The Rapidly Changing Technology of Planning

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While the incorporation of microcomputing in planning education and practice over the past dozen years has not completely revolutionized the field, computing technology has significantly changed the business of planning. Planners can now evaluate more options and have access to a wider array of data to support planning and decision making. It has also significantly changed the set of skills that entry level planners are expected to possess.

The use of computing technology is certainly not new to planning. In the late 1960s, planners and regional scientists developed a number of large scale urban models that ran on mainframe computers. Models such as the Lowry Model and its many derivatives sought to understand urban spatial structure using the principles of urban economics. The models allocate housing and other land uses given land price and transportation constraints. While these models provided new and improved understanding of the urban development process, they did not directly affect the day-to-day practice of planning due to the fact that they were expensive and poorly suited to many of the decisions planners face. The focus of this article will be on the more recent and widespread impact of microcomputers.

We view the impact of microcomputers on the planning profession over the past twelve years as a series of three overlapping but distinct waves. The first wave was the adoption of the same office automation technology that has been deployed throughout white collar industry in recent years. The second wave consists of the wide scale use of geographic information systems (GIS), which are more appropriate to planing than to many other professions. The third wave, which has just begun to break, is the enhanced communication and data access provided by the Internet and the World Wide Web (WWW). We will use these three waves to review the impact of microcomputer technology on the practice of planning over the past dozen years.

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The First Wave: Automating the Planning Office

The first wave began in 1983, when the original IBM-PC began to find its way into planning offices. The IBM-PC was originally released in 1981, but it was not until the introduction of electronic spreadsheet software such as VisiCalc, SuperCalc, and most particularly Lotus 1-2-3 that it attracted serious attention from planning practitioners and educators. In addition to spreadsheets, word processing and to a lesser degree database management were the dominant applications in this wave.

A 1986 survey of over 500 city and county planning agencies in California (Sanchez, 1987) documents the rather slow initial diffusion of microcomputer technology. Today, it is hard to believe that a mere nine years ago less than 60 percent of planning agencies were using word processing and less than 40 percent were using either spreadsheets or database management applications. Other applications such as business graphics, project management, and thematic mapping were used by only 10 to 15 percent of the planning agencies in California. After this somewhat halting beginning, adoption took off dramatically. In a survey of the same California planning agencies two years later, French and Wiggins (1989) found that nearly 90 percent were using word processing, and spreadsheets and database management software had increased to 60 and 50 percent, respectively. Interestingly, the use of other types of software continued to languish, with only about 10 percent of the agencies using them.

Microcomputers begin to appear in the planning literature in the mid-1980s. The first instance was the Spring 1985 issue of the Journal of the American Planning Association, in which Sawicki (1985) introduced readers to the basic concept of an electronic spreadsheet and raised several concerns about potential problems inherent in the microcomputer revolution. Shortly thereafter, Ottensman (1985) and Brail (1987) published books on microcomputers and their role in planning and other public agencies. This attention to microcomputers in the planning literature marks the growing acceptance of the technology and the rising tide of the first wave.

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While this first wave was characterized by the adoption of generic office automation software, planners were quick to modify this software to their own particular needs. Sipe and Hopkins (1984) published and distributed a set of spreadsheet templates designed to estimate the fiscal and economic impacts of development proposals. Originally designed for use by Florida local governments, these templates were widely used in both practice and education across the country. The first spreadsheet template published in the Journal of the American Planning Association was a shift-share model developed by Landis (1985). This was soon followed by population projection (Levine, 1985) and other template applications.

By 1990, the first wave had largely washed over the planning profession. Most documents were prepared using word processing which permitted the production of more drafts. Spreadsheets allowed planners to test the results of more alternative assumptions in quantitative areas such as demography and finance. Significant numbers of planners had discovered the power and convenience of database management software for organizing land parcel or project files. However, as pointed out by Ferreira (1987), these tended to be personal databases on individual machines rather than enterprise databases on shared networks. Planners had adopted this software and developed unique tools, particularly spreadsheet templates, to meet their particular professional needs.

The Second Wave: Location, Location, Location

The second wave consisted of the widespread adoption of geographic information systems. This wave began in 1984 when the first microcomputer mapping packages became available. The progress of this wave was somewhat slower than the first, although it may ultimately prove to be more powerful.

Geographic information systems (GIS) address planners' concerns with the locations of various natural, man-made, and social phenomena. Planners often need to manipulate spatially distributed data, a need that is not shared by a wide array of business users. Hence, mapping and GIS represented a narrower, more specialized market and, as a result, commercial software vendors were slower to develop tools to meet these needs.

Historically, there have been two basic types of GIS systems: vector systems that link map elements to a relational database, and raster systems that assign values to a grid of rectangular cells to represent area features. Much of the early development in mapping and GIS was done at the Harvard Computer Graphics Laboratory to meet the needs of planners and landscape architects. The ability to perform an automated version of the land suitability analysis techniques popularized by McHarg was a particular focus of this software development effort. In the 1970s several mainframe raster systems, including Symap and ImGrid, were developed at Harvard and distributed to other academic institutions. There was, however, little or no penetration of this mainframe software into planning practice.

