Geoinformation management 7.

Effects of GIS and future trends

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Abstract

The aim of the module is to give an overview and show in which direction GIS technology and spatial information applications are developing. The first chapter is dealing with the evolution of GIS from computer-aided mapping to spatial reasoning and visual communication applications. The economic aspects of GI are highlighted later. The last chapters are dealing with the barriers problems and future trends in GI industry.

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Chapter 7. Effects of GIS and future trends

1. 7.1 Introduction

The aim of the module is to give an overview and show in which direction GIS technology and spatial information applications are developing. The first chapter is dealing with the evolution of GIS from computer-aided mapping to spatial reasoning and visual communication applications. The economic aspects of GI are highlighted later. The last chapters are dealing with the barriers problems and future trends in GI industry.

From the module you become familiar with the:

- effects of GIS and future trends ,
- the evolution of GIS in the last forty years,
- economic aspects of geospatial information,
- GIS barriers in Europe,
- the most common problems regarding benefits of GIS projects,
- trends in GI technology development.

After learning of this chapter, you will be able to:

- summarize the effects of GIS and future trends,
- explain the main steps in the evolution of GIS in the last forty years,
- illustrate the economic aspects of geospatial information,
- demonstrate GIS barriers in Europe,
- identify the most common problems in GIS projects,
- explain the trends in GI technology development.

2. 7.2 GIS evolution[1]

Considerable changes in both expectations and capabilities have taken place since GIS's birth in the late 1960s. Information has always been the cornerstone of effective decisions. Spatial information is particularly complex as it requires two descriptors—Where is What. For thousands of years the link between the two descriptors has been the traditional, manually drafted map.

More recently, analysis of mapped data has become an important part of understanding and managing geographic space. This new perspective marks a turning point in the use of maps from one emphasizing physical description of geographic space, to one of interpreting mapped data, combining map layers and finally, to spatially characterizing and communicating complex spatial relationships. This movement from "where is what" (descriptive) to "so what and why" (prescriptive) has set the stage for entirely new geospatial concepts and tools.

Since the 1960's, the decision-making process has become increasingly quantitative, and mathematical models have become commonplace. Prior to the computerized map, most spatial analyses were severely limited by their manual processing procedures. The computer has provided the means for both efficient handling of voluminous data and effective spatial analysis capabilities.

[1] This chapter is based on http://www.innovativegis.com/basis/mapanalysis/Topic27/Topic27.htm

Computer-Aided Mapping (1970s)

The early 1970's saw computer mapping automate map drafting. The points, lines and areas defining geographic features on a map are represented as an organized set of X, Y coordinates. These data drive pen plotters that can rapidly redraw the connections at a variety of colors, scales, and projections with the map image, itself, as the focus of the processing.

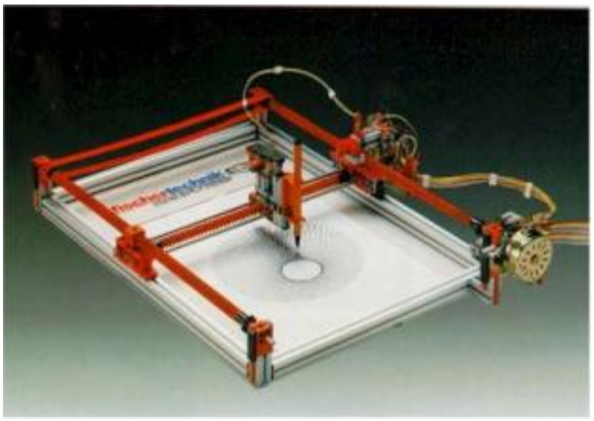

Fig. 7.1. Flatbed plotter (Source: www.procontechnology.com.au)

The pioneering work during this period established many of the underlying concepts and procedures of modern GIS technology. An obvious advantage with computer mapping is the ability to change a portion of a map and quickly redraft the entire area. The less obvious advantage is the radical change in the format of mapped data—from analog inked lines on paper, to digital values stored on disk.

Spatial Database Management (1980s)

During 1980's, the change in data format and computer environment was exploited. Spatial database management systems were developed that linked computer mapping capabilities with traditional database management capabilities. In these systems, identification numbers are assigned to each geographic feature, such as a timber harvest unit or ownership parcel.

