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**IMPROVING THE TOOLS FOR COST-BENEFIT ANALYSIS
AND OPTIMIZATION PLANNING OF RESULTS
IN INTERACTION OF SUBJECTS WITHIN A REGION**

The article grounds the necessity for improvements in the tools and methods of operational and strategic planning for business units aimed at increased efficiency of regional economy's functioning. The authors ground the expediency of creating a regional center for coordination of business activities; the new method of optimization planning of results is tested basing on the cost-benefit analysis and simulation modelling. This enabled the evaluation of managerial decisions efficiency in the process of regional economic subjects interaction.

Keywords: regional economic system; optimization planning of results; cost-benefit analysis.

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**УДОСКОНАЛЕННЯ ІНСТРУМЕНТАРІЮ ФУНКЦІОНАЛЬНО-
ВАРТІСНОГО АНАЛІЗУ ТА ОПТИМІЗАЦІЙНОГО ПЛАНУВАННЯ
РЕЗУЛЬТАТІВ ВЗАЄМОДІЇ СУБ'ЄКТІВ РЕГІОНУ**

У статті обґрунтовано необхідність вдосконалення інструментально-методичного забезпечення системи оперативного та стратегічного управління бізнес-утвореннями з метою підвищення ефективності функціонування регіональної економіки. Аргументовано доцільність створення регіонального координаційного центру ділової активності, апробовано методіку оптимізаційного планування результатів його діяльності, що базується на використанні функціонально-вартісного підходу. Це дозволило за допомогою інструментів імітаційного моделювання оцінити ефективність управлінських рішень у процесі взаємодії просторових утворень.

Ключові слова: регіональна економічна система; оптимізаційне планування результатів; функціонально-вартісний аналіз.

Форм. 2. Рис. 4. Табл. 1. Літ. 17.

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**СОВЕРШЕНСТВОВАНИЕ ИНСТРУМЕНТАРИЯ
ФУНКЦИОНАЛЬНО-СТОИМОСТНОГО АНАЛИЗА
И ОПТИМИЗАЦИОННОГО ПЛАНИРОВАНИЯ РЕЗУЛЬТАТОВ
ВЗАИМОДЕЙСТВИЯ СУБЪЕКТОВ РЕГИОНА**

В статье обоснована необходимость совершенствования инструментально-методического обеспечения системы оперативного и стратегического управления бизнес-образованиями в целях повышения эффективности функционирования региональной экономики. Аргументирована целесообразность создания регионального координационного центра деловой активности и апробирована методика оптимизационного планирования результатов его деятельности, базирующаяся на использовании функционально-стоимостного подхода, что позволило при помощи инструментов имитационного моделирования оценить эффективность управленческих решений в процессе взаимодействия пространственных образований.

Ключевые слова: региональная экономическая система; оптимизационное планирование результатов; функционально-стоимостный анализ.

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Problem definition. Formation of an effective system of spatial economic formations management requires operative solutions of a number of interrelated problems associated, inter alia, narrowing the gap in the development level of the North Caucasian Federal District entities and Russian average; a substantiation of strategic business instruments of regional area modernization; improving the system of economic interaction (Gerasimov and Gromov, 2012; Gromov and Nineva, 2012; Sukharev, 2013). Solving these problems would fuel the growth of gross regional product and improve the use of socioeconomic potential of territory (Kazakov and Bobryshev, 2012; Ketova and Ovchinnikov, 2011; Vasilyeva, 2009). Achieving the desired level of managerial effectiveness is impossible without improved forms of interaction of big and small businesses, public (non-commercial) organizations and government agencies, which should predetermine sustainable development of regional economy (Gladilin et al., 2010; Erokhin, 2011; Velychko, 2013). The rationale of scientific methods and principles and the development of practical proposals aimed at improving management methods and tools and interaction of spatial formations is required to achieve sustainable growth, polarization smoothing and elimination of spatial development asymmetry.

Recent research and publications analysis. Research on improving the tools of optimizational planning belongs to such scientists as: V. Erokhin (2011), A. Gerasimov and E. Gromov (2012), A. Gladilin et al. (2011), I. Glotova et al. (2012), M. Parlinska et al. (2010), O. Sukharev (2013), M. Vasilyeva (2009).

The main objective of the study is the justification of scientific and methodological positions and development of practical proposals that reflect the features of the formation and development of regional economic systems based on the improvement of management and interaction of spatial structures in order to achieve sustainable growth and smoothing the asymmetry in territorial development.

