ON THE SYSTEM OF CONTRACTUAL RELATIONS IN CONCLUDING CONTRACTS FOR PERFORMANCE OF ROAD WORKS

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ABSTRACT

The article considers possible options for improving the existing system of contractual relations in the road economy. One of the conditions for increasing the efficiency of road organizations, in the author's opinion, is the transition in the conclusion of contractual agreements for construction of road structures to life-cycle contracts. An example of calculating the life cycle cost of such an object is shown, as well as the criterion by which bids from potential bidders can be evaluated for contracts of this kind.

Keywords: automobile road, contractual relations, contractual bidding, road construction, life cycle cost, contract, warranty period, calculation algorithm.

Background. *The most common «traditional» scheme of interaction between customers and contractors, implemented through the conclusion of various contracts for design and construction work and the conduct of certain competitive procedures, has certain shortcomings. And their assessment serves as the basis for setting the task that the author sets out in this article.*

Objective. *The objective of the author is to consider the system of contractual relations in road performance contracts.*

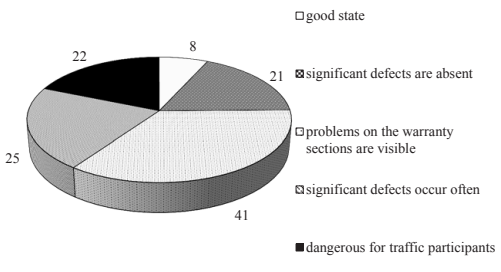
Methods. *The author uses general scientific methods, economic evaluation method, comparative analysis, statistical method.*

Results.

1.

First of all, the gap between the areas of responsibility of the project and construction organizations in the implementation of the project can cause significant losses to the customer. For example, in the case when only in the course of operation it is discovered that the road does not withstand the specified loads or does not cope with the actual traffic flows while maintaining the initial conditions contained in the project [1]. In this case, the issue of a reasonable assessment of damages caused by the project organization and their reimbursement becomes very urgent for the customer. Moreover, world experience shows that design errors and defects in the construction of bridge structures account for about 30% of all causes of their destruction, following catastrophic natural impacts, which account for up to 60%.

The problem of poor-quality project documentation continues to be one of the most fundamental in the road economy. Its solution is possible when concluding contracts that provide for the responsibility of the contractor and for the careful study of technical solutions at the design stage, and for compliance with technology in construction.



Pic. 1. Distribution of large cities in Russia as of the inspected warranty sections in 2015.

The next problem is that the existing mechanism of the warranty period, being de jure the main tool to ensure the high quality of road construction and other works performed, de facto for a number of reasons did not become a panacea for unscrupulous performance of works by the contractor [2]. Roads do not only get better, but sometimes even worsen after «reconstruction and repair».

According to the source [3], in assessing the condition of roads on the warranty period, in 117 major cities of Russia it was revealed that only in eight of them roads are in good condition. Contractors do not look after the state of the pavement and do not perform their obligations in 22 cities, where there are pits, ruts and drawdowns on the roads (see Pic. 1).

One of numerous examples of careless relations between contractors is the construction of Chekurova–Kunashak–Ust-Bagaryak road (Chelyabinsk region) [4]. The company, which had initially won the electronic auction, simply was not able to perform the work in the time set by the customer, and the contract with it was soon terminated. Completion of the construction lay on the shoulders of a new contractor who volunteered to fulfill it for the previous price, but because of gross violations of the technology of laying the road, the road was never built. The inadequate attitude to spending budget funds when choosing a contractor from the local authorities led to damage to the regional budget, administrative proceedings were initiated against a number of high-ranking officials.

This example also reveals another problem – the imperfection of the approaches used to select the winners of the auctions. Here, first of all, we are talking about holding auctions for construction services in the form of an auction, in which the financial risks of their performance with a given quality and in a timely manner from the government customers significantly increase [5]. Moreover, sometimes, but most often, the achievement of the main objective of the auction to reduce the customer's one-time costs for performing road works is jeopardized.

