Brave New GIS Worlds

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INTRODUCTION

Traditionally diffusion research has a pro-innovation bias. Diffusion is studied as a process by which older, outdated technologies are replaced by more advanced, more efficient and hence more beneficial ways of doing things. The first systematic studies of diffusion processes by Rogers (1962) and Hägerstrand (1967) looked into the way new technologies, such as new farming techniques, the telephone or television, gradually penetrated their markets. The implicit assumption, never discussed, was that adoption of the new technology was in the interest of the adopters.

However, the view that a new technology is always better than the older one it displaces has long been discredited by the dialectic of technological progress - the experience that more often than not a successful technology, once it has become dominant, also displays a destructive dark side. At least in the case of farming, this dialectic has become commonplace. The 'green revolution' helped farmers to multiply their crops by introducing fast-growing plants with higher yields, more efficient fertilizers and more effective pesticides, yet also brought new risks of water contamination and soil erosion, contributed to rural unemployment and depopulation and caused grave imbalances in global food markets.

Diffusion research was not able to visualize these long-term impacts because it was concerned with the early phases of diffusion, in which the new technology was still virgin and innocent. As only the beneficial aspects of the new technology were seen, rapid diffusion was interpreted as success and lack of it as deplorable backwardness. In fact the most frequent motivation for diffusion research has been to identify barriers to the rapid adoption of the new technology and, once these have been identified, to recommend strategies to overcome them (cf. Rogers 1993).

Diffusion research concerned with the adoption of geographic information systems (GIS) is no exception. The growing volume of studies on the adoption and use of GIS in the United States and in European countries have been stimulated not by academic interest but by the well-intended drive to identify and help remove institutional and technical bottlenecks to their universal distribution and application - not surprisingly, because the authors of the studies generally are members of the GIS community, i.e. individuals with a strong interest in this rapidly growing market (see, for instance, Masser and Onsrud 1993). The dangers of a pro-innovation bias of this kind of research are obvious. Diffusion research which only sees the positive side of the new technology it is concerned with is unable to distinguish between backwardness and other more serious reasons for differences in speed or intensity of adoption. Even where it subsumes barriers to adoption under the broad but diffuse heading of 'cultural factors', it will always view these as regrettable and something to overcome, and this will inevitably colour the conclusions drawn from the research.

Chapter 2 in Masser, I., Campbell, H. and Craglia, M. (Eds) 1996. *GIS Diffusion: The Adoption and Use of Geographical Information Systems in Local Governments in Europe*, pp. 9-21. London: Taylor & Francis.

Yet there are good reasons to move beyond a naive all-out promotion of GIS and arrive at a differentiated and balanced stance which carefully weighs their obvious benefits against their potential risks. As long as there have been computers, there have been warnings that the information revolution may endanger fundamental human values. The 'data bank' and 'information system' have always carried the Janus-face of unlimited knowledge about and control over the individual. There have always been fears that this kind of knowledge, in the hands of irresponsible bureaucrats, law-and-order police officers, power-hungry politicians, criminal organizations or unpredictable fanatics, could be used to undermine democracy and individual privacy. However, the recent success of geographic information systems has given these warnings a new dimension. Geographic informations systems, with their capability to localize every conceivable object or activity in Cartesian space, are the ultimate expression of the rationalist dream of measuring and knowing *everything*. In combination with concurrent technologies such as electronic data interchange, GIS introduces a new powerful threat, that of total *spatial* control.

The first concerns that GIS might be far more dangerous than previous information systems have been expressed not by proponents of GIS, but by social and political scientists and a few critical geographers (e.g. Smith 1992; Obermeyer 1992; Curry 1993; Lake 1993, Onsrud et al., 1994, Pickles, 1994). The GIS community itself has largely remained confined to an uncritical promotional attitude towards GIS. GIS journals such as *GIS Europe* are technology- and application-oriented and rarely deal with the social impacts of GIS. Academic discussions orbit around epistemological or methodological issues of GIS or what GIS do to geography (e.g. Openshaw 1991; 1992; 1993; Taylor and Overton 1991; Couclelis 1993) but hardly touch upon their limits and risks. However it is time that also GIS experts become aware of the debate on the impacts of GIS on society and develop adequate answers to its serious questions. This paper tries to contribute to this debate by suggesting a number of scenarios of possible future GIS diffusion which capture the range of perceptions of the impact of GIS on society found in different countries of Europe today.

