SURVEY AND GIS—BRIDGING THE GAP

—OPENING ADDRESS BY UNIV. PROF. DR. ING. HOLGER MAGEL, PRESIDENT, FIG

The FIG Report vol. 1, no. 4 *Having just returned from the 4th Annual Survey and GIS Summit, held in conjunction with the 26th Annual ESRI User Conference, I believe that it is timely to highlight the presentation made by Holger Magel, FIG President, at the inaugural Survey and GIS Summit in 2003. Since the creation of the first Survey and GIS Summit by Mike Weir, then ESRI Survey Industry Manager, both ACSM and FIG have supported the effort to Bridge the Gap between Survey and GIS by participating in and being a sponsor of the Summit. This year, ACSM was well represented by members of all four MOs. FIG was also well represented by several ACSM FIG delegates. [John Hohol, ACSM FIG Forum, Head of Delegation]*

OPENING ADDRESS

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—by Holger Magel

Today, being a surveyor, a planner, or a representative of the GIS industry means that we are also responsible for the future of our "one world." Our goal should be to jointly collaborate in order to contribute to a more sustainable and more just world. Thus, apart from the pure technical aspects that used to be a main scope of duties for many of us, we also have to address ourselves to the broader multi-faceted topics such as sustainability, civil society, good governance, poverty reduction, secure tenure, urban and rural land development, interrelationship, and, last but not least, decision-making in disaster management.

Thus acting today means to face new complex challenges and to work in a multidisciplinary environment. To achieve this goal surveyors, and especially FIG as their global organization, are in demand, as the fields I mentioned above are often the main concerns of work and of FIG's activities. But they are not alone, they have partners!

Especially companies such as ESRI which develop and constantly enhance geographic information systems and practice corporate citizenship worldwide. These companies have kept abreast with the changing world by providing surveyors and other professionals with visions, new ideas and the technological tools they need in order to deal successfully with complex spatial, environmental, and socio-cultural challenges.

When one talks about surveying today, one almost automatically talks about GIS, too. Therefore, I would like to make seven comments about integrating surveying and GIS.

1. GIS as a key infrastructural component with immense value and benefits for surveyors as well as for spatial planners and scientists

What benefit do we have by using GIS? A column written by Jeff Thurston (Director Integral GIS, Inc.) about "Determining Benefits and Advantages of GI" in *GeoInformatics* (October/November 2002) provides a partial answer to this question.

> *"GI has emerged, " wrote Thurston, "from the lone individual in the corner office working away on some unknown project and using some unknown technology, and this individual was very hard to communicate with during coffee breaks. Those GI people seemed to speak a different language. Every once in a while a person would produce a colorful and useful map. It looked simple enough, and over time more and more people kept asking for maps. Then they wanted to compare things spatially. Next thing we knew there was a GPS and some satellite data in the organization. Then more and more people wanted to do different things with the data and the organization hired more of these people ..."* [Thurston, 2002].

The text continues with the narrator questioning his fictional boss about the purpose and the benefit of this technology he does not fully understand:

"*It surprised me when the boss said we are providing GIS data for business, entertainment, and environmental applications, sociological, population and even for research studies for other organizations amongst others*" [Thurston, 2002].

Last but not the least, Thurston leaves us with the awareness that the information contained in GI-datasets such as cadastral and legal land registers, utility registers, and map databases is a key infrastructural component carrying immense (capital) value [Falk and Oliv, 2003].

But it is not only the value of the datasets; we also profit from the ability of GI-systems to analyze, compare, and combine them in their complex spatial context. By using these systems we can find answers for spatial questions that we would otherwise be hard pressed to obtain or be unable to provide. Thus it should not come as a surprise that since Roger Tomlinson coined the term "Geographic Information System" for the Government of Canada in the early 1960s (Coppock and Rhind, 1991), the development of GI-systems and applications has made giant steps forward.

Without realizing it, GIS has become a commodity without which our everyday life would be hard to imagine. But—and this is my question—do we already know and use all possibilities and advantages of GIS in our profession and for broadening the scope of our activities? Let's not forget that it was FIG and the German DVW president who sponsored the first international conference on Land Information Systems (these days discussed under the general term GIS) in Germany in 1978. I attended the conference, but the response of other practitioners and academics was close to zero! It took almost 15 years for GIS to became a hot issue among European surveyors and universities (Schilcher, 2001).

