WORLD EXPERIENCE IN THE FORMATION AND DEVELOPMENT OF THE INTELLECTUAL TRANSPORT SYSTEMS (ITS)

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Abstract: The article presents the results of analyses of the world experience in development of the Intellectual Transport Systems (ITS), transport networks, incident detection, information and navigation and control depending on the load.
Key words: world experience, development, the Intellectual Transport Systems (ITS), telecommunication and telematic technologies.

INTRODUCTION. One of the most important tasks of the transport system of Uzbekistan is to ensure the maximum efficiency of the functioning of the country's transport and road complex by improving the quality of meeting the needs of the economy and the population in safe and efficient transport services. The implementation of the task of ensuring the required mobility of the population is possible due to two mutually complementary areas of activity: the construction of new road sections and the introduction of technologies for the organizational management of the transport system using modern information, telecommunication and telematic technologies.

Existing and developing local or technologically limited departmental systems of information support and control of the activity of segments of the transport and road complex provide, in some cases, an effective solution to a narrow list of tasks. At the same time, the lack of unified state standards for the development of similar systems ITS the possibility of their integration in order to create a single control platform in which the principles of management reach a new qualitative level - predictive management, i.e. management of forecasting the situation for all indicators of the activity of the transport and road complex.

MODELS AND METHODS. In world practice, ITS is recognized as a general transport ideology for integrating telematics achievements into all types of transport activities to solve economic and social problems - reducing accidents, increasing the efficiency of public transport and freight traffic, ensuring overall transport security, and improving environmental performance. One of the major European projects implemented for the management of a wider urban area was the Munich COMFORT project, which was launched in 1991. This was the first project to coordinate transport in the city center, taking into account the layout of the motorway network in the vicinity of the city. Depending on the assessment of the state of traffic flows in the city, elements of the information and navigation systems in the vicinity of the city are activated.

Control algorithms evaluate the level of transport, optimize the operation of the SF, determine the forecast for the development of traffic load and direct vehicles from the area in which congestion is created. When analyzing the project, it was stated that the initial investment paid off after 2 years only due to a decrease in the number of accidents. The number of collisions decreased by 35%, the number of accidents with injuries - by 30% and the number

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of fatalities decreased by 31%. Other well-known projects are those implemented under the aid of the European Union. This includes, in particular, the following activities:

1. Analysis of transport networks. For basic traffic control, data from traffic sensors at transport hubs may be sufficient. Despite this, an integrated telematic strategy for transport management in urban networks requires more detailed data on the situation in the network, which was demonstrated in the QUARTET PLUS and EUROSCOPE projects. In the context of the widely accepted concept of "mobility management" and the close links between monitoring and transport management, these projects have put into practice new detection systems based on video detection, new algorithms for determining travel time, speed in lanes and on the network, and algorithms for determining points of departure. and destinations (OD matrix: Origin-Destination).

The latest received data is especially important for the transport information system. Forecast algorithms have been tried and tested. This concerned short-term (1–20 min), medium-term (11–12 h) up to long-term forecasts (1–2 days). Both projects helped to understand what inaccuracies and what limitations characterize the forecasts of the parameters of the functioning of the transport network. They also identified areas for further development. One of these areas is the use of data obtained from a running laboratory moving in a traffic stream ("floating" car) - the CAPITALS project. The work within the framework of the VERA project also helped to understand the difficult conditions in the network.

2. A private, but very important area for using the results of data analysis is the area of establishing (detecting) the places of occurrence of road traffic accidents (incident detection). Rapid incident detection can start the process of taking the necessary actions, including a traffic management strategy and informing drivers before starting and/or in the process of driving, as well as a significantly faster response by rescue services. In addition to accident detection, the IN-RESPONSE project also developed a model for predicting traffic accidents.

Automatic detection of places of traffic accidents. Several European projects were also devoted to the problem of accident management. It was about modified traffic management projects in UTC cities (Urban Traffic Control), which, with the help of special modules, provided the detection of incidents and their impact on the movement of traffic flows. The IN-RESPONSE and IN-EMERGENCY projects have demonstrated a variety of techniques, including high-speed warning systems for emergency services and tools to support decision-making by rescue operators.

