7

THE ORGANIZATIONAL HOME FOR GIS IN THE SCIENTIFIC PROFESSIONAL COMMUNITY

J L MORRISON

The rapid rise in interest in GIS fostered by rapid developments in technology has occurred faster than existing professional organizations and academic departments have been able to react. Only now is it possible to begin to talk about bringing the institutional home for the GIS professional in synchronization with developments in the technology. Training for GIS professionals appears to be in academic departments of geography. Technological developments in the computer industry continue to occur at a rapid rate. Today GIS hardware, and for the most part GIS software, is sufficient. Trained professional users and accurate, accessible, compatible data sets are the weak links in the current GIS environment. Universities must provide the training and because of data's tremendous cost and frequent change, governments will probably have to pay the data cost. The home for GIS appears to depend largely upon the future cooperation of academia, government and industry.

INTRODUCTION

Because of its rapid rise in popularity, it should not be surprising that one of the more interesting speculations at the beginning of the 1990s revolves around where the professional organizational *home* of GIS should reside. Clearly, as is the case whenever a bandwagon begins to roll, many spurious characters try to jump on board and ride it for its benefits. The GIS bandwagon is rolling and there is jockeying for ownership and leadership by several professional organizations. This chapter examines the contribution and claims of professional organizations in several countries to the past and future development of GIS. International organizations are examined first, followed by national organizations.

It is useful to break the term GIS into two constituent parts for the purposes of this paper.

GIS = Geographical + Information System

On the surface, geography would appear to be the natural disciplinary home for GIS. After all, the word geographical or geographic is the first word in GIS. Geography, the mother of sciences, has been equated with the study of space (spatial) in the sense of position and relationships among positions on the surface of the planet earth. Clearly it is this spatial (= geographical) notion that is important in GIS (as opposed to one-dimensional or simpler information systems). Within geography two aspects of space have competed for attention during the past three decades (since the onset of the quantitative revolution in the discipline): visualization and parameterization.

Cartography, as a discipline, has mainly concerned itself with visualization while spatial data experts, a small group of professionals within the

geography discipline, have mainly been concerned with parameterization of space and spatial relationships. Authors have recognized three levels of interest in space: existence, location and structure (Robinson and Petchenik 1976). Existence and location, or 'here is' information, have been the traditional province of general cartography, that is topographic maps and reference atlases. On the other hand, structure is concerned with spatial relationships. These have been investigated, specified and calculated by statisticians, spatial data specialists and cartographers in the form of thematic maps. Precise location and distances are not sought on thematic maps. Users are concerned instead with examining spatial relationships and patterns, that is, structure.

A third discipline, the cadre of remote sensing specialists, has concerned itself with both visualization and parameterization but has limited itself to what is known as the raster format for data (see Egenhofer and Herring 1991 in this volume). All three sets: geographers, cartographers and remote sensing specialists, have some ties to the discipline of geography.

The second part of GIS, Information System, has appealed to a much wider variety of professionals. There are many information systems: some deal with text, for example a telephone directory; others with sound, for example recorded phone messages; and others with visual information, for example a book of photographs. GIS are a further subset of information systems. Information about space is important and ranges from large-scale concerns expressed by surveyors, geodesists, utility companies and highway engineers, and planners, to small-scale concerns expressed by global modellers from a variety of systematic disciplines such as climatology, geology, meteorology, botany and zoology.

Those professionals in need of large-scale information primarily want information about space, that is existence and location. Those in need of small-scale information primarily want visualization and parameterization about structure. The net effect is that a myriad of traditional professional groups contain subgroups that are interested in GIS and are aboard the GIS bandwagon. These groups are competing with one another for the right to steer the direction of GIS and the perceived right of ownership.

Within the English speaking nations of the world, geographers and computer scientists, supported by major vendors of hardware and software have united to drive developments in GIS. The decade of the 1980s saw a tremendous development that has made GIS readily affordable and thus available to a wide variety of users. User groups have formed around many GIS software packages and the feedback from such groups is vital to the continued progress of GIS developments. These developments have allowed GIS to become a useful tool to professionals in medicine, chemistry and all the social sciences. But fundamentally GIS is a tool, if not the major tool, of the discipline of geography.

