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THE SPATIAL INFORMATION INFRASTRUCTURES: THE ROLE OF THE GEOINFORMATICS AND CARTOGRAPHY

Konečný Milan: The Spatial Information Infrastructures: The Role of the Geoinformatics and Cartography. Kartografické listy, 1999, 7, 3 figs., 28 refs.

Abstract: The article concentrates on the spatial information infrastructure characteristics and on the process of building these infrastructures especially in the U.S.A. On the background of the possible demands and conditions of existence of cartographic and geoinformation enterprises in the 10 years and more perspective, the author thinks about the most probable scientific agenda of geoinfoamatics and cartography. He analyzes the situation and possible starting points for the beginning of the conceptual creation of NSDI in the Czech Republic.

Keywords: National spatial information infrastructures, information infrastructures, GIS, GIS science, digital mapping, cartographic enterprise, information society.

Background

The development of the information society is nowadays a matter of the whole mankind. We are the witnesses of the number of continental and the beginning of the global activities. E.g. European Union pays attention to the creation of the European Information Society as a part of the work of different professional groups, such as Information Society Forum under EC in Brussels. The European ways and possible paths are defined and worked on, that will help in carrying the European point of view in building up an information society in different parts of the world. More and more attention is paid to building up a so-called global information society. But not all the time are the activities the same, they are mostly only similar. In the global range we can observe the marking of different things by the same terms. It is important to create a conception of the global information infrastructures, to build them gradually even in the level of the small countries. The most underestimated area by European politicians are the spatial information infrastructures (NSDI – National Spatial Data Infrastructure was used in this article). Cartographers and geoinformaticians (geomaticians) can be proud, that their activities significantly led to the creation of the GIS itself and especially to that in the U.S.A. and Australia the development of the digital methods in the field of spatial information helped to understand the place of the geographical information and initialized the idea of building up information infrastructures. In the present days, the matter of the relatively isolated development and simultaneous integration moves further. We now distinguish between the spatial information science and the GIS itself. Together with the creation of NSDI the research frontiers of disciplines, such as geography, cartography and geoinformatics, change. The development of these disciplines will be based on the on the development of the mapping agencies, respectively institutions, state and private and their guild, competition and complementation. The aim of this article is to suggest the possible development of the mapping agencies in the near future so as to name some of the scientific ways in the development of geoinformatics and cartography.

Development concepts of the national spatial data infrastructures

NSDI is developing in number of developed countries. For the need of this article we will concentrate mainly on the so called North American model which is successfully de veloped in the USA. There exists similar models but not identical, for example developed in Australia and New Zealand and also in some European countries, for example in Great

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Britain, Netherlands and Germany (DoE 1998, GI2000 1997). Some progress was achieved in some countries CEEC such as Hungary, Czech Republic, Slovakia and Poland.

European development described Konečný (1995, 1996) and Boes (1998). Bangeman report is considered as a milestone of the development of European information society, in the World activities developed since beginning of nineties in USA.

The detail overview of the US National Spatial Data Infrastructure development is given by Nancy Tosta (1997) and David Rhind (1997). During the early 1990's, the Mapping Science Committee (MSC) of the United States National Research Council began to investigate the research responsibilities and the future of the National Mapping Division (NMD) of the US Geological Survey. The MSC coined the phrase 'National Spatial Data Infrastructure' and identified it as the comprehensive and co-ordinated environment for the production, management, dissemination, and use of geospatial data. The NSDI was conceived to be the totality of the policies, technology, institutions, data and individuals that were producing and using geospatial data within the United States. The MSC (1993) report proposed a number of actions and responsibilities for various agencies and for the Federal Geographic Data Committee (FGDC) which related to their vision of the NSDI whilst another report a year later urged the use of partnerships in creating the NSDI (MSC 1994).

The FGDC adopted the term NSDI to describe a „national digital spatial information resource" and discussed the concept of the NSDI with the Clinton Administration teams which were exploring means to 'reinvent' the Federal Government in early 1993. The NSDI was recognised as an idea and a means to foster better intergovernmental relations, to empower state and local governments in the development of geospatial data sets and to improve the performance of the Federal Government. In September 1993, the NSDI was listed as one of the National Performance Review (NPR) initiatives to reinvent Federal Government. Vice-President Gore stated that '(I)n partnership with State and local governments and private companies we will create a National Spatial Data Infrastructure' (Gore 1993).