Key research findings. Problems of regional economic systems development, building effective systems of regional management, interaction between entities within regional economic systems received close attention of many well-known researchers and experts (Gorin and Pavlov, 2012). However, contemporary science has not yet elaborated a commonly agreed approach to baseline conditions, reflecting the characteristics and ways of improving regional management system and economic forms of interaction between spatial economic formations.

This makes it necessary to study individual economic objects as an assembly of unified system elements. Considerable attention should be paid not only to economic assets collection within such systems, but also to external and internal synergies related.

For the purpose of scientific disposition of regional public funds allocated for the implementation of measures on the development of information and advisory services within region's economy (Glotova et al., 2012) we propose a procedure which allows not only plan activities of such structures but also offers an opportunity to assess economic and social efficiency of the formation of such groups, practical application of which promotes the rational use of budget funds. An effective method to cope with such tasks is the creation of a regional coordination unit of business activity (RCUBA), core function of which is to render paid advisory services to business structures of a regional economic system.

In order to increase the practical relevance and transparency of the RCUBA organization and functioning, we have developed the procedure optimizing the planning of this formation based on the use of cost-benefit analysis. In a general form, the proposed procedure is presented in Figure 1.

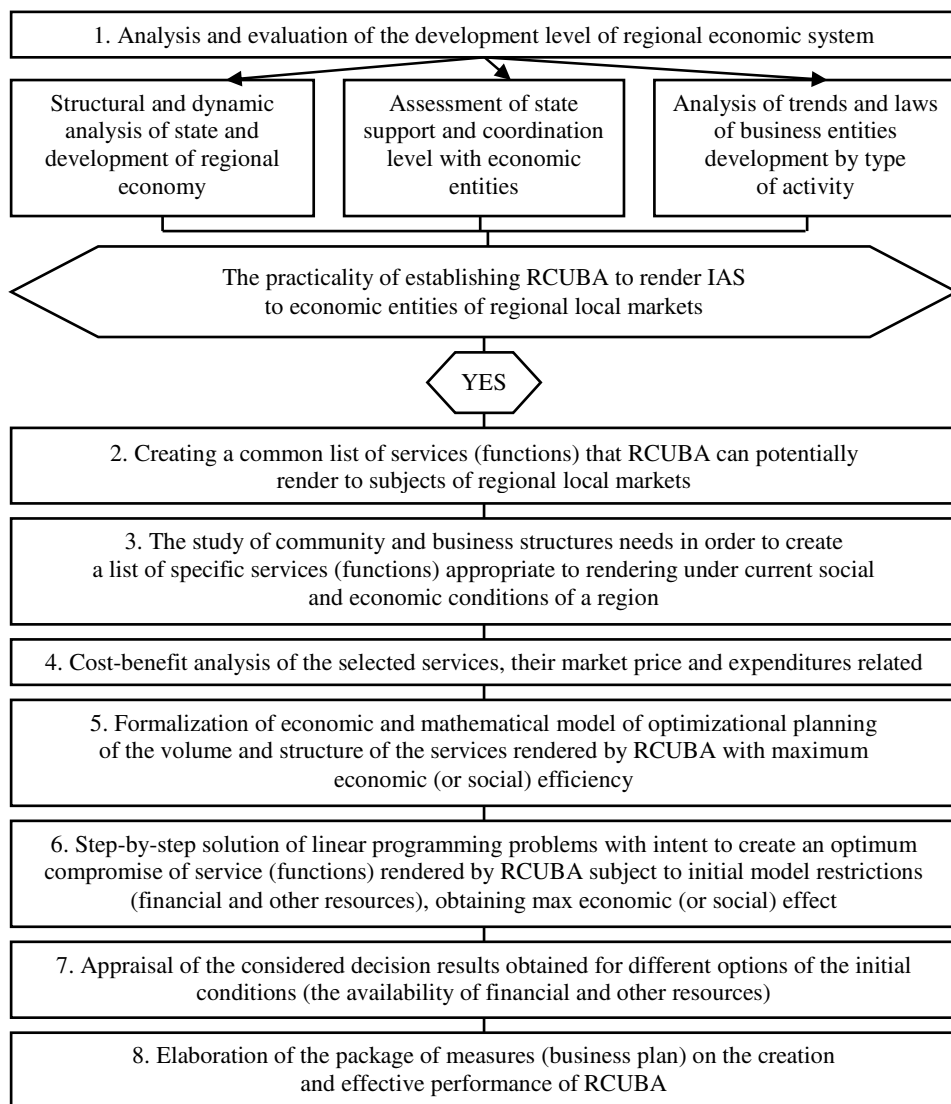


Figure 1. **Optimization of functional planning of the regional coordination unit of business activity, authors' development**

The goal of the procedure, proposed by us, is to optimize the results of financial planning for paid services to general public and supporting structures for small and medium-sized enterprises (SME) in various sectors of regional economy via linear programming and cost-benefit analysis of services intended to be rendered as per cri-

teria of their economic and social significance and demand at the market on a specific territory.

