MAIN VECTORS OF UPDATING OF RULES OF CALCULATING TRANSPORT BUILDER'S ESTIMATE

Solovyov, Viatcheslav V., *Russian University of Transport, Moscow, Russia.*
Korchagin, Alexey P., *Russian University of Transport, Moscow, Russia.*
Abou-Haidar, Samer B., *PJSC Mostotrest, Moscow, Russia.*

ABSTRACT

The wide range of conditions for performance of works in transport construction sector traditionally should meet high demands on the methodology for their accounting when calculating the estimated cost. In its current state, the national (federal) budget and regulatory framework is a compromise, especially when it comes to adjusting the costs in different circumstances of natural, climatic, different regional resources, transport accessibility. The article reveals the problem of the sectoral specificity of the use of labor resources at the objects of construction of the railway transport infrastructure. An example of the impact of typical working conditions on quantitative regulatory parameters is given as a calculation and methodical variant of solving economic problems.

Keywords: *economy, transport construction, norms, estimated cost, analysis, labor intensity, production conditions, coefficients, factors.*

Background. *Accounting for special conditions for performance of works in determining the estimated cost of construction is made in Russia by means of correction coefficients that are part of the system of estimated valuations. Their application to the components of direct costs is due to the fact that the development of norms is carried out for the following variants of process normals:*

1. *If the work is performed in the presence of a specific factor, it enters the normal and is taken into account in the resource norm indicators. So, the performance of track works always occurs in conditions of constructive constraint on the railway, therefore, this factor is taken into account by norms and quotations. This principle was taken as a basis in development of the collection (part) No.28 «Railways» of the branch estimate-normative base.*

2. *If the work can be performed under different conditions, then normalization assumes a normal, not complicated by special conditions. To take into account such conditions, coefficients for direct costs components are separately developed. The use of these coefficients in estimates is possible in the case of presence (and justification) in the project of special conditions for performance of types of work, these or those operations.*

Objective. *The objective of the authors is to consider main vectors of updating of rules of calculating transport builder's estimate.*

Methods. *The authors use general economic methods, comparative analysis, evaluation approach.*

Results.

1.

When considering the process of the impact of complicating factors, it is necessary to initially determine the functional signs of this impact, to identify those components of the estimated cost that are significantly affected. Since the current methodology for calculating the estimated cost at the design stage in railway construction, reflected in [1], is based on the use of norms and quotations for work processes, and the need to take into account special conditions is appropriate for the development of project documentation, the impact should not be considered outside of direct costs. This is especially true at the time of justification of joint investments at the pre-project stage with concession schemes of investment [2]. Of three components of direct costs – wages, machine operation costs and material costs – the latter is not an essential functional feature, as determined earlier by studies at transport construction sites [3].

The data obtained by the production method, as well as in the modeling of processes, indicate that the impact of complication factors on consumption of building materials is unimportant and in most cases is not determinable, since it is within the natural dispersion of the random values of material consumption during observations. The main impact is determined by the laboriousness and machine capacity of the work, which is linearly related to the change in the value of the basic wages and the costs of operating the machines. At the same time, it should be noted that the coefficient of special conditions for each price, as a rule, is developed by one, that is, there is no separate accounting for the increase in labor intensity and machine capacity.

In conditions of static technology and with an error-free calculation of the coefficients, the highlighted feature does not affect the accuracy of calculating the estimated cost, on the contrary, it simplifies the process of compiling a local estimate. However, with the processes of modification of the regulatory framework – such as separate indexation of the components of prices, replacement of the nomenclature (codifier) of resources, unification and separation of collections with a change in industry subordination, modeling of enlarged resource-technological models and calculation of aggregated indicators based on them, this can lead to significant errors, expressed in the absence of a methodological justification of the cost parameters of the buildings obtained during the design, incommensurability of the estimated and actual for certain groups of work. The separate accounting of the increment of labor and machine capacity remains a promising and controversial methodical method for taking into account the special conditions of production.

