Detecting the social influences in GIS technology: Getting value from comparative retrospective studies

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1. Introduction

Critical GIS has emerged at least as an approach inside GIScience, if not yet as a discipline (Schuurman 1999). It has become accepted, in some measure, that geographic information technologies influence society and that they are influenced by society (Sheppard 1995, Harvey and Chrisman 2004, Chrisman 2005). The discussion/debate has mostly been conducted on a theoretical level. Much of the direct evidence about the social component in GIScience has come from participant observation and other forms of ethnographic research. These methods involve huge time commitments and consequently cover few cases.

This paper argues for a complementary, alternate methodology to advance understanding of the interactions between technology and society. To illustrate applicability, it draws examples from a comparative study of low-level radioactive waste siting studies over the past thirty years.

2. Retrospective comparative analysis

There are many methods proposed in science and technology studies, the specific setting of LLRW disposal siting, like many GIS applications, falls under a regime of state regulation. Radioactive waste is inherently contentious; a hot potato that glows in the dark. The field of drug regulation is a close cognate. A recent study by British sociologists (Abraham and Davis 2007) applied a methodology of retrospective analysis to drug regulation and the interactions of politics and science. Their comparison contrasted the regulatory history of the same drug between USA and UK. While it may be truism that regulation occurs in a particular historical and political setting, just how that setting influences decisions takes substantial untangling. They were able to determine which issues were due to the biological response of the drug and which issues were imposed by the social and political setting. The comparative setting is crucial for this, and having just two countries still permitted substantial conclusions.

3. Low-level Radioactive Waste- multiple applications of GIS

The hierarchical structure of political life permits many applications of this method in the GIScience arena. The federal structure of Canada, Australia and United States are simple cases, but more recently the European Union adds additional potential. This paper will consider just one example from the United States.

In the 1980s, the US government made the states responsible for low-level radioactive waste (LLRW) generated in their borders. States were encouraged to form "compacts" and to locate facilities according to common rules *(10 CFR 61)* (Nuclear Regulatory Commission 1988, 1991). The regulatory guide counseled the use of GIS to perform

siting studies. Other countries have also progressed on studies (Yim and Simonsen 2000, Yun 2008). The fascination with this application of GIS remains current in various curriculum efforts (Carver et al. 2004, National Geographic Society 2006).

In the USA, about fifteen states conducted siting projects to some stage of completion. Millions were spent. Organized opposition has driven most states back to the drawing board due to court challenges or denials at administrative hearings. Revised projects provide replications under changed political circumstances. After decades of effort, no new site was opened.

The history of these historical projects challenges the glib assumption that GIS is 'simply a tool' in a rational decision-making process. GIS insiders may shrug off these failures as the result of 'politics', as if some remote force of nature beyond control. On the contrary, 'politics' in various forms play a necessary and inescapable role in all social settings. The analysis of the comparative case studies must begin with attentive examination of each setting. Some details are unimportant, but it is hard to know which ones may turn out to be crucial.

3.1 A few cases

The checkered experience of the state of Illinois in siting a LLRW disposal facility amply illustrates the peril of viewing siting procedures as a sure path to solution. After spending $85 million over an eight year period, the selected site, Martinsville, was rejected after 72 days of public hearings in 1991 and 1992. Earlier, the project had not shown any clear signs of failure. As the siting review commission concluded there had been a remarkable emphasis on technology and science, but science was ultimately ignored when the siting criteria were altered to fit the necessity to find a workable site in a "volunteer" community. This deviation caused a hearing that firmly scuppered the process. The next approach applied in Illinois relied purely on bureaucratic and procedural changes: the roles of regulator and supervisor were reversed. Illinois began afresh, refining the siting criteria through public hearings that again led nowhere.

A number of states had quite elaborate GIS-based applications applied statewide. Monmonier (1994, 1995) included the New York project as one of his "carto-controversies". New York mobilized a grid database with one mile square cells and an elaborate system of "rating and weighting" for many factors. The scoring procedure included site-engineering variables such as soil permeability along with environmental variables such as the average number of days with icy roads. Many of the criteria were scored so that each cell received the worst possible rating anywhere in the cell, yet some other criteria (including lands of high agricultural potential) were scored using the center point of the cell. The cumulation of all these special treatments reduced the credibility of the process.

Connecticut's approach placed top priority on factors derived from available state-wide layers, causing significant controversy (United States General Accounting Office 1993). The most specific problem was the failure to account for ongoing population growth (the site was not to be located in areas of relatively high population). Also, opponents claimed that prioritization of slope criteria before other criteria invalidated the siting process. Finally, the siting process followed a "blind" procedure, without any identification of potential sites until completion of the siting process. This procedure marks the high tide of trusting the GIS procedure and attempting to separate it from the weaknesses of the political process. The commission was meant to select the site based solely on the scores reported by the computer. The site was not shown in its geographic position, so that the commission could be swayed by local affinities (Connecticut 1991). The opponents' focus on these points led to legislative repeal of

the agency's mandate and develop an approach involving a community volunteering to host the disposal facility (Connecticut 1994). Eventually, Connecticut cancelled its own process and joined a peculiar Compact with South Carolina (host of the only open facility) and New Jersey (another state whose siting process led to a stalemate).