Early in the development of GIS, two alternative data structures for encoding maps were debated. The vector data model closely mimics the manual drafting process by representing map features (discrete spatial objects) as a set of lines which, in turn, are stores as a series of X,Y coordinates. An alternative structure, termed the raster data model, establishes an imaginary grid over a project area, and then stores resource information for each cell in the grid (continuous map surface). The early debate attempted to determine the universally best structure. The relative advantages and disadvantages of both were viewed in a competitive manner that failed to recognize the overall strengths of a GIS approach encompassing both formats.

Fig. 7.2. GIS database (Source: http://drnik.com.my)

By the mid-1980's, the general consensus within the GIS community was that the nature of the data and the processing desired determines the appropriate data structure. This realization of the duality of mapped data structure had significant impact on geographic information systems. From one perspective, maps form sharp boundaries that are best represented as lines. Property ownership, timber sale boundaries, and road networks are examples where lines are real and the data are certain. Other maps, such as soils, site index, and slope are interpretations of terrain conditions. The placement of lines identifying these conditions is subject to judgment and broad classification of continuous spatial distributions. From this perspective, a sharp boundary implied by a line is artificial and the data itself is based on probability.

Increasing demands for mapped data focused attention on data availability, accuracy and standards, as well as data structure issues. Hardware vendors continued to improve digitizing equipment, with manual digitizing tablets giving way to automated scanners at many GIS facilities. A new industry for map encoding and database design emerged, as well as a marketplace for the sales of digital map products. Regional, national and international organizations began addressing the necessary standards for digital maps to insure compatibility among systems. This era saw GIS database development move from project costing to equity investment justification in the development of corporate databases.

Map Analysis and Modeling (1990s)

As GIS continued its evolution, the emphasis turned from descriptive query to prescriptive analysis of maps. If early GIS users had to repeatedly overlay several maps on a light-table, an analogous procedure was developed within the GIS. Similarly, if repeated distance and bearing calculations were needed, the GIS system was programmed with a mathematical solution. The result of this effort was GIS functionality that mimicked the manual procedures in a user's daily activities. The value of these systems was the savings gained by automating tedious and repetitive operations.

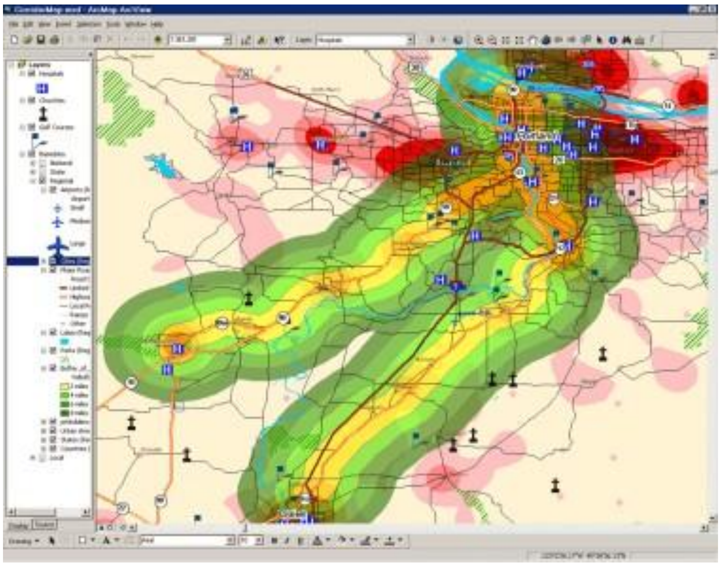

Fig. 7.3. Map analysis (Sorce: http://www.industrialinfo.com)

By the mid-1980's, the bulk of descriptive query operations were available in most GIS systems and attention turned to a comprehensive theory of map analysis. The dominant feature of this theory is that spatial information is represented numerically, rather than in analog fashion as inked lines on a map. These digital maps are frequently conceptualized as a set of "floating maps" with a common registration, allowing the computer to "look" down and across the stack of digital maps. The spatial relationships of the data can be summarized (database queries) or mathematically manipulated (analytic processing). Because of the analog nature of traditional map sheets, manual analytic techniques are limited in their quantitative processing. Digital representation, on the other hand, makes a wealth of quantitative (as well as qualitative) processing possible. The application of this new theory to mapping was revolutionary and its application takes two forms—spatial statistics and spatial analysis.

