An European Perspective on Geo-Information Infrastructure (GII) Issues

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Abstract
Presented in this paper are a number of considerations and issues which may arise when one wants to establish a nationwide or even (sub)continental wide Geo-Information Infrastructure (GII). A GII concerns the technology, policies, standards and human resources, necessary to acquire, process, store, distribute and improve the use of geo-information. Our considerations are based on experiences gained within Europe. The main message of the paper is that the availability of a technical infrastructure, or more specific the Internet, is a necessary but not sufficient condition for GII establishment. Of particular importance will be the establishment of an open market place, where all types of users will be able to look for geo-information as a commodity. In addition, commitment of decision makers and the willingness of politicians to put the GII high on the political agenda are necessary conditions. And last but not least accurate, detailed and reliable geo-information, in which the users part of the actors has an implicit and unconditional faith, should be freely available, which does not at all mean free of charge.

Introduction

Our society increasingly becomes information intensive. Information is the key element for economic growth and decision-making. Despite we are living in the 'Information Age', the quality of decisions often suffers from lack of appropriate information. Often the required information is there, but we do not know that it exists or, even worse, we know that it exists but we are not able to get access to it. It is often stated that about 80 per cent of all public sector information has a geo-spatial component, which means that it is referenced by either address or location, for example a national grid reference. In order to facilitate the variety of needs, it is therefore crucial to stimulate the use of Geo-information in both the public and private sectors as well as by individuals.

Within this context, in the early 1990s, the US mapping community began discussions about the development of a National Spatial Data Infrastructure (NSDI) to promote geospatial data-sharing (Tosta, 1997). More or less at the same time, the European Commission commenced initiatives to develop a unified European approach to the use of geographic technologies. Although already for a long time available in digital format, up to the mid-nineties one of the main hindrances for the fast and widespread dissemination of geo-information appeared to be the limited capacities of telecommunication networks. To date many of these technological impediments have been readily solved.

As a result, the paths seem to be levelled for a smooth implementation of a national Geo-Information Infrastructure (GII). Or aren't they? The best indication why this question should be answered with a denial is to acknowledge that the actual establishment of a Geo-information Infrastructure in Europe is far from being a reality.

The remaining part of this paper is structured as follows. First, we elaborate upon the perspective from which this paper has been written. Next, we address the technological and social backgrounds, which induce the conditions of and trigger the needs for establishing a Geo-Information Infrastructure. The next section lists the main issues which may arise when one wants to establish a nationwide or even (sub)continental wide Geo-Information Infrastructure. Finally, we present some conclusions.

Perspective of the Paper

Presented in this paper are a number of considerations and issues which may arise when one wants to establish a nationwide or even (sub)continental wide GII. Our considerations are based on experiences gained within Europe. Our perspective is that of an interested scientific-oriented citizen. The author has not been involved in any of the many European GII initiatives. An obvious drawback is that the issues, which I attempt to convey, are not a result of indoor-experiences and lacks an insiders perspective. However, this disadvantage is at the same time an advantage, because I will be able to perceive the issues from an objectifying distance, while being free of any form of direct interest, involvement or opportunism.

Our considerations are the reflection of an extensive examination of papers, articles and reports, which have been disseminated over the last couple of years. This paper is not designed to provide a definitive list of issues or means for successfully tackling the problem of implementing GII. Since the paper summarises what the author believes are some of the key issues, its primary objective is to offer means for discussion. The main message of the paper is that the availability of a technical infrastructure, i.e. the Internet, is a necessary but not sufficient condition for GII establishment.

As a basic framework for my consideration, I have taken a recently published EUROGI report, called: Towards a Strategy for Geographic Information in Europe (EUROGI 2000). The report has been released on the 5th of October, 2000. EUROGI is the European Umbrella Organisation for Geographic Information representing over 3000 organisations in 20 countries. Set up in 1993, its mission is to maximise the effective use of geographic information for the benefit of the citizen, good governance and

commerce in Europe and to represent the views of the geographic information community in discussion with the EU and other bodies (for more information refer to www.eurogi.org).

Technology and Society Backgrounds

During the last decade of the previous century, many new sensors types have become operational or into existence. Examples of such sensors are high-resolution airborne and spaceborne digital cameras (only bring to mind the Indian Remote Sensing (IRS) satellites), the Global Positioning System (GPS and Glonass), Laser Altimetry, and Interferometric SAR, which enable the collection of geo-data with a level of detail, accuracy, automation and collection rate never before seen in history. The accuracy and level of detail of the geo-data produced by these sensors, not only support the national economy in fields like agriculture, forestry, mining, water and coastal management, marine fisheries and sustainable development, but they are also very useful for large scale applications such as urban and infrastructure planning. This progress is accompanied by two other technological revolutions: computer technology and telecommuncation in general, and more specifically the rapid growth of the Internet and its use. These developments are still rapidly expanding.

