Inscriptions of Power: CAD's Quite Significant Other

CHRISTOPHER KOZIOL
Colorado State University

Introduction

It is no revelation that computer technology has gained a substantial foothold in architectural education programs. However, of more interest is the prospect that the schools' production technologies may not be approached with the same critical sensibilities educators insist upon in dealing with other topics in the curriculum. For example, for educators to treat emerging information technologies as mere extensions of computer-aided design (CAD) technologies — or worse yet, computer aided drafting — may be a disservice to our students, and ultimately to the profession. As CAD has established a central role in the information systems of many organizations, this technology's power as a design tool has increasingly been complemented (compromised?) by a desire to exploit its data management capabilities. In this paper, I argue that this phenomenon, that of more effectively spatially locating data in a web of management practices, is increasingly becoming CAD technology's *raison d'être* in contemporary corporate and government practice. This in turn, differs from how CAD is often perceived and taught in the academy.[1]

For the foreseeable future, which is admittedly not very long, most practicing architects will not become the programmers of new software applications, but we will be increasingly expected to understand and master a variety of "end-user applications" for the AEC market. As such, we are consumers as well as producers; and our buying decisions and usage patterns will remain of great interest to the designers and purveyors of software applications.

I propose that we treat the adoption of production technology as a matter of social practice, drawing on the scholarly tradition of science and technology studies (STS). In examining the evolution of commercial CAD products, I contend that CAD's attraction in the marketplace (i.e., practice) lies in its ability not only to achieve higher levels of **perceptual verisimilitude** (e.g., rendering, animation, virtual reality) but more significantly, to allow its users to create powerful **data abstractions.** To date, the differing capabilities of the medium, and differing foci of practice and academy, have coexisted without significant conflict or discussion. Modeling, rendering and animation provide support for design visualization and public presentation, and as such are enthusiastically incorporated into contemporary commercial practice. However, it is the management of data that powers the integration of construction and facilities documentation. My argument is not an empirical one, as to the degree to which students are taught one or the other approach to computer technologies. It is a critical and normative argument on the need to apply critical thinking to our tools as well as to our productions.

Finally, I also suggest that CAD educators "go postmodern" in a way in which many of us are not familiar; that rather than attempting to control the future trajectory of CAD we "play through" its potential oppositions in the design studio; that we allow the tension of visual and data realms to be experienced. Toward this end, I raise the possibility that CAD's ability to integrate visual and data realms will become increasingly complicated as product development is advanced, making it imperative for design educators (i.e., the academy) to explore relationships between object and data representations in a new light. This complication will demand a response from the architectural educators. Hence, my second objective is to bring recent theories of technology and culture to bear on this specific technology. The paper introduces and situates the argument within contemporary social theory. Michel Foucault's notion of micropractices of power has been convincingly extended to the study of technology and culture. In this paper, I cite this literature, as a means of stepping beyond brute empiricism, to generate a dialogue about CAD's social trajectory, past and future.

Architectural education is not identical to the experience of practice, and there are some very good reasons for maintaining this distinction (Cuff, 1991). However, we should not do so without adequate deliberation. What are the current trends in the academy and in practice as they relate to information technologies?

Academy: Focusing on Design

Schools of architecture have readily adopted computer technology. CAD's power to simulate virtual worlds is a major source of instantaneous feedback for the designer. As Don Schon (1983) has argued, designers decide future moves based on an evolving assessment of earlier ones. CAD educators have realized this, and the course of CAD education in the schools has centered on visualization and representational aspects of the medium. In so doing, the academy has well supported incipient architects as designers, a conclusion in keeping with Cuff's (1991) findings. Also, recent professional projects by Eisenman, Gehry and others serve to reinforce the mystique of the modeling and rendering capabilities of the machine. Hence, the graphic results of design projects produced using sophisticated 3-D modelers, like Form-Z, and advanced rendering programs like Lightscape have more cachet in the schools than the "drafting software," such as AutoCAD.