2. Despite the progress within GIS development further efforts to bridge the still existing gap between different standards have to be made

We have lost a lot of time. GIS is a relatively new and expanding technology and science. But, we are far from being able to benefit from the full potential of GIS. The reasons are mainly the confusing number of different interfaces and proprietary standards developed for the description of GIS data and their accuracy. Although the 1994-established Open GIS Consortium (OGC) took some steps in the right direction with regard to standardization, no uniform GIS standard exist to this day, which would apply to the entire spectrum of GIS applications and software currently on the market.

Hence the urgent need to "bridge the gap between different proprietary standards and develop a common language that every GIS will understand. We have to force an interdisciplinary understanding of object-oriented information, rather than engaging in discussions about a higher level of GIS data formats.

The importance of this issue becomes obvious when one takes a close look at the surveying offices in Germany, for example. In my home state, Bavaria, the Land Surveying Office operates a number of high-quality official datasets, such as cadastre maps, ATKIS, Digital Topographic Maps, Digital Orthorectified Imagery, and Geocoded Addresses. For all of these datasets, the Office has established different standards and interfaces. The experience at our institute shows the added cost and challenges created due to a lack of common standards.

To complicate matters further, similar official datasets have also been created by the 15 other German Land Surveying Offices. We established the AdV (a Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany), so as to ensure interoperability yet, we still have no common GIS standards and interfaces. Each state in Germany still uses its own standards. The situation is not much better in other European countries. As a matter of fact, no common European GIS standard exists, and, if you take a worldwide perspective, you will encounter the same problem.

The user-driven approach to GIS might, however, bring about what could not be achieved in the past—a more integrated approach based on geographic objects used in such applications as cadastre or topography.

The call for standardization and integration has been taken up by various agencies. At the national level, the National Mapping Agencies are playing a key role in the development of national Spatial Data Infrastructures. In Germany, the Interministerial Committee for Geoinformation (IMAGI) is working towards a national geodata infrastructure (GDI-DE), under the leadership of the Federal Ministry of the Interior.

At the European level, EuroGeographics is the a focal point for coordinating the activities of National Mapping Agencies toward the implementation of INSPIRE (Land, 2003). In its mission statement (http://www.gsi.go.jp/PCGIAP/brunei/eminar/euroge_strtgy.pdf), EuroGeographics calls for "Infrastructure for Spatial Information in Europe" as being an integral part of the E-ESDI initiative (Environmental European Spatial Data Infrastructure) to develop a user-driven approach to the development and use of geographic information. Given the great interest across Europe in sharing geographic information, the establishment of such an infrastructure is making good progresses.

An approach similar to IMAGI and INSPIRE is pursued in the USA by the Federal Geographic Data Committee (FGDC). This FGDC—as many of our American colleagues know—is a 19-member interagency committee composed of representatives from the Executive Office of the President, and various Cabinet-level and independent agencies. FGDC is developing the National Spatial Data Infrastructure (NSDI) in cooperation with organizations from state, local, and tribal governments, the academic community, and the private sector. The NSDI encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data (http://www.fgdc.gov).

At the global level, the Global Spatial Data Infrastructure (GSDI) is the focal point. The GSDI is non-profit global organization made up of members from more than 50 countries who represent emerging and developed nations, as well as industry and government organizations, and individuals (GSDI, 2003a).

This is much more than just about data; it's more about integrating and improving procedures and services with an interdisciplinary approach.

3. The relationship between Surveyors and GIS is outstandingly strong as the surveyor is the classical expert for spatial data acquisition

Given the enormous benefits that can be reaped by using GIS, it is not surprising that professionals in a number of fields are focusing their attention on furthering the development of GIS technology and standardization. Among them is the steadily growing trend towards the use of mobile computing and GIS in everyday field work.

Among all the professions with a spatial component, the relationship between surveying and mapping and GIS is particularly strong as it is the surveyors who, among all others, practice the science of measurement to assemble and evaluate geography-related information and then use that information for the purposes of planning and implementing efficient land and water management systems and practices.

The emergence of global geodata requires the surveyors' knowledge about reference systems, map projections, and geodetic data, and where these are needed. In other words, "Having started with 'data gathering,' surveyors have moved on to 'data modeling,' and they should aim to move toward an 'integrated competence of land, property and construction managing.'"—That is the FIG vision of surveyors competence (Magel, 2003a)! To accomplish this goal, we naturally have to work closely with related disciplines and professions such as lawyers, land economists, and civil engineers. Here, GIS gives surveyors the ability to combine and analyze spatial data in their complexity.

To sum up, since it is mainly surveying and maping and related disciplines that produce and use spatial information, they should aim to progress from mapping, digitizing, and data georeferencing to becoming experts in GIS principles, Geoservices, Spatial Information Management, and appropriate use of GIS itself.

4. FIG supports the development and use of GIS through its Commission 3 that is closely intertwined with its other commissions and leading GIS experts and GIS industry

To enhance the development and use of GIS, the International Federation of Surveyors established Commission 3: Spatial Information Management. One of the primary goals of this Commission, and indeed FIG, to achieve greater GIS interoperability and standardization. In particular, FIG encourages the use of GIS data and knowledge in decision making so as to change the way problems are solved.

Commission 3 is strongly intertwined with other FIG commissions, such as Commission 7: Cadastre and Land Management, whose work aims to promote the development of appropriate concepts and tools for land administration and land management. FIG encourages surveyors to use their knowledge, skills, and capabilities in this field.

The key here is to develop GIS as an accurate and reliable tool for successful field work. The insights gained from land management should be used for further enhancement and development of GIS applications and datasets.

All FIG commissions are encouraged to cooperate within and outside FIG. An example of what promises to be a very successful collaboration is the current joint effort by FIG and ESRI to develop an ArcGIS Cadastre Data Model template based on FIG's Cadastre 2014 concepts.

Together with FIG and the International Institute for Geo-Information Science and Earth Observation (ITC), ESRI recently co-hosted an international cadastre data model workshop at the ITC headquarters in Enschede, The Netherlands. More than 30 cadastre data modeling experts from around the world gathered to share their expertise and project experience to help define the core data model requirements. The goal of the workshop was to refine the initial 2014 cadastral data model so it could be used to implement core requirements, which include the management of multiple property rights and restrictions by cadastre agencies (ESRI, 2003a).

5. GIS is no end in itself—doing GIS requires more than just coping with technical aspects

In our discussion about GIS and its benefits, potentials, and technical problems we sometimes forget that GIS is no end in itself. Within the surveyor's community we can observe that many surveyors deal either with pure technical GIS aspects or with survey engineering, geodesy, land management, and land tenure. The representatives of the different subject areas of surveying and mapping often do not collaborate; instead, unfortunately, they focus on their own narrow subjects.

Therefore one often gets the wrong impression that a surveyor is either a GIS specialist or a survey engineer or a land manager. But instead of "either/ or," surveyors must develop good skills in all subject areas and should be open minded to an interdisciplinary cooperation.

I and the FIG are of the opinion that surveyors (as well as every other professional dealing with spatial and socio-political issues) need to have both general competence and specialized knowledge in one or more "spatial" fields. What is needed is the "*well grounded specialized generalist*" (Magel, 2003b). Only this well grounded specialized generalist will be able to meet the requirements of today's multidisciplinary field of surveying that I have outlined at the beginning of my speech.

Even if a surveyor's main interest lies in the technical aspect of GIS, knowledge of at least the primary fields of GIS usage is helpful in order to develop useful, practically oriented techniques for new applications.

At the Technical University of Munich, we offer courses dealing with technical GIS aspects and their application in land and disaster management and survey engineering. In lectures, seminars, and projects we encourage our students to widen their perspective towards a multidisciplinary one. We also try to contribute to interoperability by developing a web-based OGC-compliant 'GeoPortal' where experts are able to access and use data from different official Geodatabases online.

6. GIS—a bridging role for disciplines and professions

Any discussion about integrating GIS and surveying should also take a close look at the GIS community, since, not surprisingly, GIS experts and users have quite different backgrounds. They are either surveyors or geographers or archaeologists or geologists or agriculturalists, or forestry, landscape, or spatial planning experts. All of them have different specific professional skills, and all see space and spatial topics from different viewpoints, even within the same profession. But all of them are somehow connected by the phenomenon of GIS being used as a tool for visualizing, analyzing, and transferring information. It gives them a common platform.

In meetings, discussions, and conferences, experiences and know-how is exchanged. From this interaction with others from outside their fields, professionals using GIS benefit in terms of new ideas and perspectives, and by learning different ways of dealing with issues. The term commonly applied to this knowledge and work are "interdisciplinary knowledge" and "interdisciplinary work." Both have been the goals of FIG Regional Conferences since the regional meeting in Marrakesh in 2003, when the conference theme was "*urban-rural relationship for sustainable environment.*"

Sharing of experience and know-how is also the goal of the most important annual European (possibly even most important global) surveying event attended not only by surveyors but by other

spatial data professionals, as well—the German DVW INTERGEO. At the INTERGEO, GIS and its use and applications have been one of the central topics for quite some time. The hot issues of this year's INTERGEO held in Hamburg in September will, among other things, be spatial data infrastructure and the use of geodata.

