International Business Management 8 (6): 348-352, 2014
ISSN: 1993-5250

Development of Methods of the Solution of Management Problems in Social and Economic Systems

[1]Anna Anatolyevna Borisova, [2]Inessa Makedonovna Kalyakina and
[3]Nadejda Yurevna Bondarenko
[1]Don State Technical University, 109 Petrovskaya St.,
[2]Southern Federal University, 44 Nekrasovsky Lane,
[3]Taganrog Institute of Management and Economy, 45 Petrovskaya St., 347900 Taganrog, Russia

Abstract: Effective use of public funds assumes comparison of expenses and results of public financing programs. It should be noted that the assessment and comparison of expenses and results are necessary for preparation of reasonable decisions not only in state but also in private business sector. In both cases, the following factors should be defined as precisely and completely as possible: Firstly, all possible types of costs; secondly, a range of consequences caused by the costs; thirdly, the economic measuring instruments, allowing to estimate various elements of expenses and results in the single scale; fourthly, pure return, i.e., a difference between outcome and expenses. The business sector starts with the private interests of investors and the state sector from the common interests of citizens (taxpayers).

Key words: Social and economic systems, public finances, health care, dynamic modeling, management, productivity, economic efficiency

INTRODUCTION

The modern health care in Russia was transformed to the new system founded on the basic program of medico-social insurance which allow to make a person's health a factor entirely defining his/her comfortable existence in the society.

In present day conditions of the society development an increasing flow of information, difficulty of making choice and optimum decision are those classical factors operating at any level of administrative process and considerably complicating the decision-making process in health care system.

Successful functioning of health care system at federal and regional levels demands active use of essentially new forms and methods of management suitable to the market social and economic systems.

Rationality of the public expenditures in all types of the social and economic systems is defined proceeding from the following criteria.

Economization characterizes the expensive (resource) side of efficiency. Economical solutions are those which allow using all the resources, quantities and qualities with the minimum possible costs. Economization means lack of wastefulness, i.e., involvement in production of superfluous resources, creations of excessive stocks, payments of components of expenses at the prices exceeding minimum, etc.

Productivity is a ratio of production or services quantity and amount of expenses for their production. In public sector as well as in private, they use the indicators reflecting labor productivity and other separate types of resources consumptions and also the integrated indicators assuming regulation of all types of expenses.

Effectiveness characterizes the compliance of government expenses and the results achieved with their help to the specific goals which should be reached by the government in any case. While assessing productivity the attention concentrates on production and while assessing effectiveness on preferences of the society (Oleynikova and Sergiyenko, 2010; Yu and Borisov, 2014; Yu, 2010).

Financing of public programs, such as education, health care, national defense, etc., is considered as the public benefit which should be made and provided by the state. The quality and number of services rendered to the society depend on how effectively indicators of these programs are calculated.

PROBLEM STATEMENT

The latest information technologies allow to realize methods of indistinct logic in the form of expert systems with indistinct rules to model dynamic processes

Corresponding Author: Anna Anatolyevna Borisova, Don State Technical University, 109 Petrovskaya St., 347900 Taganrog, Russia

with indistinctly described mathematical model to use powerful functions of establishment of dependence between various parameters to solve problems for which formal algorithms have not been found yet. Social and economic structures are such systems in particular, health care system (Kalyakina and Ya, 2013a, b; Kalyakina, 2004).

The system of medical insurance as one of forms of the organization of medical care to the population cannot be formed and develop outside the market economic relations.

Health system functioning in the market relations should be considered in system because the system approach allows to understand the essence and to construct the health care system model.

It is known that the system approach is the area of methodology of special and scientific knowledge and social practice based on research of objects as systems.

To understand the core of the relations between MPI (Medio Prophilactic Institution) and the patient within the health care system is possible only through methodological approaches.

Social and economic structures, as researchers know are the systems of low extent formalization, therefore modeling of such structures (in particular health care systems) is connected with certain difficulties.

The health care as social system is a community and a certain type of relationship of individuals and their groups in characteristic conditions of the geosocial environment. Such characteristics predetermine possibility of receiving dynamic situational models of health care system taking into account the specifics of the subjects.