One of the primary means of implementing the initiatives arising from the National Performance Review was through Presidential Executive Orders. In April 1994, Executive Order #12906: „Co-ordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure" was signed by President Clinton, directing that federal agencies carry out certain tasks to implement the NSDI. These tasks were similar to those that had been outlined by the FGDC in its Strategic Plan a month earlier and since up-dated (FGDC 1997a,b). The Executive Order created an environment within which new partnerships *were not only encouraged, but required.* In practice, state and local governments will often voluntarily co-operate with federal agencies if this makes it likely to result in funding or improve their access to data. In addition, the Executive Order had significant effects in increasing the level of awareness about the value, use and management of geospatial data among federal agencies specifically. Perhaps more importantly, it raised the political visibility of geospatial data collection, management and use nationally and internationally.

That Order and the FGDC identified ***three primary areas*** to promote development of the NSDI. The first activity area is ***the development of standards***, the second ***improvement of access to and sharing of data*** by developing the National Geospatial Data Clearinghouse, and the third is the development of the ***National Digital Geospatial Data Framework***.

In its short lifetime, NSDI has generated huge levels of interest in the USA and beyond (see, for instance, Masser 1997). Some considerable successes have been achieved, notably in the formulation of some standards and the creation of the 'clearing house' of metadata. Perhaps its greatest success however has been as a catalyst, acting as a policy focus, publicising the importance of geospatial data and focusing attention on the benefits of collaboration – especially important in a country as large and governmentally complex as the USA. The process of involving many parties continues on several fronts; the MSC, for instance, has attempted to anticipate the most significant GIS developments to society in the period up to 2010 through a large and heterogeneous group drawn from many backgrounds (MSC 1997).

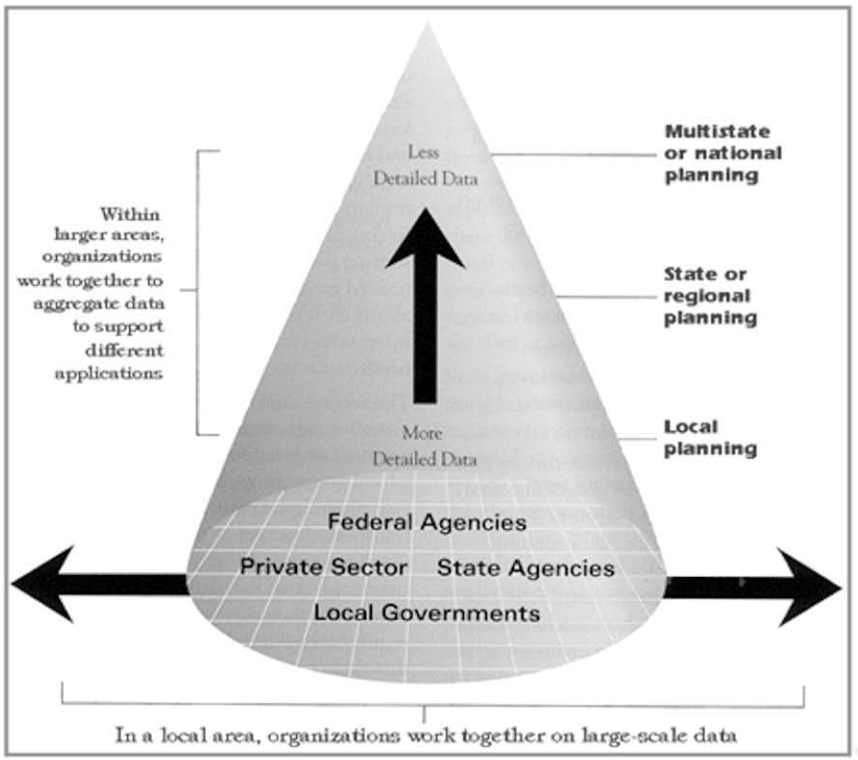

Fig. 1 Framework Data Integration in NSDI (adapted according to FGDC 1997b)

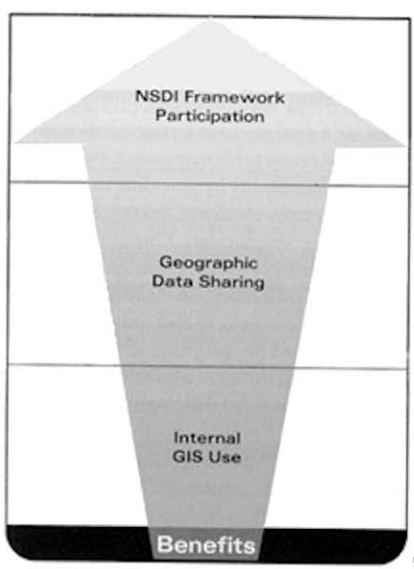

Fig. 2 Increasing Benefits of Data Sharing in NSDI (adapted according to FGDC 1997b)