Prior to the reform of 2015–2017 in the federal and sectoral pricing, the coefficients for special working conditions were mainly prepared for the budget-normative base of 1984. The technologies and features of the transportation process taken into account have undergone changes over time, which does not give confidence in the accuracy of adjusting the components of direct costs when calculating the estimated cost. Substantive materials and calculations of most of the coefficients were not preserved. In the process of creating the sectoral estimate-normative base of railway transport, they were updated to a partial extent and introduced as a tool for regulating the estimated costs at railway infrastructure facilities.

In the process of implementing investment and construction projects, adjustment of cost parameters for types of work performed in special conditions is carried out without proper regulatory justification, often by establishing particular rules for certain types of costs or construction projects.

To increase the accuracy of determining the estimated cost for railway construction facilities, periodic updating and rechecking of existing coefficients with sufficient design basis is necessary.

2.

One of the most common cases of complicating the conditions of production at railway transport facilities is to work during the specially assigned time interval when traffic is stopped to allow to proceed with maintenance and other works on tracks. This time interval is commonly called in Russia a technological «window» (further called in the article a «window»). The complexity of the problem of estimate rationing here lies in the diversity of technology for missing trains [4].

The federal regulatory framework as of early 2017 did not contain raising coefficients for the «window» on railways, they are taken into account only for subways.

Correction of labor costs and machine operation according to [1] was carried out by applying correction factors associated with performance of works within the «window», to indicators of labor costs, wages of construction workers (installers), costs of operating construction machines, including payment labor of train drivers, which was allowed only to industry-specific unit prices, in the «General Provisions», to parts of which stipulated the possibility and conditions for their application. When determining the estimated cost of works in the «window», if in the «General provisions» to parts of sectoral unit prices there was not specified a specific duration of the «window», correction coefficients were applied only for its duration up to 8 hours. At the same time, the mentioned coefficients referred to works that can be completed during the given «window» and do not interfere with the resumption of train traffic on this section after it ends within the specified duration. The coefficient system has obvious drawbacks:

1. Scant nomenclature of conditions for application of coefficients. As is known, the factor of duration of the window has the greatest impact on reduction in production rates. In accordance with this, the gradation of window durations in sectoral methodological documents should also be built. Limits of windows to 4 and over 24 hours do not provide the possibility of full-scale application of coefficients.

2. The reliability of figures, determined by the method of calculating production rates for the main types of construction works, should be supported by supporting materials. The initial data for calculations also need to be clarified: adoption of a standard list of preparatory and final works, estimated time values for formation of a working train, movement over the distillation, preparation of technological equipment and averaged characteristics of the main processes.

3. The coverage of the base rates by the coefficients of the budget and the rates did not correspond to the tasks of sectoral pricing. The division of the system of budgetary valuations into the federal and sectoral segments led to an inadequate scheme for taking into account the raising coefficients. So, for modern constructive decisions, even the base of estimated norms is still missing [5].

The compilations (parts) No. 10, 20, 28 developed by the branch divisions of JSC Russian Railways took into account the possibility of performance of works during the window. However, during reconstruction and overhaul of buildings, a situation is possible when general and other works are being performed in the window, the prices for which are contained in compilations developed by federal and other institutions. The issue with application of coefficients to the norms of the compilation (part) No. 30 remained unsolved, since it was required to determine the works performed during reconstruction and overhaul of artificial structures.

Analyzing the peculiarities of the sectoral system of adjusting the costs for work in special conditions, within the framework of reforming the pricing system, it became possible to draw conclusions about the main directions for updating the coefficients when a window appeared, which, in turn, required:

– determination of technologically justified required length of windows for the main groups of construction and installation works;

– calculation based on statistical data of the distribution parameters of duration of the windows actually provided;

– actualization of methods for calculating the decline in labor productivity and production of machines, depending on duration of the window and other production factors;

– determination of the proved list of preparatory-final operations during work in a window;

– calculation of coefficients when working in a window in accordance with the accepted specificity of their application, taking into account the modern line classification [6].