While planners naturally wanted to use the computers they had acquired in the first wave for mapping and spatial analysis applications, early microcomputers did not have sufficient processing power or storage capability to support full GIS applications. A 1989 survey found that only 36 planning agencies among the nearly 500 California planning agencies were using GIS, and over a third of these systems were implemented on minicomputers rather than personal computers (PCs) (French and Wiggins, 1990). Budic (1994) found a similarly limited adoption among planning agencies in four southeastern states several years later.

One of the key impediments to the widespread adoption of GIS technology was its extremely high cost. In 1985, a typical GIS application required a $700,000 minicomputer and a $100,000 software license. The data acquisition costs, especially for a complete parcel level base map, could easily run the total cost to several millions of dollars. Is it any wonder that relatively few jurisdictions chose to adopt this technology? However, with the advent of powerful UNIX workstations and more powerful microcomputers in about 1987, hardware and software costs dropped by approximately 90 percent. While GIS was still costly, primarily due to the data acquisition costs, hardware and software were no longer prohibitively expensive.

In the mid-1980s planners began to experiment with a variety of mapping software that would run on microcomputers, including Computer Aided Design (CAD) and thematic mapping packages (Wiggins, 1986). These packages usually sold for less than $1,000, and many came with a limited set of pre-packaged geographic features and attribute data. This brought the cost of thematic mapping of census data down to a level comparable with basic office automation applications. These packages demonstrated that basic mapping could be done on a microcomputer platform, but they were never widely adopted in practice. While census data at the tract level is useful, many planning applications require parcel level base maps and attribute data.

Real GIS capability first appeared on the microcomputer platform with the introduction of PC Arc/Info. The package was cumbersome, slow, and expensive (about $10,000 for a complete installation), but it represented a major breakthrough by bringing GIS into the budget range of most local planning agencies. The price decline accelerated further as several of the thematic mapping packages added features to grow into desktop geographic information systems. In 1989 we see the addition of a range of GIS capabilities to Atlas*GIS and Mapinfo. These systems were available for less than $2,500.

At this same time, the U.S. Bureau of the Census began to release TIGER files. While these files did not provide parcel level maps, they did provide complete street networks that could be used to construct any level of census geography down to the individual block. For metropolitan counties, these files included address ranges that could be used to locate any data record for which an address was available. These street network files were released on CD-ROM for $250 per state. By 1992 the Census Bureau began to release population and housing data down to the block level on CD-ROM. Most files were available for less than $200.

The availability of basic data at a nominal cost, relatively cheap software, and continually more powerful microcomputers and UNIX workstations combined to accelerate the adoption and implementation of GIS in planning agencies. The second wave may finally be about to engulf much of the planning profession. A recent survey of the 68 Florida counties found that nearly half report using some type of GIS. Many of these systems are shared with other local government agencies. Facilitating data exchange among agencies is considered to be one of the major benefits of the systems.

GIS first appeared in the planning literature in 1987 with a comparison of CAD and GIS capabilities (Ducker, 1987). After this initial foray we see a marked increase in the frequency of GIS related topics. Levine and Landis (1989) compared several desktop GIS approaches. French and Wiggins (1990) examined the use of these systems in local agencies and found that the majority were using them to support traditional planning activities, including comprehensive planning, zoning, and vacant land inventories. A widely used GIS text that focuses primarily on planning applications appeared in 1990 (Huxhold, 1990). Soon thereafter, Budic examined the requirements for effective implementation of GIS in a local government setting. A recent article by Drummond (1995) discusses the ways that address matching with GIS can be used in planning. The frequency of GIS articles in the planning literature appears to parallel the rate of adoption of this technology within the profession.

Geographic information systems are now becoming common among planning agencies even though there are still problems. While software is becoming easier to use, many agencies report problems in getting and retaining qualified personnel to run the systems. Although the parcel level database is still the desired base for most planning agencies, the cost of creating these digital base maps remains high due to the need for expensive aerial photography. Nonetheless, by the end of this decade a digital base map linked to an assessor's database should be available to the majority of metropolitan planning agencies.

When planners can access individual parcel information electronically and compare it with data from secondary sources, such as the U.S. Census, planners will be able to see relationships that were not apparent before. Planners will also have access to more data as municipal computer systems become more integrated, providing closer connections to other local departments. Planners have yet to develop models that take advantage of this new level of data. A whole range of traditional planning models (i.e., transportation models) will need to be rewritten to incorporate this fine grained data. Thus, the second wave is well upon us, but its full effects are only beginning to be felt.

The Third Wave: Connected to the World

Although the planning profession has not yet fully absorbed the impact of GIS, it now appears that the initial swell of the next technology wave is arriving. The most recent trend in planning-related computing is the explosive growth of national and global information networks. These networks include commercial services (e.g., America Online, Prodigy, Compuserve, and the Microsoft Network), and the global public-access network known as the Internet. Because all the commercial networks are now (or soon will be) connected to the Internet, the following discussion will emphasize Internet resources, since they are so widely available to planners.

