies they work for expected of them to come up with new ideas regarding production technologies or use of digital solutions, and to present proposals for product innovations [15,46].

Critical thinking – understood as the use of logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems [18].

Cognitive load management – refers to the ability to select information. In the future, as a consequence of the growing supply of information, the phenomenon of information overload may occur frequently. What is important here is perceptual efficiency and attention processes (concentration, divisibility, shifting), which are a mechanism for reducing the excess of information that reaches a person at a given moment. Therefore, only a part of the stimuli reaching the sensory organs is perceived to be able to activate appropriate information from memory structures and initiate further processes enabling an appropriate reaction [27].

Ability to adapt to new conditions and flexibility (resilience) – understood as readiness and openness to changes, the ability to adapt to a new environment. Adapting requires learning new tasks quickly and performing them accurately and flawlessly, as well as dealing with nonroutine situations and accepting changes in work procedures. Flexibility, however, is understood as the ability to flexibly switch thinking between different problems or sets of rules [18].

Openness to changes and to the new technologies – understood as openness to learning, readiness to accept new experiences and concepts, as well as readiness to expand assigned duties at work but also with acceptance of novelty.

5 Methodology

Research on employee competencies in the context of Revolution 4.0 is one of the dynamically developing directions; however, at the moment, only a few studies concern the competences of employees in the transport industry, hence the legitimacy of dealing with this subject in this study. The aim of the article was to verify which competences of employees in the transport industry are crucial in the context of Revolution 4.0, as well as whether the two selected groups of respondents will be characterized by similar assessments of selected competences.

At the turn of 2019 and 2020, a survey was conducted among selected experts from the transport industry. These experts are highly qualified employees of transport companies (practitioners), as well as educators, conducting transport training. In total, data from 63 respondents – 43 practitioners and 20 educators were used for the analysis. The respondents were asked to indicate the importance of selected competences.

The study was conducted in the form of an auditorium questionnaire. The research tool consisted of open-ended and closed-ended questions. The survey was used to verify the experts' knowledge of the Industry 4.0 concept, as well as to identify the key competences of an industry employee (the results discussed in this article). For the purposes of this study, two closed questions from the survey were used, concerning the selected and previously described competences.

The respondents were asked to indicate the importance of selected competences. In both questions, a five-point Likert scale was used, where the rating 1 meant the marginal importance of a given competence, and the rating 5 indicated its very high importance. For the sake of clarity, the competencies included in each question are described below. The first question "Please rate the professional skills according to transport company needs" included Big data and analytics, autonomous robots or autonomous systems, simulation, horizontal and vertical system integration, IOT, cybersecurity, The Cloud, augmented reality, information technologies and informatics applications, cooperative systems, and V2X interfaces. The second question "Please rate the soft skills according to transport company needs" included critical thinking, problem solving (decision-making ability), creativity and innovation, collaboration–team work, leadership, positive attitude, work ethic, cross-cultural competency, ability to adapt to new conditions and flexibility (resilience), cognitive load management, openness to changes and to the new technologies.

6 Results and discussion

The respondents were asked to evaluate the competences that, in their opinion, will be necessary to work in transport companies and implement the concept of Transport 4.0. The demand for a given competency was assessed on a scale, where 1 meant that the competency did not matter, and 5 – a very important competency. The results are shown in the figures below. Analyses due to group inequality were performed using the nonparametric Mann–Whitney U test.

6.1 Technical competences

Two groups of respondents are characterized by similar assessments of selected technical and digital competences. Diversification was noted in the assessment of competences: knowledge of autonomous robots and autonomous systems as well as knowledge of solutions in the area of the IOT. The analyses showed significant differences in assessments between the groups of practitioners and educators in relation to the knowledge of autonomous robots and autonomous systems, $U = 277.500$, $Z = -2.518$, $p = 0.012$, and knowledge of solutions in the area of the IoT, $U = 294.000$, $Z = -2.224$, $p = 0.026$. Educators will rate both competences higher than practitioners. It can be concluded that educators are more aware of the need for these competences than practitioners with employment stabilization.

Although the respondents from these research groups have different views on the issue of having knowledge in the field of autonomous systems, both groups assessed this competence as the most important ($M = 3.87$). Knowledge of horizontal and vertical integration of systems was considered the least important competence ($M = 3.24$), especially in the opinion of practitioners (Figures 1 and 2).