At the initial phase, the goal of the research is shaped, the object and the subject of cost-benefit analysis are determined; a detailed plan is elaborated. The key goal of this research is to promote business entities of spatial economic formations in a regional economic system. The target of the research is RCUBA, proposed to be created to render services to general public and support business structures. The subject of the cost-benefit analysis is to develop the methodical toolkit for executive decision-making on the expediency of establishing RCUBA upon the search for optimal alternatives of functions performed by it and services rendered as per given constraints (financial, technical, HR etc.) and criteria (economic or social) (Gerasimov et al., 2010; Gromov and Nineva, 2012).

Within the framework of the information phase, it is necessary to study the object and its functions and to classify them. The core function of a regional coordination unit of business activity is the development of business infrastructure within regional economic system. RCUBA implements this function by rendering a range of services to general public and business structures.

Another equally important challenge is to collect, study and summarize diverse information on the target, which must reflect the business environment of RCUBA and the services rendered to public and business. Inter alia, on the analysis of regional economic system, we determine the prices, costs and return level of the services offered.

The challenge of discovering a grounded combination of individual functions that classify specific services rendered by RCUBA to consumers by certain economic magnitudes is met during the optimization-simulation phase, and in the end the experimental test of the proposals and hypotheses put forward is carried out. The candidate solution is checked for conformity with the conditions of its use. The proposed procedure is of particular relevance for the purpose of financial planning of a regional coordination unit an infrastructural element.

Development of a procedure for the optimization of the key performance indicators planning of these formations functioning should be treated from the system approach perspective that accommodates the interest of everybody concerned with the terms of regional economic system plus allows detecting final economic and social effects from their creation (Bems and Stary, 2013; Gerasimov et al., 2008).

The effectiveness and practical relevance of optimization of planning and management of RCUBA operations against the background of regional economic system should be based on the use of formalized analysis routines, inter alia, linear programming models can be used, which for the most part are used to identify the optimum compromise of the results and expenditures connected. In general, the algorithm for solving linear programming problems can be presented as follows:

- problem definition, formalization of the solution algorithm, prerequisites and assumptions are set;
- mathematical model specification, identification of variables and parameters are presented in the form of a mathematical relationship, inequality of synergies between them, plus restrictions;
- information phase is to collect and primarily process (prepare) data;

- solution of linear programming problems is to design an algorithm based on computer software subject to all identified relationships and model restrictions;
- analysis and interpretation of findings. At the concluding stage the resulting deduction on the accuracy and completeness of the obtained model results and the possibility of their use as a practical matter is drawn.

As can be seen from the above, the primary intent of the proposed procedure is the optimization of the financial performance planning of a regional coordination unit via linear programming and cost-benefit analysis of services intended to be rendered as per specified criteria of economic and social significance on a specific territory.

Unlike in traditional practical implementation of linear programming optimum alternative seeking, subject to input conditions and restraints is made on a phased basis. Institutional structure of the spending pattern of rendering specific information and advisory service includes fixed and variable costs (FC&VC). This representation of costs allows taking into account the effect of operating leverage – with the growth of rendered services the volume the share of fixed costs in total costs (TC) is cut, leading to a decline in the prime cost of rendering a service ad extremum.

Formation of the objective function F and constraints of the considered economic mathematical problem is based on the following prerequisites:

- to achieve the maximum profit at all times (organization, operation) of RCUBA under the conditions of a regional economic system;
- RCUBA organization departments are relatively "offline", administration of the unit effects only the overall coordination of their activity as to planning of the volume and range of paid services rendering plus financing these steps;
- drive to ensure the most realistic reflection of areas for interaction between divisions;
- conformity of the objective function with the conditions and processes of regional economic system while rendering services to general public and business structures.

