

MATHEMATICAL METHODS, MODELS AND INFORMATION TECHNOLOGIES IN ECONOMICS

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REGIONAL INFORMATION TOOLS FOR PROVIDING DEVELOPMENT OF REGIONAL SOCIO-ECONOMIC SYSTEM

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Introduction. The world community is evolving rather rapidly and socioeconomic processes are accompanied by so unpredictable, often dangerous, events that in order to ensure the necessary stability of economy and society development, there is an obvious need for forming the systems and mechanisms that would ensure the stability of event management and would help to predict the vectors for the further development of individual territories. Such systems and mechanisms are needed in the entire hierarchy of governance - from individual households and entrepreneurs to the level of regional, national and global economy.

The world community is now in such a stage of development when in order to ensure better future it becomes inadmissible to ignore various dangers: military-political, technogenic-economic, economic and social including economic and informational threats. Therefore at present the issue of ensuring economic security (based on the key components: economic, socio-environmental, technical and technological, innovational, informational, demographic, industrial, financial, etc.) is rightfully considered to be the most relevant, occupies the minds not only of the state figures, scientists, businessmen, but those of ordinary citizens who are not indifferent to how people will live in the future, what resource heritage will be passed to them by the present generation [1, p. 52].

In the context of exacerbation of crisis processes in Ukraine and its regions the problem of economic security of socio-economic systems within the framework of ensuring the state-national, regional economic interests in the conditions of business structures economic management manifests itself with even greater force. In our opinion, without solving this problem it will be very difficult to fulfill the other, not less important, socio-economic tasks.

O.O. Petrova's research emphasizes that, in a market economy, each economic agent within the limits of institutions operating in a given state has an alternative as to economic activity at the macro-, meso- and micro-levels. But at the same time, economic agents are vested with certain rights and responsibilities for the results of the decisions taken and for their own well-being. As a rule, on this basis, taking into account various factors influence, business entities formulate a concept and develop forecasts of their development [2, p. 48].

At the present stage, the system of information tools for providing economic, social and innovative activities of the regions in Ukraine is undergoing a process of its formation, which is characterized by emergence and approbation of new methods and instruments of regional economic measurements, by

accumulation, analysis and evaluation of information on the development of regional economic systems, by generalization of available data and preparation of the decision.

Moreover, it should be realized that effective interaction and implementation of economic interests are thought to be fundamental mechanism of social and economic development, progress of productive forces and industrial relations, harmonization of contradiction between them and the creation of the basis for a qualitative transformation of the whole economic system. Today, the analysis of the influence of "authorities - ownership" structure on the process of realizing economic interests and socio-economic development is especially relevant for the domestic economy, in which the conditions, based on the continuity of satisfying personal interests of "those in power", for dominating authorities and large ownership over other economic actors, are maintained and constantly restored [3, p. 76].

Analysis and research of recent publications. Noting extensive research on the processes and phenomena of regional-territorial socio-economic development carried out by many foreign and domestic scientists, it should be noted that there are no studies dealing with the role of basic components of the region's economic security sphere (system) in the context of insuring regional economic interests through information security tools among other things. Scientific researches on the problem of theoretical and methodological basis of the regional-territorial development concept have been performed by such leading foreign scientists as J.-R. Budwil, E. M. Buchwald, S. D. Valentey, V. Kristaller, A. V. Kuznetsova, V. Launhardt, S. M. Leonov, F. Perroux, V. K. Senchagov, D. O. Tatarin, J. H. Thuenen, T. Hagerstrad, J. Friedman and others. Problems of regions' economic development, areas of economic security of the region, including the basic components, are studied in the works by such domestic scientists as O. Amosha, V. Bazylevych, B. Burkynskyi, Z. Varnalii, M. Voinarenko, M. Dolyshnii, V. Dubnytskyi, V. Zakharchenko, B. Kvasniuk, H. Kozachenko, A. Laiko, J. Lysenko, A. Liashenko, V. Sysonenko, V. Symonenko, S. Filippova, M. Khvesyuk, and others.

Problem statement: analysis of approaches for using information tools to provide the development of regional socio-economic systems (RCES) and their users; the application of system approach to the formation of regional information security system in the conditions of the space asymmetry of regional socio-economic systems.

Main material and results. The center of gravity in the implementation of socio-economic policy, resource-energy-ecological policy and investment-innovation policy of Ukraine is now shifting to regions through which the country's management is being implemented and the state strategy of the country's development is being implemented. The transfer of a significant part of the rights and respective share of ownership to the regional level is in line with objective trends in the development of self-government and at the same time imposes new obligations on regional economic policy, especially in terms of ensuring economic security by the basic components (including information).