6.2 Soft competences

6.2.1 Cognitive competences

In the case of cognitive skills (Figures 3 and 4), the ability to solve problems (decision-making) was rated the highest ($M = 4.54$). This competence seems to be necessary for both groups of respondents. Creativity and innovation were rated the lowest in each group. There were statistically significant differences in the assessment of the cognitive load management, $U = 255.000$, $Z = -2.937$, and $p = 0.003$. The educators considered this competence necessary probably due to the awareness that the rapid development of technology will increase the multitasking of employees. Processing large doses of information coming from the environment may, in their opinion, become a problem for employees of the industry. For practitioners, however, this skill is not the most important. This group of respondents considered openness to new technologies to be the most important competence ($M = 4.62$). Differences were found at the level of the statistical trend in the assessment of this competency between the groups, $U = 322.500$, $Z = -1.916$, and $p = 0.055$.

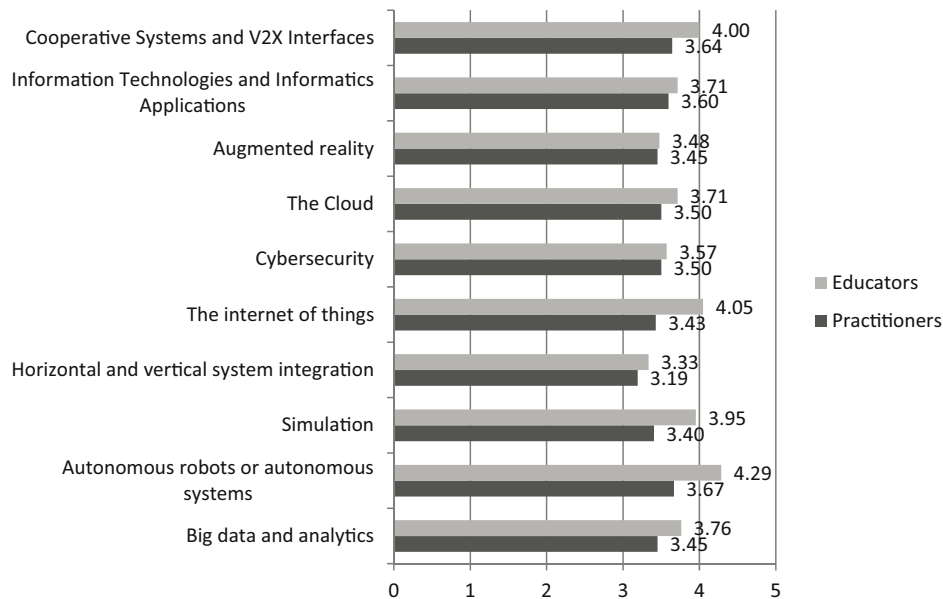


Figure 1: Technical competences in the opinion of practitioners and educators. Source: author's own study.

6.2.2 Social competences

Practitioners and educators have different views on the issue of cross-cultural competency. The greatest, significant differentiation was noted in the assessment of these skills, $U = 182,000$, $Z = -3,980$, and $p = 0.01$. Educators consider these competences to be very important, because in their opinion, an employee of Transport 4.0 should be able to effectively navigate in a multicultural environment, be able to quickly adapt to different cultural realities, should be open, tolerant, and be able to act flexibly in different, often completely different cultures. Establishing lasting relationships and cooperation with foreign business partners requires sensitivity to cultural issues.

However, the ability to cooperate is not as important for educators as it is for practitioners. Significant differences were shown between the groups of educators and practitioners in the assessment of this competence, $U = 310,500$, $Z = -2.035$, and $p = 0.042$. The ability to establish and maintain relationships with other employees of the company and the ability to compromise and focus on partnership are features that are valued by representatives of transport companies ($M = 4.31$).

It turns out, however, that these skills are not the most important for practitioners. According to experts from transport companies, compliance with the law, generally accepted standards and principles defining attitudes and behaviors that are considered appropriate

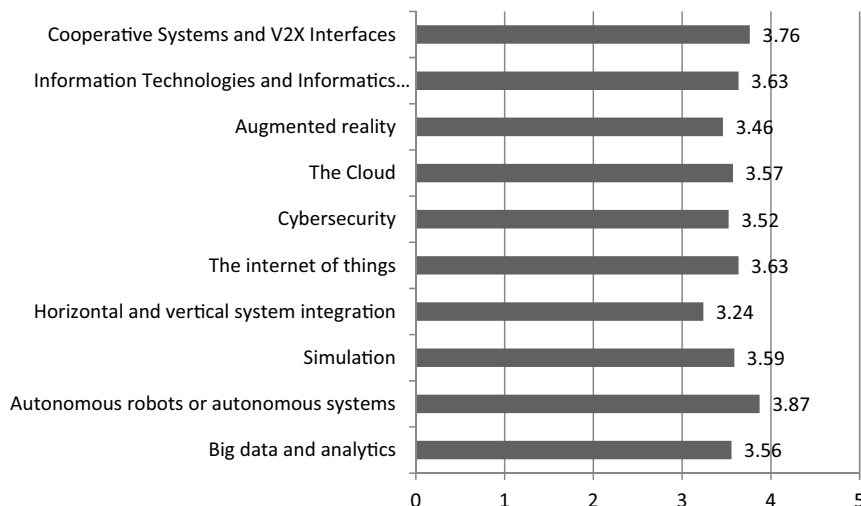


Figure 2: Technical competences, overall results. Source: author's own study.

