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MODERNIZATION OF ROADS AS ONE OF THE VECTORS OF ECONOMIC DEVELOPMENT

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The economic development of the road sector is based on qualitative changes in the condition of roads, leading to their reliable operation, the growth of markets for road construction and road transport services. The widespread use of innovative digital products has caused the urgent need to "upgrade" the roads not only in the field of design and technological solutions, but above all in the intellectual sphere of their use as a strategic resource that provides road users with such infrastructural conditions which would promote, on a par with the technical condition, the economic efficiency of transport and logistics activities in the economy. The key driver of economic development of road economy is the management of transport and operational conditions of roads which combines the traditional mechanism of ensuring their functioning with modern information and communication, technical and technological means in the service of transport-port flows. The article pays special attention to a fundamentally new vector of development of road infrastructure by carrying out a set of activities that fall under the term "modernization of roads. Such projects are focused on creating an active roadside environment, which, based on modern information technology, allows monitoring and managing the traffic of vehicles and transported goods along the entire route, as well as contributing to the maximum efficient use of drivers' and passengers' time. The advantage of this approach is that the object of regulation is not the specific values of the parameters of economic development, but the infrastructure conditions, the change in which causes a response of road users and creates the basis for the increase in economic performance of the subjects of economic relations.

Key words: *road infrastructure, road construction, classification, modernization, reconstruction*

МОДЕРНІЗАЦІЯ ДОРОГ ЯК ОДНОГО З ВЕКТОРІВ ЕКОНОМІЧНОГО РОЗВИТКУ

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Економічний розвиток дорожнього господарства засноване на якісних змінах у стані автодорожньої інфраструктури. Ключовим драйвером служить управління

транспортно-експлуатаційним станом доріг, що поєднує традиційний механізм забезпечення функціонування з сучасними інформаційно-комунікаційними засобами в обслуговуванні транспортних потоків. У статті особлива увага приділяється принципово новому вектору розвитку автодорожньої інфраструктури з проведенням комплексу заходів, що підпадають під термін «модернізація автомобільних доріг».

Ключевые слова: *автодорожня інфраструктура, дорожнє будівництво, класифікація, модернізація, реконструкція*

Introduction. Currently, special attention is paid to the implementation of intelligent technologies and the creation of innovative products in various areas of the economy. The main emphasis in the development and implementation of digital technologies is placed on the formation of modern information and communication infrastructure, the performance of work based on which is aimed at providing public services and administrative procedures in electronic form, as well as encouraging the export of high-quality IT-services [1]. The global transition to a new technological paradigm requires a revision of approaches to solving traditional economic problems. Road management as part of the transport complex performs the functions of infrastructure provision of road transport with high-quality roads, providing conditions for continuous and safe transportation of goods, as well as a comfortable environment for road users, both during the trip and during a short-term rest on the road. In the industry, along with the tasks of implementing modern software products that facilitate and promote the development of the most productive production relations, the task of informatization and digitalization of roads as a road infrastructure object becomes even more relevant from the position of maximizing the resulting economic benefits not so much from the physical movement of goods, as from the special environment of roadside IT infrastructure created around them.

Foreign experience shows that the functioning of the digital economy provides the greatest effect in industries with a high level of penetration of information technology, such as transport, trade, logistics, etc. The share of the electronic segment in the market of transport and logistics services is

about 10% of gross domestic product, more than 4% of employment, and these indicators have a steady growth trend [2]. Roads represent the infrastructural foundation of the transport and logistics industry, which reinforces the relevance of creating a modern road infrastructure.

Analysis of recent researches. Road infrastructure is at the junction of the most important sectors of the service sector: road transport, road maintenance, logistics, trade, tourism, forming a special environment for the movement of transport. Various aspects of the theory and practice of its development are considered in the scientific works [3]. In the market of transport services, road infrastructure is designed to integrate the segments of the transport process, logistics and road economy into a unified system in order to provide the most complete service in freight and passenger transportation. And just as the transport industry plays a fundamental role in the economy, road infrastructure is an integral component of the social and economic development of the state and its regions.