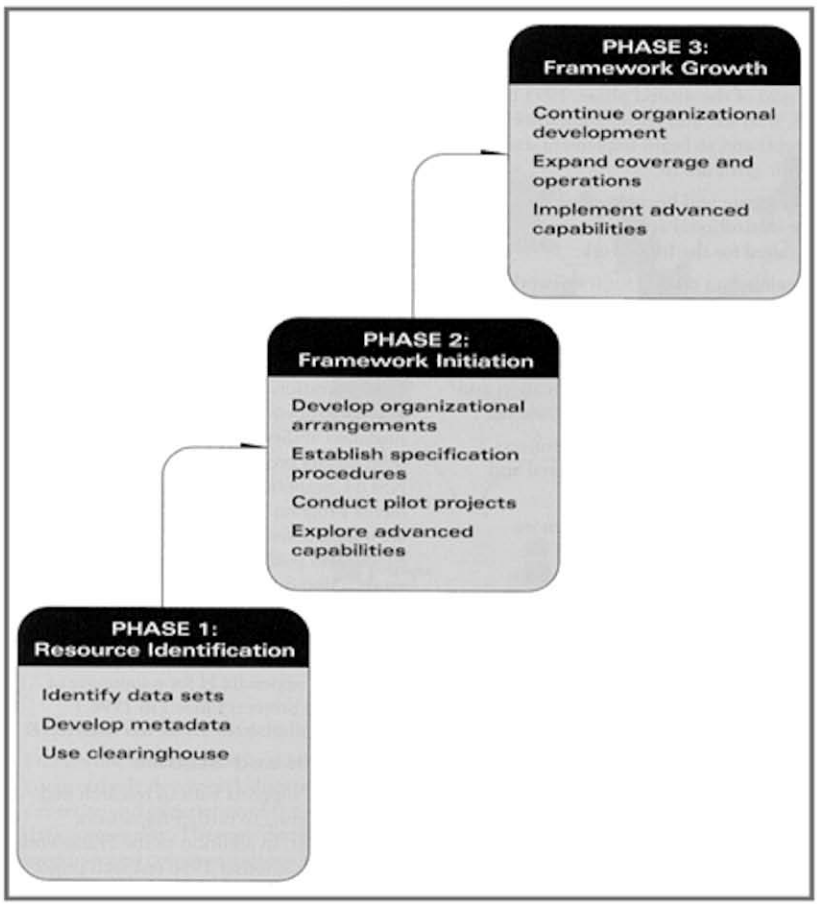

Fig. 3 Framewortk Implementation (adapted according to FGDC 1997b)

Definitions

Geographic information is critical to promote economic development, improve our stewardship of natural resources, and protect the environment. Modern technology now permits improved acquisition, distribution, and utilization of geographic (or geospatial) data and mapping. The National Performance Review has recommended that the executive branch develop, in cooperation with state, local, and tribal governments, and the private sector, a coordinated National Spatial Data Infrastructure to support public and private sector applications of geospatial data in such areas as transportation, community development, agriculture, emergency response, environmental management, and information technology (Clinton 1994)

National Spatial Data Infrastructure (NSDI) means the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data.

Geospatial data means information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the e. This information may be derived from, among other things, remote sensing, mapping and surveying (plus photo-

grammetry - *remark of M.K.*) technologies. Statistical data may be included in this definition at the discretion of the collecting agency.

The National Geospatial Data Clearinghouse means a distributed network of geospatial data producers, managers and users linked electronically.

In the both publications of the FGDC (1997a,b), the National Spatial Data Infrastructure (NSDI) is a means to assemble geographic data nationwide to serve a variety of users. The NSDI provides and environment within which organizations and technology interact to foster activities for using, managing, and producing geographic data. The framework forms the data backbone of the NSDI. It has *three aspects*:

- data,
- procedures and technology for building and using the data,
- institutional relationships and business practices that support the environment.

The framework is designed to facilitate production and use of geographic data, to reduce operating costs, and to improve service and decision making.

Geographic data are essential to many operations, yet they are expensive and time-consuming to produce. Many organizations need the same basic geographic data for their applications and spend precious resources duplicating the same data sets. Others go without data because they cannot afford the production costs. Furthermore, when an application or problem covers more than one jurisdiction, it is often difficult to find and combine existing data. The framework meets these needs by providing a reliable, standardized source for commonly needed and used geographic data themes.

The framework's seven geographic data themes are:

- geodetic control,
- orthoimagery,
- elevation,
- transportation,
- hydrography,
- governmental units,
- cadastral information.

The seven themes of geographic data are those that are produced and used by most organizations. Various surveys indicate that they are required by a majority of users, form a critical foundation for the NSDI, and have widespread usefulness. A cooperative approach to producing and sharing these common data benefits most organizations that use geographic data. The framework consists of many data sets that are, or can be, integrated and related to each other and to other data. Participants may contribute or use any data theme for any geographic area. Framework data are created and maintained by framework participants. Any data theme may have many contributors from different geographic areas, and any geographic area may have many data contributors. Framework data are made available for the cost of providing data access.