Accordingly, the regional administration acts as the leader of the nationwide economic interests within the framework of the regional socio-economic system, taking into account, of course, the specifics of the region. This does not exclude special aspects of management and allows to some extent avoid rigid centralization and bureaucratization of economic life. As noted in the work by G. V. Makhanko, the freer the subject of management can dispose its resources within the single economic mechanism, the higher the efficiency of management is [4, p. 4].

Independence of the regions of Ukraine in management, formation and use of the budget, conducting economic policy within the hierarchy of state- national economic interests, and implementing the strategy of economic security in key components (production, financial, demographic, investment-innovation, information, demographic, techno-technological, resource-ecological) is based on the resource base. In the conditions of decentralization of the domestic economy, the problems of improving optimization of management of the competitive and resource potential of the region, combined with ensuring its economic interests, become especially urgent both from theoretic-methodological and practical point of view. The solving of these problems will allow increasing the level of the region economic security (RES) aimed at accelerating socio-economic development of regions in the process of expanded reproduction and ensuring economic security in a single nationwide system.

The analysis of researches of foreign scientists dealing with the problems of RES (among them H. I. Delhi, V. Eitingon, R. Goodland, V. Cable, G. Kellenberg, G. Kleiner, A. Moore, D. Reyhar, K. Khiariden) demonstrates that there is a plurality of theoretical and methodological approaches to the problem of ensuring economic security. The above approaches (in terms of level of a region and its industrial-infrastructure complex) need systematization, studying their theoretical and practical significance and further development.

It should be noted that the lack of a concept, based on the unity of the methodological approach and mechanisms of practical implementation, for providing RES in combination with safeguarding economic interests of the region and in the context of providing it with resources (for example, with information ones), affects largely the reduction of the level of RES, business entities and economic security as well as implementation of the national economic interests of Ukraine as a whole.

As noted above, the shift of the center of gravity of economic and social reforms to the regional level and strengthening the role of the regions of Ukraine in implementing economic policy of the state led to the expediency of developing new approaches to its regulation. The practical implementation of market transformations should be based on a reasonable combination of market and administrative management methods of the national economy, the totality of which would ensure its normal functioning and development at all levels (from the country as a whole to its separate regions) [4, p. 18].

Under modern conditions it is the region that represents the most important and, in many respects, determining part of the overall socio-economic system of the country. At the same time, according to many domestic authors (B. Burkynskyi, M. Butko, M. Voinarenko, V. Dubnytskyi, I. Zabludska, V. Zakharchenko, H. Kozachenko, Y. Lysenko), on a national scale, any region is a relatively separate and independent subsystem that has its own internal structure, economy, its own goals and interests in the field of economic development.

At the same time, in today's conditions, influence of economic security and information processes level on the vital functions of society is increasing. Any information system (IS) is usually organized in some existing information space taking its properties and working rules. While developing, IS gradually generates its own information space which adds some functionality to the "parent" space changing or complementing its properties. The need to clarify the theoretical model of any system (for example, regional socio-economic, economic security, regulation of economic interests, etc.) taking into account the development of information and communication factor, is connected, on the one hand, with the development of information and communication technologies (ICT) that cause changes in information interactions within the system, and, on the other hand, with the fact that fundamentals of the theory do not adequately investigate the reflection in the information space of interaction between the subjects of any activity.

By informational tools for the development of the RSES including in the area of RES and regional innovation system the author understands the means of displaying real economic phenomena and economic interests, analyzing, evaluating and taking managerial decisions that have both the potential to form new knowledge about the state of economic systems of different levels of organization (including risks and threats) as well as the potential of systemic transforming influence on the development and security of these systems. Determining the public need for information tools for regional development and security, one must proceed from the fact that the regional socio-economic system, firstly, independently produces accounting and analytical information and organizes its movement; secondly, it is built into larger systems (national economy, international economic organizations); thirdly, it has a complex internal structure. Thus, RSES has the following basic characteristics:

- a combination of management hierarchy and the activity of individual subjects of the internal environment;
- interweaving processes of integration and differentiation in the internal and external environment;
- competitive interaction with other regional systems and subjects of other levels of organizations economic relations [5, p. 242].

