

**TRANSPORT INNOVATIONS AS A FACTOR AFFECTING THE MODERNIZATION OF TRANSPORT TECHNOLOGY BACHELOR'S TRAINING AT UKRAINIAN UNIVERSITIES****Abstract**

*The article concentrates on the analysis of modern innovations and development trends in the transport system from the global perspective. It looks at the main consequences the introduction of such technological advancements will have for society as a whole emphasizing the required changes in the transportation industry and transport technology professionals' knowledge and skills. The paper aims to draw a parallel between the innovative development tendencies in transport technologies and the state of professional training of bachelors majoring in specialty 275 "Transport technology" at Ukrainian universities. The study is based on the following methods: structural and system analysis, systematization, comparison and synthesis of information sources, experience, and achievements in this field, as well as pedagogical design for modeling the possibilities of applying the obtained results in the national educational practice. The article highlights the main transport technology development trends (computerization as well as the development and implementation of technological solutions that make transport more environmentally friendly, energy-efficient and cost-effective, stepping up the requirements for industry employees' professional training); the state of transport technology bachelors' training at the institutions of higher education in Ukraine is identified as satisfactory; it is carried out in the direction of knowledge formation and development of skills mostly in traditional transport-related disciplines. However, the training content should be complemented by courses in information technology and innovative transport systems and processes.*

**Keywords:** *bachelor; development trends; innovations; state of training; transport technology.*

**Introduction.** In recent years, the transport industry, as a tool for achieving economic, social and other goals set by society provides basic conditions for its activity. On the one hand, the emergence of innovative technology contributes to the public's higher daily activity performance level resulting in improved living standards. On the other hand, innovative technology is reformatting the transportation industry with speeds and scales that are difficult to understand. Transportation systems of tomorrow will be electric and highly automated, connected via BigData, shared, used on demand and even more. Ideas evolve quickly from introduction, research and development, diagnostics to initial and, finally, mass implementation. According to forecasts, the pace of innovation will only accelerate over time (Muzira & Quiros, 2018). Consequently, it is difficult to fully anticipate how transportation procedures can be changed in the nearest future. However, it is beyond argument that the rapid introduction of transport logistics provisions based on industry digitization according to the world-class requirements, strict regulations on motor vehicle emissions, world globalization processes and the globalization of transport systems and procedures as well as freight traffic within regions, states and continents result in the need to provide this industry with competitive professionals capable of both the creation of and the performance of duties in a high-tech transportation logistics system exercising real management and control.

The basis for studying and solving the issues of theoretical and methodological foundations underlying "Transport technology" professionals' training (specialty 275) are the findings and outcomes of famous scientists' studies in different education directions such as new technology development and introduction (A. Vorkut (1986), R. Khabutdinov and O. Kotsiuk (1997), H. Prokudin et al.(2013), M. Zaiionchyk (2010), D. Benson and J. Whitehead (1990), etc.), formation of transport systems and transport support (V. Beljaev (2014), T. Vorkut (2002), M. Dmytrychenko et al.(2007), D. Zerkalov (2006), A. Pasichnyk (2018), L. Iatskivskyyi (2007), E. Havrylov (2005), etc), integration of methods, forms, techniques and content (H. Danalakii and A. Khabiuk (2017), T. Yelina (2017)), etc. The existing research findings contribute to the implementation of the integrative approach to training and its quality improvement. However, little attention has been paid to the problem of future transport technology bachelors' professional training at higher technical education institutions in the conditions of transport innovation development. Thus, scientific papers focused on the study of this area, updated requirements for future specialists' professional competency in the conditions of society digitalization are of considerable scientific interest.

**The paper aims to** establish a correlation between the main innovative trends in the transportation industry all over the world and the way transport technology professionals are trained at higher education institutions in Ukraine. This goal is achieved through the following objectives: first, to give a general overview of current innovations and trends in transport and what their implementation will bring to transport

systems and economy in general; secondly, based on these findings to identify development priorities in transport technology professionals' training at higher education institutions.

**The research methodology** is based on such theoretical methods as the system-structural analysis, systematization, comparison and generalization of the relevant sources, best practice, experience in education and in the field as well as pedagogical design to project the obtained findings onto the existing model of transport technology professionals' training.

