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**INTELLIGENT TECHNOLOGIES AND CREATION OF THE INFORMATION
INFRASTRUCTURE OF MARKETING SPATIAL SYSTEMS**

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Summary

Spatial sciences are getting more and more popular worldwide at the last decade. Simultaneously intelligent information systems and technologies are evolving actively. This paper deals with issues of Russian and international researches in the area of spatial economics. The paper considers the new marketing paradigm - marketing of spatial interaction. The main goal of this paper is consideration the main features of contemporary intelligent information technologies and systems application for spatiotemporal analysis and creating the infrastructure of marketing spatial data.

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Introduction

The Information Society has become one of the dominant paradigms of post-industrial society. According to the currently prevailing conception - the information society development is characterized by a number of peculiarities, among which the most important are such as increasing the role of information and knowledge in society, the creation of a global information space, the development of the knowledge economy and innovative approaches to the use of modern information and communication technologies (ICTs). The theory of the Information Society considers the information and media as the primary source of social development (Chen & Dahlman, 2005; Kazantsev, Serova E, Serova L, and Rudenko, 2007; Serova, 2012).

At the present stage of Russia development use of the latest achievements in the field of ICT in economy and management, including the methods and tools of computer modeling and systems of distributed artificial intelligence, is one of the factors in improving organizational performance and increase its competitiveness. Their successful integration into the information structure of the enterprise, improves the quality of goods and services, enhances customer satisfaction, increases productivity, saves cost of labor and on materials, etc.(Krichevskii, 2005; Serova, 2007, 2012;). ICT can govern the ability of companies to generate the sustainable business models (Chesbroug, 2003, 2006; Osterwalder and Pigneur, 2010; Serova, 2013). In industrial countries, in spite of the much more favorable parameters of informatization, the questions of selection and application of modern information systems and technologies for strategic business objectives and market needs are also in the spotlight (Albright, Zappe, and Winston, 2011; Moshella, 2003; Turban, Leidner, McLean, and Wetherbe, 2008).

Simultaneously spatial science, as an area of interdisciplinary scientific research, has become especially popular in the last decades. Nowadays spatial aspects are one of the very well-known objects of analysis of the different knowledge fields. Spatial economics can be defined as the science of how space affects economic behavior. In domestic (Russian) as well as foreign journals the number of publications devoted to the issues of spatial organization of economics and related disciplines are growing rapidly (Bagiev et al, 2012; Granberg, 2000, 2009; Minakir, 2006; Minakir and Demyanenko, 2011; Serova, 2013). On the other hand, intelligent information systems and technologies are evolving actively. These technologies and systems are based on information and communication resources that belong to the class of synergistic resources. The class of intelligent information technologies (IIT) and systems, including neural network (NN), fuzzy logic, multi-agent systems (MAS), belonging to the class of expert systems, continue to improve. (Borshchev and Filipov, 2004; Karpov, 2005; Serova, 2007, 2012, 2013). The practical use of IIT is closely related to the management of information resources, technologies and services, the design of information systems architectures.

Research Aim and Objectives

The attention of many scientists, including researchers in the field of spatial sciences, in particular, spatial economics, more and more focused on the study of such important elements in the formation of the spatial relationships at all levels, as the information infrastructure and architecture of spatial information systems. Spatial Data Infrastructure (SDI) formation bases on increasing the use of spatial information in sustainable development of territories. Methodology and methods forming of spatial, especially information infrastructures, should be one of the major areas of researches in the study of spatial economic objects at all levels of the hierarchy and should be the basis of interdisciplinarity and harmonization of the conceptual approaches in the fields of spatial sciences (Krasnopol'skii, 2010: 155).

This paper deals with the issues of Russian and international researches in the field of spatial economics and marketing of spatial interaction. The main goal of this paper is consideration the features of contemporary intelligent information technologies and systems application for spatiotemporal analysis. The objectives are the study of issues of creating the infrastructure of marketing spatial data, and design of sustainable adaptive information architecture of marketing spatial systems. The rest of this paper is structured as follows: Methodology and theoretical background;

Intelligent information technologies and systems application for marketing spatial research; Research expectations and implications.

