GEOSCIENCE INFORMATION SYSTEMS IN CANADIAN GEOLOGICAL SURVEYS

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INTRODUCTION

The term Geoscience Information System is an umbrella expression which refers to the concept of multiple computerized datasets, databases and software which can be accessed to satisfy data/information requirements. A fully developed Geoscience Information System (GSIS, a new acronym), would have a common interface which would allow data to be easily extracted from a myriad of different sources and output in a set of common formats. A GSIS will use one or more types of spatial data management, manipulation and analysis software generally referred to as GIS (Geographic Information Systems) software as a large component of the system, but the term will usually denote more than the use of just one GIS package which normally could not be expected to perform adequately with all the different types of geoscience data. A GSIS can handle data sets that are distributed in 3D space, whereas today's GIS products are best at manipulating data that are distributed in 2D space. Realistically, the creation of a GSIS requires accepting and using a variety of suitable software tools developed both commercially and in-house, and building an infrastructure of standards and linkages to support the concept.

Why create a GSIS? One of the primary roles of geological surveys is to collect, analyze, store and distribute geoscience information (Prov. Geol. Journal, v. 5, p. 129-142, 1987). Geoscience information comes in large volumes in a great number of different formats. Historically, a significant proportion of data collected was neither properly described and archived, nor published, and has been lost. Much of what could be called the "Canadian geoscience database" is presently available only in hard copy form. With the recent advancements in sophisticated spatial analysis and manipulation software, demand has grown for digital data which can be used in these packages for such things as policy analyses, global change studies, exploration and development initiatives, geoscience research, and the development of better information products. Although providing these data is costly, the cost of not doing it may well be even larger if surveys become unable to respond to the reasonable requirements of their clientele whose expectations will be elevated by observing developments in other countries and by the capabilities of technology. Since providing data in multiple incompatible formats does not constitute good service to anybody, either within or external to the organization, it follows that there is a requirement both for the digital data, and for the set of software tools, linkages, standards and interfaces that we are calling a GSIS.

BACKGROUND

During the past 25 years, data essential to GSIS such as mineral deposit inventories, gravity and aeromagnetic surveys, geochemical surveys, etc., have been computerized to varying degrees in both provincial and national surveys, often with little coordination between programs, much less surveys. This was largely due to the existing data processing environment based on mainframes, minicomputers and homegrown software. General purpose GIS software did not (and could not yet) exist given the relatively low processing power of even mainframes. Some surveys in Europe have built their own GSIS, or cooperated with other agencies in their countries to build such systems during the last ten years. For example, in Finland they have a system called FINGIS which works well because of a complete set of data interchange standards and programs which transform datasets into a standard format. However, as our European colleagues have found, software development and maintenance is a person intensive activity which should not be undertaken without a sufficiently large pool of staff or money.

During the last five years, literally hundreds of spatially oriented software packages have been developed commercially, some for microcomputers that are as powerful as yesterday's mainframes. In this environment, it makes sense to talk about GSIS because the potential overall benefits, including the production of automated or partially automated map products, ease of update, the ability to do analysis and produce derived products, plus the increased ability to respond to client requirements, outweigh the still significant acquisition and development costs. Most of the national surveys in other countries are acquiring commercial GIS packages as an addition to or as a replacement for homebuilt software, and are using one or more of these packages in conjunction with a relational database management system. In some cases, for example the Federal Republic of Germany, a determined attempt to develop an integrated system is being made, while in others the emphasis is on data exchange standards.

With the development of microcomputer GIS software, came the ability of even poorly funded surveys to get into GSIS. The major impediments have become the lack of digital data in suitable formats and the lack of both money and personnel to deal with the data management problems (digitization, acquisition, conversion, reconciliation, interpretation).

PRESENT STATUS

While a number of the European surveys have already established integrated or partially integrated systems, Canadian surveys are only in the planning and initial development stage. Most provincial surveys as well as the Geological Survey of Canada have begun the planning and development necessary to create a GSIS, with varying levels of commitment to the process. The Quebec survey completed a pilot project for which all data sources in one area were digitized and the possibilities of the technology were explored. They are currently evaluating the pilot and planning the extent of future commitment to the technology. Several surveys are experimenting with and using GIS software such as Arc/Info, SPANS, CARIS and System 9 for specific applications. Two surveys are also involved in the automation of the cartographic process and the creation of related geological databases. The main problem that faces all surveys in Canada is the size of the proposed task and the lack of sufficient resources to fund the significant development effort that is needed to design the systems, purchase the hardware and software, enter the data, maintain the systems, attract and keep expert staff and educate users about the benefits of using GSIS.