At the initial development phase of economic mathematical modelling of financial performance planning optimization of regional coordination unit we surveyed 100 businesses of various organizational forms and scopes of activities. As a result, we obtained data on the inferred structure and quantity forecast of rendering information and consulting high-demand services at the market. The acquired information has been adjusted on the quarterly basis, this will allow equalizing the allocation of RCUBA expenditures in the course of the year and plan its earnings from services with provision for the seasonal nature of demand.

Regarding the variables, volumes of services to clientele of RCUBA in the course of the planning year were collected: x_{t1} – the total amount of services rendered "1" to all clients in the period t ; where t – the number of quarter ($t = 1, \dots, 4$); x_{tj} – the total volume of services rendered j in the period t ; x_{tJ} – the total amount of services rendered J to all clients in the period t . By so doing, the total amount of variables in the model is: $4 \times J$ (in this case $4 \times 45 = 220$).

Let us set the related prices of rendering one service by the unit as $p_{t1}, \dots, p_{tj}, \dots, p_{tJ}$.

Let us set the costs for rendering a service by the unit in view of variable and fixed as: differential costs of service rendering $Z_{t1}, \dots, Z_{tj}, \dots, Z_{tJ}$; fixed costs of specific services rendering $C_{t1}, \dots, C_{tj}, \dots, C_{tJ}$.

Let us set the parameters reflecting resource use and capacity constraints as $q_1, \dots, q_j, \dots, q_n$.

In summary, the objective function reflecting the maximization of profits from information and consulting services can be represented as follows:

$$F = \sum_{t=1}^4 \left(\sum_{j=1}^J ((p_{tj} - z_{jt}) \times x_{jt} - c_{jt}) \right) \rightarrow \max. \quad (1)$$

Next step, restrictions to the optimization problem are introduced, which should reflect the resource capabilities of the regional coordination unit, structural performance features, relationships, timing etc. The following restrictions to RCUBA optimization planning upon cost analysis of services rendered can be introduced:

- limitations on the overall volume of services rendering by RCUBA should not exceed the demand for them from population and business identified during the survey;
- limitations on the overall volume of services rendered within up to the quarter due to seasonal variability of demand. The value of s represents the standard deviation (Std. dev. = STD = SD) due to the selective nature of baseline information acquisition. So, if in the resulting optimal solution the variable (the volume of rendered services) quarterly equals zero (that is to say that in any given quarter, the number of j -th services equals zero), then the service should be excluded from the list;
- constraint that characterizes the need for regular income in the course of the year by quarters on particular types of services (TOS), if this is not the case, rendering of such services is inadvisable;
- restriction to the cumulative expenditures over the entire period;
- restrictions to the framework budget over the period under consideration to render a particular service;
- restrictions to the overall volume of RCUBA net revenues during the analyzed period in terms of specific services, pointing out the necessity of covering by profit in the course of the year prior expenses connected with their rendering.

By doing so, the defined problem of mathematical modeling in economics represents a linear programming problem and can be solved by standard means (Gladilin, 2011; Parlinska, 2010).

The solution of linear programming problem was carried out on a phased basis with the result that unbundled services making no economic sense were excluded from the preliminary list. After that, 10 candidate solutions on the optimization of planning came forward, providing a variety of restrictions to the proportion of cumulative expenditures connected with RCUBA services rendering – not exceeding: 100 mln RUB, 90 mln RUB, 80 mln RUB, 70 mln RUB, 60 mln RUB, 50 mln RUB, 40 mln RUB, 30 mln RUB, 20 mln RUB, 10 mln RUB.

The optimal value of the objective function was achieved after determining the optimum compromise of service rendering volumes of the proposed to be created RCUBA that are in demand at different times, identified upon cost-benefit analysis to ensure top profits and losses (P&L) impact at given prices and costs.

The basic results of the comparative analysis of economic operating effects of the regional coordination unit with various alternatives of restrictions to total expenditures are given in the Table 1.

Table 1. Comparative analysis of economic operating effects of RCUBA based on the results of mathematical modelling, authors' development

Basic solution options	To the extent that the total expenditure is no more than, mln RUB	Number of the selected IAS from the preliminary list	Service revenue – completed sales, RUB	Total costs, RUB	Total income (TI), RUB	Level of profitability, %
A	10	15	12,051,302	9,765,256	2,286,046	23.41
B	20	18	23,078,509	19,023,172	4,055,337	21.32
C	30	23	34,750,448	28,936,025	5,814,423	20.09
D	40	32	46,502,779	39,003,971	7,498,808	19.23
E	50	46	57,178,590	48,230,713	8,947,877	18.55
F	60	61	68,351,219	57,923,810	10,427,409	18.00
G	70	76	81,153,920	69,045,619	12,108,301	17.54
H	80	89	92,344,375	78,836,771	13,507,604	17.13
I	90	104	104,998,280	89,912,623	15,085,657	16.78
J	100	137	115,491,079	99,167,923	16,323,156	16.46