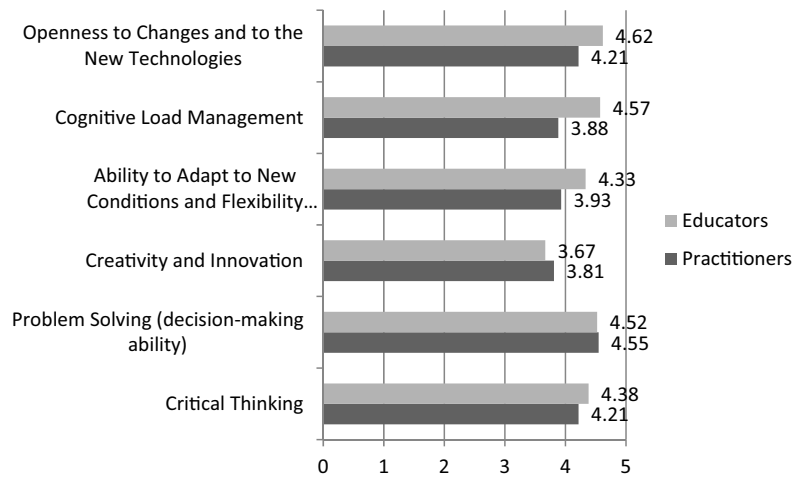


Figure 3: Cognitive competences in the opinion of practitioners and educators. Source: author's own study.

and ethical in a given company is a necessary condition for achieving the company's stability and success. The "work ethics" competence was assessed as the most important in this group of respondents ($M = 4.4$). This competence is also the highest indicator in the overall assessment, considering both groups of experts ($M = 4.3$) (Figures 5 and 6).

7 Conclusions and recommendations

Although there are many studies on the skills of industrial employees, at the moment, only a few studies concern the competences of employees in the transport industry in the context of Revolution 4.0, hence the legitimacy of addressing this subject in this article. The aim of the research was, therefore, to fill the gap in

contemporary research on employee competencies and to verify which of them are particularly important in the opinion of experts.

Due to the limited number of available empirical studies dedicated specifically to the transport industry, conducting a comparative analysis was quite difficult. However, it can be said that the results are consistent with the source material collected. Based on this study, it can be concluded that the knowledge of technologies such as autonomous robots or autonomous systems, cooperative systems and v2x interfaces, IoT, and information technologies and informatics applications will be extremely valuable for Transport 4.0 employees. The obtained results confirm the earlier assumptions, resulting from both theoretical considerations and knowledge of the results of research conducted in other countries [11,12,20,24,25,36,38,39,41].

Knowledge of technology should be supported by soft skills, such as openness to changes, cooperation

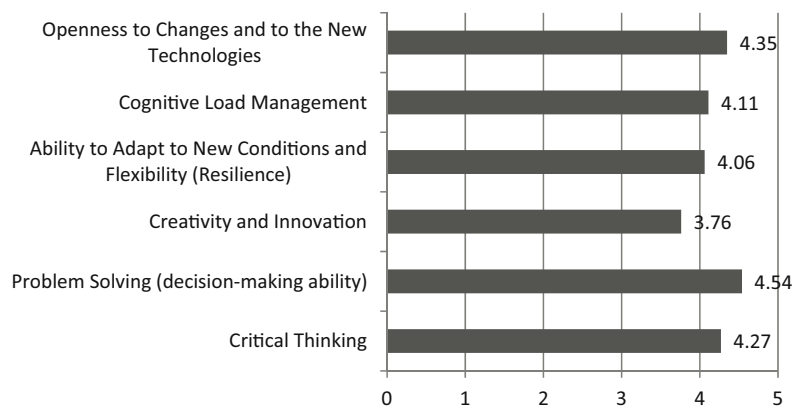


Figure 4: Cognitive competences, overall results. Source: author's own study.

