The use of modern digital technologies in transportation

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Summary

Major trends in the digitization of transportation include: Connected vehicles. Drivers are already using smartphones and onboard navigation systems to optimize travel. The next phase could help vehicles communicate with external sources such as sensors, vendors and other vehicles.

Key words: Information and communication technologies (ICTs), digital transformation, management of transport systems, digital technologies, transportation and logistics, intelligent Transportation System (ITS).

1. Introduction

Information and communication technologies (ICTs) play a significant role in transportation systems as they provide the connection between transportation system users, system planners, operators, and managers. Over the last few years, with advancements in ICTs, there has been a rapid change in travel behaviour.

The digital transformation of the transportation sector is showing incredible breakthrough results starting in 2020. Automakers, service and logistics companies are focusing on optimizing and reducing their financial costs by embarking on a new course of digitalization.

The events of 2020 have increased the value and relevance of digital transformation around the world. Economic and social constraints caused by the coronavirus pandemic have become a driver of transition to new business models, development of digital ecosystems, platforms and services, and drone technologies. At the same time, the level, readiness and capabilities of individual industries, sectors and companies for digital transformation objectively differ from each other, which reduces the speed and efficiency of digital transformation. The main barriers to digital transformation in the transportation sector are competent personnel and the maturity of the ecosystem of digital solution providers.

The demand for digital technologies in transportation and logistics amounted to ₽89.4 billion in 2020 and may grow to ₽626.6 billion by 2030. Thanks to digital transformation, labor productivity in the

industry will increase by 20% by 2030. The list of the most in-demand technologies includes paperless document management, distributed registry systems, wireless communication, artificial intelligence, augmented and virtual reality.

2. Digital revolution in the transportation industry

Digital transformation provides for the restructuring of all business processes, which will lead to the improvement and, in some cases, complete replacement of existing systems for the organization of transport and service enterprises.

A huge influence on the digital revolution in the transportation industry has been the global strategy for the development of the transportation industry until 2030 with a forecast to 2035, which envisages the active introduction of digital technologies in the transportation industry and is based on addressing a set of pressing issues facing the industry in the early 2020s[1-4]:

- high accident rate due to human factor.
- low efficiency of the transportation process by traditional modes of transportation.
- low attractiveness of transport corridors due to high transaction burden (paper documents, control procedures, intermediaries).
- lack of possibility of operational management of the transport complex from a single center depending on the situation.
- low awareness and coordinated actions of regional and local authorities, transport stakeholders on issues of transport security (including transport security, cyber security) [5].
- lack of possibility to monitor the condition of transportation infrastructure facilities at all stages of their life cycle (fig.1):

Fig. 1. Digital technologies in transport

In order to address a set of issues that have arisen in the transport sector, the **EU** has developed the Strategy for Digital Transformation of the Transport Industry, which covers 6 of the most important areas of the transport industry:

- drones for passengers and cargo.
- green digital passenger corridor.
- seamless freight logistics.
- digital management of the transportation system.
- digitalization for transport security.
- digital twins of transport infrastructure objects.

The strategy envisages the introduction of actively developing digital technologies:

- artificial intelligence;
- collection and processing of big data;
- distributed registry systems;
- virtual and augmented reality;
- spatial analysis and modeling;
- information modeling.

3. Unmanned transportation for passengers and freight

Creating the most favorable conditions for the use of unmanned vehicles implies solving the tasks of forming a huge infrastructure throughout the EU [6,7]. Estimated benefits from the project implementation: reduction of the cost of transportation for EU citizens and businesses by any means of transport by 29% and improvement of safety level by 91%.

An unmanned vehicle is a vehicle that moves without a crew on board using a special autonomous control system.

Unmanned vehicles travel on specially designated lanes along predetermined routes or are part of general traffic, being equipped with a set of sensors, cameras, radars and a decision-making on-board computer. For aviation, such sensors include: heading sensors (GPS), roll, pitch, roll, pitch, altitude, speed, other aircraft systems, ground station data, and more. For automobiles: video cameras, LIDAR sensor, radars, GPS [6]. The drone is able to adequately assess the situation on the road, interact with pedestrians, cyclists, other cars, and comply with traffic rules. This makes it a full-fledged participant of road traffic (fig. 2):

Fig. 2. Changing the Future of Mobility with Passenger Drones - FutureBridge

From a technical point of view, the developers rely on existing realities and adapt unmanned transport to them - the car "distinguishes" road signs, "sees" obstacles, pedestrians, and moves on the basis of maps and satellite navigation. Unmanned transportation can increase the efficiency of freight transportation and reduce its cost. This will mainly happen due to the absence of drivers in each truck - unmanned vehicles are able to form autonomous convoys for cargo transportation, where the driver-pilot will be only in the lead vehicle. Efficiency can also be increased by reducing accidents and the number of downtimes, and reducing the influence of the human factor.

