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**THE QUALITY OF LIFE AS A COMPLEX DYNAMIC OBJECT OF  
MANAGEMENT**

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*Abstract*

Improving the quality of life of the population is the main goal of the development of society, the criterion of the progressiveness of the socio-economic reforms in society and the most important strategic task of public administration. The solution of social and economic problems, ensuring a decent quality of life, sustainable functioning and national security of the state depend on the effectiveness of public administration. The article is devoted to the problems of management of the quality of life as a complex dynamic object. The multilayer model of the integral indicator of quality of life is offered which features consist in the following. First, each layer is a multi-connected system, which makes it difficult to analyze the impact of lower-level indicators on the integral indicator. Secondly, every partial and every system integral indicator has a mechanism of self-organization implemented by introducing feedback. Third, all components of the generalized integral indicator change over time, which necessitates consideration of the quality of life as a dynamic object of management. The two-channel quality of life control system is developed. On the first, organizational-administrative, channel control is carried out by changing the structure of the management object. On the second, economic, channel, control is carry out through the redistribution of additional financial-economic resources. The evaluation of the effectiveness of control actions, the results of which showed that the greatest efficiency is achieved with the simultaneous impact on the two control channels.

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**Keywords:** Control system, dynamic object, integral indicator, multilayer model, partial indicator, quality of life.



## 1. Introduction

The most important strategic task of state management of the social system is to improve the quality of life. The financial resources to create the conditions for good life and free development of a person increase annually. At the same time, organizational arrangements of the management structures aimed at improving the quality of life should be improved. The quality of life of the population is the main effectiveness indicator of the executive authority in the regions.

The quality of life of the population is formed under the influence of a number of subjects such as government departments and local government, various organizations, people themselves and their self-organizations. The influence of government and municipal authorities on the quality of life of citizens has an external character and appears in the socio-economic policy. The state is obliged to implement such a policy that would improve the quality of life of its citizens in the sphere of good education and medical services, providing social protection to needy population and creating conditions for the development of housing and communal services, employment of both urban and rural populations, etc. In Russia for these purposes the priority national projects in the fields of education, health, housing and the development of the agro-industrial complex has been implementing for the last 10-15 years.

## 2. Problem Statement

Formation and management of a high quality of life of the population are complex and long-term processes. Initially, it is necessary to develop and use for a sufficiently long time a system of indicators that would allow monitoring the dynamics of the quality of life of the population of the country as a whole and its regions. The used systems of objective and subjective indicators and marks were developed by the Central Economics and Mathematics Institute of the Russian Academy of Sciences, the Institute of Social and Economic Studies of Population of the Russian Academy of Sciences, the All-Russian Centre for Living Standard, the Scientific Research Institute of Technical Aesthetics, Russian Academy of Public Administration under the President of the Russian Federation, Ural Branch of Russian Academy of Sciences and other scientific-research organizations, and they are described in the works of our researchers such as N. M. Rimashevskaya, S. A. Aivazyan, A. I. Bestuzhev-Lada, V. N. Bobkov, V. M. Zherebin, E. E. Zadesenets, G. M. Zarakovsky, A. I. Tatarkin, L. A. Belyaeva, B. I. Gerasimov, S. P. Spiridonov and others.

Tracking the dynamics of the quality of life indicators makes it possible to identify those possible points on which it is necessary to concentrate the efforts of at different levels in order to ensure the growth of the quality of life of citizens. In addition, such monitoring studies to some extent indicate how effectively and efficiently the state and municipal authorities operate. Thus, the quality of life is a key goal, and its indicators are the criteria for the effectiveness rating of state policy in the development of scientific, technical and human potential, achieving social and economic security and determining the level of social and economic development of society. At the same time, the complexity of the task of the quality of life management increases due to the limited resources, the growth of the population differentiation, and the burden on the able-bodied population.

