

Methods of artificial intelligence in the indicative economy as a tool for managing socio-economic systems at the regional level

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Annotation. This article has analyzed the principal applications of artificial intelligence in the indicative economy. The mathematical model of the target function of the socio-economic system development has been determined. The effectiveness of modern solutions in the field of application of public administration information systems at the regional level has been assessed. The use of indicative planning tools as a key factor in creating long-term development strategies for the regions has been substantiated. Recommendations for the implementation of scoring models, as a comprehensive solution to assess the state of the socio-economic system have been formed.

Keywords: *indicative economy, artificial intelligence, long-term development strategy, indicative planning, machine learning, socio-economic system, information systems, state administration, regional economy, budgeting.*

I. INTRODUCTION

A key factor in the development of regions at the digitalization stage may be the indicative economy. The target state of the software and hardware complex allows it to quickly respond to changes at the macro-, meso-levels. The development and implementation of a unified system for managing the process of indicative planning using artificial intelligence methods will ensure the sustainable development of the socio-economic system of the region.

II. METHODS AND MATERIALS

The theoretical basis of the study consisted of a logical method, as well as methods of analysis. In addition to general scientific methods, the study widely used statistical methods, including the method of structural analysis; sampling method.

The mathematical model of the target function of the socio-economic system development has been determined.

III. RESULTS AND DISCUSSION

In the regional socio-economic system there is a multi-factor approach to its study. We suggest using a mathematical model of the target function to determine its development. We also suggest considering social groups on a strata basis (upper class, lower class) as its component [1]. The target function will be considered as the density divergence of social wealth allocation between these social groups (hereinafter - $F(x)$):

$$F(x)_1 = \text{div}A = \lim_{\Delta V \rightarrow 0} \frac{\Delta F}{\Delta V} = \frac{dF}{dV} \quad (1)$$

$$F(x)_2 = \text{div}E = \frac{\rho}{\epsilon_0} \quad (2)$$

Moreover, if we consider an element of a group (a person) $\text{div}A$ (1) – as a basic unit of a socio-economic system, conditionally limiting it parametrically within the coordinates of a multidimensional array ($\Delta F / \Delta V$), characterizing its position and interaction with other elements of the group (people, social groups, social classes), such a model can be represented in the form of clusters, characterizing the parameters of the socio-economic system of the region, ensuring its integrated modeling. In this regard, the target function $F(x)$, expressed through the divergence of the field

structure divE (2), where the field structure is understood as the socio-economic relations in social groups according to the strata indicator of the socio-economic system of the region, which is identified by object-specific density (ρ) distribution of public goods relative to their sources (ϵ_0).

At the same time, the concept of “element” in the context of the socio-economic system is conditional, and we do not consider it separately, which would mean a refusal to obtain a cumulative synergistic result. We propose the most effective approach in reviewing the process of development and management of the socio-economic systems of the region, which should have a dual integral/ private nature.

Nevertheless, when solving the problem of forming a sustainable vector of development of a region [2], it is necessary to take into account the factor of the temporary inversion of its ecosystem, and if in the short term the indicator of the region’s resource endowment remains constant, the target state implies an increase in the resource potential while stabilizing the target function of development of the region as a whole $F(x)$.

In this regard, the toolkit of an indicative economics allows us to carry out an effective assessment, forecasting and programming of the development of the entire social ecosystem as a whole. At the same time, in order to exercise effective control in the conditions of the modern civilization development, it is necessary to have not only the necessary methodology, but also to know the indicators of the emotional economy that allow solving the tasks quickly and accurately.

At the moment, approaches in the form of a partial solution of this task in the context of public administration are implemented by drafting the projects of a long-term development strategy and an attempt to combine natural and financial indicators for the region in the first stage, and then formalizing the stages of this strategy in the format of the three-year budget of the country by using program-oriented approach and the subsequent automation of this process.

The standard implementation of this approach occurs through the use of ERP and BI systems [2], scaled for the needs of the region, which corresponds to the approach to review the functioning of the region from the point of view of the corporation.

The following factors explain a number of disadvantages of this approach, which does not allow solving the problem:

1. In the current economic reality, the regional budget may not be decisive in its welfare.
2. Greater volatility in foreign exchange markets and constant crises leading to inflation do not allow providing a stable situation in the public finance sector.
3. Automation of financial processes is aimed at forming an idea about the distribution of budgetary funds, and not at

managing the development of the region as a whole (taking into account both government factors and transnational business).

4. The absence of a complex of non-analytical data and altered regional development scenarios does not allow making the right decisions.

Therefore, the applied method of the indicative economy makes it possible to design the development of the regional economy, provide regional leaders with objective information about the state of the socio-economic system as a whole, and about its change under the influence of external macroeconomic factors in real time [4]. At the same time, the algorithm of basic interactions between government and market structures at the meso-level can be built on information systems that can be modified by using machine learning algorithms, deep learning and a number of artificial intelligence methods. Artificial intelligence is an integral concept, and it has been evolving since its appearance in the middle of the XX century. In our case, it includes several narrower categories, such as machine learning and deep learning.

The artificial intellect is the science and technology of creating intelligent machines, as well as intelligent algorithms, the distinctive feature of which is the ability to perform creative functions [6].

Machine learning can be formalized as one of the areas of artificial intelligence, it is also the most functional in the broad sense of the word, that is, it finds the most applicable solutions in various fields of science and business at the moment. By means of machine learning at the moment, the tasks of patterns and speech recognition, translation of texts into foreign languages, etc. are being solved.

