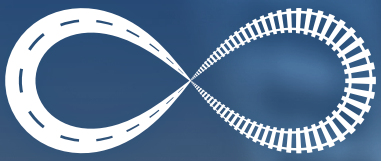

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5th International Conference on Road and Rail Infrastructure
17–19 May 2018, Zadar, Croatia

Road and Rail Infrastructure V

Stjepan Lakušić – EDITOR

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WAYS TO CREATE A COMPETITIVE ENVIRONMENT IN THE AREA OF OPERATIONAL MAINTENANCE OF ROADS

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Abstract

Maintaining the current state of the road network of Ukraine and its rehabilitation are considered as burning issues along with the reformation of the national road system. Inefficiency of traditional methods of short-term contracts is the main factor causing the issues that has been proved by many studies. This fact triggered rapid development of new types and models of contracts in the road sector throughout the world that are long-term contracts for operational maintenance of roads. Along with implementation of these contracts, creating a competitive environment on the road works market is an important task of road administrations in Ukraine. It can be implemented provided that the contractors can predict their costs and income from making long- term contracts for operational maintenance of roads and process an objective reasonable cost of such works. For this purpose, a single mechanism to calculate the number of staff workers and road machinery of road enterprises engaged in works performance on operational maintenance of the road section is developed. The mechanism takes into account the averaged scope and work packages on operational maintenance of roads to ensure the acceptable level of operation, smooth and safe traffic on the roads. Also, using modern technologies and road machinery is taken into account when calculating the required number of staff workers and road machinery of road enterprises.

Keywords: road, maintenance, road machinery, scope of work, long-term contracts

1 Introduction

Highways as the most important component of transport infrastructure are a prerequisite for economic and social development of the state. Not only the efficiency of the industry and agricultural production depends on them but also the provision of an adequate standard of living for people and the country's defense capability. Operational maintenance of roads is a set of works on inspection (surveys) and maintenance of highways, road structures and right of ways (ROWs). Works on repairs and operational maintenance of the highway are aimed at ensuring its consumer properties which directly correspond to the interests of users, the requirements of the Laws of Ukraine and the Resolution. Operational maintenance works includes inspections (surveys) of the highway and ROWs for the timely detection and elimination of damage ensuring the operation of the highway elements in different seasons of the year, maintaining them in operational condition, providing engineering and technical support and emergency works. Taking into account the fact that priority is given to ensuring safe and comfortable traffic and preventing the premature decline of riding qualities, the new approach is required for the management of the operational maintenance system of highways. With the adoption of legislative acts on the decentralization of the management system and the transfer of local roads to local self-governing bodies, the issue of the reforming the Ukrainian road maintenance system is relevant more than ever.

2 Main part

The existing road maintenance system has been operating for quite a long time and during this period its main disadvantages have been clearly identified, among which the following can be highlighted:

- concluding short-term contracts;
- monopoly of state enterprises in the field of operational maintenance of roads;
- low level of material and technical base of road enterprises engaged in operational maintenance of roads;
- slow introduction of new materials and technologies.

These disadvantages together with constant underfunding of road works adversely affect the state of the road network, therefore, it is necessary to search for a rational system for road maintenance that would enable their elimination. A set of suggestions on the strategy of the reforming the Ukrainian road operational maintenance system were developed based on the analysis of such systems in the world. Accepted proposals will contribute the improvement of the quality of system management, planning and direct execution of operational maintenance works, Figure 1.

Figure 1 Scheme of highways maintenance of national importance that is suggested

2.1 Combined operational maintenance system

Today, linear and territorial principles of road maintenance are used in Ukraine. The linear principle provides for making a contract with a contractor for the maintenance of a separate road or its sections. A contractor is selected based on tenders in which the contractors of different forms of property will participate. In this case, it is planned to restrict the use of such principle only by international and national roads.
The territorial principle of road maintenance is most appropriate for use on local roads. Currently, local roads are maintained by a large number of contractors of state form of property (Regional Road Services) whose organizational structure and material and technical base is significantly outdated. Therefore, in order to ensure their competitiveness in the market of road services, it is necessary to rationalize their structure by calculating the optimal number of staff workers and the need in the machinery for roads maintenance. In order to avoid all disadvantages in the maintenance system by linear and territorial principles, it is necessary to implement combined maintenance systems based on a harmonious combination of road maintenance by the end result using a linear or territorial principle (Figure 1).

2.2 Implementation of long-term (for five to seven years) contracts for maintenance of highways

A sufficiently effective and efficient mechanism, taking into account the European experience, is the introduction of contracts for network development and road maintenance based on the ultimate outcome. The main differences between road maintenance contracts and traditional contracts currently underway is as follows:

- long-term, rigidly fixed nature of contractual relations;
- non-interference of state and public organizations in the issues of complex road maintenance performed by the contractor. The state should only check the conformity of the road performance with the established requirements of normative documents;
- guaranteed and clearly predictable for the contractor nature and extent of funding of road maintenance services during the term of the contract;
- independence of the operator in the choice of terms and conditions for the implementation of the whole complex of required road works.

