## Information, Computers and Design

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### The Dilemma of the Specific and the General

In the Yucatan peninsula, corn is planted by Indian farmers in the same way it was done hundreds of years ago. The farmer wears a sack filled with seed slung over one shoulder. As he walks the field's rows, he uses a long stick to make holes in the ground into which he drops seeds. Although the stick is a simple tool, it is not naive. It has features that make it well-suited for its task: it is long enough so the farmer can make the hole without bending to the ground; and, the end of the stick is sharpened to a point to make the hole for the seed.

In some developing countries, one can still see people, like the farmer in the Yucatan, who are both the users and designers of their tools. In the industrialized world, the roles of designer and user have become separated. Though separate, the user-designer and the modern designer should share certain obvious concerns. It has always been the business of design to affect human experience and behavior by shaping elements of the physical world. Human artifacts such as buildings, cities, agricultural implements, industrial tools, books, and signs, are but a few examples of the items we make to support human survival, safety, comfort, communication, pleasure and rituals.

Craftsmen were, in a sense, precursors to today's designers. Craftsmen specialized in making needed goods for members of their immediate community. Unlike contemporary designers however; craftsmen physically made products; they developed expertise in manipulating tools and materials; and the things they produced both followed and reinforced the traditions and values of the communities in which they lived.

It was not until the Industrial Revolution that a complete separation between the tool-maker and the tool-user occurred. Rather than hand-producing everything for a particular person who requested it, the designer was paid by a manufacturer, developer or publisher, to specify the characteristics of artifacts made on equipment meant to make large quantities of identical products. The things he designed were for people he would never see. Not only was he separated from the users, he found himself writing and drawing specifications that would allow someone else to actually produce the item.

With economy of scale, the number of items produced were increased and individual consumers were transformed to become "the market" which grew continually larger. Producers found it economically advantageous to design for the average characteristics of a large number of users. This led to relatively low costs, and a trend for products to be *just good enough* to meet a wide number of needs. This meant in turn, that no mass-produced product could exactly match the needs or wants of a single person or group. Designing for a mass audience required a large number of compromises to be made in order to reach the level of average acceptability.

This has been one of the major dilemmas of design in the industrial age: how can one meet the needs of individuals when the central characteristics of mass production lead to messages, artifacts and buildings that are made for the average?

There is some differentiation in manufactured products. Of necessity, products come in different sizes; and, in any one general product type, there is variation in price. These variations match roughly the needs and wants of different segments of the population. But clearly, they are no more than crude gestures when contrasted to the "custom-made" work done by craftsmen for individual customers. The designer is left in the ironic position of professing concern for the user, while being restrained by mass production tools that allow him to design only for the average.

Of course, it is the economy of large production runs and other characteristics of industrialized society that has helped the Western middle class achieve its materially abundant life. The computer's capability to deal with specific details within a large amount of information allows one to consider producing more specialized artifacts.

Computers, communication systems, a highly educated population, and other contemporary developments are bringing about major structural and social changes. We are now at the beginning of an information revolution which is characterized by two major changes: the availability of a new **design tool** and a population living in a new **information environment.**

**New Design Tool**

The first change - one that speaks directly to the design dilemma - is the use of the computer as a design tool. Interactive design stations allow designers to explore far more alternatives than have been possible with traditional tools. Robotics and cyber-automated production processes are allowing both the economy of scale and a wide degree of variation in individual artifacts. Numerically-controlled printing presses and production equipment (see figure 19) are far more flexible than offset printing plates and metal production dies. The new flexibility permits alterations to be made in a product or publication according to the needs of an individual or a group. Changes are made by manipulating the information encoded in a computer database, which in turn, instructs and guides the machinery making the product.

In less technologically advanced production processes, information cannot be manipulated so simply; the information is not stored in a database, it is frozen on an offset printing plate, or in a metal production tool. As a result of the new technology, components for houses, products and printed pages can be altered to meet specific needs rather than average needs, while still being cost effective.

It is paradoxical that computer-supported design and a highly automated production process can restore the specialized design quality that was taken away by the Industrial Revolution. These are, after all, qualities we associate with phrases like "hand-made", and images of solitary craftsmen working carefully, laboriously, to perfectly execute every detail of their product.

To the designer, this design/production process offers the chance to design for the user in a way that has not been possible with mass production. But, for the time being, this remains only a potential use of the computer. For this much acclaimed new tool to achieve this potential requires the design process to take into account the needs of specific users. What is needed then, is an effective way to gather and organize information in a manner that helps lead to more intelligent solutions to problems.

Of course computers are ideally suited to helping designers analyze, organize and evaluate information. The analytical aspects of the design process, however, seem to be forgotten in all of the discussions about computer-supported design. It is here that the computer has a critical role to play. If one looks at the general divisions of the design process (defining the problem, research, idea development, forming the solution, production and evaluation), computer applications can be found to support each one.

*Defining the Problem (analysis)*

In complex problems such as the development of new lines of products, buildings, signage systems for complex facilities, or corporate identity programs, it is difficult to keep the factors of the problem in an order that allows one to see all of the relationships. There are computer programs that allow one to list the attributes of the various parts of a problem and restructure them into new relationships that lead to new insights about the basic problem.