**Results.** The most urgent trends in the transport industry today, according to Markets&Markets analysis, are the growing demand for electric vehicles, trucks, autonomous vehicles, electric /hybrid buses and smart transportation solutions. Besides, improved Transport Technology is an important goal in addressing the problem of better environmental performance, reducing greenhouse gas emissions and economic development support. Analyzing the hottest trends and new solutions, we have identified some of the fastest growing Transport Technology from 2019:

- A more powerful Global Positioning System (GPS) will change the traditional way of communication. There is already a big difference between modern GPS devices and their earlier models. GPS in the past had too little functionality – it could only calculate the approximate travel time to the destination. Nowadays, GPS devices are more resource-intensive, and now they are performing the basic travel and transportation scheduling functions. Some trucking companies already use GPS devices to adjust and calculate the optimum travel route to use for fast delivery, taking into account weather conditions.

- A water-powered vehicle is a car that hypothetically receives energy directly from the water. Water-powered cars have already become the subject of many newspaper and popular science magazine articles, international patents, news coverage on television and websites. Just like it is the case with non-driver cars that have become a reality, a water-powered car has long been tested by scientists, and as a result, it is soon expected to be launched.

- Huge interest is generated around the high-speed rail network. Recently, South Korea has begun constructing the maglev train that will operate at Incheon Airport. China is reported to be developing the second train of such a class. It is planned that the maglev will carry passengers between Nagoya and Tokyo (over 200 miles) in just 40 minutes. It will help reduce pollution, traffic jams and the number of road accidents.

- The development of string transport theory, a set of attempts to model four fundamental interactions – gravity, electromagnetism, strong nuclear force and weak nuclear force. The concept is based on the use of a two-wheeler. This is a new low-cost transportation system that can move by water, through deserts, forests, and mountains.

- Trains that will use the new magnetic rail systems – the Hyperloop train, which will travel at a speed of 800 ml / h. Hyperloop is a vacuum-magnetic transport system in which capsules with passengers or with cargo can move faster than modern passenger and transport aviation (Moayanda, 2019).

Generally speaking, we can conclude that transformations in transportation will lead to the emergence of semi-automatic transportation systems, and accordingly congestion will be eliminated as the availability of autonomous vehicles will reduce demand for private transport by 80%. Some foreign researchers (Datson, 2016; Kamargianni & Matyas, 2016) argue that, in the long run, innovative "explosive" technologies will lead to the fact that individuals will have little interest in owning a car because mobility will be available as a service (MaaS). Such a service will reduce travel and transportation time since these are new high-efficiency modes of transport.

It is also envisaged that energy costs and emissions can be significantly reduced – these figures will depend on how long it will take to introduce autonomous and electric vehicles in transport systems (Muzira & Quiros, 2018). Innovative technology in transport and logistics sectors will "work" towards the reduction of bureaucratic and administrative costs involved in shipments from the manufacturer to the final importer – today it is about 20% of the total container transportation costs.

An increase in the number of autonomous vehicles, as well as the introduction of MaaS, eliminates possible restrictions on citizens' movement, which in turn will lead to greater urban sprawl and suburban construction. Accordingly, there will be a need to build a more intelligent transport infrastructure that meets new population's needs.

All these innovations will happen in the coming years or have already been used in passenger or cargo transportation. It puts forward new requirements to shipping companies, freight forwarders, truck manufacturing companies and fleet management to increase their efficiency.

Besides, the emergence of new technology, such as digital vehicles, IT-driven transportation systems makes us vulnerable to cyber-attacks. That is, innovations, first and foremost, caused by the digitization of society can, in the long run, cause problems in the automotive sector. First of all, it is a violation of workflow confidentiality, incidents in transport system operation, etc.

Researchers are now facing a problem of how to react to such modernization. This new era of disruptive technology will require dramatic changes in regulation and, more importantly, will require regulation to respond to rapid environmental changes (Muzira & Quiros, 2018). They offer some approaches that should be addressed during the transformation period in the automotive industry:

- there is no need to spend large sums of money on assets that can become out of date too soon;
- it is worth incorporating available technology into projects (applications, open-source platforms, drones, intelligent transportation systems);
- in order to keep up with the changes, it is necessary to prepare the corresponding legal framework;
- encourage countries to train professionals in future technology;
- to study other countries` experience in taking advantage of technological innovations;
- future professionals` training should be enhanced by the STEM approach integrating the areas of science, technology, engineering, and mathematics. This position will become more critical in the educational process than ever;
- establish research cooperation with the private sector and educational institutions to drive innovation.