The quandary thus created is simple: where does GIS belong in the traditional professional society/academic department framework? Does GIS force a redistribution of traditional professional memberships or does it require a new professional organization and/or academic departments? Surveyors, planners, utility engineers, cartographers, remote sensing specialists, spatial data specialists, and geographers all want a piece of the action. Computer scientists may yet try to claim part as well. What is the professional organizational home of GIS, what should it be, or what will it be? Will it differ from country to country? These questions are investigated in the next section.

International organizations

There is a large number of international organizations with interests in GIS. The most prestigious, the International Council of Scientific Unions, ICSU, is a complex organization consisting of 20 international scientific unions, 75 national members, associates and observers and 26 scientific associates (International Council of Scientific Unions 1989). ICSU, along with many of its constituent members, is interested in GIS. The Union has initiated the International Geosphere Biosphere Program, IGBP. This programme has four research themes:

1. documenting and predicting global change;
2. observing and improving our understanding of dominant forcing functions;
3. improving our understanding of interactive phenomena in the total Earth system; and

4. assessing the effects of global change that will cause large-scale and important modifications in the availability of renewable and non-renewable resources (International Council of Scientific Unions 1989).

A GIS can be an important tool in each of these four themes as it can provide the visualization and parameterization about spatially associated existence or structure. IGBP is just one of ICSU's programmes.

The International Geographical Union, IGU, a member of ICSU, established a Commission on GIS at its 1988 General Assembly in Sydney, Australia. The Commission is under the leadership of M. Lyew of Costa Rica. This Commission is a direct outgrowth of previous IGU commissions headed by R. Tomlinson and D. Marble. This group of international scientists has been concerned with spatial data handling for over 20 years and possesses a wealth of information about working with spatial data (Tomlinson 1972; Marble 1980). Publications and conferences convened by the former commissions have presented the leading edge of this work to the world. From 1984 until 1990 a series of four international symposia on spatial data handling have been held. These symposia have been events of primary importance to the development of GIS as their proceedings attest.

CODATA, Committee on Data for Science and Technology, is an interdisciplinary scientific committee of ICSU which seeks to improve the quality, reliability, processing, management, and accessibility of data of importance to science and technology. In particular, CODATA seeks to promote the production and distribution of databases for the disciplines of physics, chemistry, engineering, bioscience and geoscience. CODATA Task Groups adopt sets of standard reference data to encourage on an international basis the appropriate use of data and the uniformity of data reporting (National Research Council 1989). GIS is becoming of increasing concern to CODATA and sessions at its July 1990 International Conference included 'Geoscience numerical information processing'. It is early yet in the history of GIS, but CODATA principles applied to data reporting may well be the necessary and most efficient way to foster the IGBP.

Other international professional organizations, not members of ICSU, who have an interest in GIS include the International Cartographic Association, ICA, the International Society of Photogrammetry and Remote Sensing, ISPRS, and the Fédération International de Géomètres, FIG. Several international trade fairs, often concentrating on hardware and software rather than theoretical or analytical problem solving, are being held annually, including those sponsored by the National Computer Graphics Association, NCGA, Autofact, Micad and A/E/C systems.

NATIONAL ORGANIZATIONS

Different approaches to the unification of professionals interested in GIS are evident in many countries and the situations in the United States and the United Kingdom offer perhaps the most striking contrast. In the United States a combination of an *ad hoc* grouping of professional organizations and a centrally funded scientific initiative have led the way from the bottom up. In the United Kingdom a top down approach led by central government has been largely responsible for formation of a single coordinating body. A third approach is perhaps at work in Japan where private industry is taking the lead role in trying to organize GIS activities. These approaches and developments in other countries are reviewed below.