GIS TODAY

Geographic information systems (GIS) include a wide range of different applications including automated mapping and facilities management as well as land information systems. As the number of applications grows, the term GIS is used increasingly as shorthand for a great diversity of computer-based applications involving the capture, manipulation, analysis and display of geographic information and the associated services that go with them.

Although many of the basic concepts underlying GIS were developed more than 20 years ago, the computer technology required to manage large amounts of geographic information and display them in graphical form has only been available since the mid-1980s. Since that time the GIS hardware and software industry has dramatically expanded in terms of both the number and range of applications. It is estimated that sales of GIS hardware since 1985 have grown at rates well over 10% per annum, while software sales have increased by 15-20% each year. As a result the volume of hardware

sales has doubled every 6 years since 1985, while that of software has doubled every 3-4 years.

The pace of technological innovation is still accelerating and the range of applications continues to expand. In fact the number of GIS facilities in operation has grown at an even faster rate than overall sales as an increasing number of budget-price installations come on the market.

The main users of GIS are central and local government agencies and the utility companies. Together these account for well over half the overall GIS market in most countries. Other important application areas are in the field of environmental management and facilities planning. Over the last few years there has been a considerable increase in the number of business applications for sales analysis and marketing. These already account for 8% of the GIS market and it is forecast that their share will rise to at least 15% over the next 5 years. Other potential fields which are still to be exploited include the use of GIS in vehicle navigation systems.

The utilization of geographic information systems is heavily dependent on the availability of digital topographic data. As a result of variations in national government policies towards data provision, there are considerable differences between countries in terms of the availability of digital topographic data at both the large and small scales. There are also important differences in the cost of information of this kind to users, as the providers in some countries attempt to recover the cost of data provisions. In Britain, for example Ordnance Survey data are protected by copyright, and the agency itself already recovers 70% of its costs, whereas the TIGER files developed by the United States Bureau of the Census are available at minimal cost without copyright restrictions.

The growth of GIS over the last years has stimulated a massive growth in specialist GIS services of all kinds. These range from bureaus specialising in digitizing, automated data capture and customizing spatial data bases to management consultancies advising agencies on the benchmarking and implementation of particular GIS packages. An important sub-group of GIS services is associated with the development of customized software for particular application fields. Of particular importance in this respect is the development of decision support systems for commercial marketing operations. As the number of systems in operation has increased, there has been a parallel growth in legal actions regarding the accuracy and reliability of the information provided by them. As a result, litigation and claims for liability and compensation are emerging as an important growth area.

The spatial impacts of these developments are not homogenous. The GIS market is particularly well developed in North America, whereas the European GIS market is still divided by national interests and highly fragmented in character. There is little agreement on common standards, and there are considerable differences in the professional cultures that are involved in GIS applications. Generally the north and west European countries have experienced higher levels of GIS penetration than those of southern and eastern Europe. However, there are also marked variations within countries in the level of GIS penetration, particularly in southern and eastern Europe.

THE FOUR SCENARIOS

This is the situation from which the four scenarios start. Each of them is a projection of one possible evolution of the uses of GIS and their impact on society. The first scenario is the *Trend* scenario characterized by incremental diffusion of information systems along the lines experienced in the past. The other three scenarios highlight and exaggerate specific tendencies that can be observed today. The *Market* scenario extends current tendencies towards commodification of information, which restricts access to information to the more powerful. The *Big-Brother* scenario dramatizes the potential of GIS to be used for surveillance and control by fully integrated omniscient systems, which pervade all aspects of life. The *Beyond-GIS* scenario, finally, speculates on how information in the public domain might contribute to more democratization and grass-roots empowerment. All four scenarios look 20 years into the future and are expressed as narratives of a person looking back to the 1990s.