So, as it can be seen both academics and practitioners in the field should be professionally trained and prepared for above-described prospects in order to have the appropriate competences to pursue professional activities under new conditions. The peculiarities of the future profession are a factor shaping the educational process at higher education institutions. The latter should be aimed at the formation and development of students` personal qualities, required subconscious mind programming, the creation of a motivational basis and the corresponding system of professional and personal values.

That is why, in order to avoid adverse effects, it is important to plan specialists` training systems in this field at higher education institutions. The search for organizational approaches to professional competence development in workers who have already found employment is also a pressing problem. In view of the above, this process is seen in integration with the development of competences the cultivation of which is influenced by industry digitization, namely digital competences. In particular, the automotive industry currently needs transport engineers capable of performing professional duties related to:

- organization;
- international, cargo and passenger transportation;
- freight forwarding, cargo handling, and customs operations;
- interaction of modes of transport;
- terminal, container, multimodal and intermodal transport;
- road traffic;
- ensuring the expansion of road network traffic capacity, a reduction in the accident rates, improved road safety, better environmental performance;
- management of traffic flows in cities;
- development of intelligent traffic management systems;
- carrying out control and audit work on transport;
- commercial work in transport;
- transport logistics (Іскович-Лотоцький & Севостьянов, 2015).

In other words, the transport system, as “a complex of different modes of transport involved in transportation” (Зеркалов, 2006), should be provided with highly qualified personnel ensuring its stability and security. Considering transport technology professionals` training at higher education institutions as powerful investment, it can be argued that, in the long run, without such investments, it will be difficult to provide safe and long-term maintenance of modern transportation systems.

So, the strategic task for Ukraine is to organize the professional training of highly qualified bachelors in specialty 275 “Transport Technology” who will be able to implement and develop innovative technology in the field of transport policy development. Excellent professional training will allow the improvement of transport industry performance indicators which are safe and high-quality cargo and passenger transportation organization under the conditions of Ukraine`s European integration in the EU.

Let us identify the factors characterizing the future specialist`s personality development at a higher education institution. First of all, it is the formation of:

- individual professional motives;
- individual algorithms for solving professional problems;
- logical correlation of meaningful professional motives (interest in the profession, the need for self-fulfillment) and adaptive ones (occupational prestige, financial gain, etc.) (Алексеева, 2013).

With the introduction of innovative technology, the use of new materials, energy-efficient solutions, digital networks and artificial intelligence, the choice of specialization in the transport sector for young people will become more motivated.

In the information society, for transport technology professionals it is opened up new perspectives on the use of digital tools for analytical three-dimensional information processing; organization of information dissemination aimed at sharing knowledge and experience with the international community, getting new insight into modern methods of transport management and more. Accordingly, they should be characterized by such professional attributes as mobility and competitiveness, their ability to organize professional activities with the integration of a wide range of competences and their adaptation given intensive scientific development.

Their main professional qualities include a high level of fundamental and professional knowledge, the ability to actively use innovation, the skills of advanced self-study. Hence the need for higher technical education institutions` educational paradigm guidance by digital society development and future professional activity as well as interdisciplinary links is evident. That is why the training programs for specialty 275 "Transport Technology" should provide high-quality education and be systematically and logically complemented by interdisciplinary programs.

In order to form the above-mentioned characteristics, there is a need to develop an adaptive system of training, in which the leading role will be given to the scientific and methodological substantiation of the theoretical and methodological foundations of its functioning.

It is important for a highly-skilled workforce to develop a secure and sustainable transportation system. Without such investments, not only will it be difficult to provide safe and long-term maintenance of modern transport systems but many jobs will also remain vacant increasing the unemployment rate.

According to estimates, in the coming decades, transportation systems will undergo dramatic transformations as a result of transit systems becoming more high-speed, the dynamic scale-up of subway services, the improvement of highways and ports. It is important to note that all of these aspects are taking place alongside the ever-increasing pace of digitalization, including artificial intelligence.

This leads to the need for training transport technology professionals that will be able to perform professional activities at a high level in the context of transport innovation, using modern information technology and developed foreign countries` successful practical experience.

Having given an overview of the main trends in the transportation industry, let us now have a look at what is taught to future professionals at higher education institutions comparing how education content keeps up with the recent developments in the transportation industry.