These differences, and their implied hierarchies, are sometimes played out in the activities and physical layouts of the schools. For example, I offer the case of one architecture department in which two distinct computer labs have evolved. In this school a clear demarcation has occurred among architectural students and faculty alike. In one lab, students labor shoulder to shoulder with their studio instructors using Form Z design and modeling software on Apple computers; in the other lab, an occasional "more practically oriented" architecture student interested in AutoCAD, settles down between urban planning students using GIS software on Intel-PC based stations. This spatial and technological distinction itself is interesting, and constitutes what anthropologists would call a "primitive classification system."

However, information management is certainly not central to studio education, nor is it always found elsewhere in the architectural curriculum. Will this asymmetry in the schools continue, and if so, how will it relate to trends in industry?

The emphasis in the schools on more sophisticated modeling and rendering applications is not a negative development. However, the way that other applications are treated is more troubling. In contrast to modeling software, architecture students too often imagine an industry dominated by dreary CAD drafting stations, an image no doubt reinforced by all those employment ads stipulating, "AutoCAD required." Despite the fact that such skills are a necessary entry credential to the profession, it is wrong-headed to imagine that the $3 trillion dollar construction industry's sole link to information technology is based on a quaint fondness for clumsy and relatively primitive 2-D drafting applications.

Practice: Industry Developments

First, it is necessary to briefly review the industry developments that have made the present analysis pertinent.[2] The use of computer aided design in the architectural / engineering / construction industry (henceforth, AEC industry) has grown exponentially in the last decade. Prior to the mid-nineteen-eighties CAD applications were mostly a novelty, or at best, a primitive tool, in most architectural practices; and virtually unheard of in the construction and facilities management segments of the industry. However, technological innovation together with the growth and consolidation of major software providers has created a broader end user market in the last decade. Today, many institutional clients specify construction document formats, including file type and layering conventions. Such clients frequently view construction documents as the base for an ongoing facilities management information system. This perspective is being supported both by industry software providers with a historic base in CAD, as well as others from different segments of the industry. For example, industry giants, Autodesk (AutoCAD) and Bentley (Microstation) have both expanded their product lines in the direction of what are becoming known as "enterprise solutions." Autodesk's Buzzsaw and Bentley's ProjectBank are both being marketed as workplace integration tools. As such, they are directed at management level personnel in the AEC industry. Additionally, these, and other CAD software companies have also been launching a variety of strategic alliances and joint ventures with other software companies specializing in estimating, scheduling and facilities management products. Concurrently, several world-wide-web based companies have emerged using an 'e-commerce' business model. In this latter model CAD is only a graphic vehicle in support of streamlined transactions between designer, builder and product supplier. While these developments do not indicate the demise of rendering and animation applications, I contend that a data centered vision of the future will provide a significantly different, and possibly opposing, context for further innovation and development than what is being taught in the schools.

The availability and control of information lies at the very heart of modern management systems. Given that corporate organizations establish a system of control, providers of professional products and services to these organizations, including software and architectural services, frequently emulate and mirror the practices of their clients. Hence, to the extent that CAD serves as a tool in advancing these practices, architects and engineers are able to provide access to a credible extension of managerial control over spatial data. While CAD "attribute data" is not among the most technologically advanced functions, it is frequently of more interest to clients than, for example, ray tracing or luminosity. Counting, not seeing, may be believing.

CAD: Visual and Data Realms

How then to treat these trends? On the one hand we are limited in our knowledge of "the most current" business developments by virtue of our self-imposed distance from the tumult of the AEC industry; and on the other we are potentially empowered by this same distance, if critically exploited. To assume a critical stance, I propose a provisional, and somewhat crude analysis regarding the role of digital design technology in "the industry."

"Verisimilitude," from the Latin, refers to that which is of "truthful appearance." However, the notion of "appearance" often evokes suspicion about veracity, or truth. At least one common dictionary (Simon & Schuster), offers two definitions of significantly different connotation: "1) the appearance of being true or real, 2) something having the mere appearance of being true or real." This implied ambivalence about imagery is neither unique nor new. W.J.T. Mitchell (1986) identifies and traces this phenomenon in and throughout Western culture. He refers to this tendency as 'iconoclasm' and documents a 2500 year suspicion of imagery; contrasting this with a belief in ideas. In his reading, Westerners are obsessed with getting to the true meaning behind surface appearances.