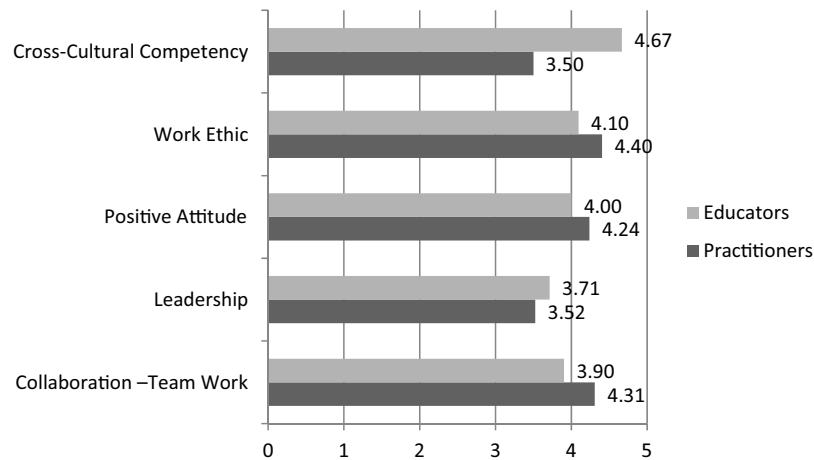


Figure 5: Social competences in the opinion of practitioners and educators. Source: author's own study.

skills and teamwork, or respecting ethics. Numerous studies indicate the importance of these competences [11,14,15,17–19,23,35]. Work and collaboration will become more complex; therefore, Transport 4.0 requires employees with competencies such as problem solving (decision-making ability) or critical thinking. The importance of these competences is emphasized by other researchers [17,18,20–22,25,33].

The obtained results confirm that selected groups of respondents are generally characterized by similar assessments of selected competences. In both groups, technical competences are slightly less appreciated than soft competences. It can be said that educators are more aware of the need for technical competence and knowledge of key technologies than practitioners. The low awareness of practitioners is confirmed by other studies [15].

This study can serve as a foundation for further research and studies on the analysis of futureproof skill sets in transport industry. This topic is extremely important because we

stand at the threshold of Revolution 4.0, which will not only introduce digital systems to enterprises but also will put very high demands on the education system. Advances in technology will reduce the need to perform predictable, routine, and repetitive activities, both mental and physical. This type of work will be taken over by automated systems based on AI or robots. Professional activities that require analytical thinking and innovation will be less sensitive to automation. Understanding and creativity will remain the exclusive domain of humanity [13]. The education system will have to transform in such a way as to provide Transport 4.0 with employees capable of critical thinking, comprehensive problem solving, group cooperation in a multicultural environment, resilient, and open to new ones. Only such employees, combining the above-mentioned skills with technical knowledge, will be able to cooperate with autonomous cyber-physical systems and control AI.

As shown by a study conducted by the European Parliament [50], along with the development of the idea of Industry 4.0, the lack of employees trained and prepared for the ongoing changes may result in the failure to fill nearly 825,000 jobs. This problem also affects the road transport industry. For example, there is already a shortage of skilled drivers. According to the results of the study presented in the report “Transport of the Future” (PwC) [3], drivers who have already been trained in Poland often do not have sufficient practical skills, and this problem concerns even more drivers from other countries. There are also communication problems between shippers and drivers. It is estimated that about 20% of drivers do not have the skills appropriate to ensure high work efficiency in terms of travel costs (economical driving) or operating time (the ability to efficiently perform parking maneuvers in logistics parks without generating time shifts

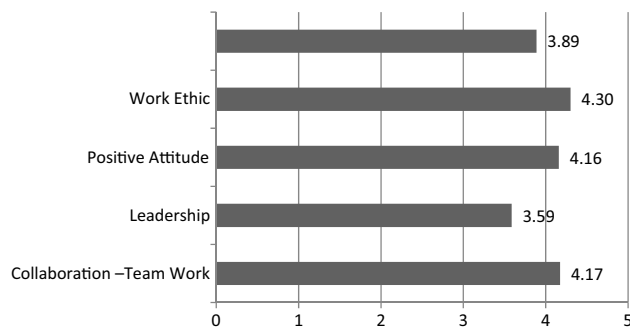


Figure 6: Social competences, overall results. Source: author's own study.

in operations on the part of warehouses) [3]. The scale of the shortage will deepen, which, in combination with the forecasts for the growth in demand for transport services, creates a significant risk for the industry.

Enterprises should focus not only on finding the perfect candidate at the moment but also on the near future. It is reasonable to invest in educational programs and in which drivers are ready to intervene in any situation establish cooperation with training institutions or universities to teach future employees the skills crucial for Revolution 4.0.

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