As many medioprophilactic institutions have become independent establishments, their status allowed them to expand a range of paid medical services and the scheme of their financing. Funds of Compulsory Medical Insurance (CMI) for payment of medical services arrive in medical institutions from insurance companies on the basis of the contractual relations.

It is possible to describe the functioning of a medioprophilactic institution by means of mathematical model. The basic elements participating in the block diagram of MPI functioning are given as (Kalyakina, 2014):

- K the balance of the account of MPI as an independent establishment, rub
- L the balance of expenses of the current period (means in medical process), rub
- M the balance of material and technical expenses (medicines and medical equipment for the organization of the medical process), rub

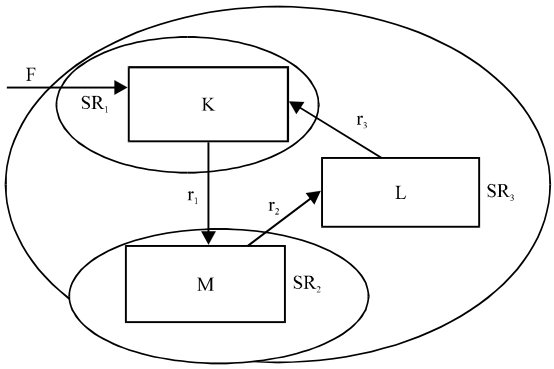

Fig. 1: The block diagram of financial flows movement in an MPI

Figure 1 represents the detailed block diagram. The physical agents who carry out the financial operations in this system are the governing body of a MPI and patients being on treatment or using the MPI during the studied period. And the government body of the MPI carries out the functions of control center and possesses the material base and a stock of medicines.

The presented block diagram describes the financial flows movement of a MPI of any type irrespective of a profile and form of ownership. For the public medical institutions the external influence F means financing from the local and federal funds of compulsory medical insurance. The commercial health centers receive money from the insurance companies according to the system of VMI (Voluntary Medical Insurance).

It is possible to present an assessment of management efficiency of a MPI, as development of intra firm planning of administrative decisions in the form of a chain of consecutive transitions in hierarchical system of economic structures. The system complexity degree depends on the research direction and the level of consideration.

For the mathematical formulation of a system complex dynamics, it is necessary to reveal the laws defining the behavior of each element from the systems of the considered class and then to define the parameters representing the links between the elements.

For a MPI the work with patients on the terms of costs refunding is connected with the problems coming from the necessity to take into account a number of the parameters that make considerable impact on the work results.

The links between the system elements are described by systems of linear differential equations and reflect the social and economic nature of elements. Mathematical interpretation of circuit decisions of systems of administrative decision-making support by MPI activity

allows to determine the speed of achievement of limiting values of revenue, a stock of medicines and money in medical process to exercise administration of investment flows. The solution of such a task gives the chance not only to predict reaction of potential patients to treatment and prophylactic services but also to plan the size and duration of investments. When using this method, administrative decisions are made not from the point of view of enterprise management intuition but from a position of commercially effective, scientifically verified approach (Kalyakina, 2014). Creation of model is planned on the basis of system of the balance equations:

- The balance of the account of MPI as an independent establishment
- The balance of expenses of the current period
- The balance of material and technical expenses

The first equation in the presented system is the balance of the account (K) of a MPI as an independent establishment. It is summed by the funds received from the treatment and prophylactic actions for compulsory medical insurance system and revenues from complete commercial treatment. It can be written as follows:

$$K = K_1 + K_2 - K_3 - K_4 - K_5 \quad (1)$$

Where, $K_1 = n_1.Z_1$ the means received for rendering of treatment and prophylactic services n_1 for a person insured in compulsory medical insurance system, rub; Z_1 the average cost of treatment and prophylactic actions provided for one patient, rub; $K_2 = k.L$ means (financial resources) earned by a MPI for rendering paid medical services in the reporting period both in system of voluntary health insurance and at the expense of direct payment through cash desk of medical institution, rub; L, expenses of the current period (means in medical process on VMI system and at the expense of direct payment through medical institution cash desk), rub; k, share of expenses of the current period in complete treatment, relative units; $K_3 = k_1.K$ expenses on remuneration of the medical staff labour (including bonus payments) for the reporting period, rub; k_1, a share of money on the account MPI directed on a salary of the staff, relative units; K_4, utility payments for the reporting period, rub; $K_5 = p.K$ expenses on acquisition of medicines and drugs; p, a share of the MPI's income used for purchasing medicines; relative units. Taking into account the accepted designations (Eq. 1) can be presented as following:

$$K = k.L + n_1.Z_1 - (k_1 + p).K - K_4 \quad (2)$$

Let's carry out necessary transformations in Eq. 2 to get a time interval which is convenient for use in the Ordinary Differential Equation (ODE) for example to 1 day. For this purpose, researchers divide all the summands (Eq. 2) on n_∂ the number of days in a modeled period (for a month the average $n_\partial = 30$). As a result, Eq. 2 will be transformed as follows:

$$\frac{K}{n_\partial} = \frac{1}{n_\partial}\left(k.L + n_1.Z_1 - (k_1 + p).K - K_4\right) \quad (3)$$

This methodical reception allows to analyze the change of means on the account of a MPI for any period (time interval). It is obvious that any changes in the right part (Eq. 3) on the time interval accepted for modeling will correct, also the left member of equation by the value dK/dt, increasing or reducing it by the speed of the function change (Eq. 3). The record dK/dt in the left part (Eq. 3) and the transfer of K/n_∂ in its right part allows to construct the corresponding linear ODE as following:

$$\frac{dK}{dt} = -\frac{1}{n_\partial}(1 + k_1 + p)K + \frac{1}{n_\partial}k.L + \frac{1}{n_\partial}(n_1.Z_1 - K_4) \quad (4)$$

According to the considered scheme, the linear ODE is built to describe the process of change of expenses of the current period in terms of money. It is obvious that in the course of carrying out treatment and prophylactic actions new cost is created. For this reason, the share of the medicines used in the medical process, enters into the equation of balance of expenses of the current period with an extra charge ς. According to the earlier mentioned, let us create the equation of money balance in the medical process for a considered interval of time (month), rub:

$$L = q(1 + \varsigma)M + (1 - k)L \quad (5)$$

Where:

ς = The relation of non-material expenses (work of doctors and medical staff) in the structure of cost of treatment and prophylactic process to material costs, relative units

q = A share of a stock of the medicines used in the medical process, relative units

Let's divide summands in Eq. 5 into the number of days in the considered interval of time and transfer L to the right member of equation. As a result, researchers receive the linear ODE, describing the speed of change of monetary current assets in medical process:

$$\frac{dL}{dt} = \frac{1}{n_{\partial}}\left[(1+\varsigma).q.M - k.L\right] \quad (6)$$

Let's construct the linear ODE, describing the process of change of medicines stock used in the medical process. Equation 6 of the stock balance has the following components: $Z_B = p.K$, a part (share) of financial resources on the account of a MPI for a considered interval of time (for example, month), directed to the replenishment of a medicines stock, rub; $Z_A = (1\text{-}q).M$, a part of medicines unused (remained in a stock) in the medical process, rub; S_M, an obligatory part of a medicines stock required for a MPI work (an insurance stock), rub. Taking into account the entered designations researchers receive:

$$M = p.K + (1\text{-}q).M + S_M \quad (7)$$

Let's relate summands in Eq. 7 to a time interval acceptable for us in the ODE, for example to 1 day. For this purpose, researchers divide all the summands (Eq. 7) into n_{∂} which is a number of days in a considered interval of time. As a result (Eq. 7), it will be transformed as following:

$$\frac{M}{n_{\partial}} = \frac{1}{n_{\partial}}\left[p.K + (1-q).M + S_M\right] \quad (8)$$

This method allows dynamic considering the volume of a medicines stock for the required period of time. It is clear that any changes in the right part (Eq. 8) on the accepted interval of time will change also its left part by the value dM/dt, increasing or reducing it by the speed of the function change (Eq. 8). The record dM/dt in the left part (Eq. 8) and the transfer of M/n_{∂} into its right part bring to the required linear ODE:

$$\frac{dM}{dt} = -\frac{1}{n_{\partial}}q.M + \frac{1}{n_{\partial}}\left(p.K + S_M\right) \quad (9)$$

