

GI CAN IMPROVE EFFICIENCY OF ECONOMY BY 15%

A PAMPHLET IN SUPPORT OF GI2000

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Human Beings Live in Space

Space is fundamental for all human activities. It is a widely accepted estimate that **80% of human decisions affect space** or is affected by spatial situations. This estimate is low, as it is difficult to find examples for purely non-spatial decisions; even decisions about persons (from marriage to selection of commissions for the EC) are influenced by spatial considerations.

Geographic Information Improves Spatial Decisions

Geographic Information is used in spatial decisions. Information about the spatial situation, if available, improves all decisions which are spatial. Today, in a large majority of decision situations, this spatial information is not readily available and is therefore not used, which leads to higher use of resources and a reduction of efficiency.

The Value of Geographic Information is the Improvement of the Decision

It is possible to assess the value of geographic information for a specific decision: it is the value of the improvement of the decision with respect to the desired goal. The value can consist in:

- a reduction of the resources used to achieve the goal;
- a reduction of risk, which means that the decision is 'on average' improved;
- a reduction of the cost of taking the decision.

In any specific case, the value can be assessed in terms of reduction of the use of resources, i.e., in standard economic terms. The increase in efficiency of processes through spatial information is substantial, as the next examples demonstrate.

Geographic Information Used in Logistics

Logistics, considered widely as the sector of moving persons and goods to the places where they are desired, is a very large part of today's economics and its importance is increasing.

Geographic Information is used in logistics in various forms. It helps to improve routing of regularly scheduled transports (from school buses to waste collection), it improves dispatching of emergency vehicles and reduces the crucial time till a victim receives medical aid, and it improves distribution of goods and services.

GI Improves Logistics by 20%

In all cases where the economic benefits of using geographic information in logistics were observed, savings of around 20% are documented. A recent case in Europe documents an overall improvement of performance of a large, Europe-wide service organization of IT products by 18% through the use of GI.

Improved Decisions are Saving Resources, i.e. the Environment

A recent study of the reduction of the length of trips of service personnel for a public utility in California has indicated that trip length can be reduced by more than 20%. In this region air pollution from vehicle traffic is high and a politically sensitive issue. It is now considered to force all companies with large fleets of vehicles to use GI and routing algorithm to reduce the travel, and thus reduce air pollution and contribute to the protection of the environment.

GI in Management of Spatial Resources

The improvement Geographic Information can bring to the management of spatial resources is at least as high. For example:

Urban Planning:

In the long run, urban planning can be improved to reduce transportation needs, to reduce criminality in cities (by better organization of space), etc.

Agriculture and Forestry:

Balanced production which achieves production goals with minimal use of resources, and thus in particular reduces environmental pollution with nitrates. Precision Farming is another key use of GI.

Geographic Information is a Major Part of Transportation Business

The economic part of information in transportation is significantly underestimated: today most trips are planned based on information acquired freely from the environment (mostly from signs in the environment, from previous experience and from inquiries from other people). The informal management of GI is a reason for the preference of individual transportation (by car one can drive with minimal previous planning); to use public transportation means needs planning which requires the acquisition of information about time tables, etc. The time required for acquiring the information is 20% to 50% of travel time (for single trips, even for air travel!).

The rapid changes in our built environment, especially in the transportation infrastructure, reduce the importance of the traditional sources of GI for transportation. Within a few years, driving a car on a *legal* path in a city without a navigation aid will be a challenge. If public transportation should increase – which environmental goals dictate –, then the information must be provided to potential users in a much better way.

Effect of GI on the Efficiency of the Economy

For logistics a consistent estimate of 20% improvement of efficiency is widely documented. Logistics is the case where the use of GI is probably simplest (because the decisions are simple) and most advanced. GI is documented as fundamental for public utilities, which spend internally around

\$ 20/year and customer for GI (at a relatively low level of usage) and can document that this is cost effective; further investments are underway which bring more efficiency gains.

There are good reasons to believe that the use of GI in other sectors would be as effective, and one can even assume higher. For example, the use of better algorithm in spatial planning will bring about substantial savings on the cost of doing business, through the improvement of the built environment (however, such other applications may take a few more years to become widely practical).

I therefore boldly conclude that **the potential to improve the overall efficiency of our economy of GI is in the order of 15%**, because 80% of all decisions are spatially affected and the contribution of GI in all documented cases brings a 20% efficiency increase. Increase in efficiency in the economy does not mean that workers become redundant, but it means that society can spend this much of its resources on better goals, goals which contribute more to the general wellbeing of the citizens. Increase in efficiency of economy means also less environmental pollution.

It is obvious that this potential will not be realized in a few years, but it demonstrates that a long-term strategy is appropriate to realize this potential over the next decades. The strategy must consist of elements to have immediate, medium term and long term effects – which means help for existing business, efforts to improvements of policies and practice, investment in skilled personnel and (long term) knowledge.