The National Geospatial Clearinghouse provides directions to available framework data. Metadata found these supplies the specific information for gaining access to the data.

The framework can greatly reduce your time, effort, and expense in using geographic data. It gives data users ready, reliable data in a consistent form. It gives data producers a reference source, standards, and guidance for creating geographic data. The framework also makes it possible to combine data from many sources and areas.

In contrast to the term "infrastructure", the term "library" brings to mind the image of an institution in which the works of both government and the private sector are made available to the public through a decentralized yet networked national system. The intention is to address and encompass needed knowledge advancements sometimes addressed separately under the terms "spatial data infrastructure" (MSC 1993) and "geo- libraries" (MSC 1997). Thus, in subsequent use of these terms, the subject matter addressed under one term should be broadly interpreted to include subject matter germane to the other as well (The Future.. 1998).

What is the cartographic and geoinformatics practice in the next ten years?

To identify role of cartography and geoinformatics in the context of NSDI which is beginning developed is complicated (In The Czech Republic passed by the government Proposition of the Legislation of the State Information System, in Slovakia was the Legislation of the State Information System passed in the year 1995). So far not eaven the basic steps were not realized in the region of NSDI. Only the partial steps are being realized. In the CR is being completed project ZABAGED I (Database of the Basic Geographic Data) which is complimenting existing ZABAGED II, digital cadaster is being prepared. In the Military environment it is being developed military Land Information System. Only in the last month we are witnessing basic steps and discussions leading to creation of NSDI from the government institution (CUZK, USI). Some individuals (Hojdar and Martinek 1996, Konečný 1997, 1998, Konečný and Veverka 1998, Veverka and Konečný 1998) and organizations (CAGI) are calling for creation of the NSDI number of years.

Lets try to imagine probable environment and demands on activities of cartographic enterprises in the next ten years. Research and practical applications will influence each other.

Number of authors are speculating on development and the role of cartography in the future that means in the environment of a developed information society, global society which decisions are influenced by creating of global data bases, standard, metadata, formats and so far. J.L. Morrison former president of ICA and one of the designers of US NSDI characterized the vision of the farther development in his key note speech of the GIS Brno 98 as follows:

„Today we are entering what has been termed the Information Age. This Information Age is characterized by the preponderance of service industries. Previously we were in the Industrial Age, an age characterized by the preponderance of the manufacturing of products. Most of us still have a difficult time thinking in terms of the sale of services and not the sale of products".

Morrison continues: the mapping profession is as guilty of this industrial age thinking as any other profession. Just as fundamental change is occurring today at an increasing rate in the electronic industries, so must fundamental change occur in the mapping sciences. How do we bring this about? What constitutes fundamental change in our thinking? What constitutes the mapping organizations that will be needed in the 21stcentury? What is needed to support these organizations? Will be offering a product free of charge but charging for a service.

What does this mean for the mapping sciences? Morrison believes that the cartographic enterprise of the 21st century must include a mature geographic information infrastructure in its organizational structure in order to operate efficiently.

On the consumer end, individuals will want, and will be willing to pay for, information created from spatial databases. Private firms, or geographic information infrastructure service providers, will provide much of this information for a service fee. It may be a subscription fee like today's Internet providers charge, or a may be a one time fee for a specific service. A service may consist of access to an extracted set of spatial data which the customer will process and analyze, or it may consist of an answer to a specific spatial query which has been processed by a service provider. A few sophisticated consumer's may want direct access to the geographic information infrastructure, but the bulk of the use will be through service providers.

Another part of the cartographic enterprise of the 21st century will consist of a consortium of data collectors, database updating and maintenance processors, and geographic information toolkit builders. Let us consider each of these parts in more detail.

1) Enterprise Designers: changed the basic aim of cartography from the production of a multi-use product, called a "map", for an unknown group of users, to the creation of a database containing accurate spatially positioned data, and the creation of a toolkit of analytical techniques, called a "geographic information system", that enabled a user to both obtain a precise answer by querying and processing the data in the database and a

visualization of the spatial data in theform of a two or apparent three dimensional display of the processed data from the database. In the Information Age, increasingly customers of spatial data will require the abilities to easily utilize spatial data and to incorporate spatial products into their communications and exchanges of information.

2) DatabaseConsortia. Data should have little or no value to individual consumers of spatial information. The value will be in the information services provided to the end users. Therefore, combinations of non-profit government agencies at all levels, local, national, and international, working in cooperation with private firms to efficiently create and maintain the foundation database necessary to enable geographic information infrastructure service providers to package and sell spatial data information in order to make a profit must come into existence. This database is the Geographic Information Infrastructure which will be a key to a viable mapping science profession in the 21st century.

