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Calculating the Innovative Construction Products Cost by Using Professor M.D. Kargopolov's Matrix Formula

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ABSTRACT

The article describes the contemporary approaches to the determination of the costs of innovative products and the procedure of their write-off for research, developmental and technological works. It analyses the regulatory framework for industrial policy in Russia, including the development of the innovative territorial cluster. The possibility of applying the matrix formula of the professor M.D. Kargopolov to calculate the cost of innovative construction products, taking into account market factors, is established. The example of calculation of reinforced concrete structures production costs (with the use of various technologies, including the use of solar technology) with the use of the recommended matrix formula is provided.

KEYWORDS
Finely-dispersed binder; fine filler; subsiding soils; injection strengthening; subsidence; viscosity.

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Introduction

Currently, the Federal law № 488-FZ (2014) regulates the relations between the subjects in the industry, including infrastructure, organizations and bodies of the Russian Federation, public authorities, public authorities of the subjects of the Russian Federation and local authorities in formulating and implementing industrial policy, including the organization of industrial clusters. According to par.13. of art. 3 (Federal Law № 488-FZ, 2014) an industrial cluster is a set of subjects of activity in the field of industry, connected by the relations in this area due to the proximity and the functional dependence, both placed on the territory of one subject of the Russian Federation and on the territory of several subjects of the Russian Federation. The main objectives of the industrial policy at the present stage should include "the formation of high-technology, competitive industry that provides a transition state of the economy from the export of raw materials type of the development to the innovative type of development" (Federal Law № 488-FZ, 2014).

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There is a separation of powers in the acting Russian cluster policy between the federal, regional and municipal levels. In the formation of regional and interregional clusters the activity of technology parks is taken into consideration, promoting the development of small and medium innovative businesses, the emergence of new industries, strengthening the technological base and creating innovative systems in all regions as an intermediate form of cluster formation. The technology park, representing the centre of the regional innovation system, can develop proposals for the development priorities, becoming the core of the regional innovation system, and identify the region's demand for the innovation among the enterprises, carry out the search, analysis and selection of innovative projects, creating intercompany alliances and creative teams for their implementation. Therefore, if the conceptual provisions are accepted at the federal level for the development of the cluster, the regional cluster policy includes: identification with the definition of a cluster structure; monitoring of cluster initiatives and informing the federal government of the possibilities of creating clusters of national importance; creation of communication platforms for the potential participants in regional clusters; ensuring the consolidation of the cluster members; creation and development of cluster infrastructure; creation of an institutional environment for the development of clusters, definition of financial opportunities for co-financing of regional clusters, solving matters on the financial support of investment projects. The development of methodological and methodical support of the implementation of the cluster approach at the regional level is essential. The municipal level measures shall include: creation of the specialized organizations to promote cluster development by the municipal bodies; collection and systematization of information on the activities of clusters formed; monitoring of cluster initiatives and informing the regional authorities of them; organization in the territory of the municipality of investment and communication platforms for cluster members; assistance in the development of small business contacts with the members of the cluster (meetings, conferences, "round tables"); assistance in the development of the cluster infrastructure (business incubators, technology parks, industrial parks, educational centres, etc.); organization of training for the cluster, etc.

Activization of the industrial development of Russia requires for the innovative approaches in the implementation of tasks aimed at (Federal Law № 488-FZ, 2014):

- encouraging the subjects of activity in the industry through the introduction of results of intellectual activity;
- study of the innovative production of industrial products based on the integration of science, education and industry.

Therefore, the analysis of the current performance of the accounting for the cost of research and development (R&D), significantly affecting both the formation of the cost of goods manufactured and the financial results of the company (organization), becomes relevant.

At the present stage in the accounting of the R&D objects, in accordance with the regulations on accounting Order of the Ministry of Finance of the Russian Federation № 115n (2006) and the provisions of the Tax Code of the Russian Federation (part two) № 117-FZ, (2016), as well as the International Financial Reporting Standards (IAS) 38 (2014), there are differences in the definition of expenses and the procedure of write-off of the costs, which ultimately affects the definition of the R&D costs.