At a lower level estimate for efficiency increases; we can just take the logistic sector, which makes 20 - 30 % of the total economy, a surprisingly large share. From this an efficiency increase of 20% makes an overall increase of efficiency of 4 - 6% (which is for Europe still \$ 360 billion).

GI is a Rapidly Growing Business

It is estimated that around \$ 100/person-year is spent for explicit Geographic Information (mid 90s, Europe or USA). This is for all of Europe around Euro 30 billion. This is a conservative estimation, as it is mostly the cost of collecting spatial data and managing it in paper-based or electronic archives. It does not include the implicit collection or acquisition of GI in business activities like transportation, logistics (unless it is IT supported), real estate management, etc., which is the sector with highest growth and highest potential for contributions to the economy.

Very high growth figures in single sectors have been reported over the past years. Overall it must be expected that a figure of \$ 500/person and year is realistic for 2005 to 2010. The speed of the development is not limited by economic factors, but mostly availability of data, skilled persons, and knowledge.

Impediments to the Use of GI in Europe

Lack of Awareness

GI is often not used because the potential users are not aware that they are making spatial decisions, or that the decision could be improved by acquiring more information. It is not known what information is available (e.g., only few business make use of the widely available spatio-demographic data collected by national statistic bureaus), where it could be acquired and how it could be used.

Lack of Availability

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

Compartmentalization of the Markets

In addition to the individual impediments in each of the national GI markets, Europe is hindered by the compartmentalization in small markets: there are only minimal European data sets available; procedures, policies and legal regime 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.

Need for Action

Actions to improve the use of GI in Europe's economy are urgently needed and a coherent and comprehensive is required. A number of effects have allowed the economy in the USA to use GI more effectively:

- widely available base data, without copyright restrictions (especially for transportation and business use);
- a large, uniform market, for which the same data sets are available, and for which products and procedures can be developed;
- a competent substantial base of industry active for long time;
- industry consortia to establish standards (with public sector participation and contribution);
- university based (publicly funded) research groups ;

The vendors for the base technology are mostly in the USA; their market share in Europe is around 70% and growing. Worldwide are the US companies dominating.

In the USA a very large number of SMEs are in the GI business: offering refined data sets for particular types of decisions, services of all kinds. Only few such companies exist in Europe today – this is even more significant than the dominance in the base technology, as in this sector, most of the future growth is expected in SMEs (indeed, the two dominant sellers of GIS software today were very small businesses only 25 years ago)

The USA economy uses GI more effectively and thus enjoys a competitive advantage – for one, it can produce the same goods and services at lower cost and second, that it develops and perfects the GI products and services, which can later be sold world-wide. The European competition in the GI sector loses currently market share, in a growing market and even within their European home market.

Two Scenarios for the GI Business

The GI market for Europe is in the medium term roughly half of the efficiency improvement induced by GI: this would be around \$ 600 billion per year (8% of GNP).

Scenario ‘No action in Europe’: European companies move out of the GI market because their small domestic markets do not pay for the necessary R&D. American companies with the technology developed for their home market will dominate the software and services part. A small number of large, hugely profitable (American?) companies will eventually build privately owned pan-European data collections, which will enjoy a natural monopoly. Availability of GI in Europe will be, due to the monopolies, at higher cost, thus generally impede European economy and cause unnecessary burdens for the environment (e.g., inefficient logistics)

Scenario ‘GI policy Europe’: The European Union establishes policies that allow European companies to produce for a pan-European market, for which data are readily available. European companies can develop technology to work with the multi-cultural situation in Europe and compete with this technology successfully in the world market. Pan-European data sets will be available at economic conditions. GI is widely used and European companies are leaders in software and services to make beneficial use of GI. Increased efficiency of economy and decreased resource usage and environmental pollution result.

Prime Impediment

To decide on an effective policy, one has to understand where the primary impediment lies:

Development of GI products and services is not economically feasible in Europe, due to the lack of economically available data. Technical solutions are found and the data is collected, but to arrange for the economic use of data in products results only rarely in a successful product on the market. Most products are based on datasets the vendor possessed initially.

Institutional restrictions, in particular differences in the institutional arrangements of the 30 plus European mapping agencies, make it economically difficult to create products for the national markets, products for a European market follow always the smallest common denominator, thus the least advanced mapping agency limits progress.

Actions Required

Following the Nobel laureate in economy Douglass North, institutional change is the result of a number of influences (hardly ever a single one); a European policy must therefore change as many of the parameters affecting the decisions of the mapping agencies, which control access to the data.

A **mandate for a European GI policy**, which includes the standardization of legal and organizational methods to make geographic information available Europe-wide with at least a base coverage to address urgent industry needs. This does not imply that a single European agency should be created, that more data should be collected, etc. It simply says, we must build structures (e.g., expand Megrin), which make the required data easily available for potential users at a cost such that they can use the data economically.

It would be sufficient if the EC acquired the data it requires for its own administrative and planning use and make such pan-European data sets on an ‘as is’ base available to value-adding resellers.