The literature describes methods of influence by the authorities at various levels to improve the life quality of the population. If earlier researchers followed the economic approach, according to which the life quality of the population can be increased by supporting scientific and technical progress, growth of gross domestic product, and also by increasing the quality and competitiveness of products, but now the most researchers follow a political approach and believe that the main way to improve the life quality is to increase the country's competitiveness, first of all, increase the competitiveness of education and science, improve the government institutions, and improve the efficiency of state and municipal service.

A great number of Russian and foreign journals published works about analysis of various approaches to the life quality rating (Discoli et al., 2014; Mellor, Cummins, & Loquet, 2012; Johnston, 1988; Malkina, 2017; Dolomatov, Martynov, Zhuravleva, & Zakieva, 2017). Special mention should be made to studies dealing with both the problems of public administration in general and the study of mechanisms and rating the effectiveness of the life quality management (Massam, 2002; McPheat, 1996). However, there are practically no researches studying modelling the dynamics of quality of life management.

### **3. Research Questions**

This research is devoted to the questions of management of the quality of life as a complex dynamic object.

### **4. Purpose of the Study**

The purpose of the study is to develop the two-channel quality of life control system for estimate the efficiency of organizational-administrative and financial-economic control actions.

### **5. Research Methods**

The methods of system analyses and control theory are used in research.

### **6. Findings**

Within the framework of the research two tasks were solved. The first task was to develop a model of the integral indicator of the quality of life as a complex multi-connected dynamic object. The second task was to develop the quality of life control system based on the feedback principle.

#### **6.1. Multilayer model for rating the life quality as a managed object**

In solving the first problem, a system approach is used, according to which a three-level model of the integral indicator of quality of life is proposed (Ilyasov, Martynov, Gerasimova, Makarova, & Zakieva, 2017). This model can be represented differently, in the form of a multilayer structure, if moving from vertical to horizontal bonds (Figure 01).

The generalized integral indicator "Quality of Life" (the first layer) is formed by three system integral indicators: Quality of living environment ( $J_1$ ), Quality of life potential ( $J_2$ ), Level of life ( $J_3$ ),

which form the second layer. Each system indicator has its own mechanism of self-organization, realized in the form of corresponding coefficients of feedbacks  $A_1, A_2, A_3$ .

Each system integral indicator is formed by partial integral indicators (the third layer). Thus the system integral indicator “Quality of living environment” is formed by the following partial integral indicators: “Quality of environment” ( $x_{11}$ ), “Quality of working life” ( $x_{12}$ ), “Quality of social environment” ( $x_{13}$ ); the system integral indicator “Quality of the live potential” is formed by “Level of education” ( $x_{21}$ ), “Status” ( $x_{22}$ ), “Level of health” ( $x_{23}$ ), the system integral indicator “Life level” is formed by “Income level” ( $x_{31}$ ), “Quality of housing conditions” ( $x_{32}$ ), “Food quality” ( $x_{33}$ ).

Each partial indicator has its own self-organization mechanism, realized by introducing corresponding feedback coefficient  $a_{i1}, a_{i2}, a_{i3}, i = \overline{1,3}$ .

The generalized integral indicator “Quality of Life” ( $QoL$ ) is calculated as the weighted sum of the system integral indicators:

$$QoL = \alpha_1 J_1 + \alpha_2 J_2 + \alpha_3 J_3,$$

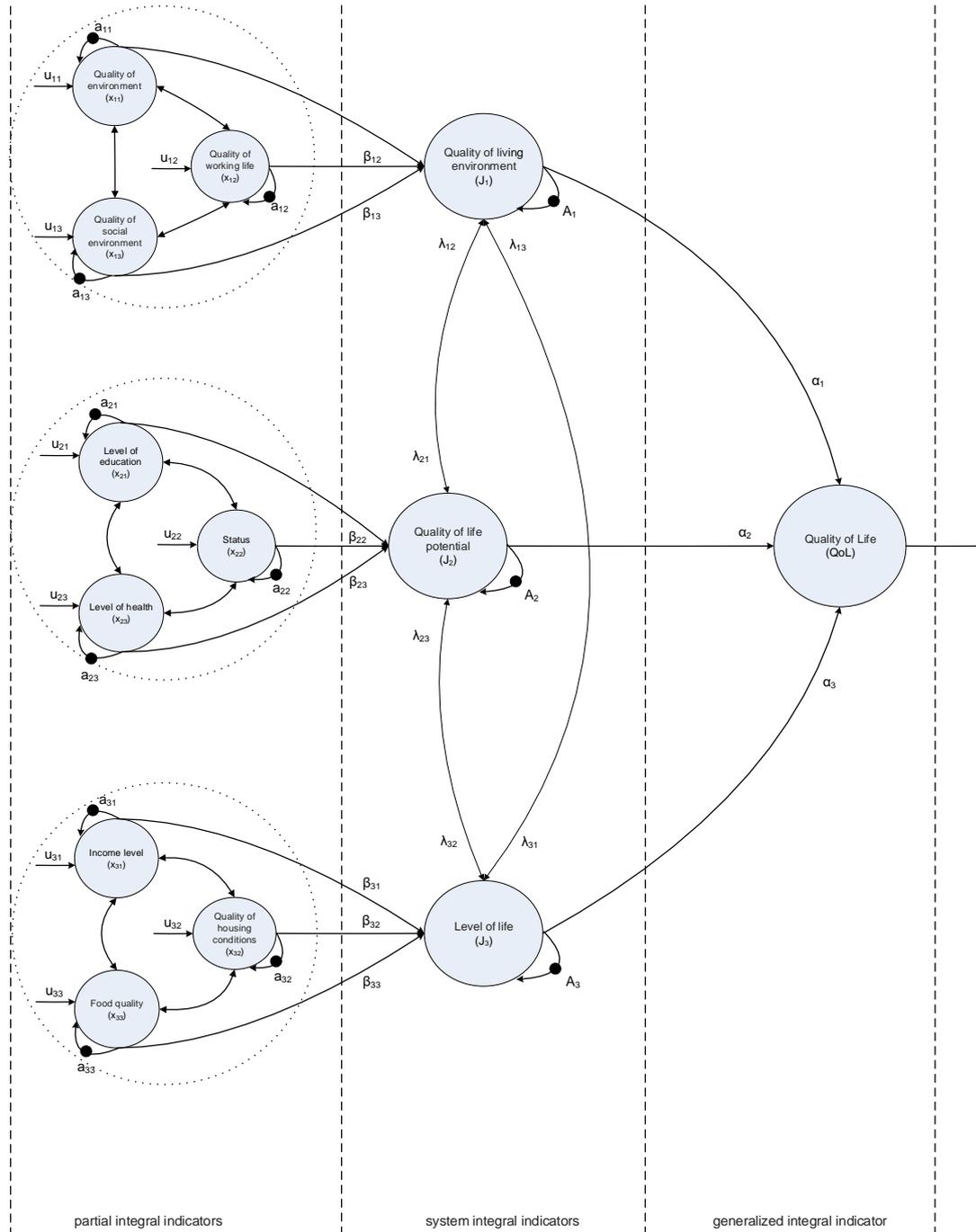
where  $\alpha_1, \alpha_2, \alpha_3$  – weight coefficients characterizing the significance of the indicator  $J_i$  and are defined by an expert, while  $\sum_{i=1}^3 \alpha_i = 1$ .

