ARCHITECTURAL DESIGN OF SUSTAINABLE INFORMATION SYSTEMS

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Summary

The theory of the information society considers the information and media as the primary source of social development. At present the use of the latest achievements in the field of Information Communication Technologies (ICT) in economy and management, including the contemporary methods and tools of computer modelling is one of the key factors in improving organizational performance and increasing its competitiveness. This paper focuses on the various modelling methods and techniques that are employed in the design of management information systems (MIS) architecture. Its goal is to evaluate the role of modelling for spatiotemporal analysis of marketing information system. The paper also considers the main features of soft computing (neural network and fuzzy logic) and discusses its implementation for design of sustainable adaptive architecture of spatial information system. It does so from a research base that draws from theoretical underpinnings as well as international and domestic industry practices.

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1. Introduction

Distinctive features of the successful Russian companies are sustainable business model, innovation, adaptability, and a deep understanding of consumer preferences. In Russia today the use of advanced information technologies in economy and management is a key factor in improving organizational performance and increasing competitiveness (Krichevskii, 2005; Serova, 2007, 2012). 80% of Russian executives believe that information communication technologies are playing a dominant role in the use of innovative business models and strategic goals realization.

ICT can reduce operating costs and increase profitability. Influenced by information technologies the activities of the company's basic departments (marketing, sales, and finance) are changing. This is due to the more efficient accumulation and analysis of information. ICT can govern the ability of companies to generate the sustainable business models (Chesbroug, 2003, 2006; Osterwalder and Pigneur, 2010; Serova, 2013a).

At the same time spatial science, as an area of interdisciplinary scientific research, has become especially popular in the last decades. On the other hand, intelligent information systems and technologies are evolving actively. These technologies and systems are based largely not on the tangible, but 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 (FL), and Multi-Agent systems (MAS), belonging to the class of expert systems, continue to improve (Serova, 2013c). IIT are developed rapidly over the past ten years and they allow creating models of interaction between different kinds of spaces.

It also should be noted the fact that the attention of many scientists, including researchers in the field of spatial sciences, in particular, spatial economics, more and more focuses on the study of such important elements in the formation of the spatial relationships at all levels, as information infrastructure and architecture of spatial information systems.

This paper deals with the issues of Russian and international researches in the field of design of sustainable information architecture of management systems in the context of spatial economics. The main goal of this paper is consideration the features of contemporary intelligent information technologies and systems applications 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 spatial information systems. The rest of this paper is structured as follows: Theoretical background, methodology and literature review; Results and findings; Conclusion.

2. Theoretical background, methodology, and literature review

Information system (IS) architecture

Variety of information systems applications for solving problems in management and economics has led to the requirement of using of information processes and technologies together with systems approach based on information systems architecture. When it comes to what actually is meant by the term "information system architecture", there is not usually lack of definitions. For example, there are a few tens of system architecture definitions on the site of Software Engineering Institute (SEI, 2014). Here are some of them:

— The architecture of a system is an abstraction of the system giving the semantics and specification for the patterns of information content and context.

— System architecture defines the physical, logical and information elements of the system which come together to realise a required set of functionality.

— Architecture is the identification of different building blocks of the system according to their responsibilities, external properties of these blocks and their interrelationships.

— Architecture - the organizational structure of a system.

— Architecture defines the data, processes, and components that make up the overall information system, and provides a plan from which products can be procured—and systems developed—that will work together to implement business solutions. Simply put, architecture provides the direction to make technology work for the business.

— Architecture is defined by the recommended practice as the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.

Architecture of management information system can be considered as a concept, which determines the model, the structure, functions and components' relationships.

The term "Enterprise architecture" is usually used concerning organizations and as shown in Figure 1, the next main types of architectures are assigned (Sovetov et al, 2012):

- Business architecture,
- Information technologies architecture,
- Data architecture,
- Application architecture or Software architecture, and
- Hardware architecture.

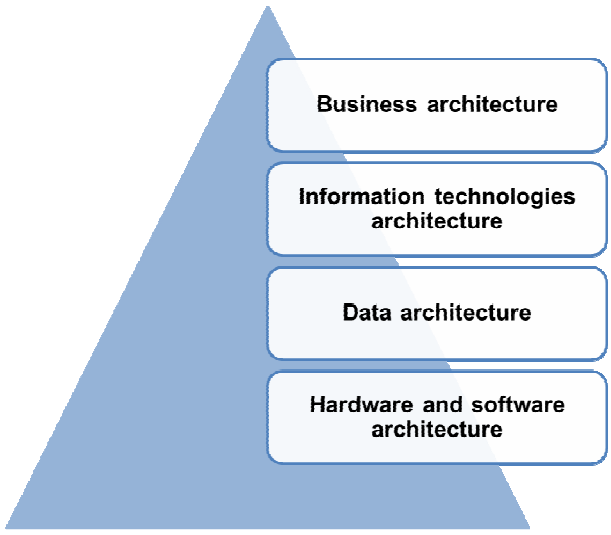

Figure 1: Information system architecture

Typically, information systems are focused on the use and satisfaction of customers' needs within a specific subject area. As examples of information systems application for solving problems in economics and management can be specified the following:

- Enterprise management information systems,
- Trading information systems,
- Marketing information systems,
- Geographic information systems,
- Health care information systems, etc.

The group of modern enterprise management systems, in the first place, includes Enterprise Information Systems (EIS) - systems using various information technologies. EISs serve for data processing of different information flows on the different management levels.

It should be noted that there is no generally accepted classification, but as a rule, the strategic level systems include analytical retrieval systems technology-based Data Mining, expert information systems (EIS), Executive Support Systems (ESS), and Decision Support Systems (DSS). IS of the middle management level include Knowledge Management Systems (KMS) and Management Information Systems (MIS). Transaction Processing Systems and Office Automation Systems are used on the operation level of management (Pearlson et al, 2006; Rainer et al, 2006; Kazantsev et al, 2007; Turban et al, 2008; Serova 2012). Today in the publications on the topic of business efficiency and competitiveness of enterprises, many names and acronyms are mentioned, such as Product Lifecycle Management (PLM), Supplier Relation Management (SCM), Customer Relation Management (CRM), and ERP. These names come after the concepts and management techniques used by successful companies. Interest in them is growing in Russia. Leaders of Russian companies are increasingly turning to the experience of the use of solutions that help integrate the people, information and business processes to effectively manage all areas of business. The term ERP — Enterprise Resource Planning, is one of the key issues in this series of current concepts. According to Serova (2012b), the recent trends in the development of enterprise information systems are associated with the intention to use information generated within the company, in the external environment to ensure cooperation with other enterprises, customers and partners. Today we should take into account the new concept of Enterprise Information System: the emphasis is placed on the EIS which is opened for the all partners operating in common business interests instead of on traditional internal business process management optimization. This concept includes five new tendencies (Serova, 2012b):

- *Change the role of ERP system.* Automation the internal business processes as well as external, counteragent relationships: customers, suppliers, banks, tax authorities;
- *The system technologies move towards an openness and transparency.* Internal processes are becoming more open. Information and data about activity of an enterprise can be available for business society member. Use of Web-technologies.
- *Structural changes of system architecture*. Instead of closed monolithic platform – open multilevel applications built on concepts of service-oriented architecture (SOA). Use E-SOA;
- *Expansion of system implementation.* Adaptation for enterprises of different kinds and sizes;
- *Deepen the system functionality.* All enterprise business processes should be automated;

Brief history and theory of "economic space"

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. RAS's research program "Fundamental Problems of Spatial Development of the Russian Federation: an Interdisciplinary Synthesis" was started in 2009.

In accordance with the basic hypothesis of the program, spatial science is defined as an interdisciplinary scientific direction, and objects of research are forms and processes of a modern society, which are space-dependent (Granberg, 2009). Three statements are offered as a conceptual basis. They related to the spatial, regional and international aspects. The first statement affirms that every category of economic activity or vital activity has its own space (spatial aspect). All kinds of spaces have a number of common characteristics: the extension in different directions, position

relative each other in space, nodes (centers), networks, etc. The second statement concerns the regional aspect and supposes that the spatial science is considered as more broad research area, rather than “regional science”. The third statement is devoted to the international aspect and the program’s author had formulated it as follows: the strategic objective 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, 2009). Speaking about the development of methodological and methodical tools of interdisciplinary research in the field of spatial sciences, we should also mention such Russian 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 of the public to scientific research in the area 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 direction 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. What is important concerning Russia is, that the general architecture has created and the main components of the Russian segment of the information infrastructure and its integration into the world system have defined (Krasnopol’skii, 2010).

The concept and theory of the “economic space” was formed in compliance with geographic, geopolitical, and regional concepts. And now an economic space is considered in the framework of concepts of globalization, industrial spatial clusters, “cumulative causation”, high information technologies and networks. Analysis of points of view on the economic space can be divided into four approaches to the study of this category: territorial, resources, information and process (Bagiev et al, 2012).

The territorial approach has long dominated over the other approaches. The essence of this approach is based on economic space as a saturated territory having a plurality objects and the relationships between them. Resource-based approach determines the economic space as an environment for decision making about use of resources. The essence of the information approach is that economic space is considered as the information component of the economic process. Information approach adequately reflects the role and importance of information exchange between business entities. Process-based approach gives reason to determine the economic space as a relationship between economic processes of business entities and aggregate economic process with the purpose of formation of the possible outcomes of economic activity. Adding the marketing function to the structure of the functions of economic space is dictated by the need to replicate the economic space in time under the influence of scientific and technological progress, innovation, transformations in the environment due to the constant changes in requirements and fluctuations of supply and demand (Bagiev et al, 2012).

Intelligence Information Technologies for design of spatial marketing systems architecture

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 determine the functioning equilibrium and development of the region, as well as creating conditions to maximize region's contribution to the spatial systems development 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 and 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.

Interdisciplinarity of spatial marketing researches consists not only in expanding the subject of research (joint study of the marketing spaces of different types), but in the synthesis of notions, concepts and methodologies of the social, humanitarian, sociological and engineering sciences, modelling and prediction of interaction and mutual influence of different kinds spaces, a generalization of the theoretical results and creating of the interdisciplinary databases.

The use of modern modelling methods and technologies are now essential components for developing management decision process that will enable companies to succeed in a rapidly changing environment. It is noteworthy that simulation is now considered an essential feature of decision making in companies that actively employ modern information technologies. The increasing demand for optimization of architecture of spatial marketing systems has caused leading modelers to consider intellectual information technologies and computer modelling in order to obtain deeper insights into complex and interdependent processes.

Modern modelling tools should facilitate mutual understanding at different organizational levels when making strategic management decisions thus bridging the gaps between a strategic vision and its implementation. One approach involves multi-agent systems (MAS) which, as a class, have developed rapidly over the last decade. The advantage of a multi-agent approach relates to the economic mechanisms of self-organization and evolution that become powerful efficiency drivers and contribute to enterprise's development and prosperity. New intellectual data analysis can be created, through MAS which is open, aimed at flexibly adaptive problems solving, and deeply integrated in decision support systems (Serova, 2012a). Modern business modelling tools use special software, programming languages and systems to develop models of business processes, relations between people and areas for optimization in the organizational structure as a whole.

Building a sustainable and adaptive architecture of marketing spatial systems is possible on based of the applying of modern modelling methods and technologies.

The major approaches (or methods) in simulation for business are: System Dynamics (SD), Discrete Event (DE) and Agent Based (AB). While SD and DE are traditional approaches, AB is relatively new.

System Dynamics is "…the study of information-feedback characteristics of industrial activity to show how organizational structure, amplification (in policies), and time delays (in decisions and actions) interact to influence the success of the enterprise" (Forrester, 1961). The range of SD applications includes also urban, social, ecological types of systems. In SD the real-world processes are represented in terms of stocks (e.g. of material, knowledge, people, money…), flows between these stocks, and information that determines the values of the flows. SD creates abstractions of single events and entities and develops an aggregate view that concentrates on policies. When approaching a problem with SD methodology one must describe the system behavior as a set of interacting feedback loops, including their balancing or reinforcing behavior (Borshchev, Filipov, 2004). One of the well-known examples of classic SD model is Bass Diffusion Model.

Discrete Event modelling can be considered as definition of a global entity processing algorithm, with stochastic elements. This modelling approach roots to 1960s when Geoffrey Gordon conceived and evolved the idea for GPSS (General Purpose Simulation System) and brought about its IBM implementations (Gordon, 1961). The term Discrete Event modelling or Discrete Event simulation are commonly used for the modelling method that represents the system as a process, i.e. a sequence of operations being performed over entities such as customers, parts, documents, etc. These processes typically include delays, usage of resources, and waiting in queues. Each operation is modelled by its start event and end event, and no changes can take place in the model between any two discrete events. The term discrete has been traditionally used to distinguish this modelling method from continuous time methods, such as SD. With the emergence of Agent Based modelling the term Discrete Event modelling in its traditional sense created confusion since in most agent

based models actions are also associated with discrete events, although there may be no processes, entities, or resources (Karpov, 2005).

Compared to SD or DE models, AB models do not allow the definition of global system behaviour (dynamics); instead, the modeler defines behaviour at individual level, and global behaviour emerges as a result of the actions of multiple actors, each following its own behaviour rules, living together in some environment and communicating with each other and with the environment (Borshchev, Filipov, 2004; Serova, 2013c).

Agent technologies offer various types of agents, model of their behavior and characteristics, through a range of architectures and components libraries. The notion "Agent" has developed from the well-known concept of 'object' which is an abstraction from a collection of real-world items with the same qualities and behavioral rules.

Among the various classifications of agents, one of the most widely known is: *Intellectual – Mobile – Stationary.*

Agent qualities are determined by their classification. Intellectual agents have the most comprehensive set of qualities; their intellectual capacity allows them to build virtual worlds where they form action plans. Minimum set of basic characteristics for any agent includes qualities such as (Gavrilova, Muromtsev, 2007):

- Activity – the ability to organize and carry out actions;
- Autonomy (semi-autonomy) – relative independence from the environment and a certain "freewill" given a good supply of behavioural resources;
- Sociability – created by the necessity to carry out tasks in cooperation with other agents and supported by communication protocols;
- Purpose – innate sources of motivation, or, more generally, special intentional characteristics.

This is closely aligned with one of the most popular definitions of agent by Wooldridge – (2002).

In addition to characteristics we can add:

- Adaptability – the ability to learn and reason. Agents may possess partial knowledge or inference mechanisms, as well as specialize knowledge in a subject matter;
- Reactivity – functional perception of the environment and adaptation to changes therein. This includes basic knowledge, creeds, wishes, commitments and intentions.

The technologies that have been used to successfully develop agents and multi-agent systems include:

- Knowledge-based systems;
- Neuron networks;
- Clustering algorithms;
- Fuzzy logic;
- Decision trees;
- Bayes' theorem;
- Genetic algorithms;
- Natural language processing.

Serova (2013c) argues that Multi-agent systems - as systems of distributed artificial intelligence - herald an era of networked organizations that are supported by the interaction of intellectual robots. This facilitates the shift from powerful centralized systems to fully decentralized ones, with hierarchical structure being replaced by a networked organization. Rigid, bureaucratic "from top to bottom" management is displaced by negotiation, and planning with flexible

arrangements. As a result, production volumes, profitability, competitiveness and mobility are growing. A significant advantage of the Multi-Agent System approach relates to the economic mechanisms of self-organization and evolution which become powerful efficiency drivers for development and success of an enterprise. The Multi-Agent approach allows the creation of new intellectual data analysis which can be open, flexible and adaptive, and deeply integrated with other systems.

This does not mean however that Agent Based modelling is a replacement for System Dynamics or Discrete Event modelling. There are many applications where SD or DE models can efficiently solve the problems. If the problem's requirements fit well with Discrete Event or System Dynamics modelling paradigms – using these traditional approaches is more appropriate. In cases where the system contains objects with timing, event ordering or other kinds of individual and autonomous behaviour, then applying Agent Based or mixed approaches is more efficient (Serova, 2013c).

3. Results and findings

Multi-Agent Systems as a system of distributed artificial intelligence, integrated into the information structure of the company, may be considered as an effective tool for spatiotemporal analysis of marketing information resources and creating of architecture of spatial marketing information system. With the using Agent Based Modelling we can obtain and analyse geospatial data, create models, linked to geographic coordinates and to develop of geoinformation architecture of complex marketing systems.

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:

- A set of organizational units with a subset of agents and objects;
- A set of tasks;
- A business ecosystems - a space where agents and objects exist;
- A set of relations between agents;
- A set of agent actions (operations on objects).

Intellectual agents have the most comprehensive set of qualities; their intellectual capacity allows them to build virtual worlds where they form action plans. Minimum set of basic characteristics for any agent includes qualities such as activity, autonomy, adaptability, and reactivity.

In the design of multi-agent systems, as a rule, there are three levels: conceptual description, initial design and detailed design. At the first level one should describe the organizational structure, goals, business processes and information support all of which act as a foundation for the next level's ontology. On the next two levels these elements form the organizational visualization - the virtual world where agents act using the ontology to achieve their goals and carry out the set of tasks.

The world's best known and most widely approaches to Multi-Agent System development are OMG MASIF (Object Management Group), which is based on the concept of mobile agents; specifications by FIPA (Foundation for Intelligent Physical Agents) based on an agent's assumed intellectuality; and standards by the Defence Advanced Research Projects Agency (DARPA) such as Control of Agent Based Systems.

As systems of distributed artificial intelligence, Multi-agent Systems have the following advantages which can be successfully use for marketing spatial research (Serova, 2013):

- They speed up task fulfilment through parallelism and reduce the volume of data transmitted by passing high-level partial solutions to other agents;
- They are flexible since agents of various capacities are used to carry out a task dynamically cooperatively;
- They are reliable given that functions that one agent is unable to carry out will be passed to other agents.

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.

Applying multi-agent systems in order to design information architecture of marketing spatial systems can consist in the following (Serova, 2013c):

- To simulate and forecast clients' behaviour, both adopted and potential ones';
- To coordinate dealers and remote divisions based on multi-agent system;
- To automate and improve the customer support process within the CRM concept;
- To store knowledge and skills of marketing and sales specialists in the relevant agents' databases;
- To develop an integrated multi-agent Internet portal for agents to keep users' personal contents;
- To create a search agents to monitor outside information;
- To organize a distance-learning portal.

Sustainability of architecture of spatial marketing system is determined by the stability of its structure, state parameters, and the most important is the stability of the current processes of its functioning and development. Adaptability of spatial marketing system first of all means its flexibility and property of adjusting itself under varying changes. Adaptive architecture of marketing information system is a methodology to create a more flexible and rational, customizable architecture that allows organizations of any size to react promptly to market and information flow changes. Design of sustainable and adaptive information architecture of spatial marketing systems is possible based on the applying of such intelligence information technologies as neural networks and fuzzy logic.

Neural networks and fuzzy logic - are methods related to Soft Computing (SC). Applying the information and communication technologies, which are used in Soft Computing, allows achieving the quantitative results, which is very important for manager to make a decision. Fuzzy set were introduced by Lotfi A. Zadeh as a means of representing data that was neither precise nor complete. There are two main characteristics of fuzzy systems that give better performance for specific applications: the first is that fuzzy systems are suitable for uncertain or approximate reasoning and the second is that fuzzy logic allows problem solving and decision making on the basis of incomplete or uncertain information. Fuzzy technologies as technologies of artificial intelligence are now having a significant influence on information systems design and analysis (Kecman, 2001; Krichevskii, 2005; McNelis, 2005).

4. Scoring model of marketing information system sustainability

Design of sustainable and adaptive information architecture of spatial information systems is possible based on the applying of such intelligence information technologies as Neural Networks and Fuzzy Logic. NN and FL - are methods related to Soft Computing. It is noteworthy that Fuzzy Logic is now considered an essential feature of decision making in companies that actively employ modern information technologies. Applying the information and communication technologies, which are used in soft computing, allows achieving the quantitative results, which is very important for manager to make a decision. Fuzzy set was introduced by Lotfi A. Zadeh (Zadeh, 1994) as a means of representing data that was neither precise nor complete. There are two main

characteristics of fuzzy systems that give better performance for specific applications: the first is that fuzzy systems are suitable for uncertain or approximate reasoning and the second is that fuzzy logic allows problem solving and decision making on the basis of incomplete or uncertain information. Fuzzy technologies as technologies of artificial intelligence are now having a significant influence on information systems design and analysis (Kecman, 2001; Krichevskii, 2005; McNelis, 2005).

Fuzzy logic models employ fuzzy sets to handle and describe imprecise and complex phenomena and use logic operations to find a solution. A block diagram of Fuzzy logic model is represented in Figure 2.

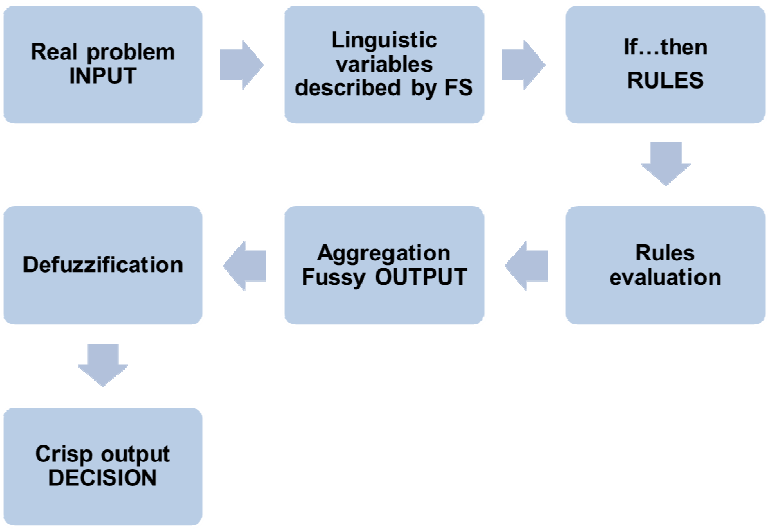

Figure 2: Block diagram of FL model creating

This section of the paper is devoted to the creation of FL model with the purpose of assessment of product diffusion system sustainability (Krichevskii, Serova, 2014, being printed). Potential Adopters become Adopters at Adoption Rate that depends on advertising and word of mouth promotion. The Fuzzy Inference System (FIS) is for three input variables and one output parameter. The input parameters are advertisement (ad), contact rate (cr), number of potential adopters (npa). Three selected attributes are included as input data to a fuzzy inference system. The output parameter determines the Information System sustainability as the adoption fraction (af).The control objective is to find the output value for a particular set of input variables. Each of input parameters is the linguistic variable with three terms: *low, middle, big*. Membership functions characterize the fuzziness in a fuzzy set in a graphical form for eventual use in the mathematical formalisms of Fuzzy Set theory. All calculations were performed in MATLAB v. 7.01. The next step is definition of the FIS rules. The number of the rules is the product of the number of terms in each input variable: 3*3*2 = 18. After forming bases of rules FIS gives the values of IS sustainability as conditional units. We finally get a crisp value of the output which represents the values of IS sustainability. The model displays the value of sustainability equal 0.12 for given set of input variables: ad = 6.8; cr = 26.1; nap = 11.The fuzzy approach for assessing of IS sustainability was supplemented by the regression equation in conclusion. In the first step all input variables were modeled by Monte-Carlo method. In the second step the modeled inputs were introduced into the FIS and the values of IS sustainability were formed as outputs of the FIS. Table 1 contains the modeled inputs and the values of IS sustainability calculated by FIS (the fourth column).

Table1: The modeled inputs and calculated outputs

	X1	X2	X3	Y (Fuzzy Logic)	Y(Regression)
2	5,0	34	0,18	0,04	0,070
3	3,6	20	0,11	0,092	0,109
4	5,9	35	0,14	0,041	0,085
5	7,4	36	0,12	0,153	0,144
6	7,3	38	0,20	0,149	0,149
7	8,1	42	0,15	0,163	0,128
8	2,2	22	0,26	0,102	0,069
9	5,1	32	0,13	0,04	0,077
10	7,1	35	0,08	0,14	0,127
11	3,9	29	0,07	0,063	0,024

In the third step the regression equation was derived with the use the first four columns of Table 1. The regression equation is of the form

$$Y = 0.085+0.046*X1 - 0.01*X2 + 0.33*X3,$$

Where $X1$, $X2$, $X3$ - are advertisement, contact rate, number potential adopter; Y - value of IS sustainability.

The last column of Table 1 contains the value of IS sustainability which is calculated by the regression equation. The comparison of the values of IS sustainability calculated by FIS (the fourth column of the table 1) and the regression equation (the fifth column) shows their similarities. Thus the derived regression equation can be used to assess the value of IS sustainability.

5. Conclusion

Formation of architecture of spatial management information system is determined by the cause of increased use of spatial information in sustainable development of the territories and is one of the significant areas of research in the field of spatial information systems. Theoretical and empirical researches prove that spatiotemporal analysis of data can be performed through applying of contemporary intelligent information technologies with using multi-agent systems as systems of distributed artificial intelligence. Architecture of spatial information system can be considered as a concept, which determines the model, the structure, functions and components' relationship. Building a sustainable and adaptive architecture of management information systems, including marketing information system, is possible with the use of soft computing methods, such as fuzzy logic.

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