Software Sessions

Introduction to Software

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McCullagh: The United States appears very bright to me compared with the U.K. Last year we had a miner strike which led to complete blackness; practically every industrial organization in the country was dark for 8 hours each day. Once again a miner strike seems likely and lights will be going out again, except in the computing and software sectors where development continues unabated, as it should.

Software is generally divided into two categories--systems software and applications software. Systems software includes driving routines and interactive software that handles, for example, movement of the cursor over an interactive screen. The single characteristic for separating these two categories is that systems software is normally written in a very efficient machine language. We heard yesterday about hardware but not about the software that makes the hardware operate. Although there are many people working in systems software, I regard the task as only a small part of the graphics endeavor. The systems software is also likely to be untransferable between centers. This software is obviously completely hardware dependent, because often the computer goes with the hardware.

Applications software, for data bases, data structures, digital terrain models, manipulation, symbology, and information systems for cartographic display, is a rather different set of programs using high-level language. This language, often FORTRAN, is compatible with most machines in the world today. If the programs are written with transferability in mind, they are probably completely compatible except for one or two random factors which always occur. I hope that all types of application software to be discussed today will be FORTRAN and transferable. One of the big problems, despite the fact that I'm European, is that I don't approve of writing in a software language such as ALGOL because it is applied differently throughout the world. FORTRAN does not tend to have this problem as it is pushed by the largest computer manufacturer.

All the sessions today will consider methods that tend to be style dependent. If you have very little data in your data base, say only a few thousand records, it is not worthwhile to move to a superb, automated structure for retrieval. For terrain analysis, unless you have large sets of data and large files which you want to keep in a big memory, you can store information block by block.

The biggest problem with automated cartographic information systems is that information sources are not often in completely readable form and must be made so. You will usually have a scale problem. And will

the software be used for research or for production? In one situation you are inundated with data which has to go through the pipeline as fast as possible, clear to the finished map. In another situation you will probably spend far longer processing the data to achieve a specially designed output. Another consideration is the size of the computer at your disposal.

According to my "plastic-bottle" philosophy, there is an ubiquitous computer--a small minicomputer system--which practically any firm or small research organization can afford. Effectively you have a domestic user for your "plastic bottle." The alternative is the large machine which can be equated to the SST--undoubtedly worthwhile, but tremendously expensive, big, complex, and always breaking down; you will have difficulty making it work. In other words, unless you are extremely involved in software operation, you do not want to be concerned with making the computer work; you want to be concerned with the cartography. Perhaps cartographers can now be less dependent on the development of big machines and manage with much smaller machines which are still reasonably fast when compared to standards of 2 or 3 yr ago.

My "plastic bottle," which I use at Nottingham, is in my opinion excellent for research work. It could also be used for production if you improved the peripherals. I think that you will get more for your dollar using the "plastic-bottle" approach rather than the SST-type approach. In terms of graphics, more work (admittedly at a less flashy level) could be accomplished using these basic small computers. The "plastic-bottle" approach also seems to have a grass-roots effect--people who are otherwise unconnected with graphics become more concerned and aware of what you are trying to do. Automated cartography would be ubiquitous.

Lastly I want to discuss the accuracy of graphic designs and how accuracy is affected by different features (in a very broad sense). Accuracy and repeatability are only required where you are producing maps to be used by legal arbiters of boundary disputes. For most other mapping, accuracy of input data is relatively unimportant. The relief representation will look fine, regardless of whether the data are exact or only marginally correct; in fact in many cases you cannot get that accurate data anyway.

(Slide) (Editor's note: Slides not available for publication.) Here is John Friend's idea of accuracy in the 1700's, a time when they believed in making maps look pretty. They also believed in making maps as accurate as possible, and this is the result.

(Slide) Maps produced by the computer can be made to look pretty by adding color--perhaps not like this but appealing to the domestic consumer.

(Slide) This was produced in London by Richard Howthe for geochemistry units--an innovation in using automated cartographic techniques to represent three variables with three different colors. This type of cartography is widely critized but can be used very effectively to illustrate relationships between variables by making them spatially obvious.

(Slide) This is the power spectrum of an image that has been contoured. You want accuracy, and you want to make it look less mundane and less

circular, hence the color.

(Slide) This is a graphic for simply representing data. Fairly high inaccuracy can be tolerated. Very little computer time and programing expertise are required to create this type of display. It does, however, lack the appeal of color.

(Slide) Here is a view of two intersecting wave forms. Although the plotter that produced this was cheap and very wobbly and the line density and representation are not what they might be, the addition of color has improved the impression of accuracy.

To summarize I suggest the use of a small machine for developing software and a series of programs which are only as good as you need. Maybe we could see more innovative representations from automated cartographic techniques.