SUMMARY OF THE 1995 U.S. NATIONAL REPORT TO THE ICA

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Abstract

In this paper I summarize the 1995 U.S. National Report to the ICA. The purpose of the report was to "...focus on the impact of the ongoing technological transition on the practice of cartography in leading private firms and government agencies..." Here I discuss my strategy for developing the report, problems encountered, and major findings of the report.

1 Developing the report

In the spring of 1993 I was asked by the U.S. National Committee of the International Cartographic Association (ICA) to serve as guest editor for the 1995 U.S. National Report to the ICA. The National Committee initially requested that the report "...focus on the impact of the ongoing technological transition on the practice of cartography in leading private firms and government agencies..." In this paper I discuss my strategy for developing the report, problems that I encountered, and major findings of the report. A more detailed version of this paper can be found in the "Introduction" to the report, which will appear as issue of Cartography and Geographic Information Systems in 1995.

In developing the report, the first major decision I had to make was who should be asked to contribute. Private firms and government agencies who contributed to the 1987 U.S. National Report to the ICA served as an initial source of potential contributors. Since the purpose of the 1987 report was to depict "the look of United States maps in the mid-1980s" [2, p. 196]; I felt that such contributors also would be appropriate for the 1995 report. Other potential contributors were based on my own perception of important cartographic firms and agencies; suggestions made by Robert McMaster, Jon Kimerling, and Robert Aangeenbrug; and suggestions from other members of the U.S. National Committee. A total of twenty-one firms and agencies were asked to contribute, but only thirteen chose to do so (Table 1).

A. Private firms	B. Government agencies
Allan Cartography	Defense Mapping Agency (DMA)
Environmental Systems Research Institute (ESRI)	Coast and Geodetic Survey/NOAA
Etak	U.S. Bureau of the Census (Census Bureau)
Eureka Cartography	U.S. Forest Service
GeoSystems	United States Geological Survey (USGS)
Intergraph	
National Geographic Society (NGS)	
Rand McNally	

Table 1: List of contributors to the National Report

Those who chose not to contribute included the American Automobile Association (AAA), Central

Intelligence Agency (CIA), ERDAS, National Park Service, The H.M. Gousha Company, Time, U.S. Army Topographic Engineering Center, and the U.S. Department of State. The reasons for not contributing varied, but a common reason was the inability to find someone in the agency willing to put the time into developing a manuscript. Those who edit similar reports in the future must realize that those writing manuscripts must often take on such projects in addition to their normal duties. It should also be borne in mind that firms or agencies who initially promise to contribute may later back out either because they failed to realize the magnitude of time commitment or their staff changes.

Once I identified a potential list of contributors, I developed a form letter, which asked all contributors to respond to a set of standard questions (to be discussed in section 2).[1] The obvious advantage of using a standard set of questions is that it would allow me to compare the practices of contributors more easily. One difficulty, however, is that the particular set of questions was not appropriate for all contributors. For example, a number of the questions were inappropriate for GIS-oriented firms. As a result, it was essential to divide the responses to the questions into two groups: those who made an attempt to answer most of the questions (ten of the thirteen contributors) and those who chose not to answer the questions and thus developed a unique contribution (ESRI, Etak, and Intergraph).

2 Responses to the seven standard questions posed

In this section I discuss the responses to the seven questions provided by ten of the thirteen contributors.

2.1 To what extent were your map production operations automated 10 years ago, and to what extent are they automated today?

The responses to this question were largely a function of whether the contributor was a private firm or government agency. Three of the private firms (Allan Cartography, Eureka Cartography, and GeoSystems) indicated that their operations were entirely manual ten years ago, while the two others (Rand McNally and NGS) were just beginning automation ten years ago. In contrast, in government agencies some form of automation had been going on for a considerable length of time; for example, automation began as early as the 1960s within NOAA and USGS. Regardless of when automation began, all contributors suggest that the most significant changes in automation occurred in the last ten years.

A related question that might be asked is to what extent, if any, are manual approaches still being used? Although several contributors indicated that some manual work is still being done, the trend is toward complete automation. Allan Cartography is probably the contributor with the largest percentage of its work still being done manually, but even here it is less than 50%. Reasons that Allan has not fully automated include: its emphasis on large-format work, contracts done on a one-time basis, and many of its maps are based on existing USGS separates.