The implementation of these measures is in line with the current strategy for unification of sectoral estimates and regulatory databases by the RF Ministry of Construction. In addition, actions of this kind are due to tasks resulting from assessment of effective techniques in the organization of railway construction, as set forth in [7].

Implementation of construction and installation works near the current railway is associated with the need to implement measures that ensure technological breaks and safe handling of moving trains. The resulting increase in labor costs and the use of machinery must be accounted for by applying to the rates of raising coefficients. The methodology for calculating such coefficients should be based on the following assumptions:

1. Scope of applicability of the method and determined coefficients – the cases of performing

work directly on the tracks and stations, as well as manual operations closer to safe removal from the extreme rail, or mechanized work, when safety requirements require termination of operations when a train approaches.

2. The increase in labor costs and computer time is inherent in any kind of construction and installation and repair and construction works, and it is assumed that the specialized (track, contact network) is the most common in the given conditions.

3. The number of tracks in which traffic is carried out does not significantly affect the complexity of work. The defining parameter is the very fact of their performance at a certain distance from the current track. The effect of mutual overlap of the time spent on handling two trains at the same time along different routes is not taken into account.

4. The differentiating factors for the coefficients should be considered the volume of traffic on the haul (station) and from the specialization of the line determined by the preferred type of trains in circulation.

5. The calculation model for determining the value of coefficients from the point of view of time costs is related to

– a break in the actions of performers and their forced inaction for the duration of train passage;

– a need to move to a safe distance from a track and then return to the work site;

– costs for signaling and fencing of work sites in accordance with safety requirements [8].

Analysis of the provisions of the normative and methodological literature allows us to judge the inadequacy of working out the nomenclature of conditions, even for the sectoral methodology, which is also noted in [9]. With the actual coverage of traffic intensities from 14 to 127 trains per day, the ratio of the estimated values of traffic on the section and the actual volumes of traffic remaining for the period of work is left unaccounted for. When performing reconstruction, construction and repair activities, certain restrictions are imposed on the speed regime on the site [10], technological windows are provided, which reduces the capacity of the site.

In order to minimize losses in the transportation process, a certain number of trains are redirected to other areas (detours). This leads to the fact that one value of the volume of traffic is laid in the project, and the work is performed with a different, much smaller number of trains. The redirection of a part of the trains, however, is only possible if there is an economically expedient detour [11]. The calculation of this phenomenon in the development of coefficients was not carried out. Also, over time, the actuality and gradation of the sections of the track in terms of speed of movement was lost.

3.

There is no high-speed movement over 250 km/h currently in Russia, and what is, or will be, is the peculiarity of Moscow–St. Petersburg line compared to other high-speed lines, the regulatory requirements have not been clarified.

According to [6], the specialization of lines includes: high-speed, speed, mainly passenger or freight transportation, especially heavy-duty, with heavy traffic and inactive. This nomenclature is taken into account when calculating these norms for handling trains in the form of time norms for handling one train and the coefficients for the work of railway men and machines in current track maintenance. However, for the purpose of budget valuation, it is difficult to apply such a nomenclature, since at the design stage of reconstruction, repair or new construction (second tracks), ensuring the compliance of traffic parameters during the production period with the original figures does not seem reliable. To enlarge the range of lines, there is also an insignificant spread in the values of the train handling time on all lines, except for high-speed and speed lines. In this connection, it is proposed to use the enlarged nomenclature of lines, as well as to take into account the factor of specialization of the enterprises that perform the work [12] when determining the calculation methodology of coefficients for handling trains. Moreover, an important condition for the calculation is comparability of the already existing indicators of handling trains with newly developed (actualized) coefficients.

As prerequisites for the calculation should be taken into account:

1. Classification of lines according to [6, 13], enlarging it for the purposes of estimated valuations,

2. Time indicators for handling one train according to [13], averaged for compliance with the enlarged classification,

3. The methodology for calculating the coefficients for labor costs and machine operation, applied earlier by the Institute of Economics and Transport Development (IETD) for similar purposes.

The authors proposed their enlargement of the nomenclature of lines:

– lines with speeds up to 140 km/h;

– lines with speeds 140–199 km/h (speed);

– lines with speeds 200 and more km/h (high-speed).