From the non-technological point of view, we may witness that the needs of society are dramatically changing. This is because for many decades, an intensifying process of exploitation of the earth has been in progress. Today land is not only a source of wealth, as it was up to the 18th century, but also a commodity and a scarce community resource with environmental and social considerations tempering the historic economic or land market drive (Ting and Williamson, 1999). As a result, a strong intensification of land use occurs, with even multi-purpose use of the land and the sea, with as an arbitrary example precision farming. These developments induce the need for proper management, increased monitoring, and planning at the square metre level. Indeed, recent times have shown a multitudinous, sometimes tremendous, expansion in many aspects of our being on earth. When making a comprehensive, non-limited list of phenomena demonstrating massive expansion over the last Century, it would include: world population, mobility, local conflicts, size and number of mega-cities, communication, food production, energy consumption, exploration of natural resources and the sea area, and use of outer space. We may witness that because of the above massive expansion, the need for geo-data is steadily growing. Because of the peculiar need from society, we may readily expect that the emerging technologies will continue to have a huge impact on the way we collect, we access and we use geo-information.

As a consequence of the above developments, awareness is growing at many organisations, institutes, the private sector and citizens for the need of a national wide or even (sub)continental wide GII. The key to understand the impact of the evolving GII is to recognise that the relationships humankind has with respect to earth are rapidly changing. We have a strong awareness of the increasing pressure we are bringing to bear upon the environment. We are deeply convinced that we have to take care of the earth, because we have the technology to destroy the weak balances created through millions of years of evolution. This is a brand new paradigm, never before seen in history. As a result, we want to monitor and manage environmental processes and the effects of human activity on these processes.

Geo-Information Infrastructure Issues

This part of the article lists the main issues which may arise when one wants to establish a nationwide or even (sub)continental wide Geo-Information Infrastructure. First of all, we have a look at the users of geo-information (Section A). Their role is central and essential. Next, we have a look at the group of geo-information producers, which is becoming increasingly heterogeneous (Section B). Does the increase of accuracy and level of detail of the wide variety of geo-data products, emerged from a heterogeneous group of manufacturers, accordingly mean that the users are better served? In Section C we show that this is not necessarily so and that the emergence of proper geo-data products is crucial. Because it may be expected that the creation of a free-market place, regulated by legislation and controlled by government, provide the best conditions to arrive at greater use and better exploitation of existing geo-information, we pay also attention to the market place for geo-information (Section D). At marketplaces, producers and consumers of commodities come together. Since money is the lubricant of any transaction, we spend a few words in Section E on the complicated issue of price setting. Key decision makers have a huge influence on the success or failure of launch and completion of a GII. Therefore, we consider in Section F necessary actions to be taken to convince politicians about the benefits to be gained from introducing a GII. The easy access of data and the need to solve complex problems, induce the need for merging of different geo-data sets stemming from different sources. Combination of data requires standards. Accordingly, a proper interoperability framework is needed, subject of Section G. The last two sections of this part of the paper, discuss governmental policy and the importance of establishing communication platforms.

A. Identification of the Targeted End-users

Keeping the overarching goal of the establishment of a GII in mind, i.e. encouraging greater use and better exploitation of existing geo-information, one of the inevitable consequences of introducing a GII will be that the number of users will increase and accordingly diverge. Many users, like utility companies, designers of infrastructure works, health and fire services, real estate agencies and retailers, need geo-information products to support them to remain competitive on the market segments at which they operate. Since the user is central in this respect, meeting the specific requirements of the users is a necessity. Many will be occasional users and all of them will put different requirements on the information they want to retrieve.

It has been acknowledged (Brox et al., 2000), that many users are often not easily to satisfy. The one wants to have little detail while for the other the level of resolution appears to be insufficient. Understanding the user will give producers an idea about the alternative possibilities for their datasets (Krek & Frank, 1999). The increase of a diverging users group requires therefore the setting up of value-added services, which transfer the raw geo-data provided by the producers, to customised geo-information, in order to satisfy the wide variety of users. Before value-added services can be created, it is necessary that the targeted end-users have been identified, that the requirements they put on the data products and services are known, and that their experience, skills and system configurations have been recognised.

