

# WALKER ART CENTER

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Introduction

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Source: *Design Quarterly*, 1966, No. 66/67, Design and the Computer (1966), pp. 2-4

Published by: Walker Art Center

Stable URL: <https://www.jstor.org/stable/4047325>

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Continuous technological advances have put a growing demand on the design professions. Recognizing the need of information for the designer, DESIGN QUARTERLY presents in this double issue, "Design and the Computer," some of the more important recent developments in the application of computer technology to design tasks. In order to answer fundamental questions such as: "*Why is the computer needed in the design process?*" and "*How is the computer used?*," this issue necessarily became more technical than usual, although all the essays presented deal with the application of the computer to daily design problems.

The survival of the design professions and, in fact, of our whole society depends upon the acknowledgment and study of new conditions and technologies. The designer needs to formulate a new design perspective which includes increased social responsibility and a recognition of technological achievement in order to deal with the problems presented by a changing society. The role and function of the architect, graphic designer, city planner and industrial designer has grown increasingly complex and responsible: the design for better learning, living and communication.

The concept of "good design" achieved by a combination of intuition, intelligence and good taste, which is still the primary concern of today's designers, is no longer adequate. Too many "tasteful" variations of all types of objects exist, but what we need most are better cities, mass transportation systems, hospitals and highways. The traditional ways of thinking, perception and communication have become obsolete and none of these complex problems can be solved by experience and intuition alone. Most design techniques are outmoded too, because they merely cope with the factors and conditions resulting from the Industrial Revolution and are not yet

concerned with the electronic age and its implications. Design must move into the area of electronic data processing because new methods and tools are needed to gather the mass of data and extend the comprehension of today's major design problems.

The computer is the tool which the designer will have to learn to use. Most designers are unaware of the existence of such a tool and only a few architects, graphic designers and industrial designers in different localities, corporations or institutions are beginning to explore the potential of the new computer technology.

In solving design problems, the designer relies mainly on experimentation with ideas. Concepts are formed and changed, associations occur, are examined, and then approved or rejected. Once the basic idea or structure is formulated, most of the ensuing work is mechanical. The computer can free the designer from many of these tedious and mechanical tasks. For example, it can generate a perspective view of an object which can be drawn by a plotter (automatic drawing equipment), present the object on a television-like display tube in different perspective views, or rotate the displayed object in space just as if the designer were holding it in the palm of his hand. Such possibilities enable the designer to examine a solution, modify it or start anew before it is ever executed in concrete or steel. If a three-dimensional model is required, the computer can be programmed to produce a tape which controls a milling machine to carve out the model in metal.

The computer not only assists the designer in his manual tasks, but because of the tremendous command of information made possible by the computer, it also enables him to process almost endless facts and figures, organize this complex data and analyze the requirements and interactions of any design problem. Beyond this, the computer may also be used as a creative medium to produce drawings, electronic sculpture, choreography and movies.

During the past few years, terms such as *computer hardware* and *software* have evolved. These terms are related to the workings of the computer: the information needed to perform a task and the procedures to be followed constitute the program which is usually entered into the machine on a typewriter-keyboard. The program is translated into electronic impulses and often stored on a magnetic tape. The control unit of the computer performs the work specified by the program and the resulting information is transferred to an output device that prints messages on pages, punches cards or tapes, or displays images on a television-like screen.

These input and output devices, arithmetic and control circuits, and a memory unit, are the so-called computer *hardware*. The programs of instructions and various machine languages which put the computer to work are the *software*. The question of how the designer, unfamiliar with computer technology, can use the computer, fortunately seems to become less and less important. Programming languages in written and even spoken English are possible in the future, and already today the designer can communicate visually with the computer. In the future he may be able to use the computer with no more knowledge of the operations performed than the average person knows about the workings of a telephone.

Computer technology is a rather recent invention if we consider that the first commercial computer was marketed as recently as 1950. In the past ten years, the typical electronic data processor has become 10 times smaller, 100 times faster and 1000 times less expensive to operate. With the development of multi-programming and the time-sharing system where one user shares a computer with several hundred others, with input devices located in offices, laboratories and private homes, the computer can serve as a community pool of knowledge and skill from which anyone can draw according to his needs.

