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CARTOGRAPHIC VISUALISATION AND INFORMATION SOCIETY

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ABSTRACT

The need for learning and using a variety of geospatial information has progressive character in the modern information society. Cartographic visualization of geo-referenced data, provides a more effective presentation and accessibility of knowledge of the geographic space. Digital technology offers great possibilities for cartographic visualization of complex geo-data structure, thereby improving the communication process. The diversity of cartographic 3D and 4D visualization is constantly increasing, and therefore the area of application in various fields of science is constantly being developed. The need for dynamic, interactive maps, and the growing use of geographic information systems leads to a specific development of cartography. The application of GIS technology include: visualization of geospatial data, linking of the spatial and attributive data and interdisciplinary decision-making. GIS technology improves graphic and visual modeling of geospatial data in qualitative and quantitative terms.

Key words: cartographic visualization, information society, an interactive map, GIS technology.

INTRODUCTION

The application of modern information and communication technologies is present in all areas of human society and is gaining greater importance as it allows a high level of efficiency in the implementation of various human activities. Modern IT, e-society, its functioning and development cannot precede without adequate knowledge of integrated geospatial data. Information based on reliable spatially and temporally referenced data and the full implementation of the standards, allow for their efficient use. Cartographic visualization of intergated geospatial data makes them clear, obvious and easy to use, and allows their better and faster distribution and

availability. Users from a map, as a model that includes a large number of integrated different datasets, get through it relevant, high quality and homogenized integrated geospatial information from a variety of sources. By using a map one can identify spatial information in an efficient way for various needs (personal and / or professional).

CARTOGRAPHIC VISUALIZATION OF GEOSPATIAL DATA

The need for learning and using a variety of geospatial information, is progressive in its character in modern - the information society. The use of geospatial data requires a high degree of their organisation in order to effectively operate the mutual alignment of numerous research activities and meaningful practical applications. The high level of efficiency means that it is possible to, in a short period of time, collect, process, disseminate and interpret large amounts of geographic data. Data processing involves their transformation into a form that is understandable to a wider audience. Map as a model of objective reality can express this the best, because it is a source of rationalised information for presentation and research. By cartographic presentation of geospatial data their transfer and cognitive processing is effectively done.

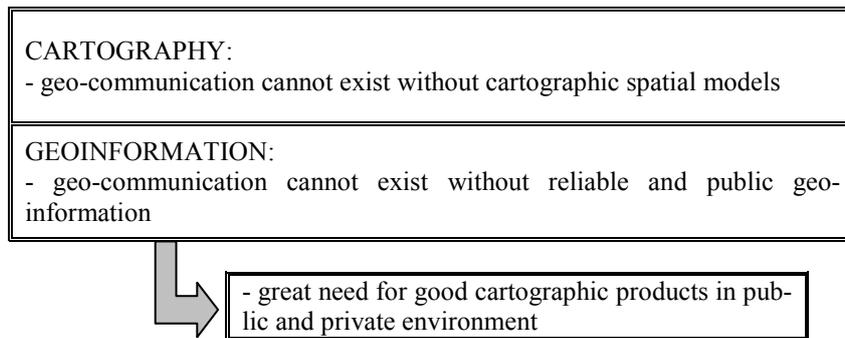


Figure 1. Link between Cartography and Geoinformation
(Lechthaler, Stadler, 2007)

Cartographic visualization of georeferenced data, provides a more effective presentation and accessibility of knowledge of geographic space, an efficient level of interactive contact, and communication between many users. Using advanced technology and updated digital map makes available information merged from multiple sources easier to use. Maps are graphic expressions of a set of geoinformation, and channels for disseminating information on the phenomena related to the location. By using digital maps we improve quality of communication.

Cartographic visualization is a graphical procedure related to the production of cartographic models, which allows the expression and presentation of geospatial data for studying and research. Map as a complex model of geographic space, allows the materialization of knowledge about the real world and graphic - visual interpretation of that knowledge (Jovanović, 2010). "Modern need for the information includes not only knowledge of the facts and increasing the fund of factual knowledge about the world around us, but also the comprehension of the meaning of acquired facts, thus understanding the complex nature of the events and their implications for the future course of action ... To mediate knowledge, through properly structured, formatted graphic information is a complex process and is realized in the process of cartographic communication." Jovanović (2007a, p. 451)

"Man invented the map in order to hold the world in his hands" (L'Atlas du Monde diplomatique, 2006)

The information revolution has brought many changes in the field of cartography, especially applied cartography. Modern technology has influenced the emergence and development of digital mapping. Digital maps, as a contemporary medium of presentation of geospatial data are widely used in many areas of life. Contemporary trends, determined by progressive development of technology for the collection and distribution of geodata for effective management of existing resources and future planning of their activation, and global trends in various activities include the creation of maps as an effective medium for the various forms of scientific and practical research.

