INTERACTIVE VIDEOTEX:

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The Domesticated Computer

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Preface

The domesticated computer is a product of technology. Technology is the art of doing things using objects that are not part of the human body.

There was a time in history when humans did not use technology, when they did not make tools out of rock, bone, wood, or metals. What drove humans to develop technology was the realization that, by adapting the materials in the world for specific purposes, they could make themselves more comfortable.

Putting technology to use involves change, and change upsets the way people have been accustomed to doing things—for decades and even for generations. Because change is rapid and our exposure to it is high, we must change our personal lives, as well as the places where we work. If we do not, we will not be able to industrialize the services now possible through technological advancement; nor will we be able to benefit from them. To assure the proper management of change, we must close the communications gap.

Computer specialists, TV designers, and telephone transmission experts, for example, are not always aware of the social impact of the devices they invent. They know a lot about microprocessors, cathode-ray tubes, switching, and transmission lines. But they don't necessarily understand consumer sensitivity. This explains why they are sometimes unresponsive to the requirements of the average person.

A similar statement can be made about the consumer's know-how in terms of computers and communications. Yet computer-based communication has become the veins and arteries of social life. Just as the human body cannot function with clogged veins and arteries, neither can large organizations and individual households operate with clogged communications channels. This has long been true of technology. Technology can be user-friendly. Computers are no cold neighbