INNOVATIVE DECISION MAKING TOOLS USED IN TERRITORIAL PLANNING AND URBAN MANAGEMENT

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Abstract. In modern cities, decision-making in urban planning activity is related with the analysis and processing of a large amount of data describing the state of all urban subsystems, which involves the participation of specialists in many fields of science and practice. Today, these tasks are performed in a scientific way, based on experience and qualification. The main objective of the CRISALIDE project is the development of a decision support system for urban environment management. It is envisaged to be used by representatives of state authorities and local governments, enterprises and local organizations, as well as by individuals working in fields like sustainable development, social innovation, information or communication technologies. Modern methods and geo-information systems are used to improve efficiency of urban management and to reduce the planning costs at different levels. The expected result when achieving the main objective of the project is the IDMT tool (Integrated Decision Making Tool), an online platform based on IGIS (Intelligent Geographic Information Systems), which aims to support local authorities from the city of Rostov-on-Don (Russia) in order to streamline the urban management and to reduce redundant planning costs.

Key words: urban planning, co-participation, GIS, schemes, IDMT

1. Introduction

Urbanization is a great opportunity for supporting innovative choices and urban solutions. Many cities, worldwide, are evolving and positioning themselves in the new economic and financial context. Strategic, smart and integrated urban management is a key tool to promote durable growth and effective processes of innovation. In urban planning a new step is represented by the shift between the classical decision-making based on ideology to a more evidence-based approach (Davoudi 2006). Evidence-based planning requires the use of the best scientific information for decision-making (Faludi and Waterhout, 2006).

CRISALIDE project (ERA.Net RUS Plus Program) focuses on the enhancement of a long-term collaboration in the field of research and innovation among researchers, companies (technology providers) and the public sector through the design and implementation of an innovative Integrated Decision Making Tool. The members of the CRISALIDE project consortium are experts (researchers, planners and technology developers) ensuring the appropriate implementation of the project.

The participants in this project are:

- **Project Coordinator:** The Southern Urban Planning Center Ltd, SUPC (Rostov-on-Don), **the Russian Federation.**
- **Project Partner 1:** URBASOFIA, **Romania.**
- **Project Partner 2**: The Eastern Macedonia and Thrace Institute of Technology, EMaTTech Forestry Department, **Greece.**
- **Project Partner 3:** The National Institute for Research and Development in Constructions, Urbanism and Sustainable Spatial Development URBAN-INCERC, URBANPROIECT branch, **Romania.**
- **Project Partner 4:** SPIIRAS Hi Tech Research and Development Office Ltd., SPIIRAS-HTR&DO Ltd., **the Russian Federation.**
- **Project Partner 5:** CORP-Consulting Research Projects DI Manfred Schrenk KG, **Austria.**

1.1. Context

In many cases, the human decision is attenuated and less optimal as the complexity of the problem and external stressors increase. The need to improve the quality of decision-making process and to reduce the likelihood of misjudgments gives rise to intensive research in this area. From this point of view, technology plays an important role under the following conditions:

- should meet the needs of users;
- should correspond to local conditions (such as climate, energy availability, education, etc.).
- should be exploited in the long run;
- people should be educated and trained in the use of technology.

Making the best decision involves the access to a large quantity of information followed by a complex process for its analysis and synthesis. The ability to collect, process and analyze the information that public administration should have is far beyond human limits. To overcome these limits in the decision-making process, means of communication and information technology are used, especially those to support the decision. Already accepted definitions of Decision Support Systems (DSS) identify the need for a combination of the following components: a database, an interface, and a model - geared toward a specific problem (Sprague, 1982).

Geographic Information Systems (GIS) provide an excellent environment for data integration and a basis for a spatial decision support system (Cowen, 1988). A GIS supports the decision-making process, and provides ways to examine and choose alternative solutions by decision makers beyond the mere possession of data, information and knowledge. GIS plays a significant role in Spatial Decision Support Systems (SDSS), while organizing, presenting and comparing spatial data and information. GIS capabilities for generating a set of alternative decisions are mainly based on the principles of the spatial relationship of connectivity, contiguity, proximity and overlapping methods. In urban planning the GIS allows a better flexibility in assessing alternative scenarios (Thompson and Hardin 2000).

The GIS distinct contribution to decision-making process lies also in its ability to store and manipulate data based on the spatial location. Choosing the most efficient solution by decision makers require a high volume of data and consequently more powerful computers. In the early years of using GIS, powerful and expensive mainframe computers were needed, which could not be easily used in a flexible way. Nowadays, the development of sophisticated GIS applications has required the use of computer systems with high speed and increased storage capacity, needed to process queries for large amounts of data.

1.2. Objectives

The scientific novelty given by the development of such an innovative decision support system for urban management consists in the **active combination** of technological, social and organizational innovation with spatial planning and urban management, which will ensure joint activities of various stakeholders in all stages of research, design and system implementation, creating thus a platform that integrates the physical and informational profile of the city. Such integration will determine synergistic effects in the urban economy and the emergence of new processes of formation and evolution of urban space, as an additional resource for economic development.

The purpose of the proposed information system is to develop a decision-making assistance system for urban management. The system will be created with the support of public authorities and local administrations, business and non-governmental organizations, individuals involved in sustainable development, social innovation, information technology and communications. It is based on modern analytical methods and geo-information systems, improving the efficiency of urban management and reducing costs of planning at different levels.

2. Methodology

To achieve its objectives, the CRISALIDE methodology is based on a simple vision: the establishment of a multi-stakeholder group for a sustainable collaboration in the field of R&D&I through participatory workshops (IDS design) and the implementation of an online collaboration platform (IDMT). The methodology will implement changes in decision making at local level, allowing a participatory approach which will include key multilevel stakeholders (institutions, enterprises, NGOs, R&D, etc.) in a long term local partnership.

Accomplishing a methodology for designing a decision support system takes into account the following considerations:

- Decision making on urban development is associated with the need to analyze a large number of urban aspects together with different specialists in certain fields of science and practice: urban planning and design, construction and management. Decision support system technology is only one ingredient in the successful implementation of the system.
- A successful urban planning and decision-making process for urban development requires a collaborative participation between a wide ranges of stakeholders. The design of the

decision support system should be based on similar principles.

- Designing the decision-making assistance system should become a source of social and organizational innovation and a basis for further cooperation between the representatives of different fields of knowledge and economic activity.
- The project of the decision-making assistance system in the field of urban management should become a bottom-up initiative, which will support and materialize the state initiatives in the field of development and innovation within urban programs and projects.
- The project should take into account existing limitations in data complexity and quality, organizational, legal, financial and other types of opportunities in the field of urban development decision-making. The system should operate efficiently under existing conditions and should be able to be further developed.
- The new technologies currently used in urban planning change these processes, as well as the decision-making process in the field of urban development.
- The design methodology should focus on defining the objectives of various stakeholders that influence urban development decisions. It should identify and extract available information from all kind of actors and should define a set of indicators to measure project success, opportunities, constraints and specific conditions in different areas of urban development.

The software and hardware system was designed to integrate decision-making processes when developing territorial and strategic plans and drawing up urban planning policies. The result of the system implementation will be a strengthened long-term cooperation between researchers, companies and the public sector in the field of research and innovation.

2.1. Responsibilities

URBAN-INCERC is part of all work packages (WPs) within the CRISALIDE project. Its team was involved in developing the manual describing the methodology of organizing the participatory workshops which were later implemented during the project. Also it was responsible with the analysis of the local context and governance in the city of Rostov-on-Don, with the stakeholder mapping and with the research concerning participatory activities.

Tea team contributed to the establishment of IDS (Innovative Development Schemes) in domains such as energy, environment and climate change; social innovation and information communication technologies, new and emerging technologies; information and communication technologies (ICT) related to tourism, agri-food and cultural heritage activities. IDSs are the basis of the online collaboration platform (IDMT), which ensures the sustainability of the project due to the constant harmonization of interests between stakeholders and decision makers. Finally, in order to design and implement the IDMT platform, the URBAN-INCER team developed Smart Indicator Schemes in order to test the functionality of the platform in the case of the city of Rostov-on-Don.

As for capitalizing and transferring results, URBAN-INCERC contributes to the development of a Guide of IDMT Replication, which describes the functionality of the Platform and its novelty.

2.2. The structure of IDMS/IDMT

The innovative system to support the decision making process in the field of urban management is focused mainly on the integration of decision-making processes when designing the city strategic and territorial plans, when formatting the city policy, promoting e-government, managing the city infrastructures and housing stock, transforming the former production areas into other types of development (scientific parks, incubators, network of clusters of small and medium enterprises).

IDMS/IDMT is a hardware-software complex based on IGIS system. IGIS can integrate maps of different formats, evaluate scenarios in urban development modeling, perform 3D modeling, and can support 2D modeling. It ensures a decision-making process based on expert knowledge and has the ability to monitor changes and to assess the possible impact of decisions in the city.

The DSS should have:

- an evolutionary continuity, ensuring a gradual transition from the existing systems to the perspective ones, by integrating the already operating systems with the new systems as they are created;
- compatibility;
- a high productivity;
- reliability and error tolerance;
- all software components of the system should be upgradeable;
- the software of the stationary workstation should work as far as possible without installing additional software on the user's computer.

The IDMS/IDMT is implemented on the basis of client-server technology. This technology assumes the functioning of the system on the principle of "request-response". The software system consists of two interacting parts, one of which, called the client, performs an active function of initiating requests and the other, called the server, responds to these requests. According to this technology, the data storage software (database) is located on the server. The interface for user interaction with the system is on the client side. To avoid inconsistency of the operation, data processing is carried out on the server side. It is called „server-2.5-level client server architecture”. Besides, data processing modules are distributed on several separate servers (for example, processing of the spatial data is carried out on a cartographic server, working with the objects specific for the city is carried out on a server of objects, etc.). In addition, different servers can communicate with each other by redistributing functions among themselves (Fig. 1).

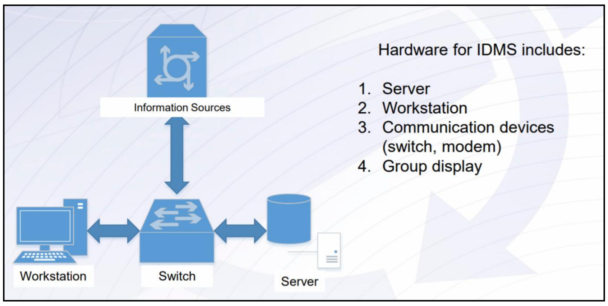

Fig. 1. Architecture of local area network for IDMS.

The architecture of the IDMS includes the following components:

- a basic component of the decision support system for urban management;
- an expert subsystem;

- a geo-information interface;
- a subsystem of urban management calculations;
- an electronic subsystem for documents exchange;
- a background component;
- a server with map information;
- a subsystem for administration;
- a component for information exchange;
- a subsystem of graphic symbols.

The central part of IDMT is a complex database, including a basic set describing the objects of the urban environment and the relations between them (e.g. transport infrastructure, engineering communications, residential areas, public areas, etc.). Another component of the database contains the aggregation of real objects from the urban environment.

- *The Expert system.* It is an important part of IDMT. It includes a mechanism of logical conclusions and a set of logical rules stored in the central database.
- *The GIS interface* consists of a set of components that allow the user's interaction with the system and integration of software components ensuring the functionality of the system.
- *The basic software component of the IDMT* is the system that ensures the development and maintenance of basic structure. On its basis, a unique GIS information area is created, which connects its other components.
- *The Cartographic information server* ensures implementation of the mechanism of access to spatial data.
- *The Administration Server* provides: resource allocation; access control for users and other components; management of system settings and operation modes; a history of the system operations.
- *The Electronic Document Exchange Subsystem.* The basic problem of a subsystem of electronic document circulation consists in transformation of the information contained in documents, to appropriated data formats.
- *The information and references component* is intended to provide reference assistance and information to the user of the integrated system, on a topic of interest.
- *The Calculation subsystem for urban environment management* is intended to support the decisions of city administration officials and other interested persons on typical functional tasks of the city.
- *The Information exchange subsystem* is designed to ensure interaction with the external information systems of the city.
- *Graphic symbol subsystem* is designed to store graphic thumbnails of the subject area.
- *The software interface* is designed to access a single object model of the whole system.

The scientific novelty of the development of the innovative decision support system in urban management consists in the active combination of technological, social and organizational innovations with territorial planning and urban management. This will ensure the joint activities of various stakeholders in all stages of research, design and system implementation and will create a platform that integrates the physical and informational aspects of the city.

3. Results

The expected results are:

- Creation and implementation of an Innovative Decision Making Tool (IDMT) in the pilot city of Rostov-on-Don.

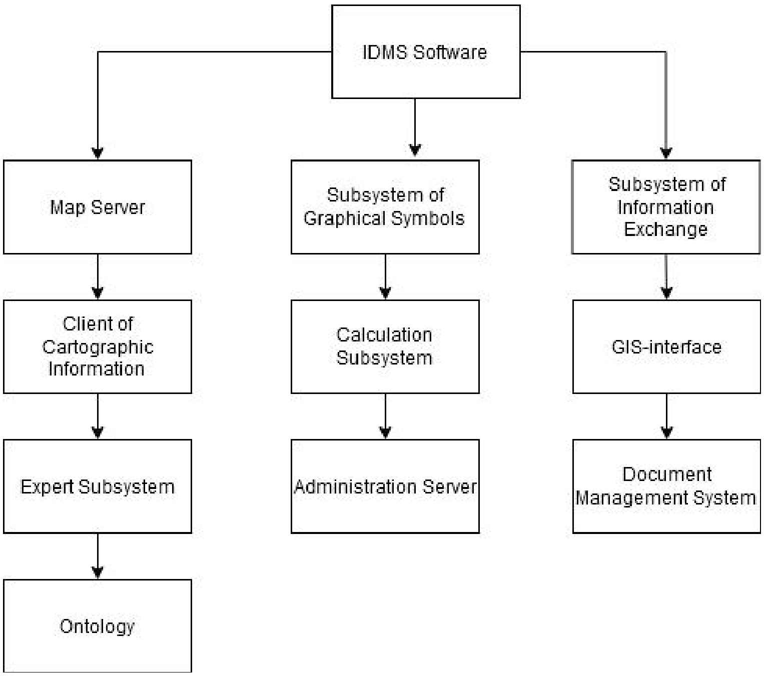

Fig. 2. Architecture of IDMS software in CRISALIDE project.

- Creating the network of stakeholders in the field of research-development-innovation.

The project is under development. Concerning the IDMT platform, the following results were obtained:

The IDMS software was designed according to the requirements presented above. It has practically 3 subsystems (Fig. 2).

The tasks of the Calculation Subsystem (Fig. 3) include:

- Integrated territory development (6 sub-tasks concerning territorial data and parameters calculation).
- Territory redevelopment.
- Assessment of availability of services on the territory under development.
- Distribution of new services on the territory under development.

The operator can define the input method of territory development boundaries and can define limitations for territory development and choose the limitations which will be used by IDMS for calculations. Also the operator can define realized functions for territorial development, such as residence functions, public space, industry, municipal and storage, recreational or agricultural functions.

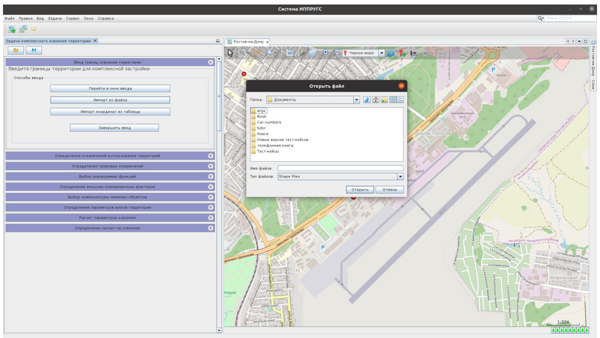

Fig. 3. IDMS software: calculation window and GIS interface in CRISALIDE project.

Using GIS-interface tools, the operator can define the external planning factors for territory development, such as: outside transport territory, city's main road territory, water / agricultural / recreation areas and others.

Public objects for development can be also defined by operator, such as standard public objects – shops, offices, markets, bank offices and others – or unique public objects – cultural, health, scientific and others.

Operator can also define three types and comfort levels of residential – individual or townhouse construction and apartments, having as comfort levels business, economy and municipal.

The final report shows the scheme of the development territory (Fig. 4).

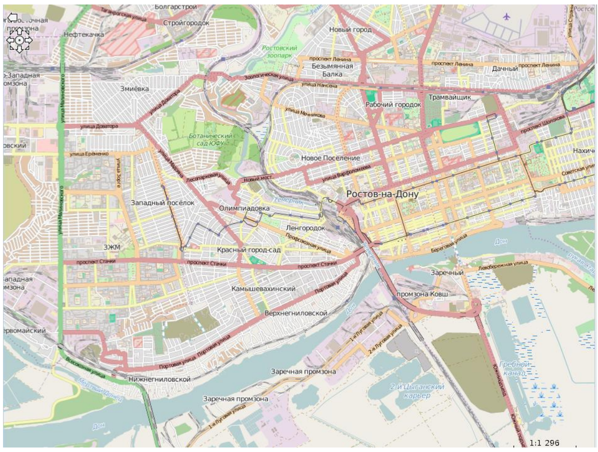

Fig. 4. The IDMS report on the development territory in CRISALIDE project.

4. Conclusions

According to some researchers, the urban planning support system should serve as a single information structure, combining theory, data, information, knowledge, methods and tools related to urban planning. The approach of the CRISALIDE project is to contextualize the requirements for a decision support system based on national, regional and local conditions, which will ensure its most efficient operation. The CRISALIDE project is based on the principle of participatory design. Its methodology is based on a simple vision: a multi-stakeholder team must be formed to support collaboration in research, development and innovation through joint activities. CRISALIDE focuses mainly on the second and third levels of influential participation - consultation and cooperation - in order to achieve long-term collaboration in research and innovation between developers, researchers, technology providers and the public sector. Active collaboration with various local actors is one of the key elements of the successful design and implementation of an innovative tool to support decisions and implementation in urban and territorial planning.

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