The Trend Scenario

The year is 2015. The past twenty years have been a period of stupendous technological developments. All of them have been based on innovations made in the 1980s, but nobody at that time would have expected the speed by which they have penetrated their markets. New materials have brought unprecedented levels of miniaturization, memory and computing speed of all kinds of electronic devices. Telecommunications, cable and computer companies have merged into transnational media conglomerates. Fibre optics, cable, cellular radiophony and satellite communications have grown together into an integrated multi-layer network of information superhighways bringing fax, e-mail, smart TV and electronic data interchange to every home and office. Artificial intelligence, multimedia and virtual reality have amalgamated to create new kinds of computer applications that are more user-friendly, entertaining and unobtrusive than ever.

All these developments have had their impacts on GIS. As a result of the immense advances in performance and reduction in cost of both hardware and software, the number of GIS installations, the development of user-friendly interfaces and the range of applications have multiplied to the extent that geographic information systems are now used universally like spreadsheets and data base management software before them. One impact of universal GIS is that most users make use of GIS facilities without ever being aware that they are doing so. This is particularly the case with multimedia applications using virtual-reality GIS. Together with Gis installations, the number, size and diversity of spatial data bases has grown explosively. Today there is a huge variety of public and private spatial data bases for all conceivable purposes, from postcode systems precise to the letter box to multimedia, virtual reality house catalogues or travel guides. GIS education is now part of the conventional school curriculum. The GIS industry has become increasingly specialized and fragmented in order to meet the great diversity of demands placed on it by different applications groups. The term GIS is used less frequently than during the 1990s, and when it is used, it tends to be prefaced by another term indicating the specific subset of applications that is involved.

Within Europe as a whole there are still considerable differences between countries. Although efforts to promote greater harmonization of GIS by the European Organization for Geographic Information have had some success, there are still considerable differences between the countries in terms of the data that are collected and the extent to which they are made available to users as well as with respect to the data models and data interchange formats used. Many of the differences between professional cultures also remain, particularly with respect to the key GIS users such as local governments and the utility companies. However, considerable progress has been made in reducing regional disparities within Europe, partly as a result of initiatives of the European Union. As a result, the gap between the European and north-American GIS industries in terms of market penetration has largely disappeared. This is also due to technological developments and automated data capture, which have resolved many of the problems previously faced by information-poor countries.

In 2015, therefore, GIS in Europe is both universal in extent and largely benign in operation, while the applications field as a whole has become highly fragmented and specialized in nature. Variations between European countries still persists despite efforts to promote harmonization. Against this backcloth, the potential of the technology and the capabilities of organizations to manage it are still being constantly tested in practice. Because of the risks involved in such operations, the media contain occasional reports on gross incompetence and inefficiency in public-sector GIS applications as well as about the enormous sums that are being paid out in compensation as a result of court decisions regarding GIS.

The Market Scenario

The year is 2015. The information industry has become the largest and most powerful economic sector. As goods production now largely takes place in the developing countries and in eastern Europe, more than 70% of all economically active persons in western Europe primarily handle information during their daily work. Digital data, text, audio and video, fax, telephone and electronic data interchange have amalgamated into one integrated multimedia information and communications technology. The desktop computer has given way to a flurry of miniaturized, interconnected electronic gadgets from credit card to hand-held super computer. All individuals and households are part of and connected with thousands of electronic networks putting at their disposal all conceivable kinds of deliveries and services. Every transaction in daily life leaves a trace in these networks: orders, sales, invoices, receipts, itineraries, reservations, inquiries, messages, sounds and images.

A large part of the traffic over the networks is geocoded. Every customer or supplier is associated with a unique address, which not only represents a point in geographic space, but is also a node of the transport and telecommunication networks and is linked to a postcode, enumeration district, electoral ward, municipality and county. Attaching a geocode to an item has become so easy that geocoding is used even where it does not serve any other purpose than identifying an object. Every trip, delivery route or electronic message represents a spatial interaction between two addresses and can be aggregated to flows of people, goods and information across the territory. Knowledge about

these stocks and flows, about potential customers and the pattern of their activities, is economic power, which can be used to contest or defend a market.