In her article the professor M.V. Vakhrushina (2014) noted that 20 years have passed since the beginning of the formation of the administrative accounting in

Russia, but there is a serious backlog of the Russian managerial accounting, which "continues to hold a retrospective orientation" and is punctuated by the "problems of organization of analytical accounting of accomplished costs, search of the techniques for their distribution and redistribution, justification of optimal methods of calculation", which relates to the definition of R&D costs, including construction products.

It should be noted that for the identification and planning of the R&D effectiveness in practice the economic and mathematical methods are used to predict the various options of economic condition of the enterprise, taking into account the existing market or target prices for the manufactured products or other factors of production.

At the end of the XX century, based on the model of the balance "input-output" method of the Nobel Prize winner in economics V.V. Leontiev (1997) and the national studies of the plan of the production, technical and financial activities by the academician V.V. Kossov (1973), developed the method of calculation of the production cost and unit price of goods (works, services) with the use of a matrix formula (Kargopolov, 1999; 2001), the innovation of which is based on the fact that it takes into account not only the variables in the economic calculations, but also conditionally fixed costs, and the interoperable balances of costs and production results serve as the base for the balanced and accurate calculation of all the indicators of industrial and economic activity of the enterprise.

The balance model means a system of equations, where each equation reflects the requirement of balance between the amount of products, produced by the economic subjects, and the market demand for these products.

B.G. Mirkin and A.I. Faenson (1990) noted that "the rigorous mathematical expression of the balance method of planning gets in matrix models", and the matrix economic and mathematical models include: a) inter-sectoral and inter-district balances of production and distribution in the national economy; b) matrix models of development plans of the sectors of national economy; c) interbranch balances of production and distribution of the republics and economic areas; g) matrix models of annual plans (plans of the production, technical and financial activities) of the enterprises.

The example of how a matrix can be developed and used in calculations to determine the volumes of construction materials in the construction of residential buildings is shown in the work of J.G. Kemeny, J.L. Snell, G.L. Thompson (1963) to solve the problems of the type: "the contractor wants to know how much of each type of raw material and manpower is required to fulfil the order," or "what is the total cost of raw materials and labour required for the construction of all houses".

In the works of the Nobel Prize winner in economics L.V. Kantorovich (1959) the optimization problems on the minimization of the costs and maximization of the national product were solved with the application of the economic and mathematical models.

Methods for calculating the cost of research, development and engineering works (R&D). The practice of referring to the research and development costs in Russia does not comply with International Financial Reporting Standards (IAS) 38 "Intangible Assets" (2014), in which the cost of creating new products are divided into the costs of R&D as primary, reflecting the cost of gaining new scientific or technical knowledge and ideas, and the R&D costs associated with the transformation of already existing knowledge to create a new product that is characterized with novelty.

According to I.D. Demina (2013), the costs of developing new products or improving the process "before the adoption of the Regulations on Accounting "Accounting for Expenses on Research, Developmental and Technological Works" (PBU 17/02) (Order of the Ministry of Finance of the Russian Federation № 115n, 2006) in 2002" were taken into account when calculating the cost products as representing the costs for the R&D. However, according to par. 4 of the PBU 17/02 [2], these Regulations do not apply to the costs associated with the improvement of technology and organization of production or improvement of the product quality and other operational properties, performed during the manufacturing (process), and regulates only the costs of the organizations carrying out R&D on their own or that are the R&D client under the contract, and calls for their reflection in accounting.