To outline the training content, let's analyze the Bachelor`s degree course scheme offered to students majoring in "Transport Technology (Road Transport)" of National University of Life and Environmental Sciences of Ukraine (2019).

The content of the training is divided into cycles – general, special (professional) training and other types of activities. The first two cycles are further subdivided into compulsory and elective courses. The total number of ECTS credits is 240.

Analyzing the content component of the compulsory block in the first cycle, it can be easily noticed the physical and mathematical focus of its disciplines (21 credits), it is also offered "Foundations of System Theory and Management" (8 credits), and subjects in law (8 credits). There is 37 credits in total. The largest number of ECTS credits is assigned to the courses necessary to equip students with important mathematical modeling and forecasting skills, taking into account the stochastic nature of the industry. The elective component in the first cycle is devoted to philological subjects (12 credits), historical and cultural studies (9 credits), philosophy (4 credits), social studies (7 credits), fundamentals of health and safety (3 credits) as well as physical education (4 credits) totaling to 36 credits. Taken together, all these subjects constitute the humanitarian educational process component.

One hundred-seventy credits are allocated for the special training cycle. Compulsory disciplines included in this unit are focused on transport technology and are comprised of 125 ECTS credits. The largest number of credits is allocated for "Information systems and technology", "Cargo transportation" – 8 credits, as well as "Passenger transportation", "Research on operations in transport systems", "Fundamentals of the theory of transport processes and systems" – 7 credits, "Interaction of the modes of transport", "Foundations of transport economy" – 6 credits each. The smallest number of 3 credits is given to "Transport technology", "Operational Properties of Roads and Structures", "Transport Planning of Rural Territories", "Safety of Vehicles", "Organization of International Transportation". 45 credits are allocated for the elective component of the block, all disciplines have a profession-related nature (the largest number of credits is given to "Vehicle performance", "Vehicle maintenance" ), some of them reflect the specificity of the institution's specialization – transport technology in agro-industrial and environmental industries. Other types of training include 34 credits of practical and scientific components.

**Discussion.** Based on the educational content analysis results, we can conclude that transport technology bachelors` training priorities mostly lie in the formation of knowledge and cultivation of skills in traditional subjects and a number of profession-specific aspects. At the same time, the training system for

such specialists, despite meeting the basic needs of the industry, still needs constant modernization to make it fit in the above-described changes and provide students with the necessary background to be ready to carry out professional duties working with innovative technology.

Accordingly, safe and sustainable transport systems require transport professionals of a new class who have advanced-level skills and cover a variety of activity fields. New paradigms, such as smart mobility and “mobility as a service” require transport industry professionals to develop additional skills in such areas as advertising, PR, psychology, marketing, behavioral sciences, etc. Thus, the knowledge of law, marketing, management, economic and business development are increasingly becoming crucial for the construction of vehicles, making “timely” transport decisions, the efficient organization and maintenance of optimal freight corridors, efficiency improvement and a rise in the living standards.

Besides, we believe that transport technology bachelor’s degree course schemes have to be supplemented with such courses as “Navigation and automation systems in the transport process”, “Innovative technologies in logistics and transport”, “Fundamentals of cyber-security”, and a number of technical disciplines aimed at the development of creative thinking. After all, in the context of a global increase in the digitalization of society, namely its transport sector, the ability of specialists involved in this field to innovate becomes a new factor in the development of motor transport infrastructure and an effective way of overcoming the following problems: rapid depreciation of rolling stock and transport infrastructure; mismatch of a technical and technological level of national transport and European requirements; low level of customer service; insufficient use of the existing transit potential; insufficient use the country’s favorable geographical location; a lag in the development of transport infrastructure, transport and logistics technology, multimodal transportations, the level of containerization; high share of transport costs in the cost of production, etc.

Such specialists’ training should be carried out to cultivate knowledge and skills in:

- economics, marketing, geography, sociology, psychology, urban science;
- management – implementation of a set of measures aimed at the organization, ordering of transport system elements; establishing relationships between such elements; making connections between transport systems and external environment; coordination of transport system operation;
- control over transport system operation – vehicle and traffic management;
- rules of financing (system financing rules: toll roads, fuel tax, etc.);
- civil engineering and urban planning – transport network development;
- mechanical engineering and specialized applied science sub-disciplines – vehicle engineering;
- efficiency determination of a vehicle – striking a balance between polar opposite points: public needs and financial gain.