In the international practice of electronic auctions, the form of the cartel collusion of the participants under the name «ram» [6] became widespread. Its main goal is the recognition as the winner of the bidding the contractor «appointed» in advance, with whom the state contract is concluded at the maximum possible price offered by him.

There are many similar schemes of conducting unfair game with the purpose of winning in the procedure of the auction, only on the official website of the Federal Antimonopoly Service, reports on consideration of such cases appear weekly.

The positions of many researchers about the ineffectiveness of the auction procedure when

Table 1

Dynamics of traffic intensity for the prospective period

№	Traffic intensity, car/day							
	Passenger cars					Trucks	Buses	Total of cars
	1 group	2 group	3 group	4 group	Total			
1	300	195	375	120	990	435	75	1 500
2	312	203	390	125	1 030	452	78	1 560
3	324	211	406	130	1 071	470	81	1 622
4	337	219	422	135	1 114	489	84	1 687
5	351	228	439	140	1 158	509	88	1 755
6	365	237	456	146	1 204	529	91	1 825
7	380	247	474	152	1 253	550	95	1 898
8	395	257	493	158	1 303	572	99	1 974
9	411	267	513	164	1 355	595	103	2 053
10	427	278	534	171	1 409	619	107	2 135
11	444	289	555	178	1 465	644	111	2 220
12	462	300	577	185	1 524	670	115	2 309
13	480	312	600	192	1 585	696	120	2 402
14	500	325	624	200	1 648	724	125	2 498
15	520	338	649	208	1 714	753	130	2 598
16	540	351	675	216	1 783	783	135	2 701
17	562	365	702	225	1 854	815	140	2 809
18	584	380	730	234	1 928	847	146	2 922
19	608	395	760	243	2 006	881	152	3 039
20	632	411	790	253	2 086	916	158	3 160
21	657	427	822	263	2 169	953	164	3 287
22	684	444	855	273	2 256	991	171	3 418
23	711	462	889	284	2 346	1 031	178	3 555
24	739	481	924	296	2 440	1 072	185	3 697
25	769	500	961	308	2 538	1 115	192	3 845
26	800	520	1 000	320	2 639	1 160	200	3 999

choosing a contractor for performance of road works converge. This is due not only to the availability of ample opportunities for unfair competition, but also to the lack of sufficient filters to screen out contractors who do not have the necessary qualifications, production facilities, personnel and other resources necessary for successful implementation of the contract.

Regarding the latter, we note that, relatively recently, the legislator, in our view, made a very reasonable step towards solving the pressing problem of customers with the admission to the auction of under-qualified contractors. The law establishes that if the initial (maximum) price of a 10 million rubles contract is exceeded, the bidder must meet, in addition to the general requirement, also an additional one – about the experience of performing similar work for the last three years [7]. However, in practice a very paradoxical situation arose in which the customers themselves accidentally or intentionally quite often either ignore their obligation to establish an additional requirement in the auction documentation, despite the direct law prescription, or allow violations when presented, opening loopholes for «in advance appointed» executors of contracts [8].

Orientation to a single indicator of the price of building products being created when choosing a contractor can be justified only in exceptional cases. Ignoring the accounting of qualitative indicators in bidding for long-term contracts in which the planning horizon reaches 30 years is completely contrary to common sense, since it is here that the requirements for the selection of a contractor should be particularly high.

When placing orders on a competitive basis, the current task is to improve the criteria base for legislation in the field of public procurement.

According to the law of 44-FZ [9], the customer, along with such cost criteria as the cost of work, the costs of operating the facility, has the right to use the life-cycle cost criterion (LC) for evaluating the bids of participants in the procurement, the significance of which in the integral evaluation for construction works should be at least 60%. To calculate the cost of LC it is proposed to use methods of determining and justifying the initial (maximum) price of the goods or the object provided in [10]. However, there is no clarity as to how they can be applied to road structures, there are a number of specific features in the calculation of the cost of LC.

