<<<Back to Table of Contents
On to Part B: Benefits for geoscience from information technology, and an example from geological mapping of the need for a broad view>>>

Geoscience after IT: Part A

Defining Information Technology, its significance in geoscience, and the aims of this publication

T. V. Loudon
British Geological Survey, West Mains Road, Edinburgh EH9 3LA, U.K.
e-mail: v.loudon@bgs.ac.uk

Postprint of article in Computers & Geosciences, 26 (3A) April 2000, pp. A1-A3

Abstract - Information technology deals with tools for handling information, notably computers and networks. It brings benefits such as more efficient and rigorous formulation and expression of ideas, and wider sharing and integration of knowledge. This review should help practicing geoscientists and students to gain a broader understanding of these changes and form a view on future trends.

Key Words - Information technology, metainformation.

1. Defining Information Technology

Geoscience after IT, published as a book (Loudon, 2000) and a special issue of Computers & Geosciences, offers a broad overview of the impact of information technology on the work of geoscientists, seen against the background of evolving global communication on the Internet.

Information technology (IT) refers to methods of handling information by automatic means, including computing, telecommunications and office systems. It deals with a wide range of mostly electronic devices for collecting, storing, manipulating, communicating and displaying information. Examples of IT devices are: computer software and hardware, including memory and disk storage; printers; the telephone, cable, broadcasting and computer networks; office copiers; facsimile (fax) machines; DVDs; video cameras; image scanners; televisions and monitors; data loggers and automated instruments in the field and laboratory; sensors on satellite cameras or downhole logging tools; digital surveying equipment.

IT applications seldom respect disciplinary boundaries. The focus here is **geoscience,** centered on geology but inevitably overlapping into such subjects as geophysics, geochemistry, economic geology, engineering geology, and soil science. I occasionally stray into related aspects of environmental science, surveying and geomorphology, but try to steer clear of such topics as hydrology, meteorology or oceanography, which may be parts of the Earth Sciences in the wide sense, but are well covered in their own specialized publications.

A primary task of geoscientists is to add to the base of recorded knowledge. Philosophers have made valiant attempts to say what knowledge is (see, for example Audi, 1998). Workers in computer expert systems and knowledge bases take a more pragmatic approach. Addis (1985) defines **knowledge** as “justified true belief”, seen not as referring to a state of the brain, but as a shared human response to a complex environment. **Information** can be defined as something that adds to one’s knowledge and understanding, and includes **data** (known facts) and their interpretation. The prefix *meta-* is sometimes used to refer to a higher logical type. Thus metalanguage deals with the nature, structure or behavior of language. Similarly, **metadata** is the name sometimes given to data about data, describing the data so that they can be understood beyond their originating project. The broader term **metainformation** refers to information about information. Definitions of knowledge, information and data seem to lead more rapidly than most to circularity. However, as the underlying concepts are familiar, these should serve our present purpose.

2. The significance of IT to geoscience

Modern IT offers opportunities for more effective handling of geoscience information in three main areas. The first is the obvious ability of computers to calculate, thus opening up possibilities of more rigorous analysis with quantitative and statistical methods, and more vivid graphical presentation with visualization techniques. A second area is the manipulation and management of information. This starts with the ability to move words around in a word processor or to move elements of a picture in a graphics system. It leads to the ability to capture data, store vast quantities of information in a database or document management system, and retrieve specific items on demand. A third area is hypertext linkage with rapid dissemination and display of multimedia information through worldwide telecommunications and the Internet.

IT influences the way in which scientists investigate the real world, how they are organized, how they communicate, what they know and how they think. They depend less on intermediaries like typists, cartographers, librarians and publishers for acquiring information and disseminating their findings. They can collaborate more widely, thanks to better control and flow of information. Individual workers and groups can enjoy greater autonomy within a defined, shared framework.

Taken together, the benefits from IT (see part B) include better science, cost savings, and speed and flexibility in data collection, storage, retrieval, communication and presentation.