Modern cartographic visualization of geospatial data is particularly important in the case of interactive map. The importance is reflected in the different way of presenting the content depending on the degree of interactivity. Unlike static maps, where there is a unique level of detail of contents, dynamic maps have a visual hierarchy of thematic geodata logically presented, i.e. defined content for each level separately. With interactive dynamic maps there is a direct link between the graphical presentation and the database. That is, sets of geospatial data presented in the form of graphical content are further enhanced by bases of supporting, necessary data.

The introduction of spatial form in 3D and 4D format allows obtaining the complex information which couldn't have been provided by a traditional 2D presentation. Applied modern technical resources can meet the growing demand for various, systematically related information which was not possible through a conventional manner of presentation of geospatial data. Interactive maps, 3D and 4D models, as well as contemporary forms of cartographic visualization provide, in addition to presentation of different levels of requested detail, also requests for additional information, control of the animation [...] Updating the content over time creates a basis for estab-

lishing a digital archive of geospatial forms, which can be used in different projects. The complex and diverse geographic space research emphasize the necessity for creating unique archival geoinformation systems based on standards. Controlled systematic collection, storage, analysis, processing, and presentation of geospatial data via modern technology should enable this. Using standards in digital geospatial information facilitates the exchange of high-quality structured geographic data sets. Sets of standards should be structured in such way as to "describe in detail: methods, tools and services, data management (including definition and description), the collection, processing, analysis, display and exchange of information in digital electronic environment between different users, systems and locations [...]. The ultimate goal of applying the standards is to:

- Contribute to the understanding and use of geospatial information;
- Contribute to the availability, access, integration and sharing of geospatial information;
- Improve the efficiency, effectiveness and economic benefits of digital geospatial information with the help of hardware and software systems;
- Contribute to universal access to addressing global environmental and human problems." Bulatović (2011, p. 108)

Map as a georeferenced digital picture of geospatial data files is a suitable means of displaying and distributing them via the Web. Publishing of geospatial data via the Web helps to meet the growing demand for customized geospatial data by a growing number of users. In the process of mapping models have multi-functional role. In addition to static, there are more and more dynamic, interactive Web maps, which makes the Web possibilities unlimited for the cartography.

On the Web, visual distribution of geospatial data creates specific conditions and great opportunities for the design of maps, especially interactive. The various functions of maps on the Web should be considered in the context of technical background (support) and basic users' questions such as: What can be done and how it can be presented with the existing tools and data? It is necessary to clearly define the characteristics (metadata) from the perspective of static and dynamic reading of the map. Designing of Web maps is a challenging task. Cartographers must take into account the characteristics and capabilities (strengths and limitations) that provides Web, as in the creation of content, so as in considering, planning and definition of possible user actions. Users of Web maps should be attracted by high-quality presentation of geospatial content (accurate, clear, up to date, attractive ...). The quality map is realized by combining the functionality of its content with adequate levels of visual attraction, geographic information design, presented content that matches the media. Cartographic design must be in the function of exact cartographic representation. The way of visualization of content elements depends on the defined purposes. In particular,

this refers to the hierarchical levels of connectivity in the interactive map. Cartographic visualization depends on the available applicable Web solutions. (Kraak, Brown, 2001)

Internet as a medium for the presentation and dissemination of geospatial data today is an indispensable instrument in the acquisition of diverse knowledge in all forms of human activity. Modern computer technology enables faster, bigger and better accessibility and topicality of geospatial data, presentation and research through visualization of not only known geospatial data but also including variables and possible variables. The Internet has changed the way of creating and using maps, and expanded their distribution. Previously associated with the paper as a medium (conditioned by printing technology - format, colors ...), the map had limited distribution and use. Today, the Internet enables not only the distribution of maps to multiple users, but it also provides great variety and possibility of interactions and animations during their use. Sophisticated interactive maps are increasingly used for information retrieval - providing users fast access and understanding of information. Using multimedia interactive maps enabled more effective communication.

The variety and availability of geospatial data by using advanced information and communication technologies redefines and integrates the basic objectives of cartography. Geo-informational concept integrates images of the map as a model, and as a means of collection, transformation and transmission of information. (Берлянт, 1996) In the modern information society, the knowledge of the geographic space is increasingly based on various forms of cartographic visualization, because it allows an efficient system organization, presentation, communication and use of geospatial data in graphic, digital and tactile form.

SIGNIFICANCE OF THE GIS - IMPLEMENTATION IN VISUALIZATION OF THE GEOSPATIAL DATA

The modern development of the society, its functioning and managing of resources, determined by global trends is based on knowledge as a primary resource. In this context, needs and requirements for knowledge of the geospatial data are of primary significance. Adequate and efficient use of geographic data enables to apply GIS, based on accurate and updated information.

Application of GIS enables the efficient planning and management in various areas of life. The application of GIS technology includes:

- Visualization of geospatial data. GIS provides a graphical representation of various data sets. Visualization of geospatial data and their relationships through interactive, dynamic maps allow the meaningful application solutions in the process of system analysis. It is believed that of all syste-

matically collected data, more than 80% cover geospatial data that are used in almost all spheres of human activity. GIS technologies enable development of applications for registration, monitoring, analysis, solving concrete problems and present solutions. Any change in the database reflects the changes in the content of the map;

- Linking of spatial and attributive data. Their introduction into digital form increases the degree of processing and allows better interpretation, analysis, reasoning and decision making;

- Interdisciplinary decision making. Interdisciplinary connections of different skills increase the potentials of GIS. By combining different but relevant, professional, scientific fields and modern technical achievements, especially in multimedia forms of visualization of collected and processed geodata, the degree of coordination efficiency between information flows and linking of geospatial data is increased.

GIS improves graphic and visual modeling of geospatial data in qualitative and quantitative terms. It has increased the possibilities of cartographic visualization (speed and manner) of a number of different realistic and abstract geospatial phenomena and processes, and their causal relations and connections in relation to the purpose, function and purpose.

GIS processes geospatial data, information associated with position, integrates information within the system and thus provides a consistent framework for geospatial analysis. GIS is a special form of information systems applied to geographic data, a computer-based tool for mapping and analysis of events and real systems. The basis for the development of a GIS is based on cartography, thus integrating geospatial and other data. GIS technology integrates operations with databases, such as searches, queries and statistical analysis with the benefits of visualisation and spatial analysis, using the benefits of maps. By placing the maps and other geospatial information into digital format, GIS allows to view knowledge on geo data in a new, more objective way. It allows its users to search, display, query, find and update maps on-line. Maps are essential functions of GIS, they present geodata in a way that other media cannot. The GIS maps are created from the GIS data base. Change in the database are automatically reflected in the contents of the maps. GIS allows the integration of geographic data according to which one creates and analyzes the content of the map. Cartographic models in GIS are certain geoinformation layers in numerical or graphical form, often in conjunction with other views. (Jovanović, Živković, 2012)

The modern information society requires high quality and fast integrated geospatial information for optimal management of resources, making effective and correct decisions on the continuing development of local, national, regional and global levels. The establishment of geospatial data infrastructure enables the exchange of harmonized and standardized geospatial data

from different sources and different data owners, making them easily accessible to users via the Internet. As such it has a range of different applications. Geospatial information, unified in a common infrastructure, provide various opportunities for improving public services, contribute to better planning and decision-making and reduce costs ensuring not duplication and inconsistency of data.

Creating a geodata infrastructure requires continuity in terms of efficient quantitative and qualitative provision and maintenance of geospatial data, their access and exchange, improving service (finding, viewing, downloading, linking, and transformation), systematic, compatible and responsible linking of public and private institutions, managing and clearly accessing to geodata systems by various interest groups. Geospatial data should be adjusted to consumers' needs - easy to understand and interpret, documented adequately and visualized in a specific, meaningful context.

Geographic Information System (GIS) based on accurate, updated and standardized geodata enables modeling of real and abstract phenomena and processes. Standardization of geodata and procedures enables their applicability to internal, national, regional and global levels. The standards provide that "a set of geospatial data becomes interactive between the different models and different applications. In addition, a set of geospatial data should coexist with different data models and different levels of quality, whereas it is most important that the user knows where and how a data set can be used in the application... The spatial data collected and held by the national mapping and cadastral institutions are the frame of reference for all other spatial data." Aleksić (2011, p. 71) Efficient spatial data infrastructure should enable the successful use of available data sets for different purposes. Development and application of information technology should greatly facilitate the monitoring, planning and use of geographic space. Geospatial information are of essential significance in almost all aspects of social action (finding of integrated geodata from various sources, the access, use and exchange of geographic data and information).

SIGNIFICANCE OF CARTOGRAPHIC VISUALIZATION IN THE INFORMATION SOCIETY

The role and importance of cartography in exploring world has always been primary. Coverage of actual knowledge of reality and ways of its visual representation have been changing. Today, the development of Web-oriented cartography is influenced by the development of modern forms of visual communication in the process of learning about the reality. The need for dynamic, interactive maps, and the growing use of geographic information systems leads to a specific development of cartography. By conversion of geospatial data from the (graphic) database in the process of cartographic

visualization, their use becomes more efficient in terms of obtaining and exchanging information from local to global levels.

Digital technology offers great possibilities for cartographic visualization of complex geodata framework, thereby improving the communication process. The diversity of cartographic 3D and 4D visualization is constantly increasing, and therefore the area of their application in various fields of science is increasingly being developed.

Development of digital mapping and the growing need for cartographic products, increased number of users and their demands for appropriate geospatial data have influenced the role and importance of the maps – from the end products that provide geospatial information to the interim products that allow visualization of geospatial databases for different purposes. That is, the maps have become a primary means of interactive, dynamic survey of geospatial databases.

Map has a special power to integrate, through its visual ability, sets of geodata and to present the information content in a user-oriented and user-friendly visual and tactile way. The quality of the map depends on the quality of data visualization and on the geographic data quality. Geovisualization, besides its technical execution - modeling of geographic data, is oriented towards management of data by the users in relation to the level of their professional, cartographic knowledge and skills, and the tasks and areas of application.

The process of visualization enables gaining knowledge about the past, present and future, through gaining known or unknown information. Successful cartographic visualization is based on the fundamental cartographic theory and cartographic design principles, which application provides the effectiveness of the presentation and data modeling. Cartographic visualization is a cognitive process. By analyzing, the geospatial data is transformed into knowledge. (Virrantaus, Fairbairn and Kraak, 2009)

CONCLUSION

The modern development of information society, its functioning and management of resources, determined by global trends, is based on knowledge and information as basic resources. Knowledge of the geographic space is increasingly based on various forms of cartographic visualization, because it allows an efficient system organization, presentation, communication and use of geospatial data. The information revolution has brought many changes in the field of cartography, especially applied cartography. Modern technology has influenced the emergence and development of digital mapping.

Digital maps as a modern medium of presentation of geospatial data are widely used in many areas of life. "The significance of digital mapping, as

an information complex of spatially and temporally coordinated database on geo-systems of varying complexity and territorial coverage, is reflected through the need for accurate, complete, complex, multi-component, and quality information. It provides adequate and timely management and decision-making, and ensures the effectiveness of exploring the desired information in the process of using the database." Jovanović (2007b, p. 227) In this context, needs and requirements for knowledge of the geospatial data are of primary significance. Social need for geo-data in digital form and use of information and communication technologies have inspired the importance of building a spatial data infrastructure. The main characteristics of geospatial data infrastructure is the ability of geo-visualization of the geospace phenomena and processes, and of their interconnections and relationships. Cartographic visualization as a graphic procedure related to the production of cartographic models presents an instrument for rapid and efficient use of geo-referenced data in the implementation of scientific and practical research, planning and decision-making in many different areas of human activity. Geospatial data infrastructure enables 2D, 3D and 4D modeling, interactivity, animation and multimedia presentation in a process of different forms of analysis, simulation and visualization.

Web technologies and developed infrastructure of geospatial data allow usage and wide application of geodata; affirms the importance and development of specialized knowledge and creativity of users; increasing efficiency in making rational decisions in implementation of scientific and practical research, planning and space management. Geospatial data infrastructure emphasizes multidisciplinary of the geoinformation science and its implementation in practical use. Modern information and communication technology, with developed geo-data infrastructure, user-oriented, provides a quick and easy access to relevant geospatial data with the appropriate use of cartographic visualization.

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