Digital imagery has only served to compound cultural ambivalence about the veracity of "picture." CAD modeling, rendering, and animation are hailed inside the industry as providing more 'truthful' and 'lifelike' representations of future fabrications than any previous representational technique. While manual architectural illustration and physical models have long been used to assure clients, digital techniques promised even more. However, there seems to be both a practical flaw and an intellectual flaw in this line of thinking. Digital imagery, even that based on three-dimensional coordinate geometry, does not *correspond* to nature, as realist assumptions about representation would demand. The criticism and differing interpretations of an earlier representational technology, photography, afford some clues. William J. Mitchell (1992) notes that commentators on photography, including those of diverse ideological persuasions, have attempted to distinguish photography from the other visual arts on the basis of its adherence and correspondence to an external referent. However, even with conventional photography this position is regularly undermined by the ability to manipulate the image. Digital imaging furthers this ability, to the point where verisimilitude is *always* questionable.

While the earliest photography often supported the folk truism that seeing is believing, later advances afford less, rather than more, credence to this position. For example, Eadweard Muybridge's early sequence of photographs of a horse in motion demonstrated that the "flying gallop" does not actually occur. However, today the reality of O.J. Simpson's Bruno Magli shoes could at least be challenged, despite photographic evidence. Hence, while CAD modeling, rendering and animation all contribute visual evidence necessary to initially persuade a client or jury (architectural or otherwise), this visual 'truth' may be suspect, both by virtue of our cultural predisposition and the accumulation of individual suspicions about images raised in everyday experience.

However, another form of representation, often also graphically communicated, seems to be at least somewhat resistant to these suspicions. Data representations make an important and powerful contribution to the technology of management. Spreadsheets, charts, graphs schedules, and timelines all provide the ability to abstract and efficiently display data (Tufte 1990). However, unlike representations that suggest visual verisimilitude, and a one-to-one correspondence between representation and external referent, data representations may be doing something quite different. Mathematization, or the reconstitution of perceptual form into manipulable data, allows scientists to bring order to nature (Lynch 1990). French sociologist, Bruno Latour suggests that these data representations themselves, what he calls "inscriptions," allow not just another way of perceiving nature, but a new way of controlling the external world.

> "The essential characteristics of *inscriptions* cannot be defined in terms of visualization, print and writing. In other words it is not *perception* which is at stake in this problem of visualization and cognition. New inscriptions, and new ways of perceiving them are the results of something deeper. If you wish to go out of *your* way and come back heavily equipped so as to force others to go out of *their* ways, the main problem to solve is that of *mobilization*. (Latour 1990:26)

The focus is on action, rather than reference. On the surface, this argument has a strangely pragmatic ring to the ear of this American listener. Like the philosophers of American pragmatism, particularly John Dewey, Latour seems to argue that representations are validated through use, or in Deweyian terms "experience." However, Latour's philosophical grounding is in the continental tradition, and directly tied, by his own reference (*ibid* p.37), to the work of Michel Foucault. For although the Deweyian paradigm privileges individual experience, it is relatively mute concerning relationships of control and power, essential aspects of Foucauldian analysis. The difference is significant to the present argument. While the focus on individual experience might not discriminate between object and data representations, beginning with a Foucauldian perspective does do so, in that the practices and technologies of control are central to the discussion.

To again quote Latour:

> "The point of departure is that we are constantly hesitating between several often contradictory indications from our senses. Most of what we call "abstraction" is in practice the belief that a written inscription must be believed more than any contrary indication from the senses....When in doubt, believe the inscriptions, written in mathematical terms, *no matter* to what absurdities this might lead you." (p.51)

While this latter point is stated as polemic, Latour's argument provides a foundation for a theoretical basis for examining a phenomenon that seems to be frequently overlooked when we engage in a narrowly defined technical research program. An historic perspective affords additional insight.