The list of areas in which the computer has been in use for some time is impressive: marketing, banking, management, steel production, assembly lines, law enforcement, statistics, poll and predictions, operation of ships, railroads and airplanes, language translation, power plants, teaching, map making, tax returns, medicine, economic planning, space exploration, library science, military planning and scientific experimentation, etc. More important for the designer, however, are the following areas in which the design has been facilitated by the computer or where the potential of computer-aided design is indicated by experiments: civil engineering, transportation planning, engineering design, architecture and urban planning, automotive design, publishing and printing, graphic design, film making and art.

For example, in *engineering*, computer programs aid in designing bridges. The engineer-designer can make free-hand drawings of a bridge on the computer system's television-like screen, the computer will convert the rough design into exact engineering specifications, calculate and display stress, and show the design in whole or in part, or in any perspective. This includes the possibility of changing the design or modifying parts of it, with the computer incorporating these changes and redrawing the design instantaneously.

In the area of *industrial design*, the airplane and automobile industries are leading the way in computer-aided design. The system used at General Motors allows the designer to build up from sketches on the display screen parts and details of an automobile such as fenders or roof sections. In the airplane industry, the design of cockpits, usually a costly and time-consuming problem, has been analyzed and solved by computers. Human engineering problems occurring in the operation of automobiles or airplanes can be examined and tested with a computer-drawn human figure which can be animated for each individual reach or operating position.

In *architecture*, computer programs have been written for structural analysis of steel and concrete, for heating or cooling systems and electrical distribution in buildings. But more important for the architect are the programs which assist him in the design and form-giving process. Computer programs which break down the design problem into smaller problems enable the designer to produce solutions to these subsystems before he attempts to solve the whole. The computer can be programmed to draw perspectives of buildings, interiors, etc., as seen from any viewpoint, thus helping the architect and planner to visualize buildings and even urban complexes, to modify the design and redraw it. This built-in trial situation is most important for the urban designer and architect because it will allow a new architecture, devoid of mistakes such as the opera house with bad acoustics or the highway interchange with no way to get on or off.

The computer will be very effective in the area of printing, publishing and *graphic design*. Print shops are rapidly acquiring computerized or tape-controlled typesetters and electronic color separators. Photo-typesetting is already partially replacing the traditional hot metal typesetting, and with the use of computer-generated typefaces, any typeface once stored in the computer can be reproduced with speeds up to 600 characters per second. The cathode ray display tube and the lightpen, a photo-sensitive stylus with which the designer, or editor in this case, makes his corrections, will revolutionize the newspaper and magazine field. The graphic designer, layout artist and typographer will be most directly influenced by such techniques as computerized typesetting, computer-generated images and new printing methods.

Computer languages have been written for the animation of pictures and diagrams, and *motion pictures* have been made utilizing the visualization possibilities of the computer used with a microfilm recorder to film the computer-generated images frame by frame. Examples produced at the University of California and at the Bell Telephone Laboratories demon-

strate not only that this is possible but that it is economical as well. The added dimension of motion, important for any sequential representation of a design situation produced by the computer, has been put to use by the Boeing Co. in a film on aircraft carrier landings. This certainly opens up new vistas for the film maker, whether he is concerned with animated line drawings or complex tonal motion pictures — even color.

Computer-produced *abstract pictures* have already been exhibited in art galleries, but computer technology has only recently begun to play a more important role in art. In addition to producing linear compositions and op-art-like patterns, computer technology has been used in electronic sculptures whose moveable parts respond to each other and to the audience viewing it, and also in structures which, if activated by the museum goer, move and produce musical tones.

How will the computer affect the design profession and our environment? Very much like the children who are caught between the old math and the new, today's designers have to face the computer age, turn away from the security of the familiar and learn to adapt the new methods. Furthermore, in order to avoid the computer specialist solving the designer's problems, the designer will have to involve himself in this computer technology. Design educators, too, have to take a close look at the use of computers in design and re-examine their curriculum because clearly these are tools which can extend the abilities of the designer in almost every discipline.

Extensive changes in our environment will occur through computer technology. Within the next decade there will be a tremendous cut in costs for computers, with a great increase in computer application, making it possible to reduce the mass-produced uniformity started by the Industrial Revolution. In reality computers will not rob man of his individuality but rather enable technology to adapt to human diversity. The visual aspects of our environment will benefit from the use of the computer's ability to preview and "pre-test" the design itself and how it relates to its environment. Because all the computer visualizations and the tooling processes are backed up by mathematics, improvements in quality and precision, too, are likely.

The acceleration of production, information, learning and communication brought on by this new technology will not only change and upgrade our physical environment but also improve the quality of our life. The resulting changes in living patterns will again present questions and problems to be solved by the scientist, planner and designer. P.S.