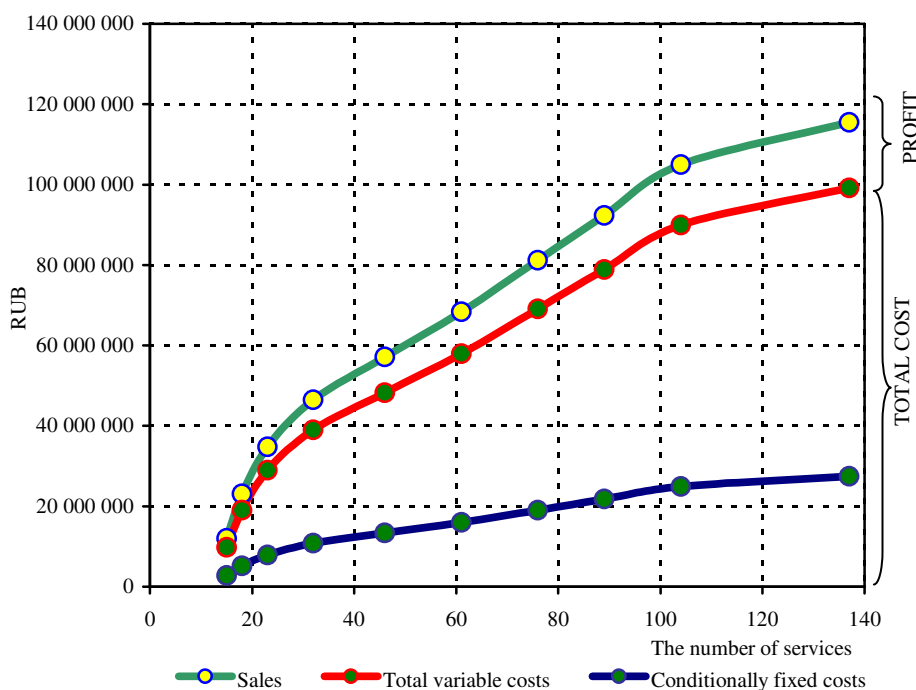


Figure 2. Relationship between operating revenues, profit returns and costs of RCUBA with different basic solution options by means of linear programming problem, authors' development

Candidate solutions to the optimization linear programming problem, presented in Table 1, suggest that the performance of the proposed to be created RCUBA at

a regional level can be cost-effective to an adequate degree. As such, profitability ratio varies depending on the amount of investments. The optimal value of the objective function (maximum profit) at combined costs of 99.2 mln RUB is 16.3 mln RUB, while at 10 mln RUB – only 2.3 mln RUB.

Economic mathematical modelling is an important tool for planning RCUBA activities as related to optimum relationship between the anticipated net revenue position and the index of capital efficiency in activity of such an infrastructural formation.

As per the results obtained we have identified some statistical regularities.

Firstly, changes in profit and profitability level ratio of RCUBA activities closely follow the number and the structure of the selected services rendered to general public and business. According to the results of the analysis, this relationship has a clear non-linear character in the form of a curvilinear regression dependence.