British sociologist John Law (1987) provides the seminal contribution of using the historical case study to illustrate points similar to those made by ethnographers. Using the example of Portuguese exploration in the 14th through 16th Centuries, he argues that the development and use of the astrolabe was a significant contribution to navigation. However, more significantly, he places this technological development within the context of the social practices of seafaring. He makes the argument that it was not just the development of the device, the astrolabe, but the ability of Portuguese seafarers to successfully "associate entities that range from people, through skills, to artifacts and natural phenomena" (p.129). Hence it is not the device, nor the mathematical calculations alone, but how they are deployed within a network of relations.

Closer to our disciplinary home, Perez-Gomez (1983) has argued that the scientific revolution brought mathematization to architecture as well. In *Architecture And The Crisis Of Modern Science*, presents a careful historical analysis of changing meaning and power relationships in the 17th through 19th Centuries. Perez-Gomez specifically cites the rise of knowledge of statics and the strength of materials as a source of change in architecture. He demonstrates how developments in these sciences were incorporated into architectural theory and practice. In his tale, it is also not the mere existence of the technology, but how it is woven into a complex practice. For Perez-Gomez it is Nicolas-Louis Durand, and his teachings at the *Ecole Polytechnique,* that transform the science and technology into a social practice.

> "From this vantage point, the talent of the architect is reduced to his ability to solve two problems: (1) the design and construction of the most convenient building with a given amount of money, as in the case of private commissions; and (2) the most economical construction of a building whose details are already given, as in the case of public institutions. For Durand, economy and efficiency were not a limitation, but sources of inspiration. They became the *only* acceptable values of architecture." (p.303)

This analysis, while not grounded in the same epistemology as that of Latour, bears a striking interpretive similarity. For where Perez-Gomez sees meaning being displaced by function, a rephrasing of this dichotomy could be the displacement of **perceptual verisimilitude** with that of **data abstraction.**

A Question of pedagogy

Returning to contemporary computer applications in the AEC industry, the promotion of products such as ProjectBank and Buzzsaw must be seen in social context; and I argue that exploration of this context can be productively pursued by at least initially posing a binary opposition between **perceptual verisimilitude** and **data abstraction.**

Once again, one may find some direction from within the Science and technology Studies literature. In recent years several scholars (e.g., Downey 1998; Henderson 1999; Suchman 1987, 1994) have ethnographically explored how drawing technologies are used in defining work practices. By occupying the offices of engineers and designers, they describe, document, and analyze the 'micro-practices of power' employed in the use of what might otherwise be seen as value-neutral representation technologies. In each of these studies, it is argued that technology is neither fully determined, nor is it completely arbitrary. Rather it is the interaction, or social construction of knowledge and practice that is significant. While these particular studies have focused on engineers, it is both logical, and superficially evident that architectural offices function in a similar manner.

Despite the potential value of scholarly interpretations, whether historical or ethnographic, they remain outsider critiques, and the demands of teaching of the art and science of architecture and the trade skill of CAD allow for only moderatedoses of such discursions. However we choose to do so – in lecture, studio, or seminar – I think it important to structure the problem for ourselves and our students. Here, I have proposed one such opposition as hypothesis and argument.

In concluding, I draw from one relatively recent contribution to the architectural discourse. Adolf Loos, like Durand, proposed an approach to modernity and ornamentation different than that of his contemporaries. However, unlike Durand, he framed his argument in contrast to an ever-present '*other.*' For Loos, *das andere,* is always nearby. Tattooing and tribal rights exist as the 'counter-factual' to Loos' modernity. My counter-factual is a socially ignorant use of our representational tools, of a slide into dumb acceptance of an inevitable use of technology. Our challenge, as educators, is to posit an alternative.

NOTES

[1] The terms "practice" and academy" are used here as they are by Cuff (1991). In her argument the value systems of the architectural schools and professional practice frequently and significantly differ in a variety of ways. The present argument extends this position to the use of CAD technology as well.

[2] This section, while not fully noted and referenced, is included to orient the reader to several widely recognized trends. The empirical validation of this, while potentially useful, is not the objective of this paper.

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