At the same time, when formulating and solving the tasks of the development and security of the RSES, regional authorities, economic entities and external economic entities entering the region have to confine themselves to isolated, inadequate to current needs, local information and analytical tools. This determines:

- narrowness of information and analytical base of regional economic measurements;
- lack of a real picture of economic processes occurring in the region, which impedes solving modernization tasks;
- estrangement of the applied tools from forming new knowledge about the regional system, which acts as the starting point for the practice of RSES innovative modernization.

The public need for regional information tools to develop RSES (including RES sector) is structured in a certain manner. It is possible to distinguish two different levels of needs:

- the needs of RSES itself as an integral subject and owner of all the assets being positioned therein, in information, new knowledge and means of territorial development;
- similar needs of various subjects of internal and external environment of the region and its territory,

which get access to information tools as to public good (free of charge) or to mixed good (on the basis of a transaction).

Among the factors that determine the needs of the users of the indicated tools in the region, we should distinguish the following:

- expansion into regions - subjects of national economy branches, transnational corporations and other subjects at mega-level;
- interaction between the center and the regions in the process of forming and implementing socio-economic policy;
- intensification of interregional integration processes which results in the formation of conglomerates of regions and increasing the need for interregional comparisons and assessments (for example, interregional interaction with a view to provide RES within the national, economic security of the regions in the west and east of Ukraine);

– development of competition at meso-level and approval of competitiveness as a development imperative and the basic factor for providing RES (within RSES);

– structuring of the economic and infrastructure space of the region and forming high-tech subregional systems in it as well as local economy systems that require new tools for their own development.

According to the author, on the basis of using differentiating feature of economic interest character (within RSES), it is possible to identify three groups of information tools users for ensuring RES (by means of intensifying innovation activities in the region included):

- users who have direct economic interests in the regional system;
- users who have indirect economic interests in the regional system;
- users having no economic interests in the regional system.

Regional economic system is a multi-purpose entity which has inhomogeneous internal and external relations and also faces the objectives of individual subregional systems that correspond to each other in the processes of functioning, development and ensuring economic security of the region.

With account taken of the circumstance described above, the reflection of the entire diversity of resources, factors and results of RSES activity in the information registers as well as formation of a new task necessary to provide the innovative and informative component of the RES is the most difficult. This is reflected in the process of developing information tools for ensuring RES [5, p. 243].

The system of information tools for developing and ensuring RES of a regional economy can not be built on the basis of a simple combination of information display systems applied at micro- and macro-levels. For example, the transition to a "knowledge-based economy" involves the emergence of new forms of registers, the expansion of the range information users and the methodological transformation of regional economic research, including in the field of RES.

The position of RSES at meso-level involves the development of a special methodology for producing information: indicators must be constructed in monetary terms in a certain sequence of reproduction cycles of the region and its territory, have forms that correspond to the variety of discovered processes, comply with each other, summarize data and be balanced with resources of the regional development and results of their use.

As noted by a number of authors in the works on developing RSES and providing RES [6, 7, 8], the information system used in practice in the region is built in isolation from the specific needs of information users and needs a systemic correction, which according to the author, should be based on the following principles :

- ensuring timeliness, reliability and analyticity of information;
- structure flexibility of the system itself.

At present, the information resources of the region relate to public good, since they represent the results of public sector functioning and are mainly paid at the expense of the budget. However, information tools of regional development and ensuring RES should be assessed as a mixed good, specific goods, demand and supply of which determine their market position. Two types of needs (within RSES and RES) in the information formed by them can be rightly distinguished. They allow to structure the range of information resource services (public good proper and mixed one):

– need for publicly available economic information on the development of the region and ensuring RES for the population of the region, regional authorities, regional business structures, as well as authorities and citizens living in other regions. The relevant information is received, registered and subject to analysis at the expense of budget funds, therefore, it is not sold, provided on the demand of any user and, therefore, acts as a public good;

– the need for special information (especially important in the field of economic security of RSES) which has undergone additional processing and was combined with other information resources, with expert assessments received, that is, with services that make the information a mixed good. If the user orders a sampling of information on certain grounds, taking into account his economic interest, then he must pay for

the work on the formation of some individual superstructure above the general information basis.

In order for information resources of the region to become a demanded commodity, it is necessary to create favorable conditions for IS consistent, useful and successful implementing its inherent functions in the specific economic environment of the regional area itself and in that of business entities within RSES. In order to provide informational tools with systemic property, it is necessary to create an environment (within RSES in RES area) that allows for efficient comparison of data in the aggregate of existing economic relations entities of the regional space. This will become possible in the case of unification of conceptual and methodological base applied. First of all, this means necessity to reduce main economic objects at meso-level to a common "denominator" - objects of regional accounting and management.