Deep learning is conducted by means of neural networks. It solves tasks that simulate human decision making. Using Deep Learning and building appropriate algorithms based on it is a rather expensive task, based on a large amount of data. However, the use of deep learning allows you to get high results in solving problems. [7]. This in turn will lead to an increase in the efficiency of the process of developing and executing a long-term regional development strategy based on carrying out integrated implementation of the indicative planning system at the meso-level [3] (Fig. 1).

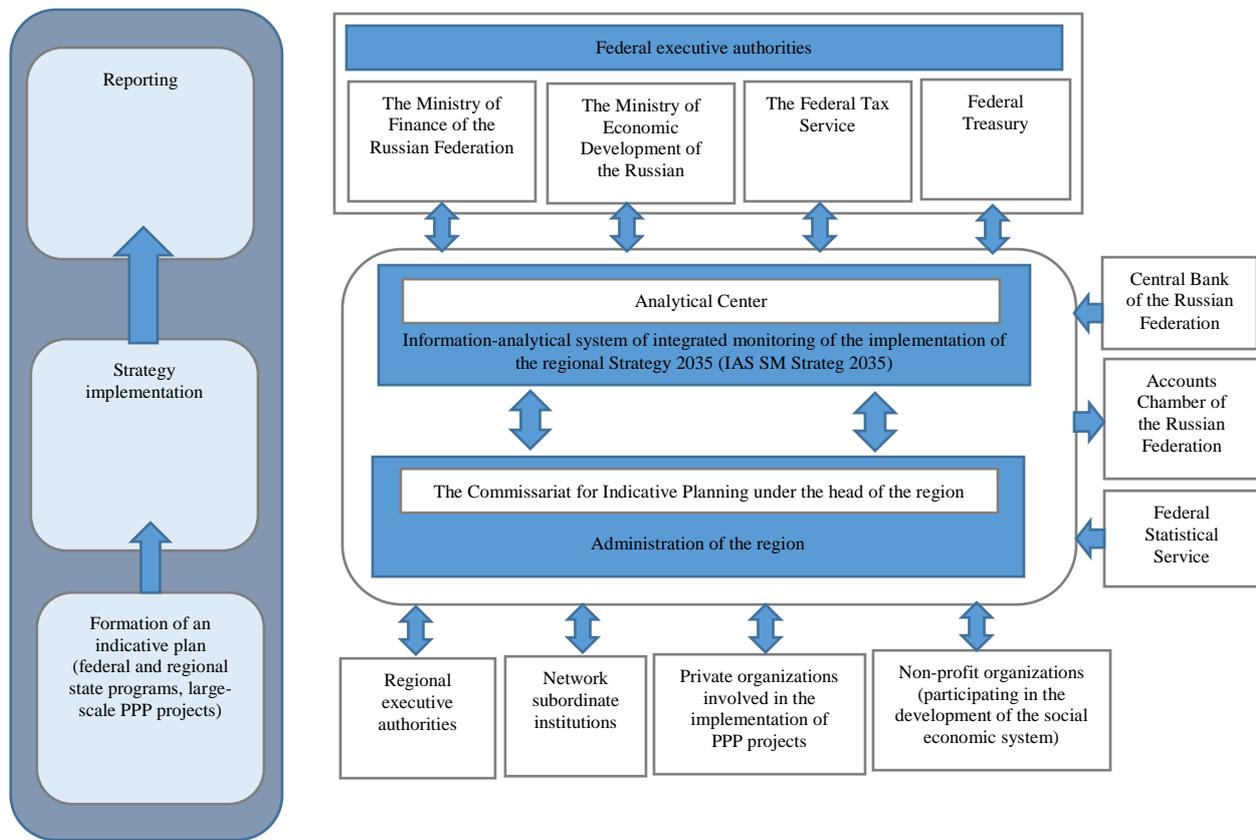


Fig. 1. Scheme of integrated implementation of the indicative planning system of the region at the meso-level

Moreover, if we consider this scheme enlarged, already at this level of development of the technological structure, we can talk about the successful application of these solutions in the field of artificial intelligence, and consequently increase the competitiveness of a number of sectors of the regional economy and certain areas of its economic activity [5]. The most successful version of the application of artificial intelligence at the present stage may be:

1. Transport industry - the creation of autonomous transport, integrated robotization, increased resiliency, reduced risk to humans. Optimization of logistics and supply chains.
2. Fuel and energy complex - optimization of energy networks, increase of efficiency in the design and operation of power units as well as ensuring the minimization of losses in energy production.
3. Agroindustrial complex - monitoring of agriculture, the creation of algorithms for the optimization of sown areas.
4. Social sphere - personal medicine, improvement of clinical practices, personal educational trajectories, social engineering.

IV. CONCLUSION

In the context of the task set within the framework of indicative economy about the socio-economic system, the use of one of the deep learning algorithms - scoring - as a base for the formation of an integral indicator that determines the complex state of the socio-economic system regarding the multifactor and multi-threaded change in resource potential for the current period will also allow in the shortest period of time to develop recommendations for stabilizing its condition while minimizing the resource s losses [8].

This approach will make it possible to single out artificial intelligence as a method for determining dynamic changes in the state of a socio-economic system in a region in real time, based on a total estimate of $F(x)$ –the target function, which will accurately determine the current state of socio-economic systems by the stability criterion.

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