B. Heterogeneous Producers Group

Traditionally, geo-information has been produced by governmental organisations, such as National Mapping Agencies, which may have in some countries already a history of hundreds of years. In the past governmental agencies were also the main consumers of geo-information. The strong centralisation of the production of geo-information resulted in rather uniform but also rigid products. The provided services did usually not exceed the delivery of a very limited number of maps. Today, as a result of privatisation and market liberalisation the main difference when comparing now with the previous era is that geo-information is now produced and maintained by companies who want to make a living out of it, whilst in the past production was mainly financed by tax payers money. In addition, because of the digital representation of the data, the ease of digital processing, and the strong increase of different sensor types, a plethora of geo-data types and formats are being offered to consumers by a group of producers which is becoming increasingly heterogeneous. As a result, National Mapping Agencies have lost their position of power and authority. They are now in competition with other geo-data providers, like the organisations, which produce high resolution satellite imagery or those who produce high-resolution digital elevation models, often collected with advanced data acquisition techniques, like laser altimetry.

C. Challenge of Proper Data

Even when the geo-data concerns one product type, like the large-scale base map in the Netherlands, many different organisations, like different municipalities, may be involved. Although a framework has been defined for the contents of the map, each producer adds details and interprets the object definitions according to needs and taste. Consequently, the contents differ in detail, heavily complicating the implementation of a meta-data information system. As mentioned earlier, the manufacturers of geo-information are increasingly becoming a heterogeneous group. Does this consequently mean that the users of geo-data will be better served? Although competition will increase, the data, which are brought on the market, will have dissimilar quality and characteristics. One of the biggest challenges will therefore be to make available accurate, detailed and reliable geo-information, in which the users part of the actors has an implicit and unconditional faith.

D. Marketplace

It is generally accepted that the success of any GII primarily depends on the demand for geo-information products and services. Consequently, in order for a GII to become successful, the targeted user groups should exceed critical dimensions. As a result, continuing promotion activities are essential to raise awareness among potential users about the benefits of using geo-information products and services for a plethora of applications. It is a well-accepted insight that the creation of a free-market, regulated by legislation and controlled by government, provides the best conditions to arrive at the objected goals. Given the nature of the commodity, it is natural to establish an electronic market (*e*market), where producers can offer their geo-information, and consumers may search for the information required. In many countries, clearinghouses have already been established for this goal. The basic resource of geo-information clearinghouses is a database, which can be accessed over the Internet by consumers, providing meta-information about the presence, nature, availability, location, formats and the like of the nation-wide available geo-information. Meta-information supports the user in exploring and inventory of geodata, whilst, when being discovered it provides the user a means, prior to purchasing and transfer, to judge whether the quality of the geo-data is appropriate for the application at hand. Another important issue to address the question whether there should be just one market-place, controlled or even initiated by government, or whether they should be many.

E. Price Setting

A market, whether physically or electronically, is characterised by the fact that prices are attached to commodities. Geo-information is a commodity like any other. It is produced by manufacturers, the product can be promoted, it can be shipped by volume and there are customers who are willing to pay a price for it. Important issues on an *e*market, where the good is delivered over the Internet, are the setting of the price and how to transfer the associated money from the supplier to the demander. Setting an optimal price is an integral part of the marketing process (Krek & Frank, 1999), which consists of four important elements often listed as four Ps: Product, Promotion, Price, and Place. Pricing is critical because a high price prevents its widespread, which is in obvious conflict with the overarching GII goal. A low price will not cover the high costs of collecting and maintaining the data.

How to arrive at a fair price setting? Keeping the data at the source by providing the geo-information products over the Internet, enables a fair pricing in the sense that the customer pays per use and for the amount of data he really uses (Van Oosterom et al., 2000). Conventionally, producers provide the data per geographic area. Even when one needs only a small percentage of the block, one has to pay the full price. Now one can be charged, in a sense, per transferred byte, i.e. per use and per quantity. However, this mechanism does not solve the actual problem of attaching a price to each use and to each quantity of data. A solution could be to leave the question and its answer to the free-market forces. Nevertheless, from a governmental point of view, keeping the overarching goal of augmenting nation-wide use of geo-information, such a solution may appear unsatisfactory.

F. Political Commitment

Since from the technological point of view, there are little impediments anymore, the actual successful implementation of an effective GII, becomes increasingly depend on the attitude of key decision makers in the political arena and the senior government officials. Lack of backing of and commitment to GII from politicians and key decision makers will greatly influence the tempo and effectiveness of its implementation. Consequently, actively influencing the leading decision makers becomes a necessity. Influencing key decision makers should be communicated in the context of the central problems they are facing. This may for example be done by explaining how infrastructure, water management and environmental protection, may benefit from the introduction of a GII. The instruments of communicating the benefits of GII may include dialogue, seminars, news paper articles and opinions. Since not technology but the geo-spatial solutions are the crucial communication issues, it is appropriate to paraphrase in this context, Land and McLaren (1998), who identified in the respect the success factors for implementing Land Information Systems

(LIS) in countries in transition: In essence, the key is to deliver business solutions, particularly in the context of political problems/opportunities rather than focussing on and over-communicating the technical capabilities of the Internet and the data bases, which are keeping the data.