Unmanned trucks - a self-driving truck, also known as an **autonomous truck** or **robo-truck,** is an application of self-driving technology aiming to create trucks that can operate without human input. Alongside light, medium, and heavy-duty trucks, many companies are developing self-driving technology in semi trucks to automate highway driving in the delivery process [8, 9, 10].

In September 2022, Guidehouse Insights listed Waymo, Aurora, TuSimple, Gatik, Plus, Kodiak Robo-tics, Daimler Truck, Einride, Locomation, and Embark as the top 10 vendors in automated trucki-ng. And, Transport Topics in November 2022 is listing fourteen companies to know about self-driving truck; Aurora, Waymo, TuSimple, Gatik, Locomation, Torc Robotics, Waabi, Einride, Plus, Embark, Kodiak Robotics, Robotic Research, Outrider and Pron-to. Self-driving trucks are expected to be on highways in the United States by 2027.

Several government agencies in the U.S. and Europe have announced new legislation surrounding the use of autonomous trucks. Some challenges of bringing self-driving trucks on public roads include, but are not limited to, road safety, the need for human drivers inside the vehicle, and the lack of specific regulations surrounding driverless vehicles.

Unmanned rail transportation - is a method of operating trains automatically where the driver is not required or required for supervision at most. Alternatively, it can be defined as a subsystem within the automatic train control, which performs any or all of functions like programmed stopping, speed adjusting, door operation, and similar otherwise assigned to the train operator [11-12-13].

Flying cars - in August 2023, representatives of the Chinese company AeroHT reported the successful completion of the Xpeng X2 flying car test, in which this original vehicle flew over the Xiang River in Changsha, Hunan Province. A distance of 1.5 kilometers was covered in 4 minutes, and the vehicle eventually landed in Zhoutou Square. The dimensions of the car are 5172 × 5124 × 1362 mm, and when folded, it measures 4949 × 2113 × 2055 mm. With a curb weight of 680 kg, the Xpeng X2 can carry a payload of up to 160 kg. At the moment, the existing model can stay in the air for 25 minutes before recharging the battery. The serial versions, which are scheduled for mass production in 2025, will have an increased range **(fig. 3):**

Fig. 3. Flying car

4. Seamless freight logistics

Seamless freight logistics will help to speed up transportation, reduce its cost, which will increase the revenue of EU transport companies several times. This will be facilitated by:

- building a tracking system for freight transportation using electronic navigation seals;
- development of a digital platform for the EU transportation complex;
- formation of a system of end-to-end exchange of electronic transportation documents;
- creation of a national digital logistics circuit.

Thanks to the special digital platform of the transport complex and the use of various digital services, the document circulation will become electronic and transport documentation will be standardized.

Planned results of the project by 2025:

- Electronic document management.

- Digital platform of the transport complex.

- Mass application of blockchain-based smart contracts.

- Green corridor" for cargo transportation.

It is also planned to reduce the cost of cargo delivery and increase the volume of transit through the EU territory by 2030 [9-10-11].

5. Digital control of the EU transportation system

The Unified Digital Platform of the Transportation Complex (UDPC) will become the systemic basis for information interactions. It will integrate all existing and planned information and digital solutions based on agreed principles, rules and standards. Additionally, it will provide an opportunity to receive and provide convenient, safe and affordable freight and passenger transportation services and related additional services. The digital management system is based on innovative information technologies, including artificial intelligence [5].

It is planned to ensure a high level of efficiency and validity of management decisions at all levels of the transportation complex - from market participants to government agencies, as well as the possibility of high-quality strategic planning of the transportation complex. The system will help to create conditions for building communication between all participants of the transport complex and realization of new and high-quality transport and logistics services.

The unified digital platform will help to consolidate at the legal level the possibility of using new objects of the transport complex: unmanned vehicles, unmanned aerial vehicles, intelligent transport systems, robotic objects.

