Geographic Information Systems Panel

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Mitchell: After yesterday's interdisciplinary warfare between cartographers and mathematicians, I began feeling comfortable that I am a geographer and maybe out of the line of fire. My comfort was destroyed by a help-wanted ad in Sunday's paper in which the Central Intelligence Agency listed needed skills--accounting, business administration, chemistry, and foreign language with high proficiency required in Arabic, Chinese, French, Italian, Japanese, Korean, Geography, and Polish. Now I know what my problem has been; I've been speaking a foreign language.

This year is the first time since the 1800's that the U. S. Gelogical Survey has had a geographic organization. Our primary program, Land Use Data and Analysis (LUDA), has been funded for the first time by Congress this fiscal year. The program will extend over the next 5 or 6 years with the rather grandiose objectives of mapping land use and four other data categories for the entire U.S.--635 1:250,000 sheets. After 5 yr, providing we last that long, these maps will be updated. In addition we will produce sheets at 1:50,000 and 1:25,000 for areas of more rapid change and of more concern in land-use planning and resource management.

To accomplish these objectives, the geography program staff was organized into three teams: interpretation and compilation, geographic information systems, and research and analysis. The interpretation and compilation staff produces the overlays: land use, Federal-land ownership, river basins and subbasins, counties, census county subdivisions, and State-land ownership if available. The data bases of the maps at larger scales will presumably have the same breakdown. When these maps have been compiled, the plan is to have them digitized to build a data base from which graphic displays and statistical data on current land use and cover can be provided to States on request. The scale of 1:250,000 was chosen, partly because of interested planning groups around the country but mainly because only at this scale is there complete map coverage of the U.S. To start we wanted to produce at least one overlay in every State. Production is currently funded through cooperative agreements with the States.

The geographic information system was started some time ago along with the EROS program. Our present objectives for LUDA are to process the maps produced on a batch basis and to produce statistics and graphics. If you have been on a USGS tour, you may know that we have acquired the equipment and are using Boyle's interactive cartographic and geographic information system.

We are using this interactive system for two reasons. First we would

like to have such a system available to our research and analysis staff, which primarily consists of research geographers. With such a system they would be able to produce digital maps as they need them and to produce clean data, which can be manipulated to support geographic analysis, environmental impact analysis, etc. Second, we hope that such a system can be used to investigate "what if" problems and land-use and resource-management problems.

Marble: Automated cartographic and geographic information systems are obviously in the early development stage. Unfortunately there is much duplication of effort and little transfer of information. This is where the International Geographical Union's Commission on Geographical Data Sensing and Processing gets involved. The Commission is an informal group associated with many international scientific unions. Our concern has largely been the handling and processing of spatial data. In the last 5 yr we have been interested in implementing technology transfer. Some of us are geographers and some represent other fields, but we all have a common interest in the techniques and problems of acquiring, storing, manipulating, and displaying spatial data. To improve technology transfer, the Commission has sponsored many activities. A conference was held in Ottawa a few years ago to summarize the state of the art. This conference produced a two-volume book, called Geographical Data Handling, which has had a wider distribution than we anticipated.

The Commission, headed by Dr. Roger Tomlinson of Ottawa, is made up of working groups which are established as problems are encountered. The number of people in each group ranges from 3 to 100. We are concerned with improving technology transfer and impartially evaluating activities. At the Ottawa meetings we published a comprehensive directory of individuals involved in this area. I have just finished updating it, and soon the Commission will release the new directory. We are also compiling a directory of cartographic and geographic information systems.

One working group has recently finished a series of indepth case studies of land-use information systems. These case studies have covered such successful operating systems as the Canada Geographical Information System, systems in New York and Minnesota, and others. We hope to release these case studies soon so that people will know the problems, successes, and failures of these systems. Our concern ranges from specialized hardware considerations to policy considerations to integration of the information system into government decisionmaking.

At present several working groups are reviewing land-use and natural-resource information systems. We are again reviewing specialized hardware hardware considerations in computerized systems, and we are working on a software directory. We also have Cliff Fry of the USGS working with us in reviewing the manual methods of handling this type of data.

We are deperately interested in learning what you are doing because technology transfer is hampered without a broad information base. If any of you have not been contacted by the Commission or don't know what we are doing, we would be delighted to hear from you.

Gunther: After 4 yr of work the Engineer Topographic Labs have developed the System for Topographic Information (STOPIN). For our use, topographic information includes both pure geographic and military geographic information as well as the information normally contained on a military topographic map. Thus topographic information is a broader term than terrain or intelligence information. If you will give me your name and

mailing address, we can include you in the distribution of the technical documentation for STOPIN.

STOPIN is an interactive storage retrieval system for geographic information in alphanumeric form. It was originally designed to support the terrain intelligence functions of the Army in the field and was later modified to support the production of standard and special topographic products. The system can be the vehicle for maintaining large quantities of alphanumeric geographic information until or before a map is produced and for storing information collected during the cycle of a map edition. It could also provide a means of production for a map errata sheet, similar to the Notice to Mariners. STOPIN consists of 18 data fields with over 1,700 data elements in each. Each data field is a unique subject of natural or cultural information, ranging from air terminals to vegetation. The system is based on a geographic unit the size of a standard military topographic map of 1:50,000 scale (about 640). We employ variable length records which are implemented with a variable block concept. Each of the 26 unique record structures in the system has a fixed and a variable portion. Information that is always present if the feature or phenomenon exists is contained in the fixed part. For those elements which are feature dependent, or for which there is no prior knowledge of how many occurrences will exist, information is stored in the variable part. Record lengths in the system vary between 60 and 20,000 characters. All of the information is stored in packed binary format on disk and expanded when processed.