That is why par. 5 of the PBU 17/02 (Order of the Ministry of Finance of the Russian Federation № 115n, 2006) clarifies that the information on R&D costs is reflected in the accounting as the investments in non-current assets, and the analytical accounting for the R&D costs is conducted separately according to the type of works, contracts (orders). It is required to take into account that according to par. 6 of the PBU 17/02 (Order of the Ministry of Finance of the Russian Federation № 115n, 2006) a unit of accounting for the research and development costs is an inventory item as an aggregate cost of the work performed, the results of which are independently used in the production of goods (works, services) or for the administrative needs of the organization.

According to par. 7 of the PBU 17/02, the expenses for research and development are recognized as those for which the following conditions must necessarily be met (Order of the Ministry of Finance of the Russian Federation № 115n, 2006):

- the amounts of the costs can be determined and confirmed;
- there is a documentary evidence of the implementation of works (certificate of acceptance of the executed works, etc.);
- use of the results of work for the production and (or) administrative needs will result in future economic benefits (income);
- use of the R&D results can be demonstrated.

In addition, according to par. 9 of the Order of the Ministry of Finance of the Russian Federation № 115n (2006), the R&D costs include the actual costs associated with the implementation of the following works:

- the cost of inventory and services of the third-party organizations and parties, used in carrying out the specified works;
- the costs of salaries and other payments to the employees engaged in the performance of work on R&D under an employment contract;.
- deductions for social security contributions;
- the cost of special equipment and accessories, designed for use as test and research facilities;
- depreciation of the subjects of main assets and intangible assets, used in carrying out R&D;
- the cost of maintenance and operation of the research equipment, facilities and structures, other property, subjects of main assets and other assets;.
- general expenses, directly related to the implementation of R&D;
- other costs, directly associated with the implementation of R&D, including testing costs.

However, when even any one of these conditions is not met, all other expenses incurred are recognized as other ones and written off to the "Other Income and Expenses" debit account 91, the other costs of the reporting period include the R&D costs without a positive result.

However, the cost of R&D, according to the Order of the Russian Finance Ministry number 153n (2007), can be reflected in the composition of intangible assets with the simultaneous implementation of the following conditions:

- R&D result is not in a material form;
- the works have been completed and their completion has been documented;
- the expected result of the R&D has been achieved;
- it has been documented as a subject with the exclusive rights to it;
- the R&D results are used in the production of goods (works, services) and for administrative needs of the organization or any other economic benefit (income), and the sale of the facility is not planned during 12 months.

Differences from the procedure, set in the PBU 17/02 (Order of the Ministry of Finance of the Russian Federation № 115n, 2006) of recognition and write-off of R&D costs, are also contained in the Tax Code (Part II) of the Russian Federation (TC of the RF) (2016). For example, according to par. 1, Art. 262 of the Tax Code (2016) the R&D shall include the works on the creation of new products or improvement of the manufactured ones (goods, works, services), as well as the costs of improving the applied technologies and methods of production organization and management. Thus, in accordance with par. 1 - 5 par. 2, Art. 262 of the TC of the RF (2016), estimates for the implementation of the R&D program approved by the taxpayer shall include only the expenses recognized as the R&D costs under the Tax Code, with the division of the elements and with the determination of remuneration amounts for each study. However, in accordance with par. 4, Art. 262 of the Tax Code (2016), the taxpayer's expenditures on R&D, set out in paragraphs 1 - 5 par. 2, Art. 262 (2016), for tax purposes shall be recognized regardless of the outcome of research and development after the completion of these studies or projects (individual stages of work), and (or) execution by the parties of the act of acceptance, so the taxpayer shall be entitled to include these expenses in other expenses in the reporting (tax) period in which the R&D or its separate stages were completed.

Currently, the RF Government Decree (2012) has updated the list the R&D works, to which, in accordance with par. 7, Art. 262 Part Two of the Tax Code (2016), the taxpayer's expenses shall be included into other expenses in the amount of actual costs, i.e. a list of objects for which the R&D costs shall be written off with a multiplying factor 1.5 to the standards after the completion of works or work stages.