Deviating from the topic to some extent, we recall that the recommendations on the field of the most effective application of contracts of the LC in the RF

Table 2

Approximate composition and structure of vehicles

Type of vehicles	Main car's brands	Share in the flow, %
Passenger cars:		
1group	VAZ (2101–2109)	20
2 group	Lada Priora, Lada Kalina, GAZ 3105	13
3 group	Ford, Nissan, Toyota, Volvo, Volksvagen	25
4 group	Mitsubishi Pajero, Grand Cherokee	8
Trucks	GAZ (33021, 3302), KaMAZ-53215	29
Buses	LiAZ (158, 677, 5256, 6240)	5
Total		100

Table 3

Standards for the smoothness of road surfaces according to the scale IRI

Technical category of motor road	Differential evaluation of the smoothness of road surfaces during the commissioning of the road, m / km	
III	up to 1,7	excellent
	from 1,7 to 2,2	good
	from 2,2 to 2,6	satisfactory
	from 2,6	non-satisfactory

Government Resolution No. 1087 are not given [11]. It is said only that they can be concluded with respect to the design and construction of roads and artificial structures on them. Meanwhile, it is obvious that in the road economy there is a need to develop a methodological document that makes it possible to choose the most effective among the potentially possible alternative organizational and contractual schemes for the implementation of the project. Such an attempt, although not very successful, was undertaken by the Federal Road Agency, which order

Table 4

Possible strategies of road reproduction

Basic (normative) strategy	Years of operation				
	0	6	12	18	24
	STR	VR	KR	VR	REK
Project strategy 1	Years of operation				
	0	9	15	20	27
	STR	VR	VR	KR	REK
Project strategy 2	Years of operation				
	0	7	12	19	25
	CTP	BP	BP	KP	PEK

approved a set of methodological documents [12], which caused considerable resonance in the professional environment. So, for example, R. M. Melnikov [13] considered in detail their controversial positions and showed how much the topic remains important.

The consequence of the foregoing is the lack of a clear understanding of the features and advantages of such a progressive form of organization of relationships between customers and contractors as the contracts of the LC, which hinders its support and dissemination, and therefore requires the search for solutions to the problem of popularization of LC contracts.

2.

Suppose that it is planned to enter into a contract for construction of a motor road of the third category with asphalt pavement. The duration of its LC, and consequently, the term of the contract was decided to be determined by the date of reconstruction, ensuring the transfer of the road to a new transport-operational condition.

Since the alternatives for construction and operation proposed by individual contractors may differ both in the total duration of the LC and in the duration of construction, between the repairs and the cost of all types of work, the choice of one that would ensure a minimum of total costs for the construction of the road, Subsequent repairs and maintenance, as well as the passage of vehicles through it, will be carried out by the criterion of the minimum unit cost per unit of warranty period of road construction operation.

It is required to choose the most effective project strategy and determine the duration of the period for which the contract will be concluded. It is proposed

Table 5

Dynamics of traffic flow speeds, km / h

Years	1	2	3	4	5	6	7	8	9	10	11	12	13
BV	90	87	84	81	78	75	78	75	72	69	66	63	69
PV 1	90	89	87	85	83	81	79	77	75	78	75	72	69
PV 2	81	80	79	78	77	76	75	78	75	70	66	63	66
Years	14	15	16	17	18	19	20	21	22	23	24	25	26
BV	66	63	60	57	54	57	54	51	48	45	REK	–	–
PV 1	66	63	66	63	60	57	54	60	57	54	51	48	45
PV 2	64	62	60	58	56	54	60	54	51	48	45	REK	–
Years	27												
BV	–												
PV 1	REK												
PV 2	–												

to be designated by the term «optimal warranty period of functioning of the road structure».