Mentioning of Moscow–St. Petersburg line is excluded due to the fact that over time the network of traffic with high speeds will expand and the requirements for handling trains will be equally characteristic of all such lines.

Normative values of time for handling one train (in minutes) as the initial data are taken for the calculation in accordance with [13], while for lines with speeds of up to 140 km/h an average index between passenger (2,4 min.), freight (2,6 min.), heavy cargo (3,1 min.) traffic and a specially loaded line (2,7 min.). The average value is 2,6 minutes. For lines with speed and high-speed traffic, time for handling one train is kept at 7,1 and 12,4 minutes. respectively. At the same time, some new calculations of the train handling time, depending on the length of the section, speed and other parameters, will not be performed.

The calculation model used by IETD takes into account the performance of work in the conditions of movement of trains along the track in which they are conducted, or tracks adjacent to it by normal interstates, and also on the interstates and up to 4 m from the axis of the last track, to take into account the interruptions caused by handling of trains. The coefficient for their handling is determined by the ratio of duration of the shift to the net work time. Net time is calculated as the difference between the duration of work (hour) and the total time of stoppage due to the passage of trains per shift.

Table 1

No.	Number of trains passing by tracks per day	Coefficients		
		for sections of the track with speeds of up to 140 km/h	for sections of the track with speeds of up to 140–199 km/h	for sections of the track with speeds of 200 km/h and more
1	10–18	1,026	1,074	1,137
2	19–54	1,07	1,216	1,449
3	55–90	1,149	1,55	2,632
4	91–126	1,242	2,139	
5	127–162	1,351		
6	163 and more	1,481		

The obtained values are reduced to the normative form. Coefficients with values greater than 3 should be excluded for use in the database, since a significant overstatement of the cost of work indicate the inadmissibility of the relevant organization schemes. Restriction of movement on the haul, or provision of «windows» is required. Also, the negative coefficients resulting from the fact that the total idle time is longer than the working time is excluded.

The remaining nomenclature of coefficients is to be consolidated for convenience of application, and also taking into account the resulting dynamics of the coefficients values at the specified calculation steps. The main interval of traffic intensity of 36 trains is accepted with the adoption of the coefficient value corresponding to the average for each interval of the traffic intensity value. The results of the calculated values of the coefficients when operating under conditions of motion are given in Table 1

For the budget and regulatory base, it is reasonable to round off the coefficients to two decimal places.

4.

Summing up the results of the analysis, we should also mention the economic significance of the revised provisions for the transport industry. Effectiveness from the introduction of a provision of the estimated norms or methods is traditionally determined by the effects of investment savings. Direct economic effect in general form can be expressed by saving the estimated costs for construction projects:

$$E_{pr} = \int_V \frac{dDC \cdot K_{pr}}{dV},$$

where direct costs DC are represented by a sample of the homogeneous set of differences $\{EP_i - EP_i \cdot K_i\}$, determined by the design data for the works i and the corresponding unit costs EP_i;

DC – amount of direct costs that are normatively dependent on the conditions of work; since in the final form the coefficients of accounting for the special conditions κi are applied to the unitary rates EP_i, the vale of direct costs is $DC = (EP_i - EP_i \cdot K_i) \cdot V_i$, where V_i – volumes for each type of work;

V – indicators of the volume of construction and installation work, differentiated according to specific characteristics, and the magnitude of technological and constructive capture;

K_{pr} – coefficient of bringing costs from direct to full estimated, taking into account overhead costs, estimated profit and a number of other costs.

The representation of the economic effect in the form of an integrable function is determined by the need to take into account the nonlinear dependence of economic indicators on volumetric in modern construction. In addition to the presence of nonlinearity in the performance of work under normal conditions, a complex dependence of the actual costs on the ratio of the size and nature of the trains on the site, the length and the number of «windows» provided, the size of technological seizures during construction of a facility appears. Since the actual costs are a fundamental criterion in further evaluation of the regulatory framework, preventive consideration of them in determining the economic effect, according to the authors, is appropriate.

In addition to the effect that arises in the investment and construction process, it is necessary to allocate an indirect effect that can be attributed directly to the transport system by increasing its production indicators. For a long time, there is an approach to determination of the optimal duration of a technological «window» on the basis of an analysis of the total minimum construction costs and losses from the suspension of the transportation process.

Until now, it was exclusively the task of planning and organizing the construction, because it is considered that duration of a window is set by the project, and the standards should be developed for the entire possible range of this duration. From an applied point of view, this provision remains relevant, and now, at least, an attempt to change the order of normative and design work can lead to an unjustified complication of the processes – both in the estimated norms and in the preparation of project documentation. For scientific analysis and proposals in the updated database of norms, it is possible to raise the question of how much the value of the norm (in this case, the raising factor) is associated with sectoral economic indicators. Such indicators according to the conclusion of the leading scientific schools of railway transport can be classified as:

– labor productivity of railway workers;

– level of resource-saving,

– indicators of efficiency of road and transport enterprises.

First of all, however, it is necessary to indicate the factor characteristics in the analysis. It can be performed only if all resources-labor, infrastructure, energy, and rolling stock of railways are taken into *account in a comprehensive manner. The requirement of complexity is determined by the fact that the factor models for rail transport contain mutually intersecting sets of both internal and external aspects of activity attributed to various farms of JSC Russian Railways [14].*

Conclusion. *Based on the theoretical foundations and tendencies in the sphere of parameterization of production conditions [15], there are reasons to consider as promising several directions for further updating the estimates associated with the coefficients of work in traffic conditions at transport infrastructure facilities:*

– determination of the types of work and the scope of the coefficients;

– adjustment of classification characteristics to refine coefficients;

– calculation of reduction in the actual number of pairs of trains as compared to the nominal for the railway line segment, taking it into account as a normative factor for various variants of the railway network lines;

– calculation of coefficients using time-use models for basic types of construction and installation works.

REFERENCES

1. Procedure for determining the cost of construction of railway infrastructure facilities and other facilities of JSC Russian Railways (OPDS-2821.2011). Appr. On 29.12.2011. Ordinance No. 2821r [*Poryadok opredeleniya stoimosti stroitelsrva ob'ektov infrastruktury zheleznodorozhnogo transporta i drugih ob'ektov OAO «RZD» (OPDS-2821.2011). Utv. 29.12.2011 goda. Rasporyazhenie № 2821r*].

2. Martsinkovskaya, A. V., Dobrin, A. Yu. Attraction of foreign investments in the construction of railway transport infrastructure [*Privlechenie vneshnih investistii v stroitel'stvo infrastruktury zheleznodorozhnogo transporta*]. *Transportnoe stroitel'stvo*, 2012, Iss. 3, pp. 26–29.

3. Mujiri, T. M., Solovyov, V. V., Shmidt, V. I. About economic features of construction and reconstruction of bridges and overpasses in large cities [*Ob ekonomicheskih ossobennostyah stroitel'stva i rekonstruktsii mostov i puteprovodov v krupnyh gorodah*]. *Transportnoe stroitel'stvo*, 2002, Iss. 5, pp. 11–13; Iss. 6, pp. 12–15.

4. Odudenko, T. A. The technology of handling trains during breaks in traffic in the railway sections of Far Eastern region. Ph.D. (Eng) thesis [*Tehnologiya propuska poezdov pri pereryvah v dvizhenii na zheleznodorozhnyh uchastkah Dal'nevostochnogo reiona / Dis... kand.tehn.nauk*]. Khabarovsk, 2014, 161 p.

5. Korchagin, A. P. Problems and perspectives of using composite materials in transport construction [*Problemy i perspektivy primeneniya kompozitsionnyh materialov v transportnom stroitel'stve*]. *Proceedings of the International Scientific and Practical Conference «Modern Problems of Economic Management of the Transport Complex of Russia»*. Moscow, MIIT, 2015, pp. 142–143.