Method of calculation of the price cost with the use of the matrix formula by the professor M.D. Kargopolov. Professor M.D. Kargopolov (1999; 2001) developed the system of models and solution methods for planning, analysis and management of production and economic activities of the company that includes (Leontiev, 1997; Kossov, 1973):

- matrix material balances in volume and value, considered as "interoperable balances of the costs and results of production" (IBCRP);
- the matrix formula of the production cost and unit price of goods (works, services).

In the estimated IBCRP system, the matrix formula of the professor M.D. Kargopolov (2012a) provides an accurate and balanced calculation, taking into account all major indicators of industrial and economic activity of the enterprise and has the following form:

$$P = (E - A^T)^{-1} D^T C$$

where: P = ||p_j||, j = $\overline{1,n}$ is a required vector-column of production (complete) cost of the unit of production of goods (works, services);

Eis a unit matrix nxn**;**

A = ||a_{ij}||, i= $\overline{1,n}$, j = $\overline{1,n}$ is the matrix nxn of consumption rates of own production resources;

D =||d_{ij}||, i∈**LUR,**j =$\overline{1,n}$ is the matrix of nxn consumption rates of primary resources (L – variable, R – invariable),

T is the sign of transposition for the matrices A and D,

C =||c_i||, i∈**LUR,** – is a vector-column for wholesale and procurement prices of primary resources;

To calculate the production cost as a derivative of the price cost under the matrix formulain (Kargopolov, 1999; 2001; 2012a; 2012b) it is offered to conduct the calculation of pricefor all n- types of products (works, services), which requires to complete: a) matrix **D** with a single, final, (**L + R + 1**)-line, where the elements in this line characterize the profit, which the enterprise plans to have (or has) from a unit of the relevant type of goods (works, services); b) vector **C**- with a single, final **(L + R**+ 1)-element, equal to the unit -1.

In the Microsoft Office Excel program the matrix formula of the professor M.D. Kargopolov (1999; 2001), defining the values of the vector P elements, is introduces as follows:

= MUMNOZh(MUMNOZh(MOBR(**E**-TRANSP(**A**));TRANSP(**D**));**C**)

This matrix equation is used to calculate the indicators of the price cost (expenses) simultaneously and with absolute precision of the production of a unit of the n- types of products (works, services) of any complexity. For such calculations the cost items in the enterprise (organization) shall be divided into two groups:

- items of costs of own production resources (OPR);
- items of primary resource costs, which are divided into variables (L - types) and invariables (R - types).

It should be noted that in this formula the consumption rates of variable resources $\mathbf{d_{lj}}$ do not depend on the production volume, and the invariable costs consumption rates $\mathbf{d_{rj}}$ depend on production volumes and are translated to the unit of the actual (planned) volumes of production (works, costs).

For a comparative analysis of the various options for calculation of production costs in accordance with different methods, the following calculation example for reinforced concrete slabs (r/c) of overlaps РҜ 10-60.12 is provided, the manufacturing technology of which is given in (Aliev, 2011):

a) for the basic variant of manufacturing of these overlay slabs - with the heat treatment of the products with steam in pit steaming chambers;

b) for the innovative plate manufacturing techniques of concrete of different brands based on the complex astringents "Biotekh-NM", filled with ash and slag mixtures and fine sand, with the use of helium and thermal processing (using

translucent coatings - helioform SVITAP), allowing to obtain 70% of the design strength during the day.

Production cost calculations were performed by the following methods:

- in the first case the cost calculations of reinforced concrete products were analysed under the "Guidelines for the Definition of Economic Efficiency of Use in the Construction of New Machinery, Inventions and Innovations in the Production of Structures from Precast Concrete"(1981), provided in the work (Aliev, 2011);

- in the second case the cost calculations of the structures mentioned above were made under the suggested matrix formula of the professor M.D. Kargopolov(1999; 2001; 2012a; 2012b).