One of the tools of information provision of the regional systems for economic, innovative development and ensuring RES is the creation of information systems (ISs) that are capable of responding quickly to the dynamics of socio-economic and innovative processes - capable of adaptation to changing infrastructure, reconfiguration, integration into the system of newly emerging geographically dispersed inhomogeneous information resources. There are now technologies for constructing similar ISs in RSES, mostly based on the concept of intermediate layer software - middleware.

One of the fast-developing technologies that are capable of meeting the requirements for the systems of innovation information support within RSES, including RES, is grid. According to Y. Arskov, V. Tsvetkov and S. Yashukov, modern infrastructures in the conditions of RSES [9, p. 32-36], - (grid) support joint and coordinated use of heterogeneous resources in dynamic, distributed virtual organizations, allowing, from geographically dispersed components, to form virtual computing systems designed to jointly maintain the required level of service. The actual power of the "grid" concept is concealed by the very word "resource", which is understood as extremely broad: it is everything that takes part in computer processing of data. In particular, resources should include communications, storage systems, data warehouses, ISs as well as software funds. So, if the data analysis application is understood as a resource, then it means possibility of remote access to it without installing on the user's computer.

In terms of implementation technology, modern grids have become a powerful and flexible tool for integrating distributed information and computing resources through the use of web and grid-oriented architectures. Modern grid provides infrastructure to support any globally distributed information processing for a variety of application types.

Another technological concept of integrating heterogeneous for distributed resources possessing great potential is Peer-to-Peer (P2P) interaction [10]. The essence of the P2P concept lies in organizing equal, symmetric interaction between all units of distributed system. Peer interaction protocols provide logical integration and flexible access to distributed information resources as a single entity. The main advantage of this technology is that in P2P-network there exist mechanisms for self-organization, that is, general and centralized coordination is not required to find information and access paths to it. This decentralization provides a high level of extensibility, resistance to failures and scalability in comparison with the classic client-server information systems [10, p. 216].

One more modern technology that integrates heterogeneous geographically distributed resources is the multi-agent systems (MAS). The main advantage of MAS technology is ensuring asynchronous interaction between system agents. The asynchronous operation and communication of agents provides the opportunity to work in conditions of heterogeneous, unreliable communications, which is very relevant for the systems of a regional scale. The active nature of mobile agents, on the other hand, positions MAS as an effective means of distributed data processing. The autonomy of agents and the possibility of their co-operation ensure the creation of flexible, easily reconfigurable distributed systems. Support of ontology by the agents allows creating advanced definitions of inhomogeneous information resources. Thus, multi-agent systems are able to meet all of the above requirements for the systems of information support for innovation development [11].

It should be noted that currently there are developments of the systems that combine architectural concepts and technological features of all three above considered technologies for building information support systems for economic and innovation activities within RSES.

The theory and practice of using information tools for regional development are moving towards each other, but the significant gap between them and the low level of demand for information of regional economic measurements reflect the list of unsolved problems: determining the users of regional economic information; creating database in the form that is necessary for different users; forming a number of autonomous branches that meet the needs of different groups of users within the information system.

The following subsystems of information tools for regional development, which are demanded by economic practice, are distinguished:

- 1) analytical subsystem intended for the users who have direct economic interests in the regional system;
- 2) internal monitoring subsystem intended to inform the users who have indirect interests in the

region;

3) external monitoring subsystem which generates information for the users having no strong interest in the region.

Each of the proposed branches in the system of information tools for regional development is able to generate information of different types and degrees of accuracy. In analytical subsystem the detailed and structured information on the subjects, processes, resources and results of the region development prevails. In internal monitoring subsystem, generalized, but widely structured information is formed that allows different variations of accuracy. Finally, in external monitoring subsystem, generalized information is used, which is usually retrospective.

Conclusions. The proposed structure of information tools system for regional development will solve the problem of demand for regional information resources, since it will provide an opportunity to meet different needs of users by natural combining tools on the basis different types of registers and building information arrays in the forms necessary for users.

