

Fall 1985

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Recommended Citation

William J. Mitchell, Architects' Encounters With Computers, 6 Computer L.J. 357 (1985)

<http://repository.jmls.edu/jitpl/vol6/iss2/10>

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ARCHITECTS' ENCOUNTERS WITH COMPUTERS

by WILLIAM J. MITCHELL*

Architects, like most professionals, have found innumerable uses for computer technology. They use word processors to produce their letters and specifications, they run programs to perform routine analyses, they use computer graphics systems to automate drawing production, and they rely on accounting and project management systems to keep track of people, time, and money. This will surprise no one. Of much more profound importance is the impact that computer technology is having on our fundamental conceptions of what a building is, of what it means to design a building, and of how a building is used.

Buildings were long thought of merely as shelters. Aristotle, for example, defined a house as "a shelter against destruction by rain, wind and heat." The elements of primitive construction were skeleton and skin, fabricated and erected by hand.

Nomads may erect simple shelters, but farmers have reason to erect more permanent and elaborate buildings, and the means to do so. The Neolithic Agricultural Revolution allowed the development of permanent settlements, the emergence of a skilled craftsman/builder class, and the beginnings of architecture.

Gradually, the activity of design separated itself from the activity of construction. Design decisions were systematically premeditated, and documented in drawings and written instructions, rather than made on site as immediate choices presented themselves. Until the nineteenth century, however, design documents were rarely extensive or detailed. The architectural drawings of Palladio, or of Thomas Jefferson, for example, illustrate this.

The Industrial Revolution changed this process. A vast array of new, manufactured construction components and materials emerged, making the task of selection and specification immensely more complex. Buildings began to have internal organs and physiologies, as well as skeletons and skins. They were equipped with increasingly elaborate

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heating, lighting, ventilating, and other systems, all of which had to be designed. Furthermore, the context of the rapidly growing industrial cities created the need for complex new building types, but precedent and tradition provided little guidance for their design.

In sum, the sheer number and complexity of decisions to be made and documented in the design of a building grew rapidly. Building design became a large-scale information processing task, and the architectural profession grew, along with other professions engaged in information work, as we entered the Post-Industrial Era.

Until the mid-1970s, the information processing tasks involved in the design of buildings were carried out in a highly labor-intensive way. Architectural offices consisted of professional staff teams, who worked with very simple, inexpensive equipment, and whose services were billed by the hour. The bigger the building, the more hours it took to design and document, and the larger the fee.

Since then, the ongoing development of VLSI technology, and the resulting precipitous drop in the cost of computing, has made it increasingly attractive to replace labor by capital in the design process. The first successes were in the automation of routine, repetitive drafting and engineering analysis tasks. We now see increased use of computers for more complex decision support functions, and in three-dimensional visualization and rendering. There is little doubt that the CAD systems employed by architects will embody increasing amounts of expert knowledge, and will perform a larger percentage of the work involved in design and documentation of a building. As a result, architectural offices are becoming much more capital-intensive, and we can expect the demand for many traditional, manual architectural skills to diminish.

This important trend is intersecting with another one. Increasingly, buildings not only have skeletons and skins, and mechanical physiologies, but they also have control systems—nerves and brains, if you like. These control systems exist at a number of levels. First, there is a growing number of microprocessors in appliances, such as microwave ovens, washing machines, and other equipment. Secondly, sophisticated computer systems are being used in buildings to monitor and control the operations of the air conditioning, elevator, and other mechanical and electrical systems. Thirdly, buildings are increasingly becoming nodes in electronic communications networks, and must be designed to serve this function. Finally, as we enter an era in which emphasis is shifting away from the creation of new building stock to the management and transformation of existing building stock, computer-based facility management systems are finding rapidly widening use.

A facility management system is essentially a database system which maintains an inventory of all the space that exists in a building,

an inventory of the furniture and equipment associated with the building, and an inventory of the employees and organizational groups that use space and equipment within the building. The system also records the relationships between these things, such as the occupation of a space by an employee or piece of equipment, and the adjacencies of spaces. This description of the building and its occupants is kept current as changes take place, and is used to produce reports and analyses that guide management, maintenance, and planning for the future.

Where does all this leave us? Architects have begun to regard buildings not just as static structures, but as resource-consuming, adapting, aging systems that require skilled, careful management throughout their lives. The design of the control system to accomplish this is as much a part of the architecture as the design of the skeleton and skin, and of the mechanical and electrical systems.

In both the design and management of buildings, the trend of increased computer use will continue. In many cases, the database that is developed to document the design of a building will continue to be updated and used, after the building is constructed and occupied, as the heart of a facility management system. We can expect to see design (initial configuring of a building) and management (reconfiguring over its lifetime) become more closely integrated in this way.

The Agricultural Revolution gave us the possibility of architecture. The Industrial Revolution allowed buildings to become large and complex. The Computer Revolution has provided a way to manage this complexity.

