The Search

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Henry Ford and his often-repeated "history is…bunk" statement notwithstanding, it doesn't seem unreasonable to look to the past to find our way into the future. To facilitate this investigation in the arena of information technology and its relation to architecture (practice and pedagogy), one can create a somewhat arbitrary construct that divides the subject into the three categories of hardware, software, and implementation. Within each section it becomes apparent that there has been significant change over the last quarter century. But as varied as industry and academic efforts may have been, there is, from a broad perspective, a consistent trajectory and direction.

Hardware

From processor speed to color space to available memory, there have been consistent increases in areas that are quantifiable and measurable. The processor speed of an IBM personal computer in 1981 (coincident with the founding of the Association for Computer-Aided Design in Architecture) was 4.77 MHz (Intel 8088 processor running DOS). Eighteen year-old first year architecture students entering the New Jersey Institute of Technology in 2006 purchase and use computers with 3.0 GHz dual core Intel processors. Faster processors are available and it is not uncommon to place multiple processors in a graphics workstation. Similarly, the amount of memory available to run software applications and temporarily store live data has increased tremendously – from RAM measured in kilobytes (16KB with the original IBM PC) to megabytes to gigabytes. Designers and students now running workstations with 4GB RAM (NJIT freshman specifications) have 65,536 times the RAM than those who were using three-dimensional modeling in the design studio twenty years ago with 64KB RAM. While it took four to five hours to create a hidden line image of models with 4,076 lines in 1986, the same model (and those that are significantly larger) can be rendered and manipulated in real time. (Notice how impatient beginning students get when they have to wait a few seconds for a large model to render on their workstation.) Twenty years ago one could spend $1,000 for a 10 MB external hard drive (with its own power supply and fan). Workstations in 2006 come "pre-packaged" with multiple 500 GB SATA hard drives that can be added (up to a limit) at less than $500 apiece. And, of course, displays have progressed from monochromatic/black and white to selections of amber or green to four colors at a resolution of 320 pixels by 200 pixels to 16 pre-selected colors to dual-scan CGA (640 x 400) allowing 16 colors from a palette of 256,000 in 1985 to 16.7 million colors to …

The demand for speed, resolution, color, and storage is unabated. This demand is not necessarily fueled by architecture-related requirements. The reality is that there are a number of industries that have driven developments in information technology and computer graphics that find their way into architectural use. Communication and visualization needed for military applications, medical imaging, and entertainment all affect what is ultimately available for our adoption and adaptation. Based on dollar volume of business, it is clear that games with more realistic graphics, faster response, more interesting visual settings, and more options; as well as movies with special effects piled upon special effects, drive hardware development in the early part of the twenty-first century.

There is still need for more work. As architects create more complex and comprehensive models there is need for more storage and memory. Speed removes the time lag that inhibits real time, interactive design processes. Greater bandwidth and improved communications facilitate collaboration – both synchronous and asynchronous. The gamut of printers do not match the gamut of the DLP projectors which do not match the gamut of LCD screens which do not match the gamut of CRT screens – and none of them have the dynamic range of the human eye. Even though there is currently a lot of research and development to improve the dynamic range of digital cameras and displays, current experiments and work-arounds are not yet ready for ubiquitous implementation. This list is not meant to be exhaustive. It merely explains that the direction in which hardware development is at least, in part, useful in architectural circles. And, most importantly, if there are specific needs for architectural applications, then architects and tool developers need to become more involved in hardware research and development. As a start, there needs to be a culture in which architects are not afraid to "get under the hood" of the computer and understand how it works and what each component can and cannot do – and understand what can and cannot be easily modified rather than insisting on an automatic "out of the box" solution.

Software

Useful applications, like their hardware counterparts, have evolved over the years. It may be possible to measure the progress numerically, but capabilities such as size of models, speed of rendering, and so on are not strictly software related and have much to do with the equipment that runs the application. (This in NO WAY should diminish the value of well-written code. Clearly, given the same computer, some applications can do more and be far more effective than others if written well. This is merely to state that there are other, equally significant ways, to discuss the changes in computer applications.) Of particular significance is the increase in capabilities – the things that we, as designers, can study, analyze, pre-visualize, explore, and create. Architectural applications have progressed from an attempt to mimic what was done by hand with traditional drafting (line-by-line two-dimensional drawings) to three-dimensional modeling to real time interactive walk-throughs of rendered spaces that do not (yet) exist to intuitive sketching with shape recognition to the inclusion of an associated database with architectural rather than (or in addition to) geometric primitives – now known as "building information modeling." (The idea of associating a database with architectural elements in a building model is not a new one and has been around for some time. The capabilities of the hardware, the comprehensiveness of the software, and the current software interfaces – along with a relatively new acronym, have rekindled and expanded interest; especially as the construction and facilities management industries can demonstrate financial incentive for BIM use.) Every release of architectural modeling, drawing, and/or design software brings new and expanded capabilities and, often (but not always), an improved interface that facilitates use and expands the user base of the product.