The United States

Within the United States, several large and established professional organizations make at least some claim to GIS. In 1987 the American Congress on Surveying and Mapping, ACSM, joined with the American Society of Photogrammetry and Remote Sensing, ASPRS, to host a GIS conference in San Francisco. The idea actually began as a regional conference, but the interest and enthusiasm exhibited in the conference from beyond that region quickly elevated it to national prominence.

The success of GIS/LIS'87 in San Francisco led to an agreement between the Association of American Geographers, AAG, and the Urban and Regional Information Systems Association, URISA, to join with ACSM and ASPRS and sponsor GIS/LIS'88 in San Antonio. GIS/LIS'88 was hugely successful, attracting over 3000

attenders and sporting an overflowing exhibition hall. AM/FM (Automated Mapping/Facilities Management) International, a fifth professional organization, with a motto of 'AM/FM is GIS' agreed to join the other four organizations in sponsoring GIS/LIS'89 in Orlando.

As a result of these activities, serious discussions within each of the sponsoring organizations were encouraged or forced (depending on your point of view). During 1989 both ACSM and ASPRS voted to discontinue their joint autumn conferences in favour of promoting the GIS/LIS series. The 1989 joint autumn conference in Cleveland ended the series sponsored by these two societies for over 25 years. Meanwhile GIS/LIS'89 held in Orlando was another success for the five sponsoring organizations. Due to the current strengths of the five sponsoring professional organizations and to the current spirit of cooperation it would appear that it is not immediately likely that a separate society devoted to GIS will emerge in the United States. A closer look at each professional organization and its changing activities is given below. Changes forced by the increased prominence of GIS are noted.

The Association of American Geographers, AAG, is primarily a professional organization of academics, most of whose members teach in departments of geography at the colleges and universities within North America. Over 50 per cent of the members hold a PhD degree and college/university employment plus active student status account for two-thirds of the total membership (5803 in 1988). The AAG has approximately 40 specialty groups of which the Geographic Information Systems Specialty Group is the largest with over 800 members.

The American Society of Photogrammetry and Remote Sensing, ASPRS, is a professional society of over 8000 members in 1988. ASPRS membership is varied; federal, state and local government employees make up 35 per cent of the membership while 30 per cent consists of engineering and consulting firm employees. Until November 1988 there were four divisions, but a fifth GIS division was announced at that time. The ASPRS established the GIS division due to a 'tremendous ground swell of interest in GIS' (Hoffer 1989: 1031). The GIS division's stated purpose is to provide members with a forum for discussing and disseminating information relating to techniques for applications of, and the system technology associated with, the design, development, applications and maintenance of GIS (Parker 1989). It is too early to determine how effective this new ASPRS division will be.

Beginning with the September 1987 issue, the monthly ASPRS publication *Photogrammetric Engineering and Remote Sensing*, began a column entitled GIS News. This section has grown and includes information on events, developments and people involved in GIS. Clearly ASPRS has established a home for GIS professionals if they choose to reside there.

The American Congress on Surveying and Mapping, ACSM, is a congress of three organizations: the National Society of Professional Surveyors (7400 members in 1988); the American Cartographic Association (2150 members in 1988), and the American Association for Geodetic Surveying (1700 members in 1988). During the 1980s ACSM served as the conduit for the establishment of the National Committee on Digital Cartographic Data Standards which created the forerunner of the Spatial Data Transfer Standard, SDTS, which is a basic standard for the interchange of digital data and of major utility to the GIS industry. Within ACSM the American Cartographic Association has taken the lead in the GIS arena and the National Society of Professional Surveyors has been concerned with a subset of GIS namely Land Information Systems, LIS. Some changes to date include a decision to rename the publication of the American Cartographic Association from *The American Cartographer* to *Cartography and Geographic Information Systems*, and to rename the publication of the National Society of Professional Surveyors from *Surveying and Mapping* to *Surveying and Land Information Systems*, with effect from 1990.