This is why most of the networks and the information they contain is private. In the 1990s, many European governments, following the neoliberal economic doctrine of that time, privatized their postal services, transport and telecommunications networks and enforced a strict cost-recovery policy for government agencies providing post-coded directories or cartographic or statistical services, which traditionally had been free or could be obtained for a nominal charge. Local governments followed suit by privatizing their utility companies and contracted out mapping and surveying tasks. Privacy legislation, which had been overly constraining the information industry in some European countries, was harmonized between European countries in the late 1990s. Today it is legal to collect and trade data on individuals as long as the information appears to be correct.

The result was the emergence of an immense market for value-added telecommunications services and geocoded information. During the 1990s small and medium-sized firms specializing in digital databases with the associated software mushroomed. There was a proliferation of digital road databases for trip planning and fleet management, of small-area population and household databases for marketing planning, and of large-scale digital city maps for real-estate development and property management and sales. Prospective home buyers could browse in virtual reality through offered houses and their environment without actually going there. The same technology was used by travel agencies, instead of bulky catalogues, to market package tours. Other rapidly growing markets were utility planning, facility management and vehicle tracking and navigation systems for the rapidly growing intelligent vehicle-highway systems (IVHS) industry.

Besides these applications for commercial and professional users, a booming market for consumer or home GIS emerged. People could download virtual travel experiences as a surrogate for actual travel to far-away countries, cities or museums - one could even book a trip to ancient Rome. Other popular home applications of GIS were trip planning, geography courses and spatial computer games. As with today's video games, customers were lured into buying cheap hardware to make them captive to expensive software.

It was a period of creative turbulence and confusion. Every conceivable spatial information of commercial value was digitized over and over again by a multitude of data suppliers. Needless to say that all these proprietary databases were of varying accurateness and reliability and incompatible with each other. As competition became fiercer, prices plummeted. There were real data wars between suppliers; even sophisticated encrypting techniques did not prevent massive reverse engineering of data bases resulting in an explosion of litigation about data ownership and copyrights. Because of the proliferation of data suppliers, it became less and less profitable to trade raw data. The real business was to compile customized 'designer information' for the specific purposes of individual clients; and as these were more often than not persuasion and manipulation if not deception, the notion of what was 'correct' information underwent a subtle change. As a consequence, litigation on the liability for damages due to the use of

incorrect or distorted data emerged as a second fast growing field of legal disputes. In particular some spectacular cases of large-scale fraud in international virtual space created a worldwide legal debate about which country's jurisdiction to apply.

In the late 1990s the market consolidated and many small suppliers of digital geocoded information went out of business. After some spectacular mergers and take-overs, a few big transnational players remained: among them Mitsubishi, Siemens-Bull and Warner-Murdoch, the US-British media giant, who had ventured into the geoinformation business by swallowing EtakMap of Atlanta, Georgia, and by launching its own fleet of imagery satellites. The Warner-Murdoch (formerly Etak) map encoding system became the factual industry standard. More recently alliances between the geoinformation industry and credit card companies, travel agencies and telecommunication networks operating worldwide have created giant online data banks capable of tracking not only lost luggage but also travellers or customers with any desired detail.

Governments at all levels, once the sole providers of geoinformation, found themselves at the mercy of the information conglomerates. Their retreat from the information scene in the 1990s, based on short-sighted budgetary considerations, proved to be a costly mistake. Since in most European countries now population and employment censuses have been abolished, governments have to pay the market price for the same kind of information which in former times they had produced themselves. Even worse, they do not get all the information available, as certain kinds of data on property values, household income, consumer preferences or travel patterns are too commercially valuable to be released to the public domain. Ironically, the refusal to sell commercially profitable data to government is often justified by reasons of confidentiality, although everybody knows that no such constraints are observed where that data are used for commercial purposes.