In the first and second cases to calculate the total cost of production of concrete slabs with helioform the factual data of the labour and material costs for the production of concrete slabs PK 10-60.12 under the GUP "Argun Factory of Reinforced Concrete Products and Structures" of the Ministry of Agriculture of the Chechen Republic (AFRCPS) was used in the conditions of simultaneous operation of the production line of slabs and the daily turnover of forms.

It should be noted that the rational structure of concrete mixes was adopted in the work (Aliev, 2011), conducted in the Research Centre for Collective Use "Nanoteknologii i Nanometerialy" of the Grozny State Oil Technical University named after the Academician M. D. Millionshchikov. Used raw materials were the ground mixture of Portland cement, pre-ground slag mixtures of the Grozny TPP or fine sands, modified with an active mineral additive "Bio-NM". Mixtures of complex astringents were obtained by mixing original cement with the ground fillers with the addition of surface-active agents (surfactants) or as the result of joint grinding of cement, filler and surfactant additive (Murtazaev et al., 2011; 2015a; 2015b; Kuladzhi et al., 2015; Taimaskhanov et al., 2016).

Cost parameters of concrete mixture components are listed in Table 1 (Aliev, 2011).

Table 1. The cost of the components used for the preparation of filling fine concrete mixtures and complex astringents (Aliev, 2011).

Name	Portland cement	AMCA 50	Sifting of grind (SG)	Water
Price, rub/kg	5	3,69	0,25	0,08

The cost of the complex astringent (CA) in (Aliev, 2011) has been defined as the sum of the components according to the formula:

$$C_{kv} = C_{pc} \times P + C_f \times H + C_a \times D$$

where C_{pc}, C_f and Ca are the cost of 1 kg, such as KVZ 50, including, respectively, the cost of cement, fillers and additives "Bio-NM", rub;

C, F, and A - correspondingly, in kg, volume of cement, filler and additive "Bio-NM" in CA.

The cost of filler Cf includes the costs of transporting it to the plant, for operations for drying and initial grinding, carried out in the scientific laboratory of the Construction Faculty of the FSBEI HPE Grozny State Oil Technical University named after the Academician M.D.Millionshchikov and subsequent co-grinding of cement and additives, as noted in (Aliev, 2011) and was at the price of 1.5$/ kg.

Thus, the cost of 1kg of AMCA was (Aliev, 2011):

$$C_{kv} = 5 \times 0{,}5 + 1{,}5 \times 0{,}5 + 22 \times 0{,}02 = 3{,}69 \text{ rub}$$

The number of components of the concrete mix per 1 m^3 of the mix, and their costs are shown in Table. 2 and 3 (Aliev, 2011).

Table 2. The number of components of the concrete mix per 1 m^3 of the mix (Aliev, 2011)

№ of mixes	Type of astringent	Materials consumption, kg/m^3				
		Cement	SG	Water	F	Bio-NM
1	AMCA 50	254	1524	152	254	15
2	ПЦ500Д0	508	1524	244	-	-

Table 3. Cost of 1 m^3 of concrete mix (Aliev, 2011)

№ of mixes	Type of astringent	Cement	SG	Water	S	Bio-NM	Cost of 1 m^3 of concrete, rub.
1	AMCA 50	1270	381	12	381	330	2374
2	ПЦ500Д0	2400	381	20	-	-	2801

According to the AFRCPS data, the calculation fuel cost by steaming of 1 m^3 of products in steaming chambers is set at 600 rub/m^3, and the cost of steam Cst is the estimated of them (Aliev, 2011):

- the estimated cost of steam: 1,290xC_{st} (where 1,290 t/m^3 – actual steam consumption for steaming of plate products by the I.B. Zasedatelev's method);

- the cost of other forms of energy was determined as follows: 600 – 1,29 x C_{st}

The price of steam was refined and adopted, according to our calculations, as equal to 279,4 rub/ m^3 (Kuladzhi, 2014; Kuladzhi et al., 2014) (in (Aliev, 2011) it is stated as 230 rub. for 1 t of steam).