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Науменко Наталія Юрївна, кандидат технічних наук, доцент. Державний вищий навчальний заклад «Український державний хіміко-технологічний університет». **Регіональні інформаційні інструменти забезпечення розвитку регіональної соціально-економічної системи.** Приділено увагу аналізу системи інформаційних інструментів забезпечення соціально-економічної діяльності регіонів України та відмічено, що система нині перебуває на етапі свого становлення, для якого притаманні поява та апробація нових способів та інструментів регіональних економічних вимірів, накопичення, аналізу й оцінювання інформації. Проаналізовано різноманітні підходи до цього питання. У сучасних умовах на життєдіяльність суспільства зростаючий вплив здійснює рівень економічної безпеки та інформаційні процеси. Автором запропоновано під інформаційними інструментами забезпечення розвитку регіональних соціально-економічних систем розуміти засоби відображення реальних господарських явищ та економічних інтересів, аналіз, оцінювання прийняття управлінських рішень, які мають потенціал формування нового знання про стан економічних систем. Розглянуто два різних рівні суспільних потреб у регіональних інформаційних інструментах; зазначено фактори, котрі визначають склад потреб користувача вказаних інструментів у просторі регіону; запропоновано виділити три групи користувачів інформаційних інструментів забезпечення економічної безпеки регіонів на основі застосування розмежувальної ознаки характеру економічного інтересу. Як інструменти інформаційного забезпечення регіональних систем економічно-інноваційного розвитку та забезпечення економічної безпеки регіону розглянуто створення інформаційних систем зі швидким реагуванням на динаміку процесів і з різномірними

інформаційними ресурсами. Проаналізовано три технології побудови системи інформаційної підтримки економіко-інноваційної діяльності. Запропоновано розглядати такі підсистеми інформаційних інструментів регіонального розвитку: аналітичну, внутрішнього моніторингу та зовнішнього моніторингу.

Ключові слова: інформаційні інструменти, інформаційна система, економічна безпека регіону, регіональний простір.

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Naumenko Nataliia, Ph.D. in Engineering Sciences, Associate Professor. State Higher Educational Institution "Ukrainian State University of Chemical Technology". **Regional Information Tools for Providing Development of Regional Socio-Economic System.** The article focuses on the analysis of information tools system for ensuring socio-economic activity of the regions in Ukraine. The author proposes to understand the means of displaying real economic phenomena and economic interests, analyzing, assessing and making managerial decisions that have the potential to form new knowledge about the state of economic systems as information tools for the development of regional socioeconomic systems. The paper considers two different levels of social needs in regional information tools. The factors that determine the composition of user needs as to the indicated tools in the region's space are indicated; it is proposed to distinguish three users groups of information tools for providing regions' economic security by applying distinctive feature of economic interest nature. The creation of information systems as information tools for regional systems economic-innovative development and ensuring economic security of the region is considered. The paper deals with such subsystems of information tools for regional development as analytical, internal monitoring and external monitoring.

Key words: information tools, information system, economic security of the region, regional space.

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Науменко Наталья Юрьевна, кандидат технических наук, доцент. Государственное высшее учебное заведение «Украинский государственный химико-технологический университет». **Региональные информационные инструменты обеспечения развития региональной социально-экономической системы.** Уделено внимание анализу системы информационных инструментов обеспечения социально-экономической деятельности регионов Украины, и отмечено, что система в настоящее время находится на этапе своего становления, для которого характерны появление и апробация новых способов и инструментов регионального экономического измерения, накопления, анализа и оценки информации. Проанализированы различные подходы к этому вопросу. В современных условиях на жизнедеятельность общества растущее влияние оказывает уровень экономической безопасности и информационные процессы. Автором предложено под информационными инструментами обеспечения развития региональных социально-экономических систем понимать средства отображения реальных хозяйственных явлений и экономических интересов, анализ, оценку и принятие управленческих решений, которые обладают потенциалом формирования нового знания о состоянии экономических систем. Рассмотрены два разных уровня общественных потребностей в региональных информационных инструментах; указаны факторы, определяющие состав пользователей названных инструментов в пространстве региона; предложено выделить три группы пользователей информационных инструментов обеспечения экономической безопасности регионов на основе применения разграничительных признаков характера экономического интереса. В качестве инструментов информационного обеспечения региональных систем экономически-инновационного развития и обеспечения экономической безопасности региона рассмотрено создание информационных систем с быстрым реагированием на динамику процессов и с разнородными информационными ресурсами. Проанализированы три технологии построения системы информационной поддержки экономико-инновационной деятельности. Предложено рассматривать следующие подсистемы информационных инструментов регионального развития: аналитическую, внутреннего мониторинга и внешнего мониторинга.

Ключевые слова: информационные инструменты, информационная система, экономическая безопасность региона, региональный пространство.