There is a rather large overlap in membership between the American Cartographic Association and the AAG. Most cartographers, remote sensing specialists and some GIS experts belong to both organizations. The American Cartographic Association, in addition to changing the name of its publication, has suggested 11 changes to its by-laws to include additional emphasis on GIS.

The Urban and Regional Information Systems Association, URISA, is a professional/educational organization for individuals concerned with the effective use of information systems by local/

regional/state/province governments. URISA strives to bridge gaps among information producers, users, and system/service vendors – to bring about a better understanding of ways in which timely and meaningful information is or can be available for decision and policy making. There are currently 2800 members which represent a multidisciplinary cross-section of government, private industry, and academic professionals. Most members are in management positions with county or municipal governments.

URISA sponsors an annual conference and produces multi-volume annual conference proceedings. Because of the increased interest in GIS one volume of the multi-volume set of proceedings has been devoted to GIS for each of the last few years.

AM/FM International, AM/FM, is the youngest of the five professional associations in the United States claiming interest in GIS. The organization has 1400 individual members but has the strong support of the vendors of GIS hardware and software, particularly the major vendors. The majority of AM/FM members work in private industry, most for a utility. The membership is young and well educated. More than half the membership is under 40 and more than half has formal education beyond the bachelor's degree.

Catering to large-scale GIS databases, AM/FM International is often most closely associated with utility and urban infrastructure building and management. The organization has adopted a motto of 'AM/FM is GIS' and includes discussions at its annual meetings of GIS versus AM/FM. The results from the discussions should be obvious from the adopted motto. AM/FM has actively supported standards for data inputs into GIS systems. It is the first professional organization to provide financial support for standards testing and development that will assist the GIS industry.

The National Center for Geographic Information and Analysis, NCGIA, was a concept advanced by professional geographers and brought to fruition by NSF. In the summer of 1987 the NSF issued a 'Request for Proposals' for NCGIA. Five areas in need of research were identified for consideration:

1. Improved methods of spatial analysis and advances in spatial statistics.
2. A general theory of spatial relationships and database structures.
3. Artificial intelligence and expert systems relevant to the development of GIS.
4. Visualization research pertaining to the display and use of spatial data.
5. Social, economic, and institutional issues arising from the use of GIS technology (Abler 1987).

The solicitation explicitly called for NCGIA to meet four goals:

1. To advance the theory, methods, and techniques of geographic analysis based on GIS.
2. To augment the United States' supply of experts in GIS and geographical analysis.
3. To promote the diffusion of analysis based on GIS through the scientific community.
4. To act as a clearinghouse for the dissemination of information about GIS research, teaching, and applications (Baerwald 1989).

A consortium of universities led by the University of California at Santa Barbara, UCSB, won the competition. UCSB along with the State University of New York at Buffalo, and the University of Maine at Orono, established the NCGIA in December 1988. NSF funding consists of $1.1 million per year for a period of up to eight years. The innovative proposal by this triad of universities initially called for 12 research initiatives. Five were initiated in 1989: Accuracy of Spatial Databases; Languages of Spatial Relations; Multiple Representations; Use and Value of Geographic Information; and Architecture of Very Large GIS Databases (NCGIA 1989).

The NCGIA competition had many side benefits for professionals of GIS in the United States. Positions were established at a number of major universities for the study of GIS and several top academics were enticed to move to form clusters of strength in GIS.

A sub-field of GIS, Land Information Systems, LIS, has also been active and the Institute for Land Information, ILI, has established centres of excellence in LIS at several universities and a

regional centre in New England and eastern Canada called the Atlantic Institute. The University of Maine at Orono is an active participant in both the NCGIA and the ILI's centre of excellence programme. Such activity coupled with the continuing NSF support for NCGIA assures the United States of a cadre of well-trained university graduates who will be the future leaders of GIS. NCGIA and the LIS centres of excellence personnel are active participants in the GIS/LIS series of conferences as well as in all five of the professional organizations listed above.