6. Methodology for classification and specialization of railway lines of JSC Russian Railways. Appr. 23.12.2015. Ordinance 3048r [*Rasporyazhenie 3048r. Metodika klassifikatsii i spetsializatsii zheleznodorozhnyh linii OAO «RZD». Utv. 23.12.2015 goda. Rasporyazhenie 3048r*].

7. Volkov, B. A., Olhovikov, S. E. Assessment of organization of construction of railways. *World of Transport and Transportation*, Vol. 10, 2012, Iss. 2, pp. 106–109.

8. Order of JSC Russian Railways of 29.11.2011 No. 2560r «On approval of the Instruction on the procedure for provision and use of «windows» for repair and construction and installation works on the railways of JSC Russian Railways [*Rasporyazhenie OAO «RZD» ot 29.11.2011 № 2560r «Ob utverzhdenii Instruktsii o poryadke predostavleniya i ispolzovaniya «okon» dlya remontnyh i stroitel'no-montazhnyh rabot na zheleznyh dorogah OAO «RZD»*].

9. Solovyov, V. V. The meaning of the concept «400 days» for sectoral estimate rationing [*Znacheninie kontseptsii «400 dnei» dlya otraslevogo smetnogo normirovaniya*]. *Ekonomika zheleznyh dorog*, 2016, Iss. 5, p. 62.

10. Rules of technical operation of railways of the Russian Federation. Approved by Order of the Ministry of Transport of Russia No. 286 of 21.12.2010, edition of 25.12.2015, 09.03.2016 [*Pravila tehnicheskoi ekspluatatsii zheleznyh dorog Rossiiskoi Federatsii. Utverzhdeny prikazom Mintransa Rossii № 286 ot 21.12.2010, redaktsiya ot 25.12.2015, 09.03.2016*].

11. Solovyov, V. V., Abou-Haidar, S. B. Integration of transport-interchange hubs in the process of passenger railway transportation [*Integratsiya transportno-peresadochny uzlov v protsess passazhirskih zheleznodorozhnyh perevozok*]. *Ekonomika zheleznyh dorog*, 2015, Iss. 7, p. 82.

12. Volkov, B. A., Demidov, S. S. Efficiency of creation of specialized enterprises for repair of track equipment [*Effektivnost' sozdaniya spetsializirovannyh predriyatii po remontu putevoi tehniki*]. *Put' i putevoe hozyaistvo*, 2007, Iss. 2, pp. 37–38.

13. Time specification for handling trains while performing work for current track maintenance. Approved by JSC Russian Railways by order No. 2937r of 15.12.2015 [*Normativy vremeni na propusk poezdov pri vypolnenii rabot po tekushchemu soderzhaniiyu puti. Utverzhdeny rasporyazheniem № 2937r ot 15.12.2015*].

14. Lapidus, B. M., Macheret, D. A., Miroshnichenko, O. F. On increase in productivity of use of resources and efficiency of the activity of railways [*O povyshenii proizvoditel'nosti ispol'zovaniya resursov i effektivnosti deyatel'nosti zheleznyh dorog*]. *Ekonomika zheleznyh dorog*, 2011, Iss. 6, pp. 12–22.

15. Osipov, A. F. Study and parametrization of working conditions for reconstruction of buildings and structures [*Issledovanie i parametrizatsiya uslovii proizdostva rabot pri rekonstruktsii zdanii i sooruzhenii*]. *Sovremennoe promyshlennoe i grazhdanskoe stroitel'stvo*, 2014, Iss. 1, pp. 33–40.

Information about the authors:

Solovyov, Viatcheslav V. – Ph.D. (Economics), associate professor of the department of Economics of construction business and property management of Russian University of Transport, Moscow, Russia, s35681@yandex.ru.

Korchagin, Alexey P. – Ph.D. (Economics), associate professor of Russian University of Transport, Moscow, Russia, korchagin1973@yandex.ru.

Abou-Haidar, Samer B. – engineer of PJSC Mostotrest, Moscow, Russia, samerah@mail.ru.

Article received 08.12.2017, accepted 03.02.2018.