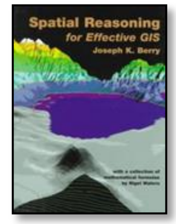
Epilog



***Spatial Reasoning* book**

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Don’t Forget the Human Factor: An Experiential GIS

(GeoWorld, July 1996)

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It is often said that "*experience is what you get when you don't get what you want.*" The corollary to this universal truth is "*learn from other's mistakes, so you won't have to make them all yourself.*" As GIS moved from its infancy in the early 1970's to its present maturity, the school of hard-knocks coughed-up an ample set of good, bad examples. We might not know what is best for all GIS environments, nor have the omnipresent formula for assured success, but the growing layers of scar tissue in the GIS community clearly point to the paths not to follow.

Given this line of reasoning, let me describe an early experience in the application of GIS to land use planning. It was a class project for a graduate course in GIS at Yale University in the spring of 1980. The saga pits a naive and somewhat dim-witted assistant professor backed by a covey of bright students against an enraged portion of the populace of Guilford, Connecticut, a picturesque town along Long Island Sound. But I am getting ahead of myself. The early stages of the project were typically blissful, with focused energy on data base development within the tender arms of academia. The students feverishly encoded twenty data layers for the nearly 70 square mile town, including the usual set from standard map sheets, augmented with special town maps, such as zoning, sensitive soils, and land use. This in itself was a great learning experience, given the pre-Paleolithic tools of the time.

Where we went wrong was an attempt to address a "real world" problem. The town had recently completed its Comprehensive Plan of Development and Conservation as a requirement of the Coastal Wetlands Act. It was the result of several years' effort among citizen groups and town officials. The plan consisted of twenty-one policy statements, such as "protect inland wetlands ...from contamination and other modifications," "preserve farmlands," and "encourage development near or within existing developed areas."

Since all twenty-one of the statements had a spatial component, it seemed natural to map the conceptual model embodied in the plan. Using a three-tier ranking scheme of *suitable*, *less suitable* and *unsuitable*, each policy statement was interpreted into a map of suitability for development. For example, the policy to "preserve farmland" used the town's land use map to identify farmland and then assign the areas as less suitable. Similarly, the policy statement to "protect inland wetlands" caused these areas on the sensitive soil map to be designated as unsuitable. In contrast, the areas near or within existing development indicated on the land use map were identified as suitable for development. Following the plan's organization, the statements were grouped into four submodels of Water and Sewage, Growth, Preservation, and Natural Land Use, and then combined into one overall suitability map.

Near the end of the term, enthusiasm was high and success seemed imminent. That was until we hosted a town meeting at the local high school to present the results. Students served refreshments and proudly stood by their computer-generated maps draping the walls. As fledgling GIS technocrats, they were eager to enlighten the audience as to the importance of the technology and the elegance of the map analysis process. However, the congregation seemed bored by the techno-babble and focused their collective attention on the final map of suitability. Once they located their property (you know, the parcel they were holding to pay for Sonny's college tuition), they did one of two things-- 1) profusely thanked the students for an undoubtedly thorough job and promptly departed to relieve the baby-sitter, or 2) lock the last student in the reception line in animated debate and, once pried loose, sat down in seething hostility. In less than a half-hour we had distilled our audience to a residue of enraged citizens holding "unsuitable" property. We left about midnight and had to sneak back in the morning before basketball practice to recover what maps we could from the walls.

So what went wrong? We had done our homework. We had developed an accurate database. We had conscientiously translated their policy statements into maps and integrated them as implied by their plan. We thought we had done it all... and we had from a GIS-centric perspective. What we had missed is GIS's wildcard-- the human factor. The textual rendering of the comprehensive plan was comfortably innocuous as it lacked threatening spatial specificity. It seemed natural to outline a set of amorphous goals, and then proceed with incremental planning whenever a developer proposes a specific parcel. If contention arises, there are always planning variances, exceptions, mitigation, and the ultimate recourse of lawyers and judges. This is the way things had always been done... the natural law of land use planning. The idea of an actual map of the spatial ramifications of a comprehensive plan is akin to poking a stick into a den a rattlesnakes. Any seasoned planner knows, you plan, then move on before you implement... it's dangerous out there.