By road infrastructure is proposed to understand the road network and the system of interconnected objects located within the right-of-way and roadside territory, including digital communications, functionally providing production activities and maintenance of traffic-related needs of road users [4].

During the life cycle, the same road is repeatedly subjected to the processes of major and current repairs, reconstruction. Maintenance is performed continuously. The presented complexes are the objects of various types of economic activity.

Reconstruction includes a set of works and activities aimed at changing and

improving the basic technical and economic indicators and the consumer properties of the existing road or its individual sections and road structures [5; 6]. Capital repair is associated with the restoration of technical, operational and consumer qualities of the object lost in the process of operation, including the use of new materials and technologies. Current repairs are carried out to prevent wear and tear, eliminate minor damages and malfunctions, improve the aesthetic qualities of the object [5; 6]. The composition of work, deadlines and criteria for the appointment of these activities are regulated by a variety of normative acts.

As a rule, in conditions of significant growth and positive dynamics of traffic intensity it is required to carry out works on the composition classified as reconstruction. If the value of the predicted traffic intensity does not create prerequisites for increasing the technical category of the road and changing the basic parameters of the plan and profile, then the implementation of reconstruction with transfer to another technical category is unreasonable and economically inexpedient. At the same time, overhaul does not always allow to fully improve the condition and ensure the achievement of the required level of all transport and operational properties of the road (speed and safety of vehicles at all times of the year, capacity and loading level (ability to pass vehicles with certain axle load, total capacity and dimensions)) for a long period of time.

Unexplored aspects of the issue. It is advisable to supplement the current classification of works by the introduction of a qualitatively new type of economic activity, allowing not only to extend the longevity of the road in the existing technical condition, but also to bring its economic resource to a new level without carrying out reconstruction, if the economic feasibility of this measure is not sufficiently justified and not supported by the prospective growth of freight traffic. The conducted research allows us to propose under such conditions to carry out a set of works on modernization.

The purpose of the study development of theoretical and methodological foundations for the modernization of roads as one of the vectors of economic development of road economy on the basis of extensive use of modern information and communication and technical and technological means in the service of traffic flows. The conceptual approach is that in the composition of road infrastructure there are endogenous (in relation to the system of road economy) components that ensure safe, continuous movement of vehicles on roads, as well as exogenous - providing services that accompany the main transport process. It is proposed to base the development of road economy on the formation and subsequent use of the potential of the road and increase the results of the use of resources, through the directed impact on its structural subsystems of a rationally selected set of measures.

Main body of the study. Analytical study of the current regulatory and technical documentation in the field of road activities has established that the classification of types of work performed on roads, there is no term «modernization» [5; 6].

The concept of «modernization» in English means «renovation» and is defined by the presence of a number of characteristics characteristic of modern highways. According to the recommendations of the board of the Eurasian Economic Commission of 25.12.2018 № 29 «On the requirements for highways planned for inclusion in the list of Eurasian transport corridors» such characteristics include the calculated (standard) load on a single axle of at least 11,5 tons, the construction of special technical means, the provision of roadside service facilities (motels, campsites, catering points, gas stations). Reconstruction and modernization are the objects of technical standardization and standardization in construction. In the construction industry the following definition is widely used. «Modernization (of buildings, structures, engineering and transport communications) (modernization) – a set of works and activities related to improving the consumer

qualities of buildings, structures, communications, their parts and (or) elements, with bringing the operational performance to the level of modern requirements in the existing dimensions». [7].

In this interpretation, modernization is presented as a subspecies of reconstruction, carried out within the existing dimensions of buildings, structures and communications. At the same time what kinds of works performed on roads should be attributed to modernization in any of the normative documents is not prescribed.

The uncertainty of theoretical information on this issue has an impact on the economic performance in accounting for roads. Thus, roads belong to the fixed assets of road economy. Restoration of fixed assets can be carried out through repair or modernization (reconstruction, technical re-equipment). In this case, reconstruction is a subtype of modernization. Then, the cost of work performed during repair refers to the costs of the current period, and in the case of modernization should be attributed to capital costs, increase the original cost of the road and further accounted for through depreciation charges.