The system integral indicator  $J_i$  is calculated as the result of interaction with other system indicators:

$$\begin{cases} J_1 = -A_1(z_1)J_1 + \lambda_{12}J_2 + \lambda_{13}J_3 + J_{10}, \\ J_2 = -A_2(z_2)J_2 + \lambda_{21}J_1 + \lambda_{23}J_3 + J_{20}, \\ J_3 = -A_3(z_3)J_3 + \lambda_{31}J_1 + \lambda_{32}J_2 + J_{30}, \end{cases}$$

where  $J_{i0}, i = \overline{1,3}$  – initial values of indicators  $J_i$ , determined by private integral indicators;

$\lambda_{ij}, i \neq j$  – weight coefficients characterizing the mutual influence of indicators  $J_i$  and are determined by expert modes. If  $\lambda_{ij}=0.05$ , then it is a weak influence, if  $\lambda_{ij}=0.1$ , then it is a strong influence;



**Figure 01.** Multilayer model of the life of quality

$A_i(z_i)$  – feedback coefficients of system integral indicators, which depend on organizational-administrative control actions  $z_i$  at the level of federal management structures.

The initial value of  $J_{i0}$  can be calculated as the weighted sum of the corresponding partial indicators  $x_{i1}, x_{i2}, x_{i3}$ :

$$J_{i0} = \beta_{i1}x_{i1} + \beta_{i2}x_{i2} + \beta_{i3}x_{i3},$$

where  $\beta_{ij}$  – weight coefficients characterizing the degree of significance of partial indicators  $x_{i1}, x_{i2}, x_{i3}$  are determined by expert modes, while  $\sum_{j=1}^3 \beta_{ij} = 1$ .

To calculate the partial indicators  $x_{i1}, x_{i2}, x_{i3}$  the system of equations is calculated:

$$\begin{cases} x_{i1} = -a_{i1}(z_{i1})x_{i1} + k_{12}x_{i2} + k_{13}x_{i3} + u_{i1}, \\ x_{i2} = -a_{i2}(z_{i2})x_{i2} + k_{21}x_{i1} + k_{23}x_{i3} + u_{i2}, \\ x_{i3} = -a_{i3}(z_{i3})x_{i3} + k_{31}x_{i1} + k_{32}x_{i2} + u_{i3}, \end{cases}$$

where  $k_{ij}, i \neq j$  – weight coefficients characterizing the mutual influence of indicators  $x_{i1}, x_{i2}, x_{i3}$ , the numerical values of which are determined by experts;

$a_{ij}(z_{ij})$  – feedback coefficients of partial integral indicators, which depend on organizational-administrative control actions  $z_{ij}$  at the level of regional management structures;

$u_{i1}, u_{i2}, u_{i3}$  – financial-economic control actions.

Thus, the multilayer model of the quality of life as a complex multi-connected dynamic object is proposed. The features of the proposed model are as follows. First, each layer is a multi-connected system, which significantly complicates the analysis of the influence of the lower-level indicators on the integral indicator. Secondly, each partial and each system integral indicator has a self-organization mechanism realized by the introduction of feedbacks. Thirdly, all components of the generalized integral indicator vary in time, which makes it necessary to consider the quality of life as a dynamic object.

## 6.2. Two-channel quality of life control system

In solving the second problem – the development of the quality of life control system – the principle of feedback is applied. To manage the quality of life as a complex dynamic object developed a two-channel system (Figure 02).