3. Information and navigation. Systems for informing drivers via on-board ITS or TFIS located along roads are of ever-increasing importance for traffic management on road networks. Information about possible problems significantly reduces congestion by allowing the driver to choose other route options or a suitable parking or parking area.

European projects are now increasingly focused on TFIS systems, due to the fact that OBUs in vehicles are not yet very common and thus cannot have a significant impact on traffic flow.

Projects in this area (AUSIAS, CAPITALS, CONCERT, CLEOPATRA, COSMOS, EUROSCOPE, TABASCO) were aimed at studying the behavior of the transport network and determining optimal management strategies.

The use of information and navigation systems within European projects can be illustrated by the example of the following cities:

– Bristol (CONCERT): TFIS for better use of the Park system and ride;

– Brussels (CAPITALS): TFIS as part of an upstream traffic management system in tunnels on the city's inner ring;
– London (CLEOPATRA): Determining the impact of TFIS in crash location detection on drivers' choice of route to travel on the road network and transport efficiency on the network;
– Lyon (CLEOPATRA): information strategy for TFIS in automatic mode using data obtained from measurements taken on the road network;
– Munich (TABASCO): TFIS for Park and Ride;
– Piraeus (COSMOS): strategy for redirecting traffic in the seaport area;
– Southampton (EUROSCOPE): integrated crash detection and parking management;
– Toulouse (CLEOPATRA): general strategy for redirecting traffic flows;
– Turin (CLEOPATRA): TFIS strategy together with the traffic management strategy for the city.

Pre-trip information and information at GPOT stops have been shown to have a significant impact on the behavior of the majority of passengers because, ultimately, they caused a small but noticeable increase in the number of passengers.

The integration of the city's transport management, GPOT and information systems services in Turin resulted in a reduction in travel time for public urban passenger transport by 14% and by 17% for cars. This resulted in a 3% increase in the GPO and an overall improvement in traffic in the city. The investment in the crash site detection subsystem of Southampton's transport management system has proven to pay off within one year. However, the payback significantly depends on the method and speed of detection of accidents.

4. Main road entry control was commonly used in cities where it was supposed to prevent congestion. However, congestion is very common on highways and roads connecting urban areas. In this case, the integration of entry control with the citywide traffic management system is very important.

The TABASCO project demonstrated traffic control at the entrance (Ramp Metering), along with traffic information and navigation via TFIS, traffic control via optical signaling in Glasgow. Ramp Method Metering has significantly increased road capacity (5% motorways, 13% urban network). In addition, the system has led to an improvement in driver behavior and, consequently, to a decrease in the number of accidents.

5. Control depending on the load. In urban environments, this type of control is of ever-increasing importance for maintaining satisfactory mobility, since it uses various telematic subsystems to manage traffic flows. The application of this system contains, for example, city center entrance control (CAPITALS project) and artificial intelligence techniques, connecting entrance control and traffic light control with the driver information and assistance system and with the subsystems for providing transport and tourist information. This system will also provide an opportunity to determine the time of movement and obtain information about the availability of parking spaces.

In the 1990s in the United States, the main stages for solving the problems of development and implementation of automated control systems were clearly formulated: mathematical modeling of the movement of cars and traffic flows (the so-called micro- and macro-modeling); unified information system; electronic system for selecting and indicating the route; driver assistance system.

The indicated stages were implemented by installing transport detectors, information signs and displays of up-to-date information (LED, prismatic, etc.), traffic light objects, united in a single network and controlled by the Control Centers, ITS the necessary signals to the controllers and further to the control elements of the system.

At present, the entire network of highways adjacent to large cities (Chicago, Detroit, Los Angeles, New York, etc.) is equipped with ACS. In the United States and Canada, much attention is paid to the interconnections of the urban system with the system of roads and highways in suburban areas. A good example is the urban network in Montreal, where commuter highways are included in the urban traffic management system, i.e. up to approximately 70–100 km from the city.