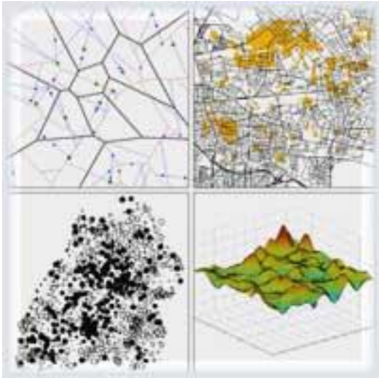

Fig. 7.4. GIS is a tool for spatial statistics and spatial analysis (Source: http://www.uni-ulm.de/summeracademy09/sc2009_about.html)

Spatial statistics uses both the location and the measurements at sample locations to generate a map. This numeric-based processing is a direct extension of traditional non-spatial statistics. Spatial analysis applications, on the other hand, involve context-based processing. Wildlife managers can consider such factors as proximity to roads and relative housing density to map human activity and incorporate this information into habitat delineation. Spatial mathematics has evolved similar to spatial statistics by extending conventional concepts. This "map algebra" uses sequential processing of spatial operators to perform complex map analyses. It is similar to traditional algebra in which primitive operations (e.g., add, subtract, exponentiate) are logically sequenced on variables to form equations. However in map algebra, entire maps composed of thousands or millions of numbers represent the variables of the spatial equation.

Most of the traditional mathematical capabilities, plus an extensive set of advanced map processing operations, are available in modern GIS packages. However, with map-ematics, the spatial coincidence and juxtaposition of values among and within maps create new operations, such as effective distance, optimal path routing, visual exposure density and landscape diversity, shape and pattern. These new tools and modeling approach to spatial information combine to extend record-keeping systems and decision-making models into effective decision support systems.

Multimedia Mapping (2010s)

In the early years, GIS was considered the domain of a relatively few techno-geeks. Today, it is on everyone's desk, PDA and even cell phone. In fact, the U.S. Department of Labor has designated Geotechnology as one of the three "mega-technologies" of the 21st century—right up there with Nanotechnology and Biotechnology. This broad acceptance and impact is in large part the result of the general wave of computer pervasiveness in modern society.

We expect information to be just a click away and spatial information is no exception. There is growing number of websites with extensive sets of map layers that enable users to mix and match their own custom views. Data exchange and interoperability standards are taking hold to extend this flexibility to multiple nodes on the web, with some data from here, analytic tools from there and display capabilities from over there. The results are high-level applications that speak in a user's idiom and hide the complexity of data manipulation and obscure command sequences. In this new environment, the user focuses on the spatial logic of a solution and is hardly aware that GIS even is involved.

Another characteristic of the new processing environment is the full integration the global positioning system and remote sensing imagery with GIS. GPS (GNSS) and the digital map bring geographic positioning to the palm of your hand. Toggling on and off an aerial photograph provides reality as a backdrop to GIS summarized and modeled information.

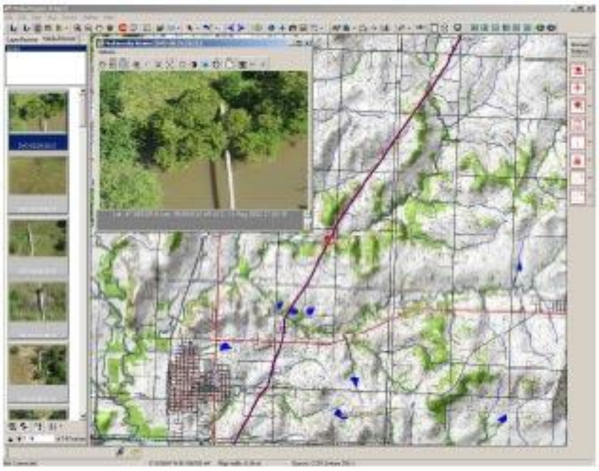

Fig. 7.5. Multimedia mapping (Source: http://www.pergamusa.com)

In addition to the changes in the processing environment, contemporary maps have radical new forms of display beyond the historical 2D planimetric paper map. Today, one expects to be able to drape spatial information on a 3D view of the terrain. Virtual reality can transform the information from pastel polygons to rendered objects of trees, lakes and buildings for near photographic realism. Embedded hyperlinks access actual photos, video, audio, text and data associated with map locations.