We believe that in order to timely respond to the expected changes, the educational-professional programs for bachelors’ training in the field of transport should:

- improve interdisciplinarity as a mandatory organizational and pedagogical condition of the training system preparing professionals ready to work in multimodal transport systems;
- strengthen the link between science and practical activities – it is necessary to make more emphasis on applied disciplines;
- take into account the cross-disciplinary nature of professional (special) courses in vertically integrated educational institutions – it will allow developing professional competences holistically;
- develop cost-effective business models, concentrate on the implementation of transport as a service and increase efficiency – to offer students more courses in marketing, business, economics, law and psychology;
- create on a university-level basis employees’ continuous training with the use of digital technology;
- active use of professional software applications (electronic resources), information systems and artificial intelligence systems in order to continuously increase the level of digital competences;
- facilitate the development of research projects in new areas such as new vehicles and materials, autonomous vehicles and more.

**Conclusions.** Transport technology is a dynamic set of techniques and methods, for the movement of goods and passengers that is currently subject to innovative changes. The main technological advancements in the field are connected with ubiquitous digitalization and making transportation more eco-friendly, energy-efficient and cost-effective. This creates the need to provide the transport industry in Ukraine with modern specialists that should be characterized by an appropriate level of competence, which, in turn, will improve the conditions for safe, convenient and continuous transport flows. To date, transport technology bachelors’ training at higher education institutions is at a satisfactory level and is carried out in the direction of the formation of knowledge and the development of skills in traditional disciplines – the theory of transport systems and technical sciences; traffic management and vehicle management; transportation economics, as well as in a number of field-specific aspects, etc. At the same time, the training system for

such professionals, despite meeting the basic needs of the industry, still requires constant modernization and change. Currently, it is not centered around technological advancements. The educational content should be enhanced with courses in IT and innovative transport technology, marketing and management. However, devising such courses has to be preceded by a huge amount of work done by academic staff, scientists and professionals in the field on analyzing foreign countries' progressive experience, "borrowing" the most efficient ideas, customizing these findings to Ukraine's needs and putting them into practice.

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## **ІННОВАЦІЇ НА ТРАНСПОРТІ ЯК ФАКТОР МОДЕРНІЗАЦІЇ ПІДГОТОВКИ БАКАЛАВРІВ З ТРАНСПОРТНИХ ТЕХНОЛОГІЙ В УКРАЇНСЬКИХ ЗВО**

### **Резюме**

*Стаття присвячена аналізу сучасних інновацій та тенденцій розвитку у транспортній системі, основних наслідків, що їх матиме впровадження таких інновацій не лише для транспортної галузі (зокрема в аспекті кадрового забезпечення), а й суспільства в цілому. Мета статті полягає у встановленні відповідності між інноваційними тенденціями розвитку транспорту та технологій та станом професійної підготовки студентів-бакалаврів за спеціальністю 275 «Транспортні технології» у вітчизняних ЗВО. В основу дослідження покладені наступні методи: структурно-системний аналіз, систематизація, порівняння та узагальнення інформаційних джерел, досвіду та*

досягнень у цій сфері, а також педагогічне проектування з метою моделювання можливостей застосування отриманих результатів у вітчизняній освітній практиці. У статті виокремлено основні тенденції розвитку транспортних технологій (комп'ютеризація і розробка та впровадження технологічних рішень, що роблять транспорт більш екологічним, енергоефективним та економічно вигідним; зростання вимог до професійної підготовки працівників галузі); визначено стан підготовки бакалаврів з транспортних технологій у вітчизняних ЗВО, що, на сьогодні, знаходиться на задовільному рівні та здійснюється у напрямку формування знань та розвитку навичок з традиційних дисциплін – теорії транспортних систем та технічних наук; управління дорожнім рухом та управління транспортними засобами; економіки транспорту, а також з ряду галузевих аспектів тощо; виокремлено перспективні напрями розвитку підготовки майбутніх фахівців за спеціальністю 275 – було встановлено, що зміст навчання слід доповнювати курсами з інформаційних технологій та інноваційних транспортних систем і процесів; визначено, що розробці таких курсів повинна передувати значна робота, проведена науковими працівниками, науковцями та професіоналами з аналізу прогресивного досвіду зарубіжних країн, «запозичення» найефективніших ідей, пристосування цих напрацювань до потреб України та втілення їх у життя.

**Ключові слова:** бакалавр; інновації; стан підготовки; тенденції розвитку; транспортні технології.