In Japan, almost the entire road network, both in cities and on highways, is equipped with ITS of varying degrees of complexity.

In the United States, there are various projects for the development of traffic control systems and intelligent transportation systems. These are projects such as FAST (Las Vegas) - traffic control on high-speed roads, CARAT (North Carolina) - identifying congestion and limiting traffic in congestion situations, Trans Star (Houston) - traffic control, CARAT (Maryland) - information support for traffic, ATCAS (California) - monitoring the characteristics of traffic flows and recording traffic on toll roads, Escort (Dallas) - traffic management, Navigator (Georgia) - traffic information, ATOMS (Dade county, Miami, Florida) is a traffic light "lattice" and parking management system.

In the state of Texas, the Texas Department of Transportation has successfully implemented an ADMS system based on a combination of central time-based and central adaptive control using a library of pre-calculated PCs.

To determine the optimal sequence for the implementation of various components of intelligent transport systems, their economic efficiency was assessed. The technologies of intelligent transport systems, which have the highest value of the “benefit/cost” indicator, will be implemented in the first place. One of the short-term interventions that has had the most impact is the crash detection system. Medium-term activities include expressway entry control systems and transit traffic management. Long-term measures are aimed at promoting alternatives to the use of individual cars and protecting the environment.

Japan is an advanced country in the development and use of higher forms of automated traffic control systems (it has moved to the level of intelligent transport control systems). The latter is explained by the fact that already since 1970 there has been a unified national policy for the use of the most comprehensive traffic control systems, managed and coordinated by state institutions, and also by the fact that there was a strong desire to reduce congestion, and, consequently, reduce the environmental load of areas strongly loaded with traffic. The whole system was developed according to five-year plans, and now almost all main roads in cities and most highways have transport information systems and in-vehicle navigation systems are widely used.

Traffic flows in all major cities are managed from city traffic control centers. According to tentative estimates, Japan in the period from 1985 to 1992. invested $1.8 billion in infrastructure, and an additional $690 million was invested in the subsequent period from 1993 to 1997. (South Korea) includes the following main subsystems:

traffic control, speed control, dynamic route determination navigation system, public transport passenger information, electronic fare payment, vehicle weighing in motion, parking information, driver information.

The electronic payment system operates on a high-speed highway and, using the technologies of intelligent transport systems, operates non-stop.
The parking information system, using electronic displays, informs drivers about the availability of spaces in certain parking lots. Six parking lots are connected to a single system.
The driver information system, using radio channels and visual information, informs drivers of the situation on the network so that they can correct the route in advance.
Intelligent transportation systems are widely applied in Taiwan. One of the components of intelligent transport systems here is an expert highway traffic control system. The system operates in real time and generates control actions in the event of critical situations, such as traffic jams, traffic accidents, worsening weather conditions, etc. The expert system and the control model in these situations make it possible to determine the effectiveness of solutions developed in critical traffic situations. In real time, based on information about the existing traffic load, the system simulates traffic parameters and creates a module for the optimal dynamic distribution of traffic flows. This allows the development of rational traffic management strategies on the expressway network.
The speed of the traffic flow above the dangerous place and the duration of the dangerous situation are two main factors that are the basis for determining the form of information support for drivers. In typical situations, the following gradation is applied: if the speed deviation is less than 10%, a warning about a potentially dangerous situation is issued, if the speed deviates from 10 to 20%, indications of a dangerous situation and the recommended speed mode, if the deviation is more than 20%, forced measures to restrict access to this network section. This expert system maintains a total of about 1,000 km of Taiwan's expressway network.
In China, there is a commission to manage the development of intelligent transportation system research. A program has been developed that includes a general strategy for the development of ITS and a list of pilot demonstration projects. These pilot projects include urban traffic control centers and electronic toll systems as a matter of priority.
Conclusion. According to the above analysis, relying on world experience to improve intelligent transport systems, using their modern and advanced technologies and systems, and implementing them in practice are among the urgent issues facing us today.

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