4D GIS (XYZ and time) is the next major frontier. Currently, time is handled as a series of stored map layers that can be animated to view changes on the landscape. Add predictive modeling to the mix and proposed management actions can be introduced to look into the future. Tomorrow’s data structures will accommodate time as a stored dimension and completely change the conventional mapping paradigm.

Spatial reasoning and visual communication

In the past, analytical models have focused on management options that are technically optimal. Yet in reality, there is another set of perspectives that must be considered, the social solution. It is this final sieve of management alternatives that most often confounds geographic-based decisions. It uses elusive measures, such as human values, attitudes, beliefs, judgment, trust and understanding. These are not the usual quantitative measures amenable to computer algorithms and traditional decision-making models.

The step from technically feasible to socially acceptable options is not so much increased scientific and econometric modeling, as it is communication. Basic to effective communication is involvement of interested parties throughout the decision process. This new participatory environment has two main elements—consensus building and conflict resolution. Consensus Building involves technically-driven communication and occurs during the alternative formulation phase. It involves a specialist's translation of various considerations raised by a decision team into a spatial model. From this perspective, an individual map is not the objective. It is how maps change as the different scenarios are tried that becomes information. Often, seemingly divergent philosophical views result in only slightly different map views. This realization, coupled with active involvement in the decision process, can lead to group consensus.

Fig. 7.6. Group consensus (Source: http://www.consensusbusiness.com/)

However, if consensus is not obtained, mechanisms for resolving conflict come into play. The socially-driven communication occurs during the decision formulation phase. It involves the creation of a "conflicts map" which compares the outcomes from two or more competing uses. Each map location is assigned a numeric code describing the actual conflict of various perspectives. For example, a parcel might be identified as ideal for a wildlife preserve, a campground and a timber harvest. As these alternatives are mutually exclusive, a single use must be assigned. The assignment, however, involves a holistic perspective which simultaneously considers the assignments of all other locations in a project area.

Traditional scientific approaches rarely are effective in addressing the holistic problem of conflict resolution. Even if a scientific solution is reached, it often is viewed with suspicion by less technically-versed decision-makers. Modern resource information systems provide an alternative approach involving human rationalization and tradeoffs. This process involves statements like, "If you let me harvest this parcel, I will let you set aside that one as a wildlife preserve." The statement is followed by a persuasive argument and group discussion. The dialogue is far from a mathematical optimization, but often comes closer to an acceptable decision. It uses the information system to focus discussion away from broad philosophical positions, to a specific project area and its unique distribution of conditions and potential uses.

Future Challenges

The technical hurdles surrounding GIS have been aggressively tackled over the past four decades. Comprehensive spatial databases are taking form, GIS applications are accelerating and even office automation packages are including a "mapping button." So what is the most pressing issue confronting GIS in the next millennium? Why should time be wasted in GIS training and education? It's just a tool, isn't it? The users can figure it out for themselves. We have been mapping for thousands of years and it is second nature. GIS technology just automated the process and made it easier. Admittedly, this is a bit of an overstatement, but it does set the stage for GIS's largest hurdle— educating the masses of potential users on what GIS is and developing spatial reasoning skills. In many respects, GIS technology is not mapping as usual.

At least as much attention should go into geospatial application development and training as is given to hardware, software and database development. Like the automobile and indoor plumbing, GIS won't be an important technology until it becomes second nature for both accessing mapped data and translating it into information for decisions. Much more attention needs to be focused beyond mapping to that of spatial reasoning, the "softer," less traditional side of geotechnology.

GIS’s development has been more evolutionary, than revolutionary. It responds to contemporary needs as much as it responds to technical breakthroughs. Planning and management have always required information as the cornerstone. Early information systems relied on physical storage of data and manual processing. With the advent of the computer, most of these data and procedures have been automated. As a result, the focus of GIS has expanded from descriptive inventories to entirely new applications involving prescriptive analysis. In this transition, map analysis has become more quantitative. This wealth of new processing capabilities provides an opportunity to address complex spatial issues in entirely new ways.

It is clear that GIS technology has greatly changed our perspective of a map. It has moved mapping from a historical role of provider of input, to an active and vital ingredient in the decision-making process. Today's professional is challenged to understand this new environment and formulate innovative applications that meet the complexity and accelerating needs of the twenty-first century.