The loss of public control over the geoinformation market has seriously affected the status and effectiveness of public planning. Some kinds of data of potential value for local planning have practically disappeared because their collection or updating is not profitable, such as historical or time series small-area data or maps of non-metropolitan areas. Other kinds of data have a negative effect on urban development because they are selectively available only to certain groups. Proprietary information on the socioeconomic composition of neighbourhoods and on property values, for instance, has been used by real-estate agents to speculatively manipulate land and house prices with the effect of displacement of poor households and reinforcement of spatial disparities. In fact, dealing with manipulated real-estate information has become an important field of activity of organized crime.

Other users of geoinformation, who formerly relied on government services for their information needs, are effectively excluded from access today. University research using geographic information is hardly able to afford privately collected data offered at market price. Users without financial means, such as students or citizen groups or protest movements, who need information for their study or political work, have no chance. But nobody complains; people see that information is a commodity and understand that the market does not produce where there is no demand. Nor is the issue discussed in the media which are controlled by the same multi-nationals that produce

the data. The free information market is not free for everybody but only for the rich and powerful. The consequence is a widening gap between the information-rich and the information-poor: between those who participate in the information society as providers and manipulators of information and those who participate in it only as consumers and have access only to manipulated information.

The information gap is widening also between regions and countries. Developing countries have become dependent on the transnational geoinformation corporations from whom they buy GIS-processed satellite images indispensable for resource exploration and water supply management. In addition, also east European countries, which had not had the time to develop their own geoinformation industry, are victims of this dependency. After their privatization, the statistical offices and mapping agencies of Poland, the Czech Republic and Hungary were acquired by Mitsubishi, whereas Siemens-Bull succeeded with their bid for designing CISGIS, the distributed geographic information system for the countries of the former Soviet Union.

The Big-Brother Scenario

The year is 2015. What a relief that the opposition of the 1990s against the geoinformation networks had not been successful. The European corporate state depends on reliable intelligence to defend itself against crime and subversive activities. Today it is hard to imagine how the security of residential areas or shopping malls could be guaranteed without efficient spatial surveillance systems. Even driving on highways has become more secure since every vehicle is being monitored by police, although this had been introduced originally merely for accounting purposes.

There had been a time when some people had resented being registered in the new geocoded information systems. There had been even fears that data banks with the capability to track everybody's movements, might endanger basic human rights. Fortunately, these concerns have long been dismissed as exaggerated fabrications of the individualistic liberal period. Today citizens realize that modern information systems are only to their benefit. They appreciate the convenience and safety of the welfare state and are eager that they are correctly represented in as many data banks as possible as home owners, customers, subscribers, patients or drivers and wherever they go, at home or abroad. Of course, people who are denied the privilege of membership may complain; but they must understand that the exclusion of people without credit line is necessary for the protection of the majority. Also people who find their whereabouts tracked in police data banks, such as narcotics dealers, traffic delinquents, HIV positives, homeless, or people with questionable political views may not like this, but they can only blame themselves for being observed in the interest of a safe society.

The integration of the geocoded information systems started in 1998, when Eurostat and Europol, with the help of Siemens-Bull, the European information giant, were amalgamated into the European Intelligence Agency (EIA). It was the task of the new public-private agency to integrate all hitherto isolated national spatial information systems into a coherent hypernetwork of distributed information interchange following the lead of the 'information highways' programmes in the United States and Japan. It was argued that only by this integration would Europe have a chance to compete with

these two rivals in the fight for global economic dominance. One can say that the integration of geoinformation did more for the unification of Europe than the Single European Market in 1993.

The impacts of this restructuring of the geoinformation scene in Europe were dramatic. It ended the chaos of uncoordinated production of geoinformation by small suppliers of the liberal period. Now it was recognized that spatial information which is freely available to everybody is intrinsically dangerous, whereas in the hands of the corporate state it can guide a society to achieving its highest economic potential. Since the European Freedom-of-Information Act of 1998 therefore every collection of geocoded information has to be licensed by the local subsidiary of the EIA, and any collected geoinformation is classified unless explicitly released by the EIA to the public domain as economically not sensitive. This law has greatly reduced the number of unqualified suppliers of geoinformation and the volume of litigation in this area.