3.2 A more positive case

A more positive interaction between the siting process and politics can be drawn from the case of Michigan. In 1982, Michigan accepted the role of host state in a compact with six others (mostly neighbours, but not included Illinois). A siting study was initiated, and the strict logic of exclusionary screening was applied. Only 81 parcels of land survived the criteria, and in a followup study the main three contenders were ruled out. Michigan stood by their study; the criteria were appropriate, none of the state was suitable. The state was ejected from the Compact, and denied access to the existing disposal facilities. Waste generators were required to store their waste for five years until South Carolina relented. As the cost of storage and disposal rose, the quantity of waste declined. Michigan was able to avoid what appeared to be unavoidable. The key element was political agreement to stick to the original compromise on criteria, and not relax them to make some site qualify. The technical argument was integrated in a political approach; the economic consequence altered the original need. Stalemate was not totally negative.

4. Analysis

The siting process turns out to be a small battle in a bigger war. In case after case, the nuclear industry wanted to ensure that their power plants could not be disrupted by environmental opponents. Consequently, various procedures were put in place to ensure that siting studies were done by the most technical of procedures. Some used exclusionary logic, others applied complex multivariate contributory formulas. It was not the specific formulation that mattered, just that the procedure would lead to a selected site. Despite this reliance on the technical case, in most cases, the criteria were modified to suit opportunities that arose. This flexibility undermined the credibility of the whole process. By contrast, Michigan stuck to their criteria, and paid some serious consequences. Interestingly, their approach reduced the production of waste, and thus reduced the need for a facility.

At the meta-level, this process does not offer a magic formula. There is no guarantee that the comparison will automatically determine which factors turned out to be important. In my first reading, Michigan appeared to be a more complete train wreck than some of the other states. After all, they failed totally to locate a site, and they suffered drastic consequences. Yet, in the end, the sharp shock caused a reduction in the quantity of waste, and thus resolved much of the original problem. From the GIScience perspective we tend to gravitate toward the expanded role of geographic analysis, and full utilization of our technology. It is important to remember that the technology is a means to an end, in this case a reduction in risk and elimination of hazardous waste.

5. Conclusions

This abstract covers a few of the many cases of LLRW siting, yet it demonstrates different interactions between GIS technology and what is loosely termed ‘politics’. The comparative approach permits these differences to appear, whereas a single case would not give as much information. This finding confirms the iterative approach of

Mathieu Noucher (2008) who adopted a method based on "grounded theory" – a corpus quite consistent with the literature on science and technology studies cited in prior work. Subsequent research will develop the procedure to provide a guide for future application.

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References

Abraham J and Courtney Davis C, 2007, Deficits, Expectations and Paradigms in British and American Drug Safety Assessments: Prising Open the Black Box of Regulatory Science. *Science, Technology & Human Values,* 32: 399-431.

Carver S, Evans A and Kingston R, 2004, Developing and testing an online tool for teaching GIS concepts applied to spatial decision-making. *Journal of Geography in Higher Education,* 28(3): 425-438

Chrisman NR, 2001, *Exploring Geographic Information Systems,* New York, John Wiley.

Chrisman NR, 2005, Full Circle: More than just social implications of GIS. *Cartographica,* 40(4): 23-35.

Connecticut, 1991, Low-Level Radioactive Waste Disposal Facility Site Screening Report. *Draft Report,* Connecticut Hazardous Waste Management Service.

Connecticut, 1994, CHWMS believes volunteer approach best way to site LLRW disposal facility. *CT LLRW Program Report,* Connecticut Hazardous Waste Management Service.

Evans AJ, Kingston RP and Carver SJ, 2004, Democratic input into the nuclear waste disposal problem: the influence of geographical data on decision making examined through a web based GIS. *Journal of Geographical Systems,* 6(2), 117-132

Harvey F and Chrisman NR, 2004, The imbrication of geography and technology: The social construction of geographic information systems. In Brunn SD, Cutter SL and Harrington JW (eds.), *Geography and Technology*. Dordrecht, Kluwer, 65-80.

Michigan Department of Environmental Quality, 2003, Low-level radioactive waste in Michigan: A survey of radioactive waste generators, Lansing MI, MDEQ.

Monmonier M, 1994, Spatial Resolution, Hazardous Waste Siting, and Freedom of Information. *Statistical Computing & Statistical Graphics Newsletter,* 5(1): 9 - 11.

Monmonier M, 1995, *Drawing the Line: Tales of Maps and Cartocontroversy*. New York, Henry Holt.

National Geographic Society, 2006, Lesson Plans: Low-level radioactive waste, http://www.nationalgeographic.com/xpeditions/lessons/18/g912/nuclearwaste.html.

Noucher M, 2008, La donnée géographique aux frontières des organisations : approche socio-cognitive et systémique de son appropriation, PhD thesis, EPFL, Lausanne CH.

Nuclear Regulatory Commission 1988, Guidance for selecting sites for near-surface disposal of low-level radioactive waste. *Regulatory Guide 4-19,* Washington DC, Office of Nuclear Regulatory Research.

Nuclear Regulatory Commission 1991, Licensing Requirements for Land Disposal of Radioactive Waste. In Code of Federal Regulations, 10 CFR 61, Washington DC, Government Printing Office 124-151.

Schuurman N, 1999, Critical GIS: Theorizing an emerging discipline. *Cartographica,* 36 (4): 1–108.

Sheppard E, 1995, GIS and society: towards a research agenda. *Cartography and Geographic Information Systems,* 22: 5-16.

United States General Accounting Office, 1993, Nuclear Waste: Connecticut's first site selection process for a disposal facility. *GAO/RCED-93-81,* Washington DC, United States General Accounting Office.

Yim MS and Simonson SA, 2000, Performance assessment models for Low Level Radioactive Waste disposal facilities: a review. *Progress in Nuclear Energy,* 36(1), 1-38.

Yun ST, 2008, Site selection for low and intermediate level radioactive waste disposal facility in Korea, *Progress in Nuclear Energy*, 50: 680-682.