Table 4 shows the calculation of cost of manufacturing 1m^3 of concrete products according to GUP "AFRCPS" (2011), stated in (Aliev, 2011).

Table 4. Calculation of the price cost of manufacturing 1 m3 of products at the GUP "AFRCPS" (Aliev, 2011)

№ i/o	Name of costs	Price cost of 1 m^3 of the product, rub		Basis
		Basic option	Offered option	
1	2	3	4	5
1	Raw and basic materials	2801	2374	Table 1-.3.
2	Fuel and energy of all types	600.0	303.3*)	Data of the GUP "AFRCPS"
3	Main and additional salary	332.0	353,9	Data of the GUP "AFRCPS"
4	The costs of maintenance and operation of equipment 127.8% of salary	424.3	452,3	Data of the GUP "AFRCPS"
5	The department costs (25% of salary)	83.0	88,5	-
6	Allocations for social insurance (34.5% of the salary in 2011)	114.5	122,1	
7	Total department costs	4354.8	3694,1	
8	The total plant costs (20 % of salary)	66.4	70,8	
9	Full price cost	4421.2	3764,9	
Economic effect of the price cost 4421,2-3764,9=656,3 rub/m^3				

* *Hereinafter, in the calculations the cost of steam is refined and adopted as equal to 279,4* rub /m^3 according to (Kuladzhi, 2014; Kuladzhi et al., 2014; 2015).

For calculations of the 2nd option with the use of a matrix formula of the professor M.D. Kargopolov Table 5 provides the production structure of the enterprise to establish the sequence of manufacturing products - reinforced concrete overlay slabs (r/c slabs) with the original data on the consumption of materials and labour resources of own production (OPR) according to the GUP "AFRCPS" (Aliev, 2011):

- department of the production of own resources - water and steam for the production;
- department of the production of r/c products with steaming chambers and helium and thermal processing.

Table 5. Characteristics of the production structure of the enterprise

The composition and name of the units (departments, teams, sites, departments, services)	Name of products, works, services), (p.u.m.)*	Commercial products (works, services) -Y	Note
1. Department of water and steam production	Water and steam for production, ths. m^3	Water and steam	For own needs
2. Department of concrete products with steaming chambers	Refined concrete products, m^3	R/c products	For the comparison with the helium and thermal processing technology
3. Department of r/c slabs production with helium and thermal processing	Refined concrete products, m^3	R/c products	Option of products manufacturing

*Here and further the following abbreviations are used: p.u.m.- product unit of measurement.

Composition of production resources (cost items) by product and application rates on the refined concrete products (RCP) are given in Table 6.

Table 6. Composition of production resources and the application rates (by product)

Goods (works, services), unit of measurement	Production resources (cost items), a.u.m. *	Application rate, a.u.m./ p.u.m*
1. Water for production, t	Water, ths. rub.	0.02365
	Energy, ths,. rub.	0.0124
	Salary, ths. rub.	0.01
	Costs of equipment maintenance (127,8% of salary)	0.01278
	Department costs (25%), ths. rub.	0.0025
	Allocations for social insurance (34 % - 2011*) , ths. rub.	0.0034
	Total plant costs (20%), ths. rub.	0.002
	Other costs, ths. rub.	0.0137

Table 6. (*Continued*)