3. 7.3 Economic aspects

As it was detailed in Module 3, economic considerations are extremely important in convincing people of the importance of a GIS project. The objective of this chapter is to summarize the economic aspects of the implementation and use of GIS in a complex way. Technical problems are very interesting to solve and organisational issues pose important challenges, but projects are executed because they improve the way an organisation works. Economic analysis is the major method to assess the utility of a project, GIS or any other.

GIS projects, like other projects, should not be executed when they do not contribute to the overall benefit of an organisation. The difficulty lies in the assessment of the full contribution of a GIS to an organisation. It was typically found that other and additional benefits of GIS projects than those included in the original project plan were more important than what was included in the original cost-benefit analysis. The approach described here is designed to reduce this difference and to make cost-benefit analysis for GIS more reliable.

The implementation of a GIS requires investment in hardware, software and data. It also requires investment in people. In the short term, the most expensive element is the collection and conversion of the data, a process that can account for around 60% to 80% of the total initial costs of setting up a system. As a simple rule, the costs of hardware and software must be multiplied by a factor of 4 to 10 to obtain the approximate costs of installing a GIS and populate it with useful data. Costs of training and the continuing professional development of staff are also important and are counted higher than the cost of hard- and software.

Having set up a system, it will be necessary to maintain it, which requires resources. The actual cost of implementing a GIS for the first time is not a one-time payment but rather a long-term commitment to expenditure.

The GIS system also produces benefits that are the effects of the improved information available. The data collected must be valuable for the users, not just costly to accumulate. A product from any system, including the information product from a GIS, is valuable only as far as it is used and creates valuable goods during its use. The information available from the GIS is often used internally to improve the functioning of the organisation that has set it up. But in other cases, the information can be sold or distributed to others. In any case, the information is used and the additional information provided leads to an improvement: a decision is made more quickly, is less risky or leads to an improved result.

Market and price

Cost-benefit analysis will in part be based on the price that can be obtained for GI. The price of a good is based on its market value. The market for GI is usually very different from the ideal market around which economic theory is developed. Price is one of the key elements of marketing, but not the only one. A complete market strategy considers the users, their needs and their willingness and ability to pay, the channels used to distribute information about the product and distribution channels for the product.

The general theory of economics was developed around 'real' goods e.g. the produce from agriculture: tomatoes as a prime example. The equilibrium price results from the balance of supply and demand. But maps or cadastral information cannot be produced by many agencies in parallel, competing for the users on a market – this would be an enormous waste in data collection! Also, maps are very different from potatoes. They can be easily copied and used many times.

Information markets are substantially different from other goods[2]:

- information can be replicated nearly without cost, therefore
- multiple users can use the same information (but only one person can eat a tomato)
- producing the information has a high cost curve initially, but reproducing has a low cost curve
- a buyer can use the information but also resell it (even multiple times).

[2]http://131.193.153.231/www/issues/issue2/different/

Determining the optimum price that can be charged for GI is difficult where there is no already established market. As we have seen in the previous paragraph, information as a commodity does not behave in the same way as physical products.

The price of GI can be established in several different ways. Consider for example a digital map sheet. The price can be set on the basis of the costs incurred during its production, to which a margin for profit would be added. This would then be divided by the estimated number of maps expected to be sold to give a market price. That might suggest, say, a price of € 200. However, the technology exists to put 3000 such map sheets on one CD-ROM at marginal additional cost. Yet obviously, such a CD would be unlikely to sell if the price were € 600,000. So a different approach to price setting is needed.

An alternative way to establish the price could be to find out what the market will bear. If the price is too high, the products will not sell and if they sell very rapidly then it might be possible to increase the price.

A third strategy would be to find out what savings could be made through the use of the product in comparison to current practice. Thus, if the possession of a paper map saves a motorist € 20 per year in fuel through more efficient selection of travel routes, and if the map is likely to last a year before becoming worn out, then it would be worth € 19 to the motorist, but not € 21 unless other factors came into play.

4. 7.4 Barriers in Europe

The market for GI in Europe has different dynamics than the corresponding market in the USA. In the USA, the United States Geological Survey (USGS) and the Bureau of Census have a mandate to collect and disseminate essentially free of charge bare spatial data, covering topography and population statistics. In Europe, topographic and demographic data are collected by National Agencies, which operate under different jurisdiction and have different mandates.