Intensity and composition of traffic on the road

The expected initial traffic flow intensity at the beginning of the period under consideration is 1500 car/day. The rate of growth in traffic intensity in accordance with the experts' forecast was accepted as 4% according to the exponential law (the law of compound interest) (see Table 1). The composition and structure of the transport flow is characterized by the data in Table 2.

Characteristics of road reproduction strategies

When forming strategies for road reproduction adopted by different contractors, let us assume that the change in the average speed of the transport flow and the frequency of repair actions depend on the smoothness of the road surface, including its initial value (see Table 3). It is assumed that the degradation of the smoothness of the road surface during the operation of the structure has a direct impact on the average speed of the transport flow, and when it reduces to 75, 63, 54 km / h, each of three strategies provides for repair work, and at 45 km / h – road reconstruction. Construction and repair impacts are carried out within one year.

Table 6

Indicators of the cost of work on the road to be built[1]

Types of road works	Cost indicators for options, million rubles per 1 km of road		
	BV	PV 1	PV 2
Construction	38	41	38
Overhaul	25	25	25
Repair	7	7	7
Maintenance	1	0,8	1,5

[1] The cost of repair and overhaul in all considered strategies is assumed to be invariant, which in general is not necessary.

Table 7

Calculation of the discounted cost of the life cycle of a road structure (basic strategy)

№	Transport conditions		Road costs, mln rubles					Socio-economic losses, mln rubles[2]			Total costs, mln rubles	Discounted multiplier	Total discounted costs, mln rubles
	Speed, km/h	Prime cost of run, thous. rubles	St_t	KR_i	VR_j	S_t,	Total	S_{at}	R_t	Total losses			
0	–	–	38,0				38,0				38,00	1,00	38,00
1	90	0,0147				1,0	1,0	8,02	9,69	17,72	18,72	0,91	17,02
2	87	0,0148				1,0	1,0	8,41	10,43	18,84	19,84	0,83	16,39
3	84	0,0149				1,0	1,0	8,81	11,23	20,05	21,05	0,75	15,81
4	81	0,0150				1,0	1,0	9,25	12,12	21,36	22,36	0,68	15,27
5	78	0,0152				1,0	1,0	9,70	13,09	22,79	23,79	0,62	14,77
6	75	0,0153			7,0	1,0	8,0	10,19	14,15	24,34	32,34	0,56	18,26
7	78	0,0152				1,0	1,0	10,50	14,15	24,65	25,65	0,51	13,16
8	75	0,0153				1,0	1,0	11,02	15,31	26,33	27,33	0,47	12,75
9	72	0,0155				1,0	1,0	11,58	16,58	28,17	29,17	0,42	12,37
10	69	0,0156				1,0	1,0	12,18	18,00	30,18	31,18	0,39	12,02
11	66	0,0158				1,0	1,0	12,83	19,57	32,39	33,39	0,35	11,70
12	63	0,0160		25,0		1,0	26,0	13,52	21,32	34,84	60,84	0,32	19,38
13	69	0,0156				1,0	1,0	13,71	20,24	33,95	34,95	0,29	10,12
14	66	0,0158				1,0	1,0	14,43	22,01	36,44	37,44	0,26	9,86
15	63	0,0160				1,0	1,0	15,20	23,98	39,19	40,19	0,24	9,62
16	60	0,0163				1,0	1,0	16,04	26,19	42,23	43,23	0,22	9,41
17	57	0,0165				1,0	1,0	16,94	28,67	45,61	46,61	0,20	9,22
18	54	0,0168			7,0	1,0	8,0	17,92	31,47	49,39	57,39	0,18	10,32
19	57	0,0165				1,0	1,0	18,32	31,01	49,33	50,33	0,16	8,23
20	54	0,0168				1,0	1,0	19,38	34,04	53,42	54,42	0,15	8,09
21	51	0,0171				1,0	1,0	20,54	37,49	58,02	59,02	0,14	7,98
22	48	0,0175				1,0	1,0	21,80	41,42	63,22	64,22	0,12	7,89
23	45	0,0179				1,0	1,0	23,20	45,95	69,15	70,15	0,11	7,83
S			38,0	25,0	14,0	23,0	100,0	323,49	518,12	841,61	941,61		315,49
											Specific cost =		13,72

[2] In this and subsequent calculations, only the most significant losses are taken into consideration: from increasing the cost of transporting goods and passengers and increasing the time of stay of passengers en route [16].