From an engineering point of view, the European information network is a marvellous achievement. DESCARTES (distributed European spatial control and real-time early-warning system) represents the latest advance in hypernetwork technology. It is in fact a network of networks, superseding the hotchpotch of formerly separated and incompatible public (police, secret service) and private (commercial data bank and corporate data and transaction) networks in one grand, unified design - a splendid synthesis between German thoroughness and French elegance. Equipped with latest artificial intelligence, DESCARTES is an adaptive, learning, decentralized system. It has therefore no single primary control centre; its alert rooms are virtually distributed over all its levels, in police headquarters, corporate offices or the various spatial levels of government. In the control rooms planners watch for sensor lights to flash on floor-to-ceiling maps at places where trouble is likely to occur (cf. Wegener 1987). The EIA has the responsibility of maintaining the network and controlling access to it as well as linking it to similar networks in the United States, Japan and China.

However, DESCARTES was not only an engineering achievement; it also has had a deep influence on the relations between people. Never before had there been such a harmonious society. Violence and street crime have practically disappeared, since all public spaces have been equipped with video surveillance system; without surveillance people would not feel safe. Most people have asked the authorities to link their homes to the circuits to demonstrate that they have nothing to hide, in fact privacy has become associated with something unethical if not illegal. Surveillance is moulding behaviour in many beneficial ways. For instance, neighbourhoods now look much tidier, since remote sensing has enabled police to monitor garden maintenance.

Of course, where there is much light, there must be some shadow. There remains the misery of those who are excluded from the surveillance society, such as illegal immigrants, tax evaders, or subversive elements living in sewers or abandoned underground tunnels. They do not enjoy the benefits of surveillance but are themselves strictly observed by police and, if necessary, ruthlessly attacked. It remains an interesting question why the authorities have tolerated the existence of this underclass in an otherwise perfect society.

The Beyond-GIS Scenario

The year is 2015. Seen from today, the GIS craze of the 1990 looks like a strange fad. Certainly, there have been some useful applications of geographic information systems in cartography, planning or facility management, but to call this a revolution was a vast exaggeration. More likely it was fuelled by the hope of a fringe discipline for "the movement of geography to center stage" (Curry 1993). Today geography already exploits its next revolution, holography in four-dimensional hyperspace, hailed by an elderly Lord as "the greatest revolution in geography since the invention of the globe".

The end of the GIS boom in the late 1990s coincided with a major change of values. What had been a minority opinion in the early 1990s, now became a broad movement: that the most advanced countries in the world could not continue to pursue economic growth forever, but needed to move towards qualitative growth in terms of equity and sustainability (Masser et al. 1992). Political landslides in major European countries brought back the welfare state but also a revival of grassroots democracy.

These developments changed the role of information and by that of geographic information systems in society. People rediscovered that the most important types of knowledge are *not* data and are *not* spatial, but are informal, personal and political, i.e. everything information systems, and GIS in particular, are unable to offer. Some even claimed that the hypothesis that with more and better information all problems could be solved, was itself an expression of a technocratic and functional view of the world (Postman 1991). All sorts of computerized information systems became associated with everything that was negative: central power, technocracy, the corporate state, police surveillance and organized crime. A wave of violence against computer centres and agencies dealing with data of all sorts swept across Europe. In November 1997 a small group of Luddites set fire to the Eurostat complex in Luxembourg. The fire lasted 5 days, and the smoke trails it generated were recorded by satellites.

Violence cannot solve social conflicts, but in this case it forced the information authorities to radically decentralize and democratize their operations. All cross-links between secret service, police and all sorts of public and corporate data banks were interrupted and put under strict public control. New freedom-of-information acts in many European countries determined that information collected in the public domain had to be made available to the public at no or marginal cost, except where privacy constraints precluded it.