It is proposed to conclude contracts on the basis of final results for a period of 5 years with the possibility of prolongation of the contract for 2 years. If the Contractor does not adhere to the established levels of service, then, in addition to the calculation of penalty points, the contract with him may not be prolonged. In case of gross violations, failure to comply with the established levels of service, the termination of the contract and the exclusion of the Contractor companies from future tendering procedures for the procurement of road maintenance works should be provided. The development of the highway network in Ukraine needs to be combined with the potential of the state and private sectors, the formation of state-business partnerships, the strengthening of the role and importance of private investors and operators, the search for the most rational forms of their interaction and the division of responsibilities. According to the legislation of Ukraine, the implementation of public private partnership projects (hereinafter referred to as PPPs) can be carried out on the basis of PPP agreements, concession agreements, joint venture agreements, and others. Concession contracts and life cycle contracts have become the most widespread in the road sector. The concession in European countries is primarily used for the construction and operation of new highways in the areas that are in line with the directions of the international transport corridors and the international highways of category “E”.

2.3 Development of road maintenance schedules

The customer should ensure that road maintenance schedules are developed based on the results of diagnostics and the actual road state survey. Works on visual and instrumental surveys, feasibility studies, etc. can be performed by road operators on their own or, if necessary, with the involvement of specialized organizations.

2.4 Calculation of a number of employees and road machinery units of road enterprises

Along with the introduction of long-term contracts in Ukraine, an important task is to create a competitive environment in the market of road works. This can be implemented provided that the contractors can predict their costs and revenues from the conclusion of long-term maintenance contracts and are able to calculate an objective and a reasonable cost of such works. To this end, a single mechanism has been developed for calculating the number of workers and road machinery units of contracting enterprises that carry out works on the maintenance of the road section. The mechanism takes into account the averaged volumes and works on road maintenance works to ensure the acceptable level of operation, ensuring uninterrupted and safe traffic on highways. Calculation technique provides for the following steps:

- definition of the composition and types of road maintenance works;
- adoption or development of works technique with the indication of processing procedure and operations;
- determination of work scope on as per individual processing procedures and operations;
- choice of road machinery type for the implementation of accepted processing procedures and operations;
- calculation of the productivity of works taking into account the peculiarities of individual operations;
- development of the operations schedule;
- calculation of the required number of workers and the need for machinery;
- compilation of a summary list on the need for the machinery.

2.4.1 Determination of the road maintenance works scope

The road maintenance works scope is established taking into account the specifics of works during different seasons and are determined depending on the road length, its state, type of road pavement, the presence of artificial structures, road equipment elements and other factors.

2.4.2 Calculation of the number of administrative staff, workers and needs in road machinery

The calculation of the number of workers (needs in machinery) required for the performance of road maintenance works is fulfilled by the formula:

$$П_п = \frac{П_1}{T_T} \tag{1}$$

Where:

$П_1$ – the number of changes needed to perform a certain amount of works;

m_T – number of days of possible work throughout the season (taking into account weather-climatic conditions in the region), days;

$$П_1 = \frac{F}{B \times H_{work} \times T_c} \times К_{op} \times К_{m.a} \times К_{tr} \times К_{E.r} \times К_{border} \tag{2}$$

Where:

F – maintenance work scope, m2 (running meter, m3);

B – an indicator of a separate type of work, m2 (running meter, m3);

H_{work} – standard of time work of workers (machinery) for the performance of a work scope unit;

T_c – duration of work during the day, hour / day;

K_{op} – coefficient of conditions of the road section operation which depends on the terrain, the degree of complexity of winter maintenance of roads, the presence of bridges and other artificial structures, etc.

$K_{m.a}$ – correction factor taking into account the passage of the road section in the mountainous area;

K_{tr} – correction factor taking into account the actual traffic volume on the road section;

$K_{E.r}$ – correction factor taking into account the raised level of maintenance of the the road section which coincides with the European highways (with the index E);

K_{border} – is a correction factor that takes into account the maintenance of the total road section near the international e check points across the state border.

2.4.3 Drawing up a calendar schedule for the calculation of resources

Schedule of works execution determines the general necessity in the resources by months and types of maintenance works. The initial data for drawing up the calendar schedule are:

- the project of operational maintenance of highways;
- linear calendar schedule;
- flowcharts for the implementation of certain types of work.

The development of a calendar schedule of works performance (Figure 2) should be conducted in the following sequence:

- outline the schedule form, define the work scope by type, and from the estimate – the expenses basing on the project (work draft) and the linear calendar schedule;
- outline from the linear calendar schedule the initial and final terms of each work type performance.