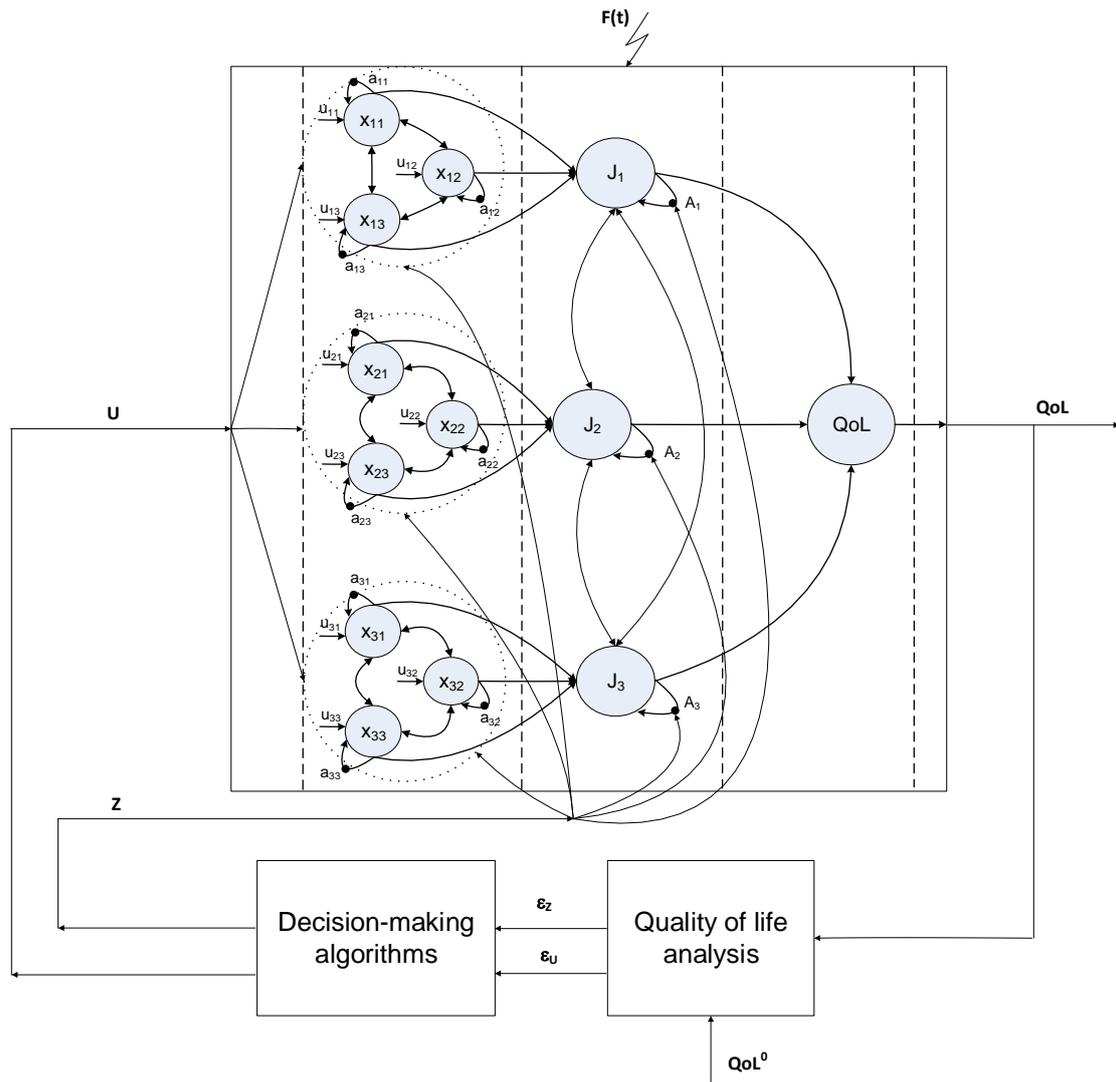
According to the feedback principle, the actual (current) value of the quality of life ( $QoL$ ) is measured at each time and compared with the target value ( $QoL^0$ ). The social standards of life quality and living standards developed by government departments should be considered as a target value of the quality of life indicator.

As a result of comparing the current and target values of the quality of life indicator, a deviation (control error)  $\varepsilon = QoL^0 - QoL$  is calculated (block “Quality of life analysis”). There are two components of the control error: error  $\varepsilon_u$ , associated with the financing of the social system, and error  $\varepsilon_z$ , associated with organizational changes in the social system, the elimination of which requires financial-economic impact on partial indicators and organizational-administrative measures.

At the output of the block “Decision-making algorithms” formed two channels of control: organizational-administrative, which reduces the error  $\varepsilon_z$  and financial-economic, which reduces the error  $\varepsilon_u$ .