Table 8

Indicators of unit cost per unit of warranty period for the functioning of a road structure

Name of the indicator	BV	PV 1	PV 2
Discounted cost of the life cycle of the road structure, million rubles	315,49	321,17	324,70
The duration of the warranty period for the functioning of the structure (life cycle), years	23	26	24
Specific cost, million rubles / year	13,72	12,35	13,57
Evaluation of the smoothness of road surfaces during the commissioning of the road, m / km	2,6	1,6	2,4

Basic strategy

When this reproduction strategy is formed, it is planned to observe the normative periodicity of repair actions (once every 6 years for roads of the third technical category) and use of integrated life cycle cost indicators taken from sources [14, 15] and recalculated taking into account CPI values, developed by the Ministry of Economic Growth of the Russian Federation for the forecast of social and economic development. The average speed of the traffic flow when putting the road into operation corresponds to the required (90 km / h), but its subsequent decrease, at a rather rapid pace, is due to the intensive deterioration of the initial smoothness index IRI = 2,6 m / km (threshold value for roads of this category) because of impact forms of interaction of a car wheel with an uneven pavement.

Project strategy 1

The road is planned to be put into operation with the indicator IRI = 1,6 m / km, i.e. with an «excellent» score. The best initial smoothness, and consequently, the increase in the period for carrying out the next repair to restore the smoothness, was achieved by increasing the solidity of the road structure, which entailed an increase in the cost of its construction (from 39 to 41 million rubles / km). At the same time, with a high initial smoothness, maintenance costs are reduced to 0,8 million rubles / km.

Project strategy 2

The road is planned to be put into operation with the indicator IRI = 2,4 m / km, i.e. with a «satisfactory» score. To maintain the state of the road, which provides an acceptable level of socio-economic losses in transport and in the transport industry, it is required to increase the cost of its maintenance in comparison with the base version to 1,5 million rubles / km.

Data on the frequency of repair activities, the dynamics of traffic flow rates before the potentially possible period of reconstruction of the structure, as well as a summary statement of costs for the implementation of all strategies for the reproduction of roads are presented in Tables 4, 5, 6.

Calculation results

The cost of the life cycle for the basic reproduction strategy of the road section in question (for 1 km of its length) is presented in Table 7. Similarly, the calculations for two remaining strategies were made. The specific unit cost per unit of the warranty period for functioning of the road structure for individual contractors is summarized in Table 8.

As can be seen from Table 8, by the criterion of the minimum unit cost per unit of the warranty period for the functioning of the structure, the first project strategy (i.e. the optimal warranty period is assumed to be 26 years) is most preferable, which is characterized by the highest level of road surface smoothness. Thus, all other things being equal, the better the initial smoothness is, the greater is the warranty service life and the lower are total costs of construction, subsequent repairs and maintenance of the structure, as well as the passage of vehicles through it.

Conclusions.

1. There are a number of reasons why, in the transport construction industry in modern Russia, the existing warranty period mechanism practically does not work, which necessitated the development of alternative schemes for interaction between the participants in the investment and construction process.

2. The large-scale transfer to the LC contracts in the road sector requires very serious study of the methodological issues of their conclusion, primarily related to the industry's specific features of construction and operation of road structures, high capital intensity of the facilities created, inflation, as well as risk factors and uncertainties in the performance of road works.

3. When summing up the results of the tender for concluding contracts for the performance of road works based on the LC cost, it is possible to use the criterion of the minimum unit cost per unit of the warranty period for the functioning of the structure proposed in the article.

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