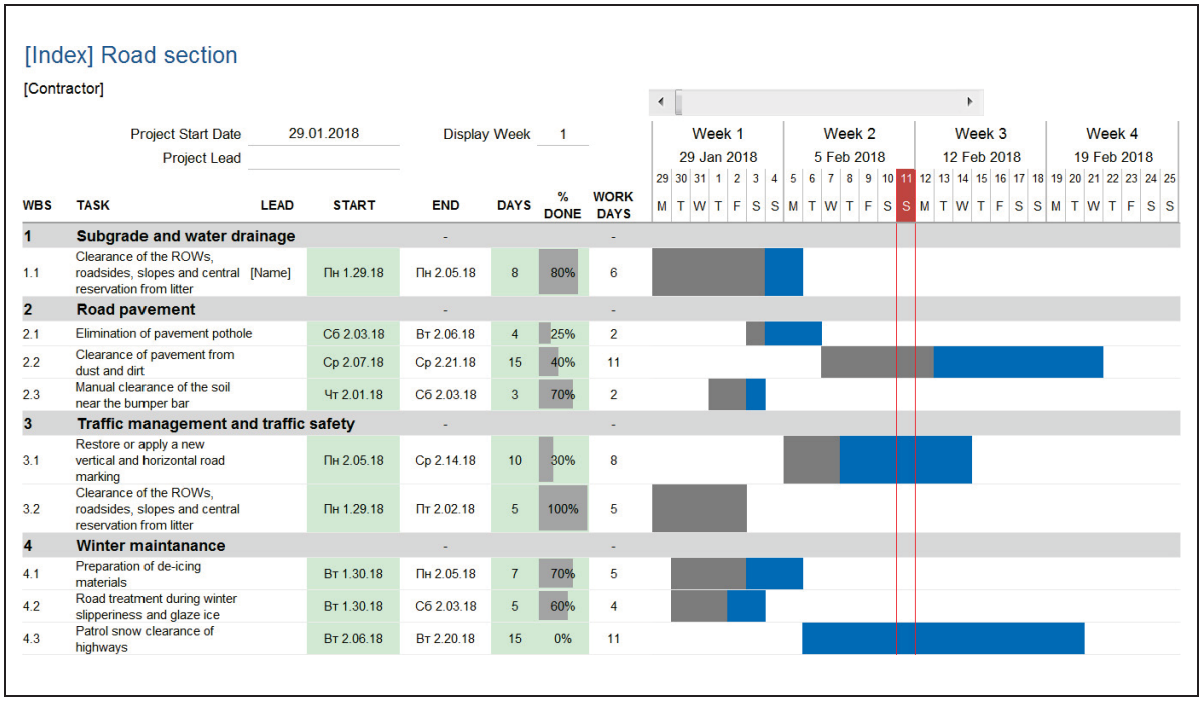

Figure 2 An example for drawing up a schedule of works performance

3 Conclusions

Thus, for the successful solution of the tasks of improving the quality of roads, close integration of all technological stages of their maintenance which includes: road performance indicators record and road certification, collection and analysis of information on the parameters, characteristics and availabilirty of roads; implementation of a complex of works on roads maintenance taking into account their actual state; architectural and aesthetic design and road equipmenrt, etc. is required. Accepted proposals will contribute to improving the quality of the road maintenance system management in Ukraine. Taking into account the transformational processes currently underway in Ukraine, in the near future, the efficiency of the use of funds can be increased due to the introduction of new management mechanisms in the public sector. In particular, the introduction of long-term contracts and the use of a combined road maintenance system will allow ensuring the effective management of roads in conditions of market economy.

References

[1] Transport complex of Ukraine. Roads. Problems and prospects. I.R. Yukhnovskyi

[2] Analytical note "On the improvement of the mechanisms of the road sector development in the context of the implementation of the roads state management reform." National Institute for Strategic Studies [Electronic resource]. URL: http: //www.niss.gov.ua/articles/1661/

[3] An overview of management tools of road structure state (Internet Journal "Transport structures" [Electronic resource]: URL https: //t-s.today.

[4] Road Matrix Brochure [Electronic resource]. URL: http://roadmatrix. stantec.com/Announcements/V31.pdf

[5] Resource Capacity Management and Infrastructure Development. Long-term contracts in road economy as a tool for motivation, risk optimization and budget expenditures. Izosimov D.A., Gromova E.G.

[6] Technologies used in the construction, repair and maintenance of highways and artificial structures. Electronic resource]. URL: http: //www.bntu.by/images/stories/ftk/Kaf/SED/kat_tehn1.pdf

[7] Mantenimiento Vial Informe Sectorial. [Electronic resource]. URL: http://publicaciones.caf.com/media/1133/IS_Mantenimiento_vial.pdf

[8] Automated control system for winter maintenance of highways. Leonovich I.I., Publishing house "Vestnik" BNTU

[9] Highways: new approaches to financing. Publishing House "Finance". Record. Audit 2016

[10] Maintenance and repair of highways. A manual for the chief of the road linear distance for repair and maintenance of highways. Kravchenko S.E., Reup Zh.V. Minsk BNTU

[11] Leonovich, I.I.: Diagnostics and quality control of highways: Manual "New Knowledge" Minsk. I. I. Leonovich, S.V. Bogdanovich, I. V. Nesterovich