2. Steam for production, t	Water, t	1
	Energy, ths,. rub.	0.0414
	Salary, ths. rub.	0.025
	Costs of equipment maintenance (127,8% of salary)	0.0395
	Department costs (25%), ths. rub.	0.00625
	Allocations for social insurance (34 % - 2011*) , ths. rub.	0.0085
	Total plant costs (20%), ths. rub.	0.005
	Other costs, ths. rub.	0.1355
3. Concrete product with steaming in the pit steaming chambers, m^3	Concrete, m^3	1
	Cement, t/ths. rub.	5.0
	Reinforcement, t/ths. rub.	0.065/5.0
	Sifting of grind, t/ths. rub.	0.25
	Filler, t/ths. rub.	1.5
	Bio-NM, t/ths. rub.	22.0
	Steam, t	1.29
	Capital investments for the pit chamber, ths. rub.	0.14
	Fuel and energy of all types, ths. rub.	0.600
	Salary (main and additional), ths. rub.	0,2996 (0,332-1,29xx0,025 – 0,0015)
	Costs of equipment maintenance (127,8% of salary)	0.3834
	Department costs (25%), ths. rub.	0.0749
	Allocations for social insurance (2011*) , ths. rub.	0.10186
	Total plant costs (20%), ths. rub.	0.05992
4. Refine concrete product with helium and thermal processing, m^3	Concrete, m3	1
	Cement, t/ths. rub.	5.0
	Reinforcement, t/ths. rub.	0.065/5.0
	Sifting of grind, t/ths. rub.	0.25
	Filler, t/ths. rub.	1.5
	Bio-NM, t/ths. rub.	22.0
	Capital investments for helioforms, ths. rub.	0.012
	Fuel and energy, ths. rub.	0,2794 = (0,6 -1,29x0,24853), where 0,24853 – cost of 1 t of steam)
	Salary (main and additional), ths. rub.	0.3439
	Costs of equipment maintenance (127,8% of salary)	0.4395
	Department costs (25%), ths. rub.	0.086
	Allocations for social insurance (2011*), ths. rub.	0.1169
	Total plant costs (20%), ths. rub.	0.06878

* - for comparison with the example for calculating the allocations of 34% were retained to 2011 (Aliev, 2011).

Table 7 defines the composition and types of primary inputs and wholesale purchase prices specified in (Aliev (2011).

Table 7. Composition and wholesale purchase prices of primary resources (Aliev (2011)

Primary resources, unit of measurement	Price, rub./unit
1. River water before purification, ths. m3	23.65
2. Filler, t	1500
3. Portland cement, t	5000
4. Reinforcement, t	5000
5. Sifting of grind, t	250
6. Additive "BIO-NM", t	22000
7. Capital investments for helioform, ths. rub./ m^3	0.012
8. Capital investments for steaming pit chamber, ths. rub./ m^3	0.14
9. Fuel and energy of all types, ths. rub.	1
10. Costs for remuneration of work, ths. rub.	1
11. Allocations for social insurance, ths. rub.	1
12. Costs for equipment maintenance, ths. rub.	1
13. Department costs, ths. rub.	1
14. Total plant costs, ths. rub.	1
15. Other costs, ths. rub.	1

To calculate the cost indicators of reinforced concrete (r/c) overlay slabs ПК 10-60.12 according to the matrix formula of the professor M.D. Kargopolov the matrices A, D, C, P were compiled, where:

A – a matrix of consumption norms of own production resources (water, steam, concrete mixtures: CA 100, AMCA 70, SCA 50KV 100, KV3 70, KVP 50with the rates of consumption of the i-th resource, consumed during production of the j-th product (Table 8);

E - a unitary matrix, corresponds to the dimension of the Matrix A (14x14);

P - a matrix of estimated price costs (Table 9) for:

- the resources of own production (water, steam)

- components of concretes;

- r/c slabs f different trademarks - CA 100, AMCA 70, SCA 50, produced in various conditions: withtranslucent coatings – helioforms SVITAP,and under normal conditions - in pit steaming chambers with the use of steam.

D - a matrix of consumption rates of primary resources (PR) (Table 10) ;

C - a matrix (vector-column) of wholesale purchase prices of primary resources (Table 11).