The period until the performance of partial or complete reconstruction can be 50–60 years. During this time, at the current rate of innovation in technology, technology and IT-sphere, it is obvious not so much physical as moral wear and tear of the road, road structures and surrounding infrastructure facilities (rest areas, roadside service facilities, gas stations, etc.). Physical wear and tear is constantly eliminated by ongoing maintenance and repair activities. Moral - requires renewal of the object taking into account the requirements of the country's economy. There is a shift in the system of values by moving from the usual role of the road network, to the understanding of the role and importance of each road in the economy.

Prerequisites for increasing the volume of modernization of roads are changes in public consciousness of the role and place of road infrastructure in the economy, expressed in the development of transport and logistics

system of the country, intelligent transport system, the formation of markets of transport and road construction services [8–10].

The factor of road modernization is overcoming and replacing conventional technologies that impede quality changes and, consequently, economic growth, with technologies that motivate, on the one hand, road users to meet their needs, on the other hand - road building organizations to innovative activities in the development, creation and use of new technologies.

Thus, it is proposed to consider the modernization of the road as a factor contributing to the economic growth of the area of gravity of the road due to the timely improvement of not only qualitative, but also aesthetic and planning solutions taken to increase its attractiveness for users within a single global transport space (roadside service, logistics infrastructure).

In order to be able to apply the presented approach in practice, we propose the following definition of road modernization. Road modernization is a set of works and activities aimed at improving and enhancing the consumer properties of the existing road or its individual sections and road structures, bringing the performance indicators to the level of modern requirements in the parameters corresponding to the actual technical category of the road.

In order to ensure the functionality and practical relevance of the proposed concept, a classification of works attributed to modernization was developed. The names of works on modernization of highways include the following list:

- changing plan elements when increasing the radius of the curve in order to increase the speed and safety of vehicles;
- increasing the stability of the earth bed;
- increasing the width of the roadway without changing the dimensions of the earth bed;
- rearrangement of the roadway for design load with provision of the required flatness according to the international flatness index and road structures;

– reconstruction (if necessary) and arrangement of rest areas equipped with modern means of sanitary and hygienic and consumer services for road users;

– conversion (if necessary) and arrangement of engineering and technological complexes of traffic control and winter maintenance on the basis of the latest technologies;

– re-equipment (if necessary) and installation of engineering road equipment, communications, modern information systems, working in automatic mode, to improve road safety, implementation of weight and gauge control of vehicles, improving the information of road users about the situation on the road and traffic;

– arrangement of intersections and construction of road junctions in accordance with the requirements of the existing technical category;

– construction of new roadside service facilities and development of existing ones, by improving the quality and comprehensiveness of services included in the road modernization project.

– organization of road traffic, including temporary, arranged for the period of construction and installation works;

– increase of road capacity on the basis of equipment with elements of intelligent transport system.

The above list is a recommendation and should be supplemented taking into account the practical experience in the implementation of infrastructure projects in the road sector. Its scientific value lies in the proposal and selection of directions of qualitative new development of roads, which, according to the author, should set the vector of digitalization of road facilities [11].

Conclusions and prospects for the further research. Separation of infrastructure projects of modernization and reconstruction is economically necessary in conditions of limited resources. Analysis of the cost of these types of work allows us to conclude that road modernization should be a less costly project compared with reconstruction, primarily due to the smaller

amount of work and the lack of the need to rebuild the existing road structure to upgrade to a higher category. The exception may be the cases of application of fundamentally new innovative solutions that require large initial investments, which, as a rule, should be compensated by a greater effect in the course of subsequent operation.

Modernization is a transition to fundamentally new consumer characteristics (level of convenience, speed, durability, reliability, safety, environmental friendliness). The most important roads for the country's economy need to be upgraded. With this approach, the main quality attributes are not the number of lanes and type of pavement, but the provision of conditions for the whole range of transport and logistics services, ensuring transport links and the necessary transit traffic.

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