Being a slow learner and somewhat bent on self-flagellation, I decided to extend the project the following year. First, the students refined both the database and the model, then determined the most limiting policy goals by systematically relaxing criteria in successive runs (sensitivity analysis). Armed with this insight, we solicited the help of the three town commissions instrumental in the plan's development; the Economic Development Commission, the Planning and Zoning Commission and the Conservation Commission. At working meetings, policy-rating questions were posed to each group and their hierarchical orderings of the policy statements where used for subsequent model runs.

The results were three maps of overall suitability, expressing alternative interpretations of the plan. For example, the Conservation Commission's interpretation of "protect inland wetlands" was emphatic. Since it's damp about everywhere, 83% of the town was deemed unsuitable for development. The Economic Commission, on the other hand, believed sound engineering protects wetlands, thereby lowering the wetland policy's rating, which resulted in only 21% being unsuitable. By simply subtracting the two maps, the locations of agreement and contention were easily identified. The comparison map and the three alternative interpretations by the commissions were published in the local paper... "a healthy *a priori* discussion ensued." Most importantly, we minimized GIS student casualties.

The Guilford experience has forever altered my perspective of what GIS is (and isn't). Yes, it's hardware and software. It's a database. And GIS models. But, in actuality, it is the domain of the end-user and those impacted. Neither GIS Jerk nor Jock can "solve" someone else's concern with rapid geo-query and pallet of 64,000 colors draped on a 3-dimension plot. In real world applications, GIS acts as a communication tool in understanding the important factors, their interactions and various interpretations of both.

For more on this "watershed experience," see Assessing Spatial Impacts of Land Use Plans, by Berry and Berry, 1988, in Journal of Environmental Management, 27:1-9; and Analysis of Spatial Ramifications of the Comprehensive Plan of a Small Town, Berry, et. al., 1981, in the proceedings of the 41st Symposium, American Congress of Surveying and Mapping.

Developing an Understanding GIS

(GeoWorld, August 1996)

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Effective GIS applications have little to do with data and everything to do with understanding, creativity and perspective. It is a common observation of the Information Age that the amount of knowledge doubles every 14 months or so. It is believed, with the advent of the information super highway, this periodicity will likely accelerate. But does more information directly translate into better decisions? Does the Internet enhance information exchange or overwhelm it? Does the quality of information correlate with the quantity of information? Does the rapid boil of information improve or scorch the broth of decisions?

GIS technology is a prime contributor to the landslide of information, as we feverishly release terra bytes of mapped data on an unsuspecting (and seemingly ungrateful) public. From a GIS-centric perspective, we are doing a bang-up job. Lest I sound like a mal-content, let me challenge that observation. My perspective might not meet the critical eye of a good philosopher, but that's not the objective. The thoughts simply explore the effects of information rapid transit on our changing perceptions of the world around us.

First, let's split hairs on some important words borrowed from the philosophers-- *data, information, knowledge, and wisdom*. You often hear them interchangeably, but they are distinct from one another in some subtle and not-so-subtle ways.

The first is data, the "factoids" of our Information Age. **Data** are bits of information, typically but not exclusively, in a numeric form, such as cardinal numbers, percentages, statistics, etc. It is exceedingly obvious that data are increasing at an incredible rate. Coupled with the barrage of data, is a requirement for the literate citizen of the future to have a firm understanding of averages, percentages, and to a certain extent, statistics. More and more, these types of data dominate the media and are the primary means used to characterize public opinion, report trends and persuade specific actions.