Clearly GIS professionals in the United States can select a home from among several professional organizations. So long as the five major professional organizations already sponsoring the GIS/LIS conferences cooperate, it is probably unnecessary for a new organization to form in the United States. This annual conference is probably a sufficient forum to allow interested professionals to introduce their work to the world and to discuss current and future developments and needs.

United Kingdom

The concept of the Association for Geographic Information, AGI, was voiced in 1987 and a provisional council was established in March 1988 which led to the formal launch of the AGI in January 1989. The AGI is a multidisciplinary organization dedicated to the advancement of the use of geographically related information (Shand and Moore 1989). AGI is defined to cover all interest groups including local and national government, utilities, academia, system and service vendors, consultants and industry. Two overriding aims are to increase the awareness of the benefits brought by the new technology of GIS and to assist practitioners in the attainment and use of these technologies (*AGI* 1988).

The concept of AGI follows a recommendation made by a committee of the UK Government headed by Lord Chorley (DoE 1987; Chorley and Buxton 1991 in this volume). One of the Chorley Committee's principal findings was a lack of awareness of developments in information technology which had important implications to users of spatial data. The committee was convinced that firms, organizations and nations who most successfully tackled this problem would gain important competitive advantages. The Committee emphasized a need for a central body to provide a focus and a forum for the great diversity of users of geographical information (*AGI* 1988). AGI was the result.

AGI functions as a National Centre for Geographic Information and provides an 'umbrella' organization for professional bodies and individuals interested in this technology (Wellings 1989). AGI's first national conference was held in Birmingham in October 1989 and over 600 delegates attended. The theme 'GIS a Corporate Resource' emphasized managerial issues and implementation. The Association publishes a quarterly newsletter (*AGI NEWS*) and annual yearbooks.

The United Kingdom is not without organizations similar to the five professional organizations in the United States (e.g. the British Cartographic Society, the Institute of British Geographers and the Royal Geographical Society), yet probably due to the leading role played by the Chorley Committee a new association was formed prior to the establishment of big annual meetings. Many of the individuals prominent in AGI are also leaders in other professional organization activities within the United Kingdom.

The Regional Research Laboratory, RRL, Initiative which commenced in February 1987 (Goodchild and Rhind 1990), is the United Kingdom's equivalent to the NCGIA in the United States. Initially four centres, later expanded to a network of eight centres, were funded by the Economic and Social Research Council, ESRC. The objectives are:

1. To establish a resource base for research and policy analysis.
2. To examine methodological issues arising from the management of large scale databases.
3. To develop centres of expertise within the United Kingdom (Masser 1988).

The research projects within the centres show a similarity to those being conducted by NCGIA. A core group of newly well trained experts in GIS appears to be forthcoming within the United Kingdom. In 1990 it was announced that ESRI, the vendor of ARC/INFO agreed with the Combined Higher Education Software Team, CHEST, to provide the GIS software system ARC/INFO to all

of the United Kingdom's 192 higher education establishments (ESRI 1990). This will undoubtedly produce a significant number of graduates versed in GIS skills.

Whether this early top down organizational focus in the United Kingdom will result in fostering developments and educational opportunities in GIS faster or more efficiently than similar developments in the United States remains to be seen. Certainly the leaders of AGI are not unaware of GIS activities in the United States and vice versa.

Japan

A 'caretaker's group' has been established to lead establishment of an organization primarily interested in GIS in Japan. The group consists of corporate, utility, government and research institute members. A meeting was held at the annual meeting of the Japan Surveyors Association in 1990 and the group is in contact with organizations in the United States. Exactly in what manner the organization will form remains to be seen. Clearly there is a need, and whether a new organization forms or an amalgam of older organizations takes the leadership role, Japan will respond to the current interest in GIS. The financial strength of corporations in Japan and their abilities to form loose organizations and to work together to attain an agreed upon goal spells success for future GIS activities in Japan (see Kubo 1991 in this volume).