In the area of geographic information system analytical processing development a similar condition will exist. There will be competing systems of modules for analysis. There may be a sufficient market by the geographic information infrastructure service providers to keep a modest number of firms in business creating modules for the processing of spatial data, but the market by the end user will again be small because they will be more willing to pay for the service from a geographic information infrastructure service provider than to undertake the overhead necessary to do the processing themselves.

3) Geographic Information Infrastructure Service Providers. To perform its mission. In this sense, an agency must know which areas have what restrictions. It must know where businesses or individuals are located who qualify for its various governmental programs. And perhaps most contributive to the overall geographic information infrastructure, the government agency must be able to provide its services for the entire area of the political entity, including areas so sparsely settled as to render economic viability impossible.

The economics of the geographic information infrastructure in the Cartographic Enterprise will basically result from the efficient collection, maintenance, and updating of the information that will be commonly shared among the database consortia of the enterprise.

4) Consumers. Once in place the geographic information infrastructure will serve a variety of consumers. There will be individuals who wish to take an active role in any geoprocessing of the data, or the specification of queries to the database. There will be others who may wish to have this done for them. Private firms will offer subscription services to a package of services similar to cable TV services today. Other firms will respond to user specific requests. Others will offer while-you-wait processing, overnight service, etc. Government agencies will provide services dictated by their missions.

To date we have examples of private firms utilizing digital spatial data available from governmental agencies to produce "products" for sale in the marketplace, and the beginning of agreements between "enlightened" private firms and governmental agencies on the efficient collection and maintenance of databases. Furthermore we are beginning to see the positioning of private firms to be able to offer geographic information infrastructure services for a fee to the public. These developments are just the beginning of a suite of services based on spatial data that we have never even considered in the past history of the mapping sciences.

What does it take for this 21st century Cartographic Enterprise to succeed? I believe that the key is the creation of the geographic information infrastructures that are currently on the drawing boards and/or being built, in combination with a suite of well thought out standards. Private firms and government agencies will have to recast their thinking to fit the service industry environment of the Information Age. Cooperation on the creation of the geographic information infrastructure by the members of the same consortia who provide competing geographic information infrastructure services will have to become commonplace. The potentials for the mapping sciences are tremendous. If today, I saw or experienced the Cartographic Enterprise of 2020, I assume that I would not recognize it. Rapid change characterizes our progress (Morrison 1998).

New trends in Cartography

Here is a several years old vision of the development the cartography as a science Morrison (1995, see also Konečný and Mikšovský 1992, 1998, Veverka and Konečný 1998) mentioned in ICC Barcelona these most important trends:

- Globalisation v. importance of the local differences
- Potential for small business
- Strategic cojuctions are often than fusions. Competition and cooperation.
- Ease of the financial transactions
- Global collection and standardisation of the spatial data and their local using
- Vizualisation
- Electronic technology
- Rennaissance of the geographical thinking
- Intelectual complexity

M. Wood (1997), past president of ICA, is expecting after year 2000:

- Existence of the world developed networks and infrastructures
- Distance mapping
- Internet access to the real data, i.e. geospatial DB with the possibilities of the cartrographic generalisation

Contemporary and future Research Priorities

One of contemporary approaches is documented by the „Revised White Papers, 1998 Spatial Information Infrastructure Research Tenets". The joint authors of this paper are known authors: H. Onsrud, X. Lopez, A.H. Miglarese, R. Rugg and Lyna Wiggins. The research agenda for the spatial information infrastructure as articulated below has arisen from three foundation tenets, which involve a mix of natural and social science perspectives.

1) Underlying social principles, institutions and traditions matter: Democratic governments must develop in ways that enhance public participation while supporting responsible use of science and technology.
2) Technical facts matter: the policy issues associated with the development of spatial information infrastructures cannot be fully understood without an understanding of the technical components of public issues.
3) Information policy issues arise at all levels, from local to global and from public to private sources:

The Priority Research Areas are defined as four broad areas in which research will help to strengthen the future of the nation's spatial information infrastructure:

1) Information policy. The factors that shape the development of spatial information policy and law reflect traditional and contemporary culture and technology. Research is needed to identify optimal government information policies and practices for promoting a robust spatial information infrastructure. Basic policy issues include intellectual property rights, information privacy, and liability as they pertain to spatial data. Perspectives from local to global vantage points and perspectives from public, commercial, scientist, citizen, user and data subject vantage points will need to be considered.

2) Access to government spatial information. Research is needed to examine how government information policies affect the access to and use of data for a broad spectrum of public and private sector stakeholders for a variety of public and private purposes. Public and private roles in information creation through partnerships and cooperative arrangements must be a subject of particular attention.