G. Interoperability

Often geo-data is considered to be the fuel of a GIS. However, from the perspective of the networked society, in our opinion, a better metaphor would be that of cargo. The main difference with physical cargo like real fuel, e.g. oil and coil, is that after use, information in digital format is not burned but is still existing, it remains entire intact. In combination with the widespread use of the Internet, the fact that geo-data is not a physical entity enables its repetitive –theoretically infinite- use, reuse and exchange without wear. The good is delivered on demand to consumers whenever they need it, enabling to keep the data at the source databases. Consequently, the users do not need to worry about the management of their data. Data in digital format needs a computer accessible carrier, the database. Keeping the data at the source draws consequently a heavy load upon the reliable and continuous operation of the database. This is because not a single organisation depends on it anymore, but a whole heterogeneous community (Van Oosterom et al., 2000).

In order to solve their specific problems, users will need to combine geo-data sets stemming from different sources. For example, large and small scale topographic data, which form the skeleton of any GII, may be combined with thematic information, like land use data, administrative data and soil data in order to determine the land value for tax purposes. The data model, the thematic content, quality, geometric accuracy, spatial reference system, quality and administration and the like of all geo-datasets, topographic as well as others, have to be stored in metadata information systems, to which targeted users have open access. In order to allow the merging of these different data sets and to combine geo-data services, which possibility are delivered to users in the form of software packages, which are, like the data, also transferred over the Internet, interoperability standards are required. The OpenGIS consortium (OGC) and the official standardisation organisations (ISO, CEN) address the Interoperability issue.

H. Governmental Policy

Although many developments in the ICT arena are fostered by private companies, the majority of European Union governments are actively involved in improving the development of the Information Society in their country. This is because, amongst other reasons, governments need ICT to improve their internal working processes and their services to others. Many governments are working on the concept of *ICT for All* or *Internet for All*. Information is now considered to be a major priority for all EU governments. All EU countries have already invested lots of efforts and resources in raising awareness and the widespread use of ICT. It seems that these efforts will be substantially be reinforced in the coming years, fuelled by huge amounts of funding (Chatrie and Wraight, 2000).

Within this framework, it has been acknowledged that the European GII (EGII) should be strengthened. Although, the main elements of a EGII are already in existence, national conventions cause differences, which result in problems when applications cross boundaries of countries. In order to improve harmonisation and interoperability, the GI2000 document: *Towards a policy framework for Geographic Information*, has been compiled and published in 1996. However, approval of the GI2000 document by the European Commission does not seem to have received any priority as yet. Because of the failure to put the GI2000 high on the political EU agenda and since the activities of the European Commission are of significant importance in this respect, it is questioned by Kok (1999), whether the EGII would still have any function as a strategic policy instrument in the future.

I. Forums

During our work in the Mid-European countries in transition (Lemmens, 1999; Lemmens & Kurm, 1999), we experienced that West-European consultants, often take the situation of their home institute as measure for all. The work processes and organisational structures of their own institutes are in their eyes not only unique, but also special and the best of all worlds. This form of rigidity, which I have called the home-country syndrome, appears to be a general human attitude. Those who are in the process of creating a national GII get often frustrated in this respect. For example, Brox et al. (2000), express a high level of annoyance, when stating: "One of the main problems hindering the rapid development of national and regional geospatial infrastructures today is the reluctance to learn from others, supported by national (or even state) pride and the deeply rooted belief of facing a very special situation. However, the relevant economic and technological evolution is pretty much the same for large parts of the world. And there are much better ways to preserve cultural diversity than through a plethora of arcane data formats and monolithic system architectures." In order to avoid rigidity, it is important to create and maintain platforms and forums for the exchange of ideas and experiences for all the organisations involved. In addition, it should be recognised that it takes a long time to fully build up the capacity of organisations involved in the GII process. The activities of the few national GI associations in Europe, which have over a decade operational GII experience, are still evolving.

Conclusions

The world is moving towards an economy in which information is of primary importance. The last decade national and regional initiatives have emerged to establish Geo-Information Infrastructures, aimed at increasing the use of geo-information among a wide variety of users. It is our strong belief, among others fostered from experiences in implementing Information Systems in Mid-European Countries, that the success and long term sustainability of a Geo-Information Infrastructure will depend only in a marginal sense on technological conditions, and far and foremost on non-technical factors. Of particular importance will be the establishment of an open market place, where all types of users will be able to look for geo-information as commodity. In addition, commitment of decision-makers and the willingness of politicians to put the GII high on the political agenda, are indispensable conditions. And last but not least accurate, detailed and reliable geo-information, in which the users part of the actors has an implicit and unconditional faith, should be *freely available*, which does not necessarily mean free of charge.

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