Methodology and theoretical background

The definition and conceptual framework of the Spatial Sciences are still in the stage of discussion and debate. Several scientific schools of spatial economics were founded in Russia: in St. Petersburg and Moscow, Far Eastern school, Siberian school, and the Ural school. The Economic Research Institute of the Russian Academy of Sciences (RAS), with the support of the Scientific Council for Regional Development at the RAS Presidium has been publishing the academic journal "Spatial Economics" since 2005.

Significant contribution to the development of the spatial approach was made by academician of Russian Academy of Sciences - Granberg A.G. He was the initiator and ideologist of the RAS research program for 2009-2011 - "Fundamental problems of spatial development of the Russian Federation: an Interdisciplinary Synthesis". In accordance with the basic hypothesis of the program the spatial science is defined as an interdisciplinary scientific area, and the objects of research are forms and processes of a modern society, which are space-dependent (Granberg, 2009). Three propositions are offered as a conceptual basis. They related to the spatial, regional and international aspects. The first proposition affirms that every category of economic activity and vital activity has its own space (spatial aspect). All kinds of special spaces have common characteristics: the extension in different directions, position relative each other in space, nodes (centers), networks, etc. The second proposition concerns the regional aspect and supposes that the spatial science is considered as more broad research area, rather than "regional science." The third proposition is devoted to the international aspect and the author had formulated it as follows: the strategic goal of the program is to provide theoretical and methodological foundations of forming harmonious and competitive space of Russian Federation integrated into the world space (Granberg, 2000). Speaking about the development of methodological and methodical tools of interdisciplinary research in the field of spatial sciences, we should also mention such fundamental studies as the monograph of Minakir P.A. (Minakir, 2006) and the textbook written by Granberg A.G. (Granberg, 2000).

In the other countries the attention to the scientific research in sphere of spatial sciences and spatial development is also growing. "Journal of Spatial Science" has being published in Australia (information available from the website: MSIA mapping science institute, 2012). Famous international publisher Springer has produced more than 40 volumes of the series "Advances in Spatial Science" (information available from the website: Springer, 2013). U.S. National Science Foundation (NSF) has approved a strategic plan for research in 2008-2012 entitled "Geography Spatial Sciences" (information available from the website NSF National Science Foundation, 2013).

Great importance, both in Russia and in the other countries, is given to the development of global, regional and national spatial data infrastructure. The most important initiatives in this field are the existing international programs: Infrastructure for Spatial Information in Europe, National Spatial Data Infrastructure, Global Spatial Data Infrastructure, and Global Monitoring for Environment and Security. As for Russia, the general architecture of the Russian segment of the information infrastructure has already established. The main its components and technologies of its integration into one of the world systems had determined. (Krasnopol'skii, 2010: 155-156).

The major advantage of the spatial approach is the ability of multidimensional representation of spatially localized complex systems, in which the economic, ecological, social, geographical, political, and technological components interact. These components are determining the functioning equilibrium and development of the region, as well as creating conditions to maximize region's contribution to the development spatial systems of higher level. The basis of the spatiotemporal concept to marketing is the principle of systemic approach and consideration of marketing system as a large complex system consisting of elements of different types having heterogeneous relationships between them. Spatial system of marketing is treated as a complex system, a set of subsystems and their relations in many dimensions: social, industrial, territorial, etc.

According to Bagiev et al, (2012: 219-224), the transition to the marketing of spatial interaction requires a reforming of the existing market information system and a changeover to an Information Marketing-Management (IMM). In this context the role of IMM is considered as a replicator of interaction between marketing system and information business space. The information space is regarded as a set of market subjects and relations under forming and use of information resources. Thereby marketing information system is the interface to the system of spatial interaction of business subjects.

Bagiev (Bagiev, et al, 2012) defines marketing space as a set of interrelated and interacting relations on the creation, distribution and use of unique values, i.e. it is the single integrated system. Interdisciplinarity of marketing spaces researches consists not only in expanding the subject of research (joint study of the different types of spaces), but in the synthesis of notions, concepts and methodologies of the social, humanitarian, sociological and engineering sciences, modeling and prediction of interaction and mutual influence of different kinds spaces, a generalization of the theoretical results creating interdisciplinary databases.

Intelligent information technologies and systems application for marketing spatial research

Multi-Agent Systems as a system of distributed artificial intelligence, integrated into the structure of the company, may be considered as an effective tool spatiotemporal analysis of marketing information resources. Integrating client oriented strategy (Customer Relationship Management) and multi-agent approach allows creating marketing spatial data infrastructure (Serova, 2012, 2013). With the using Agent Based Modeling we can obtain and analyze geospatial data, create models, linked to geographic coordinates and to develop of geoinformation marketing infrastructure.

Multi-Agent systems and agent-oriented programming are the next step in the development of Object-Oriented programming (OOP) and integrate the achievements of the last decades in the field of artificial intelligence, parallel computing and telecommunications.

Any MAS consists of the following components:

- The set of organizational units, which contains a subset of agents and objects;
- The set of objects;
- Environment (business ecosystem), i.e. a space in which agents and objects exist;
- A set of relations between the agents;
- The set of agents (e.g., operations on objects).

In the design of multi-agent systems, as a rule, there are three levels: conceptual description, initial design and detailed design (Kalchenko, 2005).

Agent technologies usually involve the use of certain typologies of agents, their models and MAS architectures. These technologies are based on appropriate agent libraries and tools which serve for support development of different types multi-agent systems.

Integration of customer-oriented technology and multi-agent approach, in other words, the implementation of a CRM (Customer Relationship Management) strategy with the using multi-agent systems in order to create infrastructure of marketing spatial data can consist in the following:

- Creation of agent-based model and prediction the behavior of customers, both regular and potential;
- Work coordination of the dealers and remote subdivisions using multi-agent system;
- Automation and improvement of Customer Support process within the concept of CRM;
- Accumulation of knowledge and skills of workers marketing and sales departments in the knowledge bases of the respective agents;
- The development of an integrated multi-agent Internet portal with the purpose of management of agent of users' personal data;
- Creating a search agent to monitor external information.

Research expectations and implications

Formation of spatial data infrastructure for marketing (Marketing Spatial Data Infrastructure, MSDI) determined by the problem increased use of spatial information in sustainable development of the territories and is one of the perspective areas of research in the field of spatial marketing spatial systems. Based on the theoretical and empirical researches the author believes that spatiotemporal analysis of marketing data can be performed through the applying of contemporary intelligent information technologies with using multi-agent systems as systems of distributed artificial intelligence. Architecture of marketing spatial system can be considered as a concept, which determines the model, the structure, functions and components' relationship of the marketing information space. Building a sustainable and adaptive architecture of marketing spatial systems is possible based on the applying of hybrid technologies, which combine neural networks and fuzzy logic. Neural networks and fuzzy logic - are methods related to Soft Computing (SC). The term "Soft computing" was introduced by the founder of fuzzy logic Lotfi Zadeh and used in computer science to refer the problems whose solution is not predictable. The essence of this approach is that, in contrast to traditional computing methods, soft computing focused on adaptation to inaccuracy and uncertainty. Soft computing is a set of computing methodologies that provide the basis for understanding, design and development of intelligent systems (Kecman, 2001; Krichevskii, 2005; McNelis, 2005).

The future research will be devoted to the issues of modeling complex marketing spatial systems, creating and analysis of marketing spatial data infrastructure with the help of modern intelligent information technologies which allow creating models of interaction between different kinds of spaces.

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