7. GIS and surveying—from partnership to integration for a sustainable world

In conclusion, let me reiterate that, without doubt, GIS is an essential tool for a variety of daily decision making and professional work. As ESRI's president Jack Dangermond so rightly proclaimed at the 22nd Annual International User Conference, "*Geography and GIS are necessary tools if we are willing to sustain our world*" (Dangermond, 2003 in ESRI, 2003b).

GIS contributes to sustainability in two primary ways:

1. Databases and data management used in geodatabases contribute to an economically sustainable data storage and sustainable use of the core of every GIS application. This represents a vast amount of valuable geodata about our world and its environment.
2. Better understanding of the processes and problems affecting our world, which contribute to a sustainable use and management of resources and a more just world.

I would like to expand on Jack Dangermond's quote: Not only geography and GIS, but also, or even mainly (in my opinion), surveying and GIS are necessary tools for sustaining our world. So it is no longer a question of bridging the gap between surveying and GIS; indeed, it is no longer only a question of closer partnership between the two, but, that of integrating them and creating a new professional entity.

That is exactly what happened in the last decade in the countries of the "Old Europe," especially in Germany. If you want to study surveying at a university, you'll discover a new term—not Geomatics (because this does not cover the full range of surveyors' activities or competencies)—but "Geodesy and Geoinformation."

The message is very clear: GIS is an essential part of the study, but only as one of many other fields and competencies. To apply "*from the single land parcel up to the planet Mars*" (as the slogan in Munich proclaims), GIS knowledge and competence must be combined with additional competencies and oriented toward various fields of application.

Thus, I will continue to encourage FIG and its commissions and our partners to help establish GIS knowledge and competence centres in all parts of the world. With its exemplary education programs, ESRI is an outstanding model of corporate citizenship and one of FIG's most valued partners and corporate members!

Many thanks for your support. Let's jointly go on implementing our vision of worldwide bridging the gap and let's make integration solutions happen in order to contribute to a better world! [*Edited by Ilse Genovese*]

REFERENCES

Coppock, J. T., and D. W. Rhind.1991. The history of GIS. In: Maguire, Goodchild, Rhind, Geographical information systems: Principles and applications. New York, New York: Longman Scientific & Technical; Wiley.

ESRI. 2003a.ESRI Press release, 25.04, 2003. [http://www.esri.com/news/releases/03_2qtr/cadastre.html].

ESRI. 2003b. ArcNews Online. [http://www.esri.com/news/arcnews/fall02articles/setting-a-course.html].

Falk, T., and S. Oliv. 2003. The link between surveying and GIS. ArcCadastre for Cadastral Management. *GIM International* (May 2003). pp. 34-37.

FGDC (Federal Geographic Data Committee). 2003. [http://www.fgdc.gov/].

GSDI (Global Spatial Data Infrastructure). 2003a.[http://www.gsdi.org/press/2002bro.pdf].

GSDI. 2003b. [http://www.gsdi.org].

Land, N. 2003. The role of the National Mapping Agencies in building Europe's Spatial Data Infrastructure. [http://www.fig.net/figtree/pub/fig_2003/PS_2/PS2_1_Land.pdf].

Magel, H. 2003a. About the future of cities. Keynote speech at the parallel event at UN-Habitat Governing Council 19th session, 9. May 2003. [http://www.fig.net/figtree/].

Magel, H. 2003b. About surveyor's contribution to a free and vital society and economy. Opening speech at UN/ECE— Committee on Human Settlements, WPLA-Workshop: "Spatial Information Management for Sustainable Real Estate Market—Best practice guidelines on nation-wide land administration," Athens, 29 May 2003. [http://www.fig.net/figtree/].

Schilcher, M. 2001. 20 Jahre GIS-Entwicklung: Perspektiven für die Geodäsie. *DVW–Hessen/DVW–Thüringen-Mitteilungen*. Heft 1. pp. 2-15.

Thurston, J. 2002. Determining benefits and advantages of GI. GeoInformatics (October/ November 2002), p. 35.