3. This publication

3.1 Target readers

- Practicing geoscientists with a general interest in how modern information technology (IT) will affect their work and influence future directions in their science
- Geoscientists, familiar with computer or IT applications in their own specialist field, who need a broader perspective on future trends

- Students or educators specializing in IT applications in geoscience who require a top-down view of their subject

3.2 Objectives

To provide an overview and rapid reference to assist readers to:

- understand the ways in which geoscientists can collect, record, analyze, explain, assemble and communicate information in the evolving geoscience information system
- understand how IT affects methodology and enables hidden constraints imposed by traditional methods to be overcome
- understand the theory underlying IT applications and know how to find examples and guidance for their implementation
- form a view on future trends and thence develop a framework to influence new developments and operate effectively within them

3.3 Structure and overview

One effect of IT can be to separate content from container. The same material can be held (as here) in an electronic archive and presented as a book, a special issue of a journal or a set of articles for browsing on screen or printing locally. I have tried to harmonize the results with established bibliographic conventions and terminology, and apologize for any remaining confusion.

Although I wrote this account for reading in sequence, there is probably enough repetition and cross-reference for you to refer to sections out of context. I hope you will have little difficulty in dipping into sections of interest from the table of contents, abstracts and keywords. Internal cross-references should help you to follow threads leading to similar topics.

The parts deal with the following topics.

Parts A-B: definitions and motivation.
Information technology deals with tools for handling information, notably computers and networks. Geoscience can benefit from IT through more efficient and rigorous formulation and expression of ideas, and wider sharing and integration of knowledge. Progress requires a broad systems view. This account should help geoscientists to understand the overall changes and form a view on future trends.

Parts C-H: familiarization with IT methods and the underlying theory.
Not all geoscientists are familiar with available methods of IT, although these influence all phases of a project and every type of information. This review looks for underlying principles, moving from individual to project to global requirements. It tracks the process of familiarization, from ubiquitous tasks like word processing through statistical analysis and computer visualization to the management of databases and repositories.

Parts I-M: the emerging system.
Earlier parts dwell on the benefits of IT and the nature of IT tools. For a clearer view of how geoscience and IT will interact, we need to reconsider our own methods of

investigation: how we observe, remember and record, how we build knowledge from information, cope with changing ideas, and create a shared record in the geoscience information system. Our methods relate to the potential of IT: the flexibility of hypermedia, the developing standards for the global network of cross-referenced knowledge, and the particular value of well-organized structures of geoscience knowledge. They help us to understand the emerging geoscience information system, to define our requirements and to build on current initiatives and opportunities, which are outlined here.

3.4 Acknowledgments

I remember with gratitude the help of too many colleagues to list here. In particular, Dan Merriam and Graeme Bonham-Carter have made this publication possible, and Peter Henn and Lee Hodge of Elsevier have offered patient guidance. I am indebted to the British Geological Survey for access to their facilities and for moral and intellectual support. I am grateful to Dr Peter Allen for his encouragement over many years, and to John McInnes and Bob McIntosh for their constructive advice.

4. References

Addis, T. R., 1985. Designing Knowledge-based Systems. Kogan Page Ltd., London, 322pp.
Audi, R., 1998. Epistemology: a Contemporary Introduction to the Theory of Knowledge. Routledge, London, 340pp.
Loudon, T.V., 2000. Geoscience after IT: a view of the present and future impact of Information Technology on geoscience. Pergamon, Amsterdam 142pp.

4.1 Internet reference
Loudon, T.V., 2000. Geoscience after IT. Computers & Geosciences (special issue), 26 (3A). http://www.sciencedirect.com
[search *title*: Geoscience after IT *author*: T V Loudon]

Disclaimer: The views expressed by the author are not necessarily those of the British Geological Survey or any other organization. I thank those providing examples, but should point out that the mention of proprietary products does not imply a recommendation or endorsement of the product.

<<<Back to Table of Contents
On to Part B: Benefits for geoscience from information technology, and an example from geological mapping of the need for a broad view>>>