Paradoxically only on first sight, the anti-GIS movement benefited local government GIS. As local self-governance and local planning reemerged as a central forum of political debate, local government GIS became even more important decision support systems for local land use, transport and environmental planning. In particular the need to redirect urban development towards sustainability gave an unexpected boost to local government GIS as it became apparent that environmental analysis in fields such as air pollution, noise propagation, vegetation, wildlife or micro climate required a more disaggregate spatial scale than conventional aggregate methods.

However, the relationship of local government GIS to power changed. Whereas they were originally designed for the use of the authorities, they now became a public good explicitly designed for public use in an open and participatory process of social experimentation and grassroots decision making. This, of course, required a different type of GIS, one especially designed to be used by non-experts. Therefore a new generation of GIS designed as 'expert systems for non-experts' emerged. Public libraries and institutions of adult education were given a new responsibility as mediators between non-experts and GIS in order to reduce the information gap between the authorities and the public. The result was a revival of public participation in local decision making, in particular in matters of urban planning, and a surge of self-organized user groups exchanging data bases and analytical techniques (cf. Wegener 1987).

Some say that local planning has become more difficult as public inquiries are more thorough and hence more time-consuming. It is also true that there have been periods of public disinterest when political apathy seemed the ultimate barrier to participatory planning. Moreover, the democratization of knowledge has not solved, but rather acerbated the problem of how to cope with the flood of largely irrelevant information. There even have been instances of deliberate misinformation in the open information arena, and it must be recognized that without the former comprehensive surveillance police work has become less effective. However, most people agree that these are small problems compared with the gain in civic culture.

CONCLUSIONS

Which of the four scenarios is likely to become reality? One view is that there could be different scenarios for different countries. The benign Beyond-GIS scenario, for instance, might have a chance in the mature democracies of north-west Europe, whereas countries with less developed political checks and balances might be at risk of moving into the directions of the Market or Big-Brother scenarios. An opposite view holds that the global competition will bring convergence rather than polarization between countries. In any case it is likely that the future will contain some facets of each of the scenarios. Low-cost GIS software will be widely available and used like spreadsheets and companies will use GIS to increase their profits as in the Market scenario; government agencies will use GIS to process personal spatial data for their purposes as in the Big-Brother scenario and local planning will be changed by access to spatial planning information for everybody as in the Beyond-GIS scenario. Each country can choose to which degree each scenario will come true.

What can be done to enhance the benefits and minimize the dangers of the GIS revolution? The first and most important task is to promote computer literacy and mature and responsible use of GIS through information and education for social consciousness. Like all strategies built on the principle of the enlightened and competent citizen, this may not sound very convincing vis-à-vis powerful economic interests not constrained by moral principles. Therefore good legislation in the area of information is essential. Even though many European countries have made substantial progress towards efficient privacy protection, all are sadly lacking in legislation guarding the right of citizens to have access to information collected in the public domain. Recent tendencies

to force public agencies to recover the cost of data collection from their users seem to be steps in the wrong direction. Lastly it remains to be seen whether the forthcoming harmonization of privacy and freedom-of-information legislation within the European Union will settle for the lowest common denominator or will bring genuine progress.

These political considerations should, however, not distract from the more fundamental philosophical questions concerning GIS. These questions have hardly found an answer. For instance, it needs to be asked in how far the data model of GIS implies a certain perception of the world and, if applied, will impose that perception on its users. It has been said that because of their US origin many existing GIS not only require their users to communicate in English but also reflect American cultural values (Campari and Frank, 1993; Wegener and Junius, 1993). Lake (1993) claims that the relationship between spatial units of reference and attributes in GIS is essentially positivist, and Curry (1993) points out that current GIS embody the principles of a property-based society. If this is true, GIS would secretly have a conservative and system-stabilising effect - the direct opposite to their desired innovative and emancipatory role in planning. Under this perspective, the ESRI slogan "geography organizing our world" takes on an insidious double meaning.

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