Netherlands

NEXPRI, the Nederlands Expertise Centruum voor Ruimtelijke Informatiererwerkig, (Dutch Expertise Centre for Spatial Data Analysis) is jointly funded by the Dutch National Science Foundation and computer firms and environmental consultancy agencies (NEXPRI 1989). The universities at Amsterdam, Delft, Utrecht, Wageningen and the International Institute for Aerospace Survey and Earth Science, ITC, in Enschede jointly cooperate in NEXPRI which began in 1989. The goals are:

1. Research into the development and applications of GIS and spatial analysis.
2. Coordination of GIS research and training in the Netherlands.
3. Collaboration with similar research programmes elsewhere.

Four major research initiatives were undertaken in pursuit of these goals:

1. Theory of spatial analysis.
2. Quantitative land evaluation.
3. Transport of materials and pollution studies.
4. Development of GIS methods and techniques.

Canada

GIS developments in Canada often are included and reported along with the activities of professional organizations in the United States. The close connection between professionals in Canada and the United States is indicated by the fact that two of the five professional organizations mentioned under the United States above, AAG and URISA, held their 1990 annual meetings in Canada, Toronto and Edmonton respectively, and AM/FM held an informational meeting in Etobicoke, Ontario. Nevertheless, Canadian professionals interested in GIS have organized conferences on GIS and Canadian entrepreneurs and firms have made significant contributions to GIS developments.

The Department of Energy, Mines and Resources Canada, EMR, and the Canadian Institute of Surveying and Mapping, CISM, jointly sponsored the first of a series of national conferences in early 1989 in Ottawa. This national conference was entitled 'Challenge for the 1990s GIS' and brought together professionals interested in GIS from many nations. A volume of presented papers, exceeding 1400 pages in length, was an impressive result (Grant 1989). Canadian societies paralleling those in the United States are interested in GIS and the GIS professional activity in Canada focuses on this newly established series of GIS conferences much like similar attention focuses on the GIS/LIS series of conferences in the United States.

Republic of South Africa

Thanks to the advent of *NAGIS News* in June 1989 by an energetic group of GIS experts in Pietermaritzburg and the SAGIS89 Conference in 1989, the Republic of South Africa, RSA, has jumped aboard the GIS bandwagon (Natal/KwaZulu Association for Geographic Information Systems 1989). *NAGIS News* reports a modest amount of undergraduate GIS education within the RSA in 1989 at eight universities. While GIS education at RSA universities is only beginning perhaps the greatest need, according to *NAGIS News*, is for a self-standing GIS course for those individuals already established in professional careers. Equally important are short courses for decision makers/managers. A shortage of skills in GIS is evident in RSA and this fact could potentially foster the establishment of a GIS centre of excellence which would help to concentrate the current efforts. It appears to be agreed that the success of GIS in RSA will depend on the training of potential users by universities and vendors. The energetic group in Natal has started this process and was responsible for the EDIS87, Earth Data Information Systems, conference, held in Pretoria in September 1987 (South African Society for Photogrammetry, Remote Sensing and Cartography 1987).

Other Nations

The Utvecklingsradet for Landskapsinformation, ULI, in Sweden is in operation. This organization encouraged and sponsored in part by the Lantmateriverket in Gävle is led by a full-time professional. It serves as a professional forum for GIS activities in Sweden, holding regular meetings, workshops, education tours and publishing useful literature (Cederholm 1989; see also Ottoson and Rystedt 1991 in this volume).

The AFI3G in France has sponsored several successful conferences and would appear to be one organization fostering interest and interchange between French corporations and individuals interested in GIS in France.

GIS is being introduced into the People's Republic of China at a rather rapid rate. Systems are working at the National Bureau of Surveying and Mapping in Beijing, Wuhan Technical University, and Nanjing University to name but three sites. Interest is very keen and Chinese professionals are attending international GIS conferences in large numbers.

Within Eastern Europe and the Soviet Union the introduction of GIS has been much slower. Recent political events should tend to hasten its introduction but the lack of foreign exchange may keep GIS from widespread use in the near future. Most large GIS systems already being utilized in this region are closely controlled by the governments. Open systems are often very small and run on rather dated hardware and hence the more sophisticated GIS software perhaps cannot be accommodated.

DISCUSSION AND CONCLUSIONS

GIS is an enabling computer-based technology which allows its practitioners to collect, analyse and display spatial data. Those capabilities will lead to needs for vast spatial databases which will form one part of an information infrastructure which all levels of government, private enterprise and individual citizens will profit from utilizing in the future. The potential for use of GIS as a tool for bettering mankind is staggering. Not surprisingly, professionals leading the developments in this technology seek the opportunities to meet and discuss the major challenges, to compare their research results and to chart future directions for the creation, maintenance and use of these databases and the invention and extension of analytical procedures useful when applied to these data. Usually professional membership organizations, through annual conventions and publications, provide these opportunities, and university departments provide the basic education for a cadre of new professionals in the technology. Private industry, sometimes supported by governmental development dollars, provides the technology itself.

The rapid rise in interest in GIS fostered by rapid developments in technology has occurred faster than existing professional organizations and academic departments have been able to react. Only now is it possible to begin to talk about bringing the institutional homes for the GIS professional into synchrony with developments in the technology. The situation in North America is

following a 'bottom-up' path where professionals from a number of existing organizations have sponsored a series of meetings in an attempt to accommodate this GIS interest.

In contrast, the situation in the United Kingdom has followed a 'top-down' approach. Resulting directly from a government study, the AGI was established and GIS professionals in the United Kingdom have their own separate membership organization.

Training for GIS professionals for the moment appears to be in academic departments of geography. The NCGIA is closely associated with departments of geography in the United States and the AGI is hopeful that its influence will promote GIS education at selected UK institutions of higher education. For a technologically dependent tool it is appropriate that one scientific discipline assumes the leadership role. Geography appears to have done so and it is to be hoped that it will continue to rise to the occasion and satisfy national needs for GIS professionals in all nations.

Technological developments in the computer industry for the moment continue to occur at a rapid rate. Because of this a spirit of cooperation among GIS professionals enables individuals to maximize the accessibility to the latest technological advances. If technology advancement slows this spirit of cooperation may not continue. It is not absolutely necessary for a technologically driven tool to have its own society or association. With the current spirit of cooperation among the professional associations in the United States, it is possible to accommodate the needs of GIS professionals in the existing societies. If the UK model results in more focused developments at a faster pace an association similar to AGI may be created within North America. Barring the above and assuming the continued cooperation in North America, GIS will find its professional home wherever it finds an open door and a comfortable couch.

Today GIS hardware, and for the most part GIS software, is sufficient. Trained professional users and accurate, accessible, compatible data sets are the weak links in the current GIS environment. Universities must provide the training and it has been proven to be to the manufacturer's advantage to donate hardware and software to established university curricula. The collection of validated data is the most expensive part of the equation. Because of data's tremendous cost and because useful data change so rapidly, the huge data costs will probably have to be paid by government and/or distributed among governmental agencies and some private firms. The GIS environment cannot afford restricted or copyrighted data sets. Current basic data must be made available on an 'as needed' basis to all potential users. Continuing education to keep professionals abreast of technological developments is also important. The potential operation and contribution of GIS in a national information infrastructure may in fact prove to be too large for a single professional organization to handle. In the interim it is important to ensure the continued development of GIS and its full utilization. If development proceeds the professional home for GIS will become self-evident in the future.

REFERENCES

Abler R F (1987) The National Science Foundation National Center for Geographic Information and Analysis. *International Journal of Geographic Information Systems* **1** (4): 303–26

Association for Geographic Information (1988) *AGI NEWS* **1** (1): 1–8

Baerwald T J (1989) Fostering cooperation among academia, industry, and government – the establishment of the National Center for Geographic Information and Analysis in the USA. In: Grant N G (ed.) *Proceedings of National Conference Challenge for the 1990s GIS*. Canadian Institute of Surveying and Mapping, Ottawa, pp. 4–10

Cederholm T (ed.) (1989) *Utvecklingsradet for Landskapsinformation Geografiska Informationssystem*. Landmateriverket, Gävle Sweden

Chorley R, Buxton R (1991) The government setting of GIS in the United Kingdom. In: Maguire D J, Goodchild M F, Rhind D W (eds.) *Geographical Information Systems: principles and applications*. Longman, London, pp. 67–79, Vol 1

Department of the Environment (DoE) (1987) *Handling Geographic Information*. HMSO, London

Egenhofer M J, Herring J R (1991) High-level spatial data structures for GIS. In: Maguire D J, Goodchild M F, Rhind D W (eds.) *Geographical Information Systems: principles and applications*. Longman, London, pp. 227–37, Vol 1

ESRI (1990) *ARC News* Spring. ESRI, Redlands California

Goodchild M F, Rhind D W (1990) The US National

Center for Geographic Information and Analysis: some comparisons with the Regional Research Laboratories. In: Foster M J, Shand P J (eds.) *The Association for Geographic Information Yearbook 1990* Taylor & Francis and Miles Arnold, London, pp. 226–31

Grant N G (ed.) (1989) *Proceedings of National Conference Challenge for the 1990s GIS*. Canadian Institute of Surveying and Mapping, Ottawa

Hoffer R M (1989) President's Inaugural Address. *Photogrammetric Engineering and Remote Sensing* **55** (7): 1031–2

International Council of Scientific Unions (1989) *Yearbook 1989* ICSU Press, Paris

Kubo S (1991) The development of GIS in Japan. In: Maguire D J, Goodchild M F, Rhind D W (eds.) *Geographical Information Systems: principles and applications*. Longman, London, pp. 47–56, Vol 2

Marble D F (ed.) (1980) *Computer Software for Spatial Data Handling* 3 volumes. IGU Commission on Geographical Data Sensing and Processing for the US Department of the Interior Geological Survey, Ottawa

Masser I (1988) The Regional Research Laboratory Initiative: a progress report. *International Journal of Geographical Information Systems* **2**: 11–22

Natal/KwaZulu Association for Geographic Information Systems (1989) *NAGIS NEWS* June. Institute of Natural Resources, Pietermaritzburg 3200 Natal South Africa

National Research Council (1989) *Numerical Data Advisory Board Annual Report 1988–1989*. National Academy Press, Washington DC

NCGIA (1989) The research plan of the National Center for Geographic Information and Analysis. *International Journal of Geographical Information Systems* **3**: 117–36

NEXPRI (1989) *Geographical Information Systems for Landscape Analysis Research Programme*. NEXPRI, University of Utrecht

Ottoson L, Rystedt B (1991) National GIS programmes in Sweden. In: Maguire D J, Goodchild M F, Rhind D W (eds.) *Geographical Information Systems: principles and applications*. Longman, London, pp. 39–46, Vol 2

Parker H D (1989) *The GIS Sourcebook*. GIS World Inc., Fort Collins Colorado

Robinson A H, Petchenik B B (1976) *The Nature of Maps: essays toward understanding maps and mapping*. University of Chicago Press, Chicago

Shand P, Moore R (eds.) (1989) *The Association for Geographic Information Yearbook*. Taylor & Francis and Miles Arnold, London

South African Society for Photogrammetry, Remote Sensing and Cartography (1987) *Proceedings of Earth Data Information Systems, EDIS 87*. South African Society for Photogrammetry, Remote Sensing and Cartography, Pretoria

Tomlinson R F (ed.) (1972) *Geographical Data Handling* 2 volumes. IGU Commission on Geographical Data Sensing and Processing for UNESCO/IGU Second Symposium on Geographical Information Systems, Ottawa

Unwin D J (1991) The academic setting of GIS. In: Maguire D J, Goodchild M F, Rhind D W (eds.) *Geographical Information Systems: principles and applications*. Longman, London, pp. 81–90, Vol 1

Wellings C (1989) A review of the Association for Geographic Information Yearbook 1989. *Mapping Awareness* **3** (4): 51