The STOPIN software is modular, allowing implementation of 1 to 18 data fields as long as one copy of the main program is in residence. The system consists of an executive and 8 primary overlays--4 are unique to each of the data fields, and 4 are common to all fields. STOPIN was written in FORTRAN, and the data base is indexed sequentially. The records in the data base are keyed by data field (an alpha code from A through Z), map sheet number, and feature identification. The system includes a major key search option which allows searching on the data field and the map sheet. For instance, this option allows all buildings to be listed within a given sheet.

The system operates on the CDC 6600, under the SCOPE operating system. One report in the documentation series provides a test of the conversion to the Univac 1108 and reveals basic problems encountered during conversion. It provides a sample version of one program for each computer and shows which changes must be made. Although this system is quite large (we wrote approximately 75,000 lines of code during the development, 28,000 of which are used during the operational version), the complete software package will operate interactively under INTERCOM, requiring less than 75,000 words of core.

As a computer systems analyst who is concerned with information, I would like to emphasize the importance of geographic information systems and to define the purpose of the designers of such systems. The primary purpose of any information system is to provide the user with the required information. Systems must be developed with purpose and defined from the beginning. In come cases, however, requirements will distort all purposes and even negate many design features established for those requirements. Regardless of the problems created by working in a dynamic environment, we as systems designers must always attempt to provide the user with the required information in the desired format. My purpose as a designer of geographic information systems is to provide the user with a tool for storing, retrieving, and manipulating the required information economically and efficiently.

Aangeenbrug: Information is the most powerful tool at the disposal of local government officials, but many of us have problems communicating with these people. The word systems turns off most of the local authorities. Systems is a catchy word that usually means a lengthy discussion which most elected officials don't have time for or should not take the time for. We have a lack of clarity in our profession, and I'm pleased to hear that we are beginning to improve this situation. An enormous amount of confusion is heaped on beleaguered city officials, who have to solve the problems that Federal officials talk about. Saying that we're studying 50 independent State systems but can't take any Federal leadership confuses and embitters the local authorities. As a result they are beginning to send messages, one of which is the Moorhead bill, that say, "I don't care what your agency does, please help; if you don't, I'll require you to do so." This message is important because it will require us to improve professionalism. An elected official doesn't really care whether a cartographer or a mathematical physicist solves the problem as long as he gets the job done. The elected officials want answers to problems, not problems to problems. They don't want to know how accurate something ought to be or if the DBF DIME works or not. They don't care if it doesn't work.

The lack of operating successes is a second frustration. Some fantastic "geoplan" and super-duper systems are still being peddled that were documented prior to completion. Don't document a system that isn't complete. At subsequent meetings such as this one, maybe we should have local officials criticize our work. We need to be examined under the more critical eye of people who have the daily problem, not by long distance from Washington.

A third problem is people. We have to share credit, and let other people take credit even though we may feel that we are not getting our share.

Fourth, hardware costs are still a problem. Even the price of a plastic bottle is rather high in River City. We must encourage technology transfer experiments that will allow people to share plastic bottles. Universities and Federal and State officials will have to take risks and help local authorities.

The fifth problem is software. The lack of standardization is the most vexing problem. Next the documentation is usually written in a language almost impossible to understand. If you're learning FORTRAN, for example, you have to learn it experimentally. I would urge IDU, similar organizations, and perhaps this conference to prepare short statements written in English that policymakers can understand.

Dr. Mitchell, it might be useful if we knew what documentation is available on LUDA and where it can be obtained.

Mitchell: The documentation on LUDA is rather good regarding long-range plans but rather transitory regarding exact plans. We are focusing more on the problem of documentation, and we are trying to inform people about the program. For example, seminars will probably be held in April 1975. Local planners are invited for a 2-day seminar concerning their problems and our plans for solving these problems. This series of seminars is similar to those held a few years ago on the land-use classification system. I plan to release additional information on the geographic information system of the LUDA program, but for general information, write the U.S. Geological Survey, National Center, Stop 115, Reston, Virginia 22092.

Gunther: I'm pleased to see that the work of the Army Engineer Laboratories is being released. One problem in technology transfer has been the question of public and private information. The more information that we get in the open to examine and to learn from, the faster we will progress.

Aangeenbrug: Local governments are also concerned and confused because various Federal agencies have requirements that overlap. This overlap is a serious problem, and I'm glad to see that Federal agencies are communicating here. Second, local people continue to wonder why the Federal Government does not exhibit more cooperative public efforts in such areas as geographic information systems. They are not particularly eager to hear how much time it will take to report on one more task force. I urge you to stimulate your agencies to exhibit your cooperative efforts. By the way, it is also true that local officials take advantage of the duplication of efforts. The mayor of Denver received $3,000 for the same thing from 3 different agencies. Local officials with administrative talent like the confusion because they can manipulate it to their advantage.