In Europe is overwived the basic document about access of the data, so called Public Sector Information (1998) „Green Paper". The geographic information is mentioned, but NSDI is not mentioned.

3) Economics of information. Geographic information is an unusual commodity of great value. Issues of cost recovery, pricing, and markets for geographic data and their relationship to intellectual property rights are of central importance. We need to achieve a

better understanding of the economic characteristics of information, especially government information, through such concepts as public goods theory, network externalities, and value-adding processes.

4) Local generation and integration of spatial information. Locally generated information and knowledge is increasingly important because new developments in technology make it possible for local people to more readily gather local geographic data germane to their own needs, draw data from library depositories, develop the information products they need, use the data for decision-making and contribute their locally gathered data to library depositories. Contributions of data can be systematic or ad hoc, coming from civic groups, schools, local institutions, and informed individuals. Local users can make significant contributions of their local knowledge, identify gaps in existing data resources, and identify errors. Developing the technical and institutional means to support creation and contribution of local knowledge presents a novel challenge to technologists and decision makers alike.

David Mark made exact definition of the role of geographic information in the year 2010. He is concluding results of the discussions in the framework of the Workshop National Science Foundation, January 14-15, 1999 (Mark 1999).

Scenarios for geographic information use in the year 2010 suggest great potential to extend the capabilities of scientific researchers, decision-makers, and the public. This potential, however, will only be realized if there are substantial advances in Geographic Information Science, enhancing knowledge of geographic concepts and their computational implementations. Workshop identified two important research streams: research in basic Geographic Information Science (GIScience), and research using geographic information systems (GIS). It is imperative that research in these two areas be integrated, as applications motivate the science, and awareness of theory improves applications. Basic research in GIScience has several compelling components. First is software integration, a general problem that needs specific research to solve its geospatial dimensions. Second, scale and resolution are spatial problems that interact with the scales (characteristic lengths) of environmental and social processes and with data quality. Third, process models are a general computing problem, but again geographic applications will require uniquely geographic solutions. And fourth, usability of systems and technologies is also a major component in need of research. In addition, uncertainty and spatial dependence were recognized as Geographic Information Science is clearly a coherent research field of strategic importance.

Between research using geographic information systems are:
- interoperability,
- dimensionality and temporality,
- ease of use barrier.

Research in Geographic Information Science

Geographic Information Science (GIScience) is the basic research field that seeks to redefine geographic concepts and their use in the context of geographic information systems. GIScience also examines the impacts of GIS on individuals and society, and the influences of society on GIS. GIScience re-examines some of the most fundamental themes in traditional spatially oriented fields such as geography, cartography, and geodesy, while incorporating more recent developments in cognitive and information science. It also overlaps with and draws from more specialized research fields such as computer science, statistics, mathematics, and psychology, and contributes to progress in those fields. It supports research in political science and anthropology, and draws on those fields in studies of geographic information and society.

Enabling GIS Use through Geographic Information Science:
- integration,
- scale,
- process models,
- usability.

Research Challenges:

- **Representation.** To find ways to express the infinite complexity of the geographical world in the binary alphabet and limited capacity of a digital computer.
- **Uncertainty.** To find ways of summarizing, modeling, and visualizing the differences between a digital representation and real phenomena.
- **Cognition.** To achieve better transitions between cognitive and computational representations and manipulations of geographic information.
- **Simulation.** To create simulations of geographic phenomena in a digital computer that are indistinguishable from their real counterparts.

The Data Challenge additional technological trend requires a response is the increasing quantity of data being collected and archived. The existence of unimaginable quantities of data does not guarantee that researchers will find needed data more quickly and easily. Solutions for geographic information will need focused research efforts. Even if the right data can be found, complex problems need sophisticated tools that may fail to be useful or usable, for reasons noted above.

Situation in the Czech Republic

The situation in the Czech republic is influenced by outside and inside aspects.

The outside influence are both, low acceptation of North American (Gore 1998), Australian, European (GI2000 1998) and other approaches and as well as low priorities NSDI in the European Union, namely on the level of politicians.

Inside aspects are:

- General concept of information infrastructure and its components does not exists. The steps must be coordinated by USIS and CUZK. It is necessary to realized organization steps as in the USA and GB ant then partial steps.
- Non governmental organizations should be involved.
- Resolving connections of government and private organizations.
- To make problems of spatial information more visible in the context information society (for ex. Newly established Czech Information Society Forum).
- To support research in the above fields.

On the level CZUK, USIS and other government institutions to create financial fond for support of research of NSDI and following geoinformatics and cartography.