The American market was fuelled early when these two agencies converted their data to electronic format. The integration of topography, street network and demography in datasets, which cover the entire nation at small to medium scale, became freely available on the Internet for the cost of reproduction. This made experimentation and the development of applications possible. A similar development did not occur in Europe for several reasons, the three most important ones are (Frank et al. 2000):

Lack of Awareness

Often GI is not used because the potential users are not aware that they are making spatial decisions, that the decision could be improved by acquiring more information. It is not known what information is available, where it could be acquired and how it could be used.

Lack of Availability

It is not primarily that spatial data is not collected, – indeed Europe probably has better collections of spatial data than the USA, but the data collected is not readily available. The list of impediments include: data is not available in electronic from, the form does not meet the form required by the user (lack of standardisation), bureaucratic procedures, pricing schemes that are based on cost and do not consider the benefits the user can maximally draw from the data.

Crumbled Markets

In addition to the individual impediments in each of the national GI markets, Europe is hindered by compartmentalisation in small markets. There are only minimal European data sets available, procedures, policies and legal ties for GI in each country are different and make it impossible to develop solutions, which work in the larger European market with the corresponding economies of scale.

5. 7.5 Common problems

Observation of GIS projects, especially the ones that failed, shows a number of common failures. Observing these potential pitfalls is a major step towards successful GIS implementation.

Stakeholders

Users in an operational GIS environment consist of operations, management, and policy levels of the organisation. All three levels should be considered when identifying the needs of your users.

User needs

A wide spectrum of GIS hardware and software choices currently exists. The right choice will be the GIS that provide the needed performance for the minimum investment.

Expectations

GIS projects tend to involve many parts of the organisation and during the requirements analysis many possible applications surface. A GIS project may fail because too many expectations were raised, which cannot all be fulfilled with the available resources.

Pilot project

The GIS implementation plan concerns itself with the many technical and administrative issues and their related cost impacts. Three of the most crucial issues are database design, data loading and maintenance, and day-to-day operations. The pilot project will allow you to gather detailed observations, provided it is properly designed, to allow you to effectively estimate the operational requirements. GIS projects often fail by underestimation of difficulties; pilot projects help to become realistic.

Knowledge transfer

Training and support for on-going learning, for in-house staff as well as new personnel, is essential for a successful implementation. Staff at all levels should be educated with respect to the role of the GIS in the organisation. Education and knowledge of the GIS can only be obtained through on-going learning exercises.

Complexity

A GIS project may fail from sheer complexity: too many different demands cannot be reconciled, even when the resources are available. The complexity increases exponential with the number of applications. Realise a first step and add later – even under the risk that some changes may be required. Do not attempt to get it right the first time.

Total costs

The GIS acquisition cost is relatively easy to identify. Many projects failed because the initial budget provided only for hard- and software acquisition. However, it will represent a very small fraction of the total cost of implementing a GIS. Ongoing costs are substantial and include hardware and software maintenance, staffing, system administration, initial data loading, data updating, custom programming, and consulting fees.

6. 7.6 Trends

Spatial Data is crucial for the economic development of a country, it is central to the protection of the environment and it contributes to a democratic society. Most spatial data are acquired by people living in their environment and used daily without thinking about it. The advent of the Internet and mobile communication technology, where essentially every user is connected to every computer in the world opens the path for the delivery of GI to whoever needs it, exactly when it is needed and in the form most effective for the decision to be made.

Cost-Benefit Analysis

GIS projects today must be based on a careful assessment of the benefits the GIS will bring the organisation. The information the GIS produces, what we call the ‘GI product’, must be assessed for its value to the business. The overall contribution GI makes to the business goals must be evaluated. GIS that do not substantially contribute to the strategic goals of the organisation and are not cost effective should not be started, because they will eventually fail. This does not include projects that are done for demonstration, research or experimentation. In these, the value is in the experience gained and this must be compared to the cost. For many companies, GIS is a strategic investment, which is crucial for the business to survive in today’s competitive situation. This is especially true for all public utilities, which move from a public (protected) non-competitive environment in market competition. Timely, up-to-date information about the network improves services and reduces cost.

Distributed GIS

GIS are connected to the web and can be distributed: servers provide data that is used by many clients. In this section we discuss aspects that relate to intranet solutions: data are collected and used by a small number of organisations. Contractual arrangements for protection of data, compensation, liability etc. are set up initially and cover a multitude of interactions.