Rising Awareness: Encouragement and support for demonstration projects, which explore new ways of using GI, introduce GI in new areas; documentation of 'best practice' cases and support for networks of sectorial or regional exchange of experience.

The current situation lacking standards for data and data availability makes even the few example cases existing in Europe not portable to other countries (unlike the USA) – European efforts are necessary, which must be organized in an environment where results from one country can be transformed in successful business in another country.

Support for **Standardization Efforts:** the compartmentalization of the European market can only be overcome with the development of internationally accepted standards, which consider the European needs. The Open GIS consortium is supported mostly (90%) by US industry (direct support \$ 1.5 million/year, additional indirect support through technical contributions twice as high).

Special European issues have to be considered (differences in the data collection, in terminology, in graphical mapping traditions) and to be included in the efforts (currently there is an EC funded project with 150 kEuro/year for two years). Efforts must be expanded beyond the technical issues and include commercial issues (pricing methods, effective protection of data, privacy safeguards, etc.). The EU must support such efforts (as OGC is already substantially supported by US government agencies).

Skills and Knowledge: Lack of skilled personnel and lack of knowledge are important impediments; it is a worldwide observation that personnel to lead GI commercial initiatives is scarce and that positions are hard to fill. It is the result of neglect during the past 20 years. A European policy to establish centers for the education of GI professionals is required as the necessary size and level of technology for such centers is beyond what most of the European nations can do. Cooperation is required (as demonstrated by the cooperation between Manchester University and University of Salzburg or the planned school in Villach, serving Austria, Northern Italy, Southern Germany and Slovenia).

Similarly, research is only possible by cooperation across national borders to achieve the 'critical mass'. In Europe there are probably 1/3 of all researchers in GI. The US researchers can cooperate through funding from a single agency (NSF) (even Canadians can usually participate). Research cooperation in Europe is hopelessly hindered by two dozen national funding agencies with different priorities and rules. Europe has less researchers and their efficiency is further hindered; the 'critical mass' for advanced and imaginative research is only reached if the strong American research centers work with European counterparts.

Funded University based research is a contribution to the solutions of the problems encountered in a few years; it produces the ideas for new products for industry, but it also produces the skilled high level professionals who carry new ideas and initiatives in the industry (MIT is consistently working on problems and potential products which will perhaps appear on the market in 15 to 30 years). The USA demonstrates how around the leading university centers commercially most effective high-tech regions emerge (Route 128 around Boston, Silicon Valley, Research Triangle). Cooperative efforts between universities (focus of funding) and industry (advice and feedback), with medium and long-term goals should be supported substantially from EU in the area of GI.

Data Collection: the collection of new data is only occasionally required; efforts should concentrate on making good use of the existing data.

Building Structures for European Research and Education in GI

As the impediment is mostly public institutions which are not sensitive to economic incentives and thus extremely resistant to change, and have means to protect against politically mandated change, increase in the level of knowledge and knowledgeable personnel is likely the most effective change agent: new personnel entering the agencies will be oriented towards a GI business, the professional peers from outside the agency will construct a status system which pressures towards change. People to capitalize on the change will be available and the success will advance the change further and speed it up.

Two specific doable actions are:

Research: The National Center for Geographic Information and Analysis has in 10 years and with total funding of \$ 1.5 million per year fundamentally affected GI in the USA. Nothing comparable exists in Europe and the top researchers here are extremely happy to be tolerated at the NCGIA meetings. This can be copied within a year and a European Center can work in cooperation and at par with the US center within 2 to 3 years (funding necessary Euro 1- 2 million per year). This center should include (as has the NCGIA) research in business practice, legal issues and societal and ethical concern.

Education: A number of European education centers for GI are necessary, serving Europe (or large parts of Europe) – national centers are not economically feasible. The

Austrian/Italian/German/Slovene planned center in Villach is a first example. EU should install several GI schools that teach technical and business aspects of GI for EU regions.

Summary of Needs

The GI market in Europe is compartmentalized. In addition to the cultural differences – which we must preserve – national agencies, which have a natural monopoly for the data, make it difficult (and thus economically unfeasible) to assemble pan-European data for many uses. Europe does not have the economy of scale the uniform US market enjoys and therefore our companies cannot finance their R&D.

The situation is not only compartmentalized with respect to data, but also with respect to the market for the products (national preferences) and finally with respect to R&D: we have fewer researchers in GI and these cannot cooperate well under present structures.

Summary of Actions

Investment in knowledge and skills is most likely the best strategy to advance the institutional change in the mapping agencies which control access to the base data. A European Center for GI research and several cooperating regional technical schools to educate the personnel necessary for the GI industry should be funded by the EU. Effective use of geographic information is quickly paying for such an investment.

Immediate help for industry is achieved with as European mandate for the collection of European base data sets, which are primarily used for EC internal planning and administration, but made available at economically viable conditions to value-added resellers.

Standardization support and encouragement for best business practice projects builds awareness and develops the uniform market.