References

Boes, U. (1998). Geographic Information Systems, Regional Policy, and Future European Research and Development. 5-21. In: Konečný M., ed.: *Geographic Information Systems: Information Infrastructures and Interoperability for the 21st century Information Society. Proceedings* I. Brno, Czech Republic, June 28-July 1, 1998.

Clinton, W.J. (1994). *Executive Order 12906. Co-ordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure.* Washington. 2 p.

DoE (1987). Handling Geographical Information: the report of the government's Committee of Inquiry. London, Department of the Environment.

Europe and the Global Information Society: Recommendations to the European Council. Bangemann Report. (1994). Corfu.

FGDC (1997a). *A strategy for the National Spatial Data Infrastructure.* Washington, Federal Geographic Data Committee.

FGDC (1997b). *Framework. Introduction and Guide.* NSDI. Reston, Virginia.

GI2000 (1997). *Towards a European Policy Framework for Geographic Information: A Communication from the Commission to the Council, to the European Parliament, to the Economic and Social Committee and the Committee of the Regions*, March, 27.

Gore, A. (1993). From Red Tape to Results: Creating a Government that Works Better and Costs Less. *Report of the National Performance Review.* Washington, U.S. Government Printing Office.

Gore A. (1998). *Digital Earth: Understanding our Planet in the 21st Century.* Speech Delivered at the California Science Centre, Los Angeles, 02/02/98.

Hojdar J., Martínek, M. (1996). Bariéry rozvoje GIS v České republice. In: *Zpráva grantového projektu 205/95/0894 „Tvorba GIS v ČR: současný stav, bariéry růstu, podmínky optimálního rozvoje a aplikací v mezinárodním kontextu".* GA ČR a Laboratoř geoinformatiky a kartografie, Brno.

Konečný M. (1995). The GIS Superhighway for Government Decision Support. In: *Space and Time in Environmental Information Systems.* 618-623. 9th International Symposium on Computer Science for Environmental Protection CSEP'95. Metropolis-Verlag, Marburg.

Konečný M. (1996). Národní prostorová informační infrastrutura: předpoklad rozvoje a plného využití GIS. 123-138. In: *Digitální data v informačních systémech.* Antrim s.r.o.. Vyškov. Ed. V. Voženílek.

Konečný M. (1997). Information and Communication Technologies in Public Administration. 81-84. *Proceedings on Third EU/CEEC Information Society Forum.* Brussels, 9-10 October. European Parliament-European Commission.

Konečný M. (1998). The Global Information Infrastructure: Small Country Agenda. *Ist International Conference and Exhibition on Geographic Information Congress Center of the International Fair of Lisbon,* September, 7-11, 12 p.

Konečný M., Veverka B. (1998). Tvorba GIS v ČR: současný stav, bariéry růstu, podmínky optimálního rozvoje a aplikací v mezinárodním kontextu". *Závěrečná zpráva grantového projektu GA ČR 205/95/0894.* Laboratoř geoinformatiky a kartografie, PřF MU, Brno.

Mark D. (1999). *Geographic Information Science: Critical Issue in and Emerging Cross-Disciplinary Research Domain.* http://www.geog.buffalo.edu/ncgia/GIScienceReport.html

Masser I., 1997. *Data Integration Research: Overview and Future Prospects.* 27-37. Geographic Information Research at the Millenium. GISDATA Final Conference. Le Bischenberg, France, 13-17 Septembre 1997.

MSC (1993). *Toward a Co-ordinated Spatial Data Infrastructure for the Nation.* Mapping Science Committee, National Research Council, National Academy Press. Washington, D.C., 171 pages.

MSC (1994). *Promoting the National Spatial Data Infrastructure Through Partnerships.* Mapping Science Committee, National Research Council, National Academy Press. Washington, 113 p.

MSC (1997). *The future of spatial data and society.* Mapping Science Committee, National Research Council, National Academy Press. Washington, D.C., 68 pages.

Morrison J.L. (1995). Changing Borders and Shifting Frontiers: Cartography for the New Millenium. 1-9. In: *Proceedings 1:* 17th Int. Cartographic Conference, Barcelona.

Morrison J.L. (1998). *Geographic Information Infrastructures: Keys to Mapping in the 21st Century. Keynote Speech.* Brno GIS 1998 Conference, June.

Public Sector Information: *A Key Resource for Europe.* Green Paper on Public Sector Information in the Information Society [COM (1998) 585]

Rhind D. (1997). *The relationship between national and international global information Infrastructures.* Le Bischenberg, France. http://www.shef.ac.uk/uni/academic/D-H/gis/rhind.html

The Future of the Spatial Information Infrastructure.Research Priorities. Revised White Papers. (1998). http://www.geog.umn.edu/umucgis/research_priorities/infra.html

Tosta N. (1997). National Spatial Data Infrastructures and the Roles of National Mapping Organisations. In Rhind D. (ed.): *Framework for the World,* 173-186, Cambridge, GeoInformation International.