Today's web technology permits the connection of a user with any computer on the web. This is of great benefit to GIS, as it permits integration and the use of data combined from different sources. The promise of spatial integration of data from different sources according to location can be fulfilled without the physical centralisation of data in a single location. Today's technology does not justify physical centralisation. Technically it is sufficient to connect the different data holdings logically using a distributed database system.

The design of new GIS applications must always consider the Internet as a means to distribute the data storage and thus resolve organisational problems of data ownership, and a means to deliver the results to a larger number of potential users.

The potential of connecting the data holdings of different organisations and using them jointly, overcomes the reluctance of independent organisations to give up their ownership of data and bring them into a central pool. Organisations often believe (mistakenly) that having the data gives them power and do not understand that in today's competitive but cooperative world, sharing of information benefits both sharing partners.

Questions of compensations between users of data and the providers are difficult to address. Traditionally the discussion is defined by the effort and the cost invested in the initial collection of the data and the cost of maintenance. It is recommended that the value of the data to the user is also considered.

Metadata

Investigations in the potential for re-use of spatial data have shown that most users who would need spatial data do not know that others have already collected them. Advertising the availability of data is an important first step to realise re-use. The information that describes the data available is called meta-data, data that describes the data. Standardised formats for metadata have been established. They help providers of data collect necessary data in a uniform format, which can be inserted in a database and queried automatically. Unfortunately, the current metadata standards usually have a data producer perspective. They describe in detail how the data was collected and treated. They do not respond to the user's questions about what the data could be used for. The potential user must have extensive and detailed knowledge about data collection technology to deduce which data is usable for his application. Metadata are very important for knowledgeable users, but they are not the answer to a widespread use of GIS. Once data is localised, the transfer of the data and the conversion from the format the data is stored in to the format in which it could be used is necessary. Widely used commercial data formats and standardised transfer formats are requirements for use of off-the-shelf data translators.

Open GIS

The Open GIS concept brings interoperability into the area of the web: instead of transferring complete data sets as files from computer to computer, the user can access the particular data she is interested in. The advantage is that the data accessed is the current, up-to-date version, not the version that was acquired and transferred a few months ago. To allow this, the client software on the computer of the user and the server software on the computer of the organisation maintaining the data collection must communicate the users' precise need for data and respond with the data required in the formats agreed upon.

Open GIS makes cooperation of GIS software from different vendors possible. It is not important that the same vendor provides all the software under which the data are collected and stored. Different systems can be used and be accessed from software from various vendors. From the user's perspective this avoids the trap of having the data in a proprietary format of one vendor and not being able to use software from other vendors. High cost is not incured, when changing from one vendor to another one.

Business GIS

GIS in the past decades was mostly built for public administration, to help them with the collection and management of spatial data for complex planning and administration purposes. A single organisation managed the data and used them. IT, especially the web, has opened new opportunities: the use of GI in business.

New opportunities to start a business are created: Companies can collect and maintain data or assemble data from other sources into useful packages and make the data available for others. This makes a GI business possible, where a single user cannot cover the cost of collecting the data for the occasional use she has – but a multitude of users together create a viable business.

These new opportunities to provide various business processes with the necessary GI in a cost-effective manner are very large: they are given in real-estate marketing, tourism, travel, road navigation, etc. One can assume that the volume of these businesses is in total much larger than the current GIS business, which mostly addresses the needs of large, public organisations. In this business area, each transaction is small, the amount of GI provided is small and the value is limited, but the number of transactions is very large.

E-Commerce

Widespread use of GI by many users is only viable if the complete transaction can be completed over the Internet and no human intervention on the provider side is necessary. The user electronically requests the data – probably using an Internet enabled web browser, which follows the open GIS standard, completes electronically the arrangements for payment and gets the requested data delivered.

Location-based services

The ability to communicate person-to-person by voice telephones and between computerized systems is a major new factor for GIS. GIS is built on the promise to produce and deliver GI where it is needed and replaces the previous paper-based maps, where GI had to be produced ahead of times and distributed to all potential users who then had to extract the information they needed – reading a dense topographic map and drawing the right conclusions is quite difficult! With a mobile a person in need of the GI can connect to the GIS and get the exact information needed at this moment. This is further simplified by the fact that the position of a mobile phone is known and can be used to select the information of interest for the user.