Although there are those who disparage architectural computing – especially as used towards the end of the twentieth century – as merely drafting or image-making, it must be noted that images can represent a moment caught in time that accurately pre-visualizes in a *qualitative* manner the effect of light on materials, the nature of a space not yet built or inhabited, or the impact of a proposed structure in a community and on its immediate neighbors. Information in these instances is good – it helps designers and community members make informed decisions about the built environment. Optimistically, one can assume that more informed decisions will lead to more rational decisions about what is built and where. While high quality images are more easily attained in 2006 than they were ten years ago, this fact should not diminish their importance in either the design or presentation processes.

Implementation

Uses of information technology today are virtually unlimited. As professionals, architects use computers to communicate (one should not underestimate the value of email and how it has changed business), to document, to design, to propose. Designers, including those trained in architecture, use digital media to create spaces that *only* exist within the media of creation when they produce virtual worlds for research, exploration, or entertainment. Individuals with architectural education use three-dimensional modeling software to create cartoons, sets for motion pictures, and even backgrounds for comic books. The methods by which authors create books that will ultimately be printed with ink on paper have changed with the introduction of information technology. Patterns for silk-screened t-shirts are now routinely created and produced with common (but not unsophisticated) commercially available illustration software. Whether designing buildings or virtual spaces, passive or interactive entertainment, two- or three-dimensional objects; computers are used – and often by people who have studied architecture. There is no longer a question as to whether or not a computer can or should be used for a task – only *how* it is to be used. The development and *acceptance* of accessible technology has taken place over the last twenty-five years.

And, of course, pedagogy has had to change. Over the objections of initial doubters, computers have been inside the design studio for twenty years. And now, a significant number of architecture programs introduce a combination of digital and analog media in the first graphics and design studio courses, relying on a combination of computer assisted design, modeling, and drawing along with freehand sketching and physical models; having completely eliminated the parallel rule and traditional drafting from the program. A look at the design work emanating from schools of architecture clearly demonstrates that students today seriously consider a greater number of variables, and go through more design iterations in a project, than did previous generations of students.

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There are still those architects and demagogues whose use and pedagogy wait for the complete and "perfect" solution: the (affordable) combination of hardware and software that does everything. This anticipated solution will serve as an electronic sketchpad, intuitively understanding what the designer is trying to create; and then ultimately this data will automatically be turned into a complete and thorough model with parametrically derived architectural objects (that don't look pre-packaged or standard, and are rendered with accurate depictions of material and lighting) that can be coupled with fabrication equipment driven by the same digital instructions that created the model while, at the same time, is linked to a constantly self-updating, maintenance-free pricing/cost system that (of course) predicts future costs of materials (including shipping and handling) and regional labor shortages or potential contract difficulties in those states that do not have "right-to-work" laws that may occur throughout the entire construction process in order to enable the designer to rapidly and expediently change finish materials and/or structural systems to bring the project in on budget, and on time.

The search for the "Holy Grail" goes on – and its absence remains an excuse by some to delay implementation or experimentation. It is important to recognize that the perfect application on the perfect platform (1) may never exist because of changing expectations and (2) is less important than what is discovered during any attempted search. Many of the topics studied today – and in various forms of implementation in the academy and the profession – had their start and introduction years ago. Ten years ago there were already papers and presentations about using information technology to bridge the gap between (digital) bits and (physical) pieces. Now, there are buildings and components that use this technology to alter the way we design and construct the spaces in which we live. Conference calls have given way to a variety of communication and collaboration devices – all of which depend heavily on the use of digital technology to make information visually accessible. These are all incremental and evolutionary steps in the ultimate attempt to influence the way we conceive, design, and inhabit our environment. Architecture, as a profession and business has changed because of the computer. To survive, it will need to continue to change.

Like scientists looking to cure the common cold, we search and don't necessarily find all of the answers – but we do find lots of useful stuff along the way. In *Monty Python and the Holy Grail*, we were enthralled with the chase and episodic adventures rather than the chalice itself. We must remain open, alert, and agile as we explore and implement.

> *"And that, my liege, is how we know the earth to be banana-shaped."*
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> *Sir Bedevere*
> *(Monty Python and the Holy Grail)*