As in the linear ODE (Eq. 4, 6 and 9), dynamic variables are not ordered, let us order them and write down the required system as follows:

$$\left\{\begin{array}{l} \dfrac{dK}{dt} = -\dfrac{1}{n_{\partial}}(1+k_1+p)K + \\ \qquad \dfrac{1}{n_{\partial}}k.L + \dfrac{1}{n_{\partial}}(n_1.Z_1 - K_4) \\ \dfrac{dL}{dt} = -\dfrac{1}{n_{\partial}}k.L + \dfrac{1}{n_{\partial}}(1+\varsigma)\,q.M \\ \dfrac{dM}{dt} = \dfrac{p}{n_{\partial}}K - \dfrac{1}{n_{\partial}}q.M + \dfrac{1}{n_{\partial}}S_M \end{array}\right\} \quad (10)$$

With entry conditions; $K(0) = K_0$; $L(0) = L_0$; $M(0) = M_0$ where, K_0, L_0 and M_0 initial means on a MPI account, money in the medical process and money in medicines stocks at the initial moment of time (Carney, 2008; Marcinko and Hetico, 2006; Gapenski, 2006).

CONCLUSION

The constructed model includes three ODEs, modeling such important parameters of a MPI, as financial means on the account, means in medicines and in the medical process. In the developed model, the budgetary and commercial sources of financing are considered separately that allows the management of a MPI to model various scenarios of the establishment development and to make the verified managerial decisions to control this process.

After the development of the circuit decision of the treatment and prophylactic activity system, it is possible to transfer to the basic dynamic system balance of the account of a MPI being an independent establishment-balance of material expenses-balance of expenses of the current period.

Application of dynamic systems for optimization of support of administrative decision-making is new. It is possible to formalize the system of support of administrative decision-making on treatment and prophylactic activity of medical institution by means of systems of the homogeneous differential equations on the basis of composition of static, causal and dynamic approaches to an assessment of the economic effect, considering the amount of delivery and a medicines stock.

REFERENCES

Carney, P.J., 2008. Managing company health care: High-performing employers have lower per-employee costs. Indiana Business Magazine, May 1, 2008.

Gapenski, L.C., 2006. Understanding Heal thcare Financial Management. 5th Edn., Health Administration Press, Chicago, IL., Pages: 700.

Kalyakina, I.M. and N.A.Ya, 2013a. Forecasting and modeling of social and economic systems. Proceedings of Materials of the International Scientific and Practical Conference on Methodology, Theory and Practice in the Modern Physical and Mathematical, Technical, Chemical Sciences, August 17, 2013, Center of Assistance to Scientific Researches Development, Novosibirsk, pp: 33-36.

Kalyakina, I.M. and N.A. Ya, 2013b. Management of social and economic system. Natural and Mathematical Sciences in the Modern World, No. 8, pp: 36-40.

Kalyakina, I.M., 2004. Dynamic factorial models of the analysis of activity of small enterprises. News of Southern Federal University. Technical Science, Vol. 39, No. 4, pp: 233-236.

Kalyakina, I.M., 2014. Design and development process of management decision-making in health care. Socio-Economic Development: Problems and Solutions, Monograph Book 2, Logo, Stavropol, pp: 24-41.

Marcinko, D.E. and H.R. Hetico, 2006. Dictionary of Health Insurance and Managed Care. 1st Edn., Springer Publishing Company, New York, Pages: 372.

Oleynikova, I.N. and N.V. Sergiyenko, 2010. Public Sector of Economy: Methodology and Conditions of Realization of the Budgetary Mechanisms of Management by Results. Kravtsov Publishing House, Taganrog, Pages: 168.

Yu, B.N., 2010. Coordination of the investment interests of economic entities in the mesolevel through the application of elements of indicative planning. Bulletin of the Taganrog Institute of Management and Economy, No. 1, pp: 19-22.

Yu, B.N. andA.A. Borisov, 2014. An indicative approach in planning and management of regional investments. Proceedings of the International Scientific and Practical Conference on Theoretical and Practical Questions of a Science of the 21 Century: Part 2, February, 28, 2014, Russia, pp: 31-34.