This type of location-based services (LBS) can be used in a variety of contexts, such as health, work, personal life, etc. LBS include services to identify a location of a person or object, such as discovering the nearest banking cash machine or the whereabouts of a friend or employee. LBS services include vehicle tracking services. LBS can include mobile commerce when taking the form of coupons or advertising directed at customers based on their current location. They include personalized weather services and even location-based games. They are an example of telecommunication convergence.

This breakthrough in technology (communication, portability and integration of devices) relevant for GI opens the door for new services and therefore for new business opportunities. It is most likely that these services will be offered by independent private companies and it is, in the current political climate, not expected that governmental agencies will enter this market. In each case, a potential provider has to evaluate carefully what the value of his service is to the customer and how many customers he may find to assess the economic viability of a business idea. Clearly, all these ideas require the availability of the base spatial data, e.g. topographic data, street network etc. and investments today in improving the quality of this data and the access to the data will pay off in the future fostering such new GI businesses.

Mainstream GIS

The separation of GIS from other software packages in the 80s and 90s must be overcome. Very little is special about spatial, but these special aspects must be covered by (Open GIS) standards. In most aspects, GI is similar to other data and must follow the general standards. As both public and private sector organizations acknowledge the need for geoprocessing to be integrated in the mainstream of information technology, GIS will continue to evolve so as to make this information technology tool become even more user friendly. The automated desktop will include globally distributed client server systems with extensive use of portable devices, cellular communications, video and transparent access to remote databases. GIS is a multi-billion-dollar industry in the United States, and most mainstream GIS companies are located in the United States. These companies also represent the major GIS suppliers worldwide, including suppliers in Asian countries. Japan, South Korea, Singapore, and Hong Kong are a few of the countries to embrace the United States' GIS technology to further their economic growth. The GIS industry is positioned well for rapid growth and increased revenues.

Free data

The availability of the few core data sets that are most often used in an easily usable format and attractive business conditions are the primary conditions to have a viable GI business take off. Despite being public, open access to the spatial data has not been automatic, and in Europe in particular, complex licence agreements are common. The European Union recognised in 2003 the potential for innovation and economic growth that easy access to publicly funded information could unlock, and adopted a directive setting the conditions under which public sector bodies should encourage re-use of their information resources. The PSI directive requires that member states "will encourage the reuse of public data by third parties to develop enriched services that maximise the value for the public. Good news on this field that UK government has taken an important unilateral first step towards freeing public data. In the very near future UK's Ordnance Survey mid-scale maps will become freely available - and re-usable - online. UK joins Canada, South Africa, Australia, Norway and the United States in making core geospatial data freely available. The momentum behind increasing access to public sector geospatial information will continue to improve and will allow innovators everywhere to create cool, useful products.

7. 7.7 Summary

The aim of the module is to give an overview and show in which direction GIS technology and spatial information applications are developing. The first chapter is dealing with the evolution of GIS from computer-aided mapping to spatial reasoning and visual communication applications. The economic aspects of GI are highlighted later. The last chapters are dealing with the barriers problems and future trends in GI industry.

After learning of this chapter, you are able to:

- summarize the effects of GIS and future trends,
- explain the main steps in the evolution of GIS in the last forty years,
- illustrate the economic aspects of geospatial information,
- demonstrate GIS barriers in Europe,
- identify the most common problems in GIS projects,
- explain the trends in GI technology development.

Review questions

1. Give an overview of the main characteristics of the GIS developments (1970 - 2000)!
2. What are the current issues of GIS developments?
3. Introduce the economic aspects of geospatial information!
4. Explain the difference between the traditional and information products!
5. What are main obstacles of GIS industry in Europe, in comparison with US!
6. Identify the most common problems towards successful GIS implementation!
7. Explain the current trends and the factors in GI technology development!

Bibliography

Ed. Frank A. - Raubal M. - van der Vlugt M.: *PANEL - GI Compendium,* Geoinfo Series nr. 21, Vienna, 2000

Berry, J. K.: *Map Analysis - Beyond Mapping,* GeoWorld Magazine, 2009

BEST-GIS: *Guidelines for best practice in user interface for GIS, GISIG - EU ESPRIT project*, 1998