Some of the most advanced work in developing computer-supported methods for structuring problems is being done by Professor Charles Owen at the Institute of Design, Illinois Institute of Technology. His computer programs are designed to break complicated problems into elements which can be reorganized into various structures. The designer evaluates the structures for appropriate and insightful relationships.

*Research (analysis)*

If doing research for a design problem includes gathering information and reorganizing it into useful components, then there are two main ways the computer can be used in this phase.

Gathering information can be helped by computer-assisted searches through banks of information. At its simplest level, this takes place through bibliographic searches directed by key words. As information about design accumulates and the cost of using these systems comes down it is likely that a computer information network dedicated to information about design will develop. The computer can also be used in a more basic information gathering mode called data capture. As its name implies, this technique does not gather information, but data, which through analysis, becomes information. Data capturing is used to monitor environments to develop information related to human factors such as temperature, humidity, sunlight, and noise levels. The same procedures can be used to monitor physiological characteristics such as muscle fatigue, heart and breathing rates, and eye motion. The quickness, patience, and objectivity of the computer make it a very desirable monitoring system.

Its usefulness is enhanced if the computer can also organize data into a meaningful hierarchy. By taking information from networks and data from the environment the computer can organize it into structures that relate to a problem.

*Developing Alternative Ideas (synthesis)*

This part of the design process is often characterized by drawing, building models, or trying alternate text/image relationships for printed materials. In this phase, the computer is used to quickly develop two-dimensional images of these alternatives. As with the computer industry in general, the cost of systems is coming down as the capabilities are increasing. As this leads to affordable systems that display relatively high quality images, it allows the designer to rapidly make, view, modify and review images. **It alters the process to one that combines the versatility of drawing and the speed of collaging.** The London Column (figure 2) is a good example of this. The sketching done on the machine produces images which can then be evaluated. Because the drawing can be done more rapidly, more ideas can be tried, presumably resulting in better, more appropriate solutions. This process is being extended into the design and production of products by connecting the database used for design to numerically-controlled milling machines which produce models and molds more efficiently than those done by hand.

A more current aid to the development of three-dimensional objects is solid modeling. This is a process in which an image can be displayed in three-dimensional perspective. Although these images do not look significantly different from perspective surface drawings, they are significantly different in that they can contain information about the material proposed for the product. The product can be tested for impact, wear, and user requirements by computer processes before it is physically made. The aluminum wheel design (see figure 18) is an example of this. In another example, architects can, using a computer, "walk through" environments they have designed before they are actually built, to see the structure from different positions and perspectives.

*Forming the Solution (synthesis)*
The same functions that allow one to view alternate images can be used to produce final working drawings, floor plans, elevations, typeset text, layouts, and enhanced photographs. The complex plans (figure 4) are a good example of this.

*Production (synthesis)*
Robots, laser printing and numerically-controlled manufacturing equipment can be guided in production by the use of the same database as that used in design development. This potential could eliminate a good deal of what lies in the middle area between design conception and design production. (This includes the people producing printing mechanicals, technical drawings and plans, and assembly line workers. Conversely, it also offers the potential of new design activities, particularly in the analytical areas.)

*Evaluation (analysis)*
The process of evaluating a completed message, product or space can be done by using systems similar to those used in the research phase. These would gather data, and organize it into a hierarchy relevant to, not only the design solution at hand, but to the entire field of design. The information gathered in such analysis can be used in building a body of knowledge about design issues that can be used in the future.

**Information Environment**
The second major change is that members of our society are living in an information environment. Evidence of the change is plentiful; for example, there has been an increase in the percentage of workers in knowledge industries and a decrease in manufacturing, mining and agriculture.

The shift in occupation is evidence of other broad changes occurring in society that have consequences for design. The type of work that people do has changed, their level of education has changed; and, not surprisingly, their tastes, and buying habits have changed as well. There is evidence, for example, that some consumers are willing to buy expensive items of very high quality while skrimping elsewhere. A consumer like this might have an $800.00 Italian espresso machine and serve the espresso in cracked mugs. Our hypothetical consumer may be isolated in his extreme devotion to espresso but he is not alone in having a highly sophisticated taste for a particular product. What is becoming increasingly clear about the information environment society is that its members have very discrete tastes and are segmented into small groups. Predicting the tastes, and desires of these consumers is difficult, if not impossible. To design for today's society one needs to have an understanding of the new patterns, and an understanding of the means of designing for it.

While today's society is radically different and more complex than yesterday's, we now have the quintessential tool for helping us respond to complexity.

With few exceptions, the use of computers in design has been limited to supporting the synthesizing phases of the design process. This is somewhat ironic because the computer gives us the ability to rapidly gather and analyze information; and the information environment is presenting us with a situation as complex and rapidly changing as mankind has ever faced.

The inherent advantage in using the computer as a tool is in increasing speed, not quality. The assumption that quality will follow is based on the assumption that the people producing the larger number of images will have the ability to evaluate them and make a choice about which is best to use. The use of this new equipment will certainly not be limited to designers and others with critical faculties. What is likely to happen is that in the hands of a good designer, computer graphics systems will allow him or her to do more good work. In the hands of others it will mean more visual garbage can be produced than the world has ever seen.

The central question facing the design field is not simply how to use these computer tools to produce solutions more rapidly; but to use computers and to gain a clearer understanding of what should be designed to fit the new context of the information environment.