Thus, Tables 8 and 9 present: Matrix **A** (with the dimensions 14x14) and Matrix **P,** in Table 10 – Matrix **D,** and Table 11 – Matrix **C.**

Table 10. **Matrix D** of the consumption rates of primary resources, including purchased ones for the production of r/c products

RSP					Production of refined concrete products								
water	steam	Composi-tions of astrin-gents			Dry concrete mix			a) with steaming in chambers			b) with helium and thermal processing		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0	0,14	0,14	0,14	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0,012	0,012	0,012
0	0	0,5	0,354	0,254	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1,5	1,495	1,492	0	0	0	0	0	0
0	0	0	0,151	0,254	0	0	0	0	0	0	0	0	0
0	0	0,01	0,00708	0,00508	0	0	0	0	0	0	0	0	0
0,0124	0,0414	0	0	0	0	0	0	0,6	0,6	0,6	0,2794	0,2794	0,2794
0	0	0	0	0	0	0	0	0,065	0,065	0,065	0,065	0,065	0,065
0,02365	0	0	0	0	0	0	0	0	0	0	0	0	0
0,01	0,025	0	0	0	0	0	0	0,2996	0,2996	0,2996	0,3439	0,3439	0,3439
0,01278	0,03195	0	0	0	0	0	0	0,3834	0,3834	0,3834	0,4395	0,4395	0,4395
0,0025	0,00625	0	0	0	0	0	0	0,0749	0,0749	0,0749	0,086	0,086	0,086
0,0034	0,0085	0	0	0	0	0	0	0,10186	0,10186	0,10186	0,1169	0,1169	0,1169
0,002	0,005	0	0	0	0	0	0	0,05992	0,05992	0,05992	0,06878	0,06878	0,06878
0,0137	0,05	0	0	0	0	0	0	0	0	0	0	0	0

Table 11.
Matrix C (in ths. rub.)

Capital investments for pit chambers,	1
Capital investments for helium and thermal processing	1
Cement, t	5
SG, t	0.25
Filler, t	1.5
BIO-NM t	22
Energy+fuel	1
Reinforcement, t	5
Water, t	1
Salary	1
Costs of equipment maintenance	1
Department costs 25%	1
Allocations for social insurance 34%	1
Report 20%	1
Other costs	1

All the elements in this example (in Tables A and D) are designed so that they sequentially reveal the corresponding indicators required to manufacture both intermediate products - own production resources (OPR) from simple products (water, steam) and concrete components and the final products: r/c products with various technologies of production of volumes of primary resources. Thus, in matrices **A** and **D**:

- Column 1 - indicators for the production of process water (from the river);

- Column 2 - indicators for steam production;

- Columns 3-5 - indicators for the production of complex astringents CA (dry mix: cement, filler and additive "Bio-NM"), made in a scientific laboratory of the Construction Faculty of the Grozny State Oil Technical University named after the Academician M.D. Millionshchikov (Aliev, 2011);

- Columns 6-8 - indicators for the production of components of concrete mixtures (dry mix: complex astringents - CA and sifting of grind);

- Columns 9-11 - indicators for the production of 1 m^3 of r/c products with steaming in the steaming pit chambers;

- Columns 12-14 - indicators for the production of 1 m^3 of r/c products with helium and thermal processing;

The calculations in the Microsoft Office Excel system in the Matrix P (Table 8) provided all the unit costs of 14 types of products, the absolute values of which are different from the respective indicators in the work S.A. Aliev (2011) to 0,07% due to the refinements made for the estimated cost of steam.

Conclusions

The material matrix balance model is the system of equations, expressing the requirement of a balance between the produced individual economic entities, the number of products and the total demand for them. Thus, if the balance equation of the Nobel Prize winner in economics V.V. Leontiev is a tool for the macroeconomic forecasting of the output at the national and global levels of economy, the matrix formula of the professor M.D. Kargopolov should be viewed as the tool of the microeconomic forecasting of the cost indexes of any products of economic entities - businesses, households and others, as well as the subjects of a cluster, including innovative construction products.

Disclosure statement

No potential conflict of interest was reported by the authors.

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