Intelligent Transportation Systems (ITS) help to operate the transportation network more efficiently through the use of a set of technologies embedded in the vehicle or road infrastructure. The use of modern **Big Data** analytics makes it possible to analyze the movement of people through SIM cards in phones by collecting large amounts of anonymous data. Such solutions are the basis of modern urban passenger transportation management systems, as well as entire smart cities.

The **ITS** complex is able to perform the functions of dispatch situational and operational coordination of interaction of all road users, special services and agencies, which receives a huge array of information from traffic cameras, traffic flow detectors, electronic means of fare payment, smart traffic lights. **ITS** also includes electronic information boards, parking meters, automated lighting control, means of automatic violation detection.

ITS allows modeling various situations and predicting the result. As a result, it is possible to determine exactly how this or that event will affect the traffic situation, minimize traffic jams, the impact of construction of a new interchange on traffic. **ITS** also helps to create infrastructure for drones **(fig.4):**
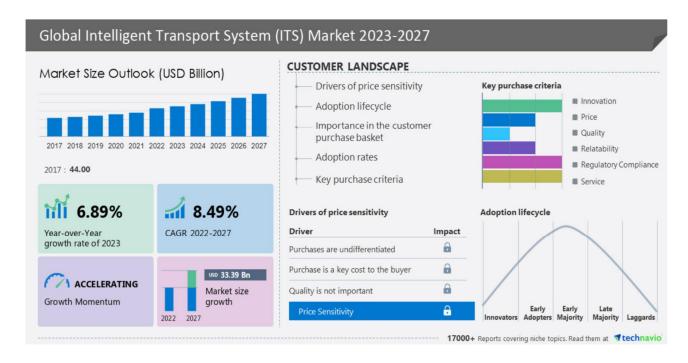
Fig.4. Intelligent Transport System (ITS) Market to grow at a CAGR of from 2022 to 2027|Increased use of the meta-intelligence concept in transport systems is one of the primary trends Technavio

6. Digitalization for transport security

The project is aimed at creating a secure information space for passenger data. Thanks to real-time security analysis of the state of the digital transportation complex, it will be possible to manage the risks of personal information leakage or fraudulent actions towards passengers. The latest vulnerability search systems and the creation of a unified environment for monitoring the security of transportation infrastructure will help prevent and eliminate possible attacks [7-8-10-11-12].

Planned results by 2025:

- Introduction of mechanisms ensuring information security in the transportation infrastructure.
- Creation of a national system of preliminary passenger information.
- Creation of a unified closed secure digital environment ensuring the safety of transportation infrastructure facilities.

By 2035, it is planned to introduce artificial intelligence technologies in the transportation infrastructure.

With the help of digital technology, cities can regulate and electrify their informal public transport, slashing emissions and bringing considerable benefits to road safety, accessibility and economic inclusion [13-21].

7. Conclusions

The digital transformation of the transportation sector is not the future, not a dream, but a reality. A few years ago, flying cars and drones seemed like science fiction to us. Now we are already moving on roads that have been built thanks to highly intelligent information systems, and in our phone we can form the necessary route in seconds and cover long distances by transport without carrying any documents. Passengers' lives become safer and businesses can earn more (domestic and international freight transportation). Thanks to digital technologies, gigabytes of information about everything related to transportation are collected and a new value is formed - digital assets of the transportation sector.

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თანამედროვე ციფრული ტექნოლოგიების გამოყენება სატრანსპორტო გადაზიდვებში

ემელიანე გოგილიძე; ნათია გოგილიძე

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რეზიუმე

სატრანსპორტო გადაზიდვების „გაციფრულების" ძირითადი ტენდენციები მოიცავს ინტერნეტით დაკავშირებულ სატრანსპორტო საშუალებებს. მძღოლები უკვე იყენებენ სმარტფონებსა და საბორტო ნავიგაციის სისტემებს მოგზაურობის ოპტიმიზაციისთვის. შემდეგი ეტაპი სატრანსპორტო საშუალებებს დაეხმარება გარე წყაროებთან ურთიერთქმედებაში, ისეთებთან როგორებიცაა: სენსორები, მომწოდებლები და სხვა სატრანსპორტო საშუალებები.

საკვანძო სიტყვები: საინფორმაციო და საკომუნიკაციო ტექნოლოგიები (ICTs), ციფრული ტრანსფორმაცია, სატრანსპორტო სისტემების მართვა, ციფრული ტექნოლოგიები, ტრანსპორტი და ლოგისტიკა, ინტელექტუალური სატრანსპორტო სისტემა (ITS).