The Internet is a global network connecting millions of computers through the use of a well-defined set of public protocols. Although the major Internet users are educational institutions, governmental agencies, and businesses, the general public can gain access to the Internet through small, often local, Internet providers, large telecommunications corporations, and commercial online services.

While the Internet was originally developed for the Department of Defense and later sponsored by the National Science Foundation, no single entity actually owns or controls the network. Individual universities, businesses, and government agencies are linked through high-speed data connections which often take the form of leased telephone lines. Basic services available through the Internet include electronic mail (email), direct computer-to-computer file transfer (FTP), and an immense collection of news-discussion groups including, for example, "alt.urban.planning," "sci.econ," and "comp.infosystems.gis."

However, the glitziest and fastest growing portion of the Internet is the World Wide Web (WWW), often known simply as the Web. The Web is essentially a colossal, cross-linked, multimedia application that includes digital information in the forms of text, graphics, photographs, audio, and video. Anyone connected to the Internet can obtain a free piece of software known as a browser. Once the browser is running, the user can "surf" from Web site to Web site by simply pointing and clicking with a mouse. Pages of Web material from any one site on the Web can be directly linked to pages at any other site, so the complex, global pattern of hypermedia linkages indeed does resemble a web.

Persons interested in "publishing" Web material can obtain free Web server software and use a relatively simple markup language to develop text, incorporate graphics, and add links to other Web sites. Most Internet providers and several of the online services now allow subscribers to easily publish their own material.

These developments have had, as yet, little impact on the planning profession. However, the Internet (and its successors) will transform planning in at least three major ways. First, over the short run, planners will soon realize the tremendous information resource provided by the Internet in general and the World Wide Web in particular. For example, nearly all the 1990 Census data and TIGER files can be downloaded from the Web at no cost. As the Web grows, it is rapidly becoming the method of choice for obtaining timely, accurate, and free computer data of all types. (See the sidebar for a brief listing of major WWW sites of interest to planners.)

Second, planners will increasingly use the Internet to publish their own materials, solicit feedback, and conduct public discussions. For example, economic developers in many state and local governments are already sponsoring Web sites. Within the next several years we can expect draft comprehensive plans (with full-color maps and supporting analytical spreadsheets) to be posted to the Web for public comment through email and public discussion groups. Direct comparisons between the plans of adjacent (and distant) jurisdictions will become routine. A new form of multimedia comprehensive plan will combine text, graphics, photographs, analysis, links to regional and statewide plans, and the public record of discussion about the plan.

Third and perhaps most importantly, over the long run the global information network could have dramatic effects on the form and function of cities themselves. Telecommunications technology essentially allows the movement of data (bits) to substitute for the movement of people and things (atoms). Even with the current primitive state of email and FAX technology, increasing numbers of knowledge workers can forego traditional offices and work from home. In the near future, global information networks may radically alter both business and residential location decisions, resulting in very different forms of city and community. Ultimately, computing technology may transform not only the way that planners work, but the nature of planning itself.

WWW Sites of Interest to Planners

http://www.arch.buffalo.edu/pairc/
The best single collection of WWW links to material of interest to city planners, developed by the State University of New York at Buffalo.

http://www.city.vancouver.bc.ca/commsvcs/cityplan_report.html
The draft Vancouver city plan, which (unfortunately) contains only text.

http://www.census.gov
A gold mine of planning information, with very easy lookup of all kinds of historical and projected demographic information.

http://www.lib.virginia.edu/socsci/reis/reis1.html
Lookup access to the Bureau of Economic Analysis REIS CD-ROM, which contains dozens of county, state, and metro-area annual variables for the last 25 years.

http://cedr.lbl.gov/pdocs/feas/pop/census_resources.html
The University of California WWW collection of over 300 CD-ROM disks, including most 1990 Census disks, TIGER files, County Business Patterns, and County and City Data Book.

http://www-mitpress.mit.edu:80/City_of_Bits/index.html
The WWW version (including full text) of William Mitchell's visionary book, *City of Bits*, about planning and architecture in the coming digital age.

Conclusions

It is astounding to consider how the first two waves have affected the practice of city and regional planning over the past dozen years. A mere dozen years ago planners were fascinated by the idea of an electronic spreadsheet, and the idea of parcel level GIS was a distant dream. The rate of change is likely to continue to increase. Before the profession can completely incorporate the advances of one wave, another is already beginning to break. If this pattern continues, it is difficult to speculate on where the profession will be twelve years from now. Clearly, by the turn of the century microcomputers will be thoroughly integrated into planning practice, both as office automation tools and in the form of integrated GIS that ties tax records, public works information, land use, and permit history data to each land parcel. We are already beginning to see examples of network communication among jurisdictions and with state and regional agencies.

These new technologies virtually guarantee that planners in the 21st century will operate in a data rich environment. This is a marked contrast to the conditions faced by earlier generations of planners. While they will clearly have more information, better information will not necessarily lead to better decisions. Technology has empowered planners to acquire and manipulate vast amounts of information. Hopefully, our educational institutions can equip planners and their elected and appointed decisionmakers to use that information to create more livable communities. CP

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