Veverka B., Konečný M. (1998). GISy na přelomu století, bariéry a perspektivy. *GEOinfo* 1/98, Škola, 1-8.

Wood M., 1997. Maps and Mapping: The ICA Vision of the Future. *Proceedings, 6th Regional UN Cartographic Conference for the Americas,* New York.

Resumé

Prostorové informační infrastruktury: úloha geoinformatiky a kartografie

V řadě zemí světa jsou již po několik let úspěšně rozvíjeny koncepce informačních infrastruktur, jejichž nedílnou součástí jsou prostorové informační infrastruktury resp. národní prostorové datové infrastruktury (v článku použit termín NSDI, který odpovídá severoamerické terminologii). Oba termíny jsou v článku považovány za synonymum, byť autor v jiných článcích odděluje úlohu dat a z nich vzniknuvších informací. President Clinton ve svém výnosu z r. 1994 definuje geografickou informaci jako kritickou pro podporu ekonomického rozvoje, zdokonalení správy přírodních zdrojů a ochranu ži-

votního prostředí. Moderní technologie nyní dovolují zlepšovat sběr, distribuci a využití geografických (geoprostorových) dat a mapování. National Performance Review doporučilo, aby exekutiva ve spolupráci státní a místní správy a správ rezervací, a dále privátního sektoru, vytvořila koordinovanou národní prostorovou informační infrastrukturu pro podporu aplikací geoprostorových dat ve veřejném a privátním sektoru, a to v takových oblastech, jako doprava, rozvoj sídel, zemědělství, situace ohrožení, správa a řízení životního prostředí a informační technologie.

NSDI je chápána jako soubor geografických informací, které popisují uspořádání a atributy charakteristických rysů a jevů na zemi. Infrastruktura zahrnuje materiály, technologie a lidi nezbytné pro sběr, zpracování, uložení a distribuci takových informací, které by pokryly široký rozsah různých potřeb.

NSDI se skládá ze sedmi základních geografických datových tematik, a sice:
- geodetické základy,
- ortofotosnímky,
- nadmořské výšky,
- doprava, hydrografie,
- správní jednotky
- informace o katastru.

V článku je nastíněn možný vývoj a podmínky existence kartografických institucí resp. firem ve výhledu deseti a více let. Na pozadí uvedených skutečností se autor článku zamýšlí nad pravděpodobnou vědeckou agendou kartografie a geoinformatiky tak, jak je v současném světě chápána. Uvádí temata z oblasti využití GIS:
- interoperabilita,
- dimenzionalita a časovost,
- překonávání bariér,

tzv. geografické informační vědy:
- integrace,
- problematika měřítek,
- vývojové modely,
- upotřebitelnost

a dále naléhavé úkoly:
- reprezentace,
- neurčitost,
- kognice,
- simulace.

V závěru článku se autor zamýšlí nad některými vlivy, které prozatím brání koncepčnímu rozvoji NSDI v ČR. Za vnější vliv považuje malé povědomí a nízkou akceptovatelnost zahraničních přístupů k tvorbě NSDI, nízké priority problematiky v EU, zejména na úrovni politických elit. Mezi vnitřní vlivy patří neexistence koncepce informačních infrastruktur a jejich součásti, NSDI v ČR. Doporučuje uskutečnit postupné kroky, nejprve organizační, poté kroky další, obdobné jako v USA, Velké Británii nebo Nizozemí. Některý z vládních úřadů by měl být pověřen koordinací prostorových dat v celé ČR, měla by se prohloubit koordinace činností ÚSIS a ČÚZK v oblasti tvorby informačních infrastruktur a jejich součástí, NSDI. Na řešení čeká i otázka zapojení nevládních organizací (ČAGI, Kartografická společnost ČR, aj.) do procesu tvorby NSDI. Naléhavá je i potřeba řešení vazeb soukromého a státního sektoru, i když tvorbu koncepce a náplně základních vrstev české NSDI by mělo být záležitostí státních složek. Za prospěšné by autor považoval i zvýšení povědomí o problematice prostorových informací v rámci rozvoje české informační společnosti (např. Českého fóra pro informační společnost).

Ve vědeckovýzkumné oblasti je nutné podporovat výzkum v obdobných oblastech, jak bylo zmíněno výše. Prostředky z GA ČR, universitní či fakultní granty nepostačují. Řešením situace by mohlo být vytvoření společného finančního fondu pro podporu výzkumu v oblasti NSDI a následně geoinformatiky a kartografie na úrovni ČÚZK, Zeměměřického úřadu a ÚSIS.

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