To reduce the organizational-administrative components of control error  $\varepsilon_z$  the management decisions  $Z$  (the first control channel) are taken for changing organizational structures, for example, by changing the feedback coefficients  $A_1, A_2, A_3$  responsible for stabilizing the system integral indicators at the federal level, as well as the feedback coefficients  $a_{ij}$ , responsible for stabilizing the partial integral indicators at the regional level.

To reduce the financial-economic component of error  $\varepsilon_u$  the management decisions  $U$  (the second control channel) are taken to change the amount of financial resources invested in the growth of partial integral indicators.



**Figure 02.** Quality of life control system

Thus, the two-channel quality of life control system is developed. The first channel is intended for the implementation of organizational-administrative management by changing the structure of the management object, and the second channel – for the implementation of financial-economic management through the redistribution of additional allocated financial resources.

### 6.3. Simulation results

On the basis of the developed models the efficiency of control actions on the first and second control channels is estimated.

When assessing the efficiency of control actions on the second channel (U), it is first necessary to determine the so-called screening parameters, that are most sensitive to the perception of control actions.

Let's define the most sensitive indicator for the partial integral indicator "Quality of health". The structure of this indicator was suggested by the authors of this article (Ilyasov et al., 2017). Let's analyze the impact of control actions in the form of increasing allocated resources on lower-level indicators, such as "Level of medical personnel qualification", "Level of equipment, technologies and drug supply in medical institutions" and others. The results of the analysis made it possible to reveal that the most

sensitive to the perception of control actions is the partial indicator “Level of medical personnel qualification”. If this indicator increased by 5%, the integral indicator “Quality of health” in this model increased by 1.27%.

Similarly, the most sensitive indicators are determined for other partial integral indicators. Thus, for the indicator “Quality of environment” the most sensitive indicator is “Air quality”, for the indicator “Quality of working life” – “Quality of labour potential”, for the indicator “Quality of social environment” – “Security of living”, for the indicator “Level of education” – “Supply with educational facilities”, for the indicator “Status” – “Social status”, for the indicator “Income level” – “Wages”, for the indicator “Quality of housing conditions” – “Provision of comfortable housing”, for the indicator “Food quality” – “Healthy food index”.

After determining the screening parameters, the efficiency of control actions on the second channel (U) was evaluated. In the course of the research it was found that with an increase in the amount of financial resources invested in the growth of each of the screening parameters of the partial integral indicators by 1%, the generalized integral indicator (*QoL*) increased by 0.85%.

The estimation of efficiency of control actions on the first control channel (Z) is carried out. The results of estimation showed, that with a decrease the feedback coefficients of the partial indicators by 1%, at constant values of other parameters, the generalized integral indicator increased by 1.1%; with a decrease the feedback coefficients of the system integral indicators by 1%, the *QoL* increased by 1%; with a simultaneous decrease the feedback coefficients of partial and system integral indicators by 1%, the *QoL* increased by 2.2%.

In the case of simultaneous impact through two control channels, i.e. with an increase in the amount of financial resources invested in the growth of each partial indicator by 1%, and a decrease the feedback coefficients of partial and system integral indicators by 1%, the value of the quality of life indicator increased by 3.22%.

Thus, for the greatest efficiency is achieved with the simultaneous impact on the two control channels.

## 7. Conclusion

The multilayer model of the quality of life as a complex multi-connected dynamic object is proposed. The features of the proposed model are as follows. First, each layer is a multi-connected system, which significantly complicates the analysis of the influence of the lower-level indicators on the integral indicator. Secondly, each partial and each system integral indicator has a self-organization mechanism realized by the introduction of feedbacks. Thirdly, all components of the generalized integral indicator vary in time, which makes it necessary to consider the quality of life as a dynamic object.

The two-channel quality of life control system is developed. The first channel is intended for the implementation of organizational-administrative management by changing the structure of the management object, and the second channel – for the implementation of financial-economic management through the redistribution of additional allocated financial resources.

The evaluation of the effectiveness of control actions, the results of which showed that the greatest efficiency of quality of life management it is advisable to act simultaneously on two control channels.

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