The second term, information, is closely related to data. The difference is that we tend to view information as more word-based and/or graphic than numeric. **Information** is data with explanation. Most of what is taught in school is information. Because it includes all that is chronicled, the amount of information available to the average citizen substantially increases each day. The power of technology to link us to information is phenomenal. As proof, simply "surf" the exploding number of "home pages" on the Internet.

The philosophers' third category is **knowledge**, which can be viewed as information within a context. Data and information that are used to explain a phenomenon become knowledge. It probably does not double at fast rates, but that really has more to do with the learner and processing techniques than with what is available. In other words, knowledge is data and information once we can process and apply it.

The last category, **wisdom**, is what certainly does not double at a rapid rate. It is the application of all three previous categories, and some intangible additions. Wisdom is rare and timeless, and is important because it is rare and timeless. We seldom encounter new wisdom in the popular media, nor do we expect deluge of newly derived wisdom to spring forth from our computer monitors each time we log on.

Knowledge and wisdom, like gold, must be aggressively processed from tons of near worthless overburden. Simply increasing data and information does not assure the increasing amounts of the knowledge and wisdom we need to solve pressing problems. Increasing the processing "thruput" by efficiency gains and new approaches might.

OK, how does this philosophical diatribe relate to GIS technology? What is our role within the framework? What do we deliver— data, information, knowledge or wisdom? Actually, if GIS is appropriately presented, nurtured and applied, we can affect all four. That is provided we recognize technology's role as an additional link that the philosophers failed to note.

Understanding sits at the juncture between information and knowledge. **Understanding** involves the honest dialog among various interpretations of data and information in an attempt to reach common knowledge and wisdom. Note that understanding is not a "thing," but a process. It's how concrete facts are translated into the slippery slope of beliefs. It involves the clash of values, tempered by judgment based on the exchange of experience. Technology, and in particular GIS, has a vital role to play in this process. We not only need to deliver spatial data and information, but deliver a methodology for translating them into knowledge and wisdom.

Our earliest encounters with GIS viewed maps as "**images**," with automated cartography providing rapid updating and redrafting of traditional map products. The field quickly progressed from computer mapping to spatial database management by focusing on the derivation and organization of mapped data. It provides efficient storage and retrieval of vast amounts of land-based data in both tabular and graphic form. From this view, GIS acts like a "**cash register**" to record transactions on the landscape. More recently, GIS is viewed as a "**toolbox**" of map analysis operations in which entire maps are treated as variables and related within a specific context. It is the GIS toolbox that transposes mapped data into spatial information.

Tomorrow's GIS builds on the cognitive basis, as well as the spatial databases and analytical operations of the technology. This new view pushes GIS beyond data mapping, management and modeling, to spatial reasoning and dialogue focusing on the communication of ideas. In a sense, GIS extends the toolbox to a "**sandbox**," in which alternative perspectives are constructed, discussed and common knowledge and wisdom flows.

This step needs to fully engage the end-user in GIS itself, not just its encoded and derived products. It requires a democratization of GIS that goes beyond GUI interfaces and attractive icons. It requires the GIS priesthood and technocrats to relish the opportunity to explain concepts in layman terms and provide access to the conceptual expressions of geographic space through intuitive means divorced from macro code.

I hope we consider the importance of knowledge and wisdom in the Information Age, and eagerly grasp the opportunity GIS has in contributing to their derivation. I fear that GIS "factlets" masquerading as knowledge in the Information Age will mask the importance of wisdom. I fear that our all-consuming focus on maps and "home pages" on the Internet will distract from the assimilation of the significance embedded in spatial information and the communication of the ideas it spawns. GIS has an opportunity to empower people with new decision-making tools, not simply entrap them in a new technology and an avalanche of data. What we have accomplished is necessary, but not sufficient for effective GIS solutions.

Like the automobile and indoor plumbing, GIS won't be an important technology until it fades into the fabric of society and is taken for granted. It must become second nature for both accessing information and translating it into knowledge... we must refocus its emphasis beyond mapping to that of spatial reasoning.

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