2.2 What sort of hardware and software have you used in the process of automating map production operations?

Although the nature of the hardware and software used has been a function of the size of databases that contributors have dealt with, there have been some general trends. One is the move from mainframes to minicomputers to workstations (and/or microcomputers). The Census Bureau is an

[1]Questions were developed with the assistance of Robert McMaster and Jon Kimerling.

example of this trend, with initial work done on Univac 1108 mainframes in the early 1980s, while today the bulk of the work is done on Tektronix 4335 graphic workstations. Of course, firms which automated only recently (such as Eureka Cartography and Allan Cartography), never used mainframes and today use only workstations and microcomputers.

A general characteristic of government agencies is that much of the software was developed in-house using traditional programming languages such as Fortran (or more recently C and Ada). In some cases this involved a considerable amount of effort; for example, DMA (using various subcontractors) has developed approximately 7,000,000 lines of code in seven programming languages. Recently, government agencies have begun to make greater use of applications software; for example, USGS has developed a new product generation capability (PGE) based on ARC/INFO.

Some programming has also been done in the private sector (by Rand McNally and NGS), but it has not been nearly as extensive as in government agencies. Iscol (NGS) notes that one common need for programming is the development of conversion routines between various pieces of software and various computer platforms. Rather than write computer programs, it is more common in the private sector to use off-the-shelf applications software. GeoSystems, NGS, and Rand McNally all note the use of ARC/INFO software for use in managing their databases. Other software commonly used in the private sector includes Freehand (Macromedia), Illustrator and Photoshop (Adobe), AutoCAD (Autodesk), and Microstation and MGE (Intergraph).

2.3 What advantages and disadvantages have you seen as a result of converting to an automated operation?

One obvious advantage of automation is that it speeds up the process of production, and thus increases the volume of production. As an example, for the 1990 census the Census Bureau produced over 1,300,000 maps (more than 40 times the number for the 1980 census) with less than one-tenth of the staff used in 1980. The speed (or ease) of making changes is a closely related advantage. Being able to make changes at the last minute means that map users will get the most current information; this is especially important when mapping at a global scale, where the boundaries and names of countries change frequently.

Another major advantage of automation is the flexibility it offers. Once a digital database has been created, it is relatively easy to focus on some subset of the database, change its scale, or combine it with another database. As a result, it is possible to customize the database for a particular purpose. Other advantages of automation include the ease and safety of digital archival, the capability to work with larger data sets, and the potential for creating special effects (e.g., softening the edge of a coastline). A good illustration of the need for archival is the case of Eureka Cartography, which is located in the Hayward Fault zone and fire-prone Berkeley Hills of California.

Major disadvantages of automation are the start-up costs for hardware/software acquisition and training of employees. Associated with these are the high maintenance and retraining costs to keep the hardware/software and employees up-to-date. Three of the contributors (DMA, GeoSystems, and U.S. Forest Service) specifically noted that specialized training programs had been developed.

Other disadvantages include a tendency to make changes later in the map design process (simply because they can be easily made), the lack of digital data at a broad range of scales, limitations imposed on design capabilities by the software, and the loss of design control over the digital version of a map once it leaves a firm or agency. An interesting disadvantage noted by Iscol is that an automated relief map of the Chugach Mountains produced at NGS was of lower quality (and took longer to create) than its manual counterpart produced by a relief artist.

2.4 How has automation affected the quality of the maps you produce?

From a technical standpoint, contributors concurred that the quality of maps produced by automation is higher than maps produced manually; for example, image setters yield more accurate maps than traditional photomechanical methods and map digitizing (and scanning) is more accurate than conventional pen-and-ink and scribing procedures. The use of automated databases also enhances quality by reducing the likelihood of misspellings and improper identification of features that often occurred on manually produced maps.

Although maps today generally are technically superior, they often are lacking in the quality of map design. Allan (Allan Cartography) indicates that "We are still seeing a lot of very poor quality work coming through, especially from GIS-oriented clients...But that's a failure which creates some job opportunities for contract production shops like ours..."