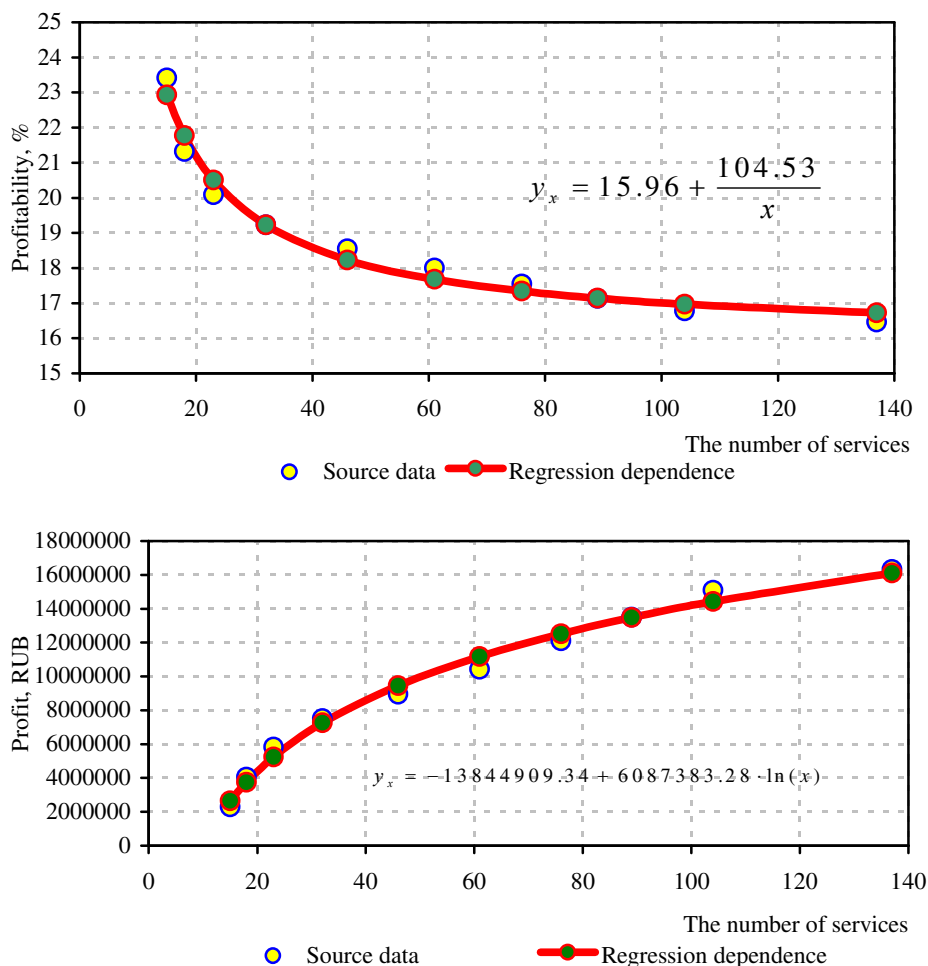


Figure 3. Changes in profit and profitability level vs. the number and the structure of the selected services, authors' development

Another thing, high correlational dependence of changes in profit performance on the volume of monetary costs is connected with rendering services selected following the optimization within the framework of the proposed creation of the Unit, the regression dependence takes the form:

$$y_x = 2.726 \times x^{0.848}, \quad (2)$$

where y_x is profit, RUB; x is total costs, RUB.

The dependence is shown graphically in Figure 4.

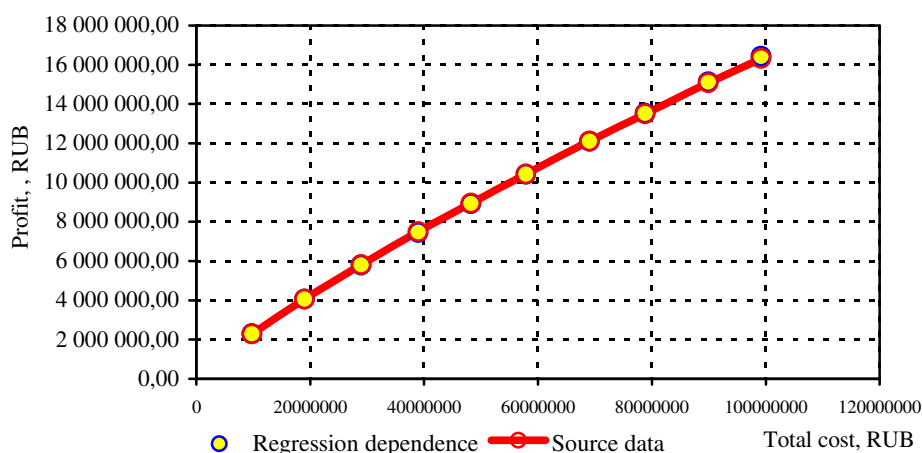


Figure 4. Dependence of profit on the amount of total costs of the regional coordination unit, authors' development

Conclusions and recommendations. The presented procedure can also be used for performance planning optimization in subsequent periods upon the footing of the projected values of criteria such as prices for services rendered, expenditures connected with their provision etc. using appropriate methods to assess the pattern of seasonal variations and curve fitting.

The proposed planning optimization procedure makes it possible not only to optimize the key performance indicators, but is also an effective tool for making final decisions on viability (economic or social) of creating such infrastructure for business environment to activate and develop SME in a region.

The resulting optimization candidate solutions make it possible to increase the economic efficiency and profitability ratio, even with startup investment being as small as 16–24%.

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Стаття надійшла до редакції 13.02.2015.