The Committee of Provincial Geologists, in its brief to the Mines Ministers' Conference that was held in Quebec City in 1988, recommended that the Ministers "support as a high priority the computerization of geoscience databases and the adoption of GSIS's, while maintaining the ongoing information gathering activities". The National Geological Surveys Committee (NGSC), which consists of the territorial and provincial geologists and the Assistant Deputy Minister of the Geological Survey of Canada, recognized that for such a recommendation to be successfully implemented, cooperation among geological surveys is crucial. This will optimize both the effective use of scarce resources and compatibility between the GSIS's specific to each jurisdiction.

To start the cooperative process, the NGSC held a GSIS workshop in Ottawa, in November of 1988, which was attended by staff from most geological surveys. This workshop became the founding meeting of the GSIS Coordinating Subcommittee of the NGSC. Some of the more important terms of reference of the Subcommittee are summarized below:

- national focus
- sharing of information on:
  - computer systems and database management techniques
  - results of data base projects (costs, technology, system introduction)
  - current and future GSIS activities and plans
- users' needs
- cooperative projects
- national inventories

Participants agreed that the first steps in a cooperative effort was to create inventories of existing digital (or potentially digital) datasets and GIS projects in each survey. The Geological Survey of Canada (GSC), which had just begun the process of creating a directory of GSC data, volunteered to add provincial data to this directory and manage the project of creating what could truly then be called the Canadian Geoscience Data Directory. The needs for standard data exchange formats will be prioritized and specific recommendations for exchange formats will be made. A standard data dictionary may be developed. These decisions are completely in line with what is happening internationally where data directories exist (e.g. Great Britain, USA), or are in the process of being created (e.g. Australia). Questionnaires were developed, revised and sent out during 1989, and the results are now coming in.

The Ontario Geological Survey offered to coordinate and manage a GSIS project inventory which would enable staff in each survey to keep abreast of relevant ongoing developments. Some effort has been made to design this inventory which will be created during the next few months. These inventories are considered to be the building blocks of good inter-agency communication and cooperation.

The process of sharing experience and knowledge between geological surveys has begun: a network of people is in place. Now the dedication of a committed core group is needed to maintain the momentum. Each geological survey has to put time and effort into this venture now, to take good advantage of the cooperative process.

THE FUTURE

Challenges and Opportunities

The establishment of Geoscience Information Systems in Provincial and Federal Surveys should not be viewed as the introduction of a few computers that create a minor diversion from the other, more important, activities of the Surveys. We are at the start of a period of fundamental change; a period in which digital data in particular and information in general will be viewed as a resource with a high value. To give data value requires that they be easily available to and in the appropriate form required by those who need to use them. This currently is not the case.

To make data readily available requires the building of an information infrastructure. Until recently, infrastructure building was limited to physical support systems, for example, the creation of road and telephone networks. The new challenge of this decade and beyond is the building of an information infrastructure. In order to make this happen data must be regarded by organizations as a resource. The comparison of information systems with road and telephone networks is deliberate as these now mature networks were established only after very large capital investments had been made and there was acceptance of the need to maintain them. Geoscience data are a small part of the over-all information environment, but obviously a significant part. As minor players in the information business, geological surveys must look to established and emerging data standards and methods currently being used or developed. Thus, this work must not be done in isolation from other disciplines and organizations as they are also working on building the means to provide effective information services for the benefit of their own clients.

The competitiveness of any economy or sector of an economy will primarily be based on how effectively information can be organized, accessed and utilized. This provides the underlying impetus for change for all organizations that handle information.

Developing an information infrastructure for geoscience will require a major commitment from each survey both in capital investment and also in the development of new skills to manage these projects successfully. The geoscience organizations are not alone in these activities. Standards will have to be coordinated nationally. This includes adoption of existing standards and development of extensions to existing standards for geoscience information.

The development of an infrastructure for geoscience information means that all activities related to the collection and handling of information generated by geological surveys will have to be re-examined. Major investments in training will be needed by surveys to enable staff to collect, analyse, manage and distribute the data. End users also require education to make use of the data. Considerable coordination will be required between external users and the designers of Geoscience Information Systems so that useful and practical services are provided.

With the increased use of computers in the handling and delivery of geoscience information, many changes will continue to be made to current methods used by surveys. Since the investment required to build a geoscience information infrastructure is considerable, it is imperative that there be an open exchange of experience gained on projects between surveys, and that management at the assistant deputy level and higher be both aware and supportive.