A notable aspect related to map quality identified by Littlefield (DMA) and Belton (U.S. Forest Service) is the high level of accuracy provided by GPS data. Littlefield indicates that "Previously, DMA products were more accurate than an individual's ability to navigate, but now,..., locational accuracy attainable in the field is beyond the quality specifications of our standard products...This may have a significant impact on the resolution of databases and data volumes required in the future."

2.5 Has automation enhanced the range of map products you create, or are you producing essentially the same products, albeit in an automated fashion?

Automation certainly has the potential to enhance the range of products created due to the ease of customization (see my comments in (3) above). Probably more interesting, however, are the novel map products that are being generated. For example, Brennan (GeoSystems) indicates that "Ten years ago, printed maps and film were the 'finished' products...", but today "our delivery vehicles...include floppy disks, CD-ROM's and on-line systems." Brennan also notes that customers increasingly are asking for data as the final deliverable. In a similar fashion, government agencies are being asked to provide data as the final deliverable (e.g., TIGER files from the Census Bureau and DEM data from USGS). Several contributors (Eureka Cartography, GeoSystems, and NGS) also noted that they have developed or are in the process of developing multimedia applications.

2.6 What future benefits for map users do you expect to see as a result of automation? (You may wish to consider the role that maps on computer screens will play as opposed to paper maps.)

Several contributors expressed optimism concerning the future benefits of automation for map users. Two quotes are indicative of these feelings. Waldorf (Eureka Cartography) states:

> "...maps...will get 'smarter' and more interactive when used in digital formats. Cartographers have always known how to symbolize and label a town, but now they can choose to add 'live' layers of information about the town's cultural and economic statistics, points of interest, transportation options, or any other information...Essentially, the map becomes the interface to a catalogue of supporting data, limited only by the whims and budget of the map authors."

McCulloch et al. (USGS) carry this point a bit further.

"This empowerment can be characterized as a 'democratization of cartography' in which the user no longer is forced to depend on the analog map with its inherent limitations ... technological advances allow the user to directly access the source data, to explore a variety of interactions of geographic variables, and to produce custom analyses and visualizations of these interactions."

2.7 How have changes in your production operation changed the education and training that you expect people in your firm (or agency) to have?

Not surprisingly, automation has had a major impact on the education and training expected of employees. Traditionally, a background in geography/cartography was sufficient, but today expertise is expected in a broad range of areas, including: use of design software, computer science (including computer programming), multimedia, digital pre-press technology, GIS, remote sensing, artificial intelligence, and statistics. Probably the most difficult aspect is that remaining current in these areas requires constant retraining of employees.

3 Conclusions

Goodchild [1, p. 317] argued that "The most straightforward objective of digital technology is the emulation of manual methods, to the point where the two products are indistinguishable." The contributions presented here suggest that this emulation has been largely achieved -- maps created by automation today are as high or higher in quality (technically speaking) than maps created by conventional photomechanical approaches. In addition to being able to emulate the quality of traditional maps, automation permits greater flexibility (and thus greater likelihood for customization), modifications up to the time of publication, more dependable archival, use of larger data sets, and the creation of more special effects.

Digital methods are, however, not without disadvantages. The ease of making changes means that naive users will often make changes simply because it is easy to do so, without thinking about the design implications. Other disadvantages of automation include the start-up costs for hardware/software acquisition and training of employees, and concomitantly the high maintenance and retraining costs to keep the hardware/software and employees up-to-date.

Although the emulation of traditional mapping is a worthwhile goal, Goodchild [1, p. 312] also argued that "...[The] most significant impact of digital methods on cartography will occur when the field evolves to fit the constraints of the new technology and moves beyond its traditional limitations." Multimedia is one area in which contributors have evolved "to fit the constraints of the new technology." As the field of cartography continues to evolve, it will be interesting to see what other areas of the "new technology" the contributors adopt.

References

[1] Goodchild, M.F. 1988. Stepping over the line: Technological constraints and the new cartography. The American Cartographer, Vol. 15, pp. 311-319.

[2] Loy, W.G. 1987. Editor. U.S. National Report to ICA. The American Cartographer, Vol. 14, No. 3.

[3] McMaster, R.B. and K.S. Shea. 1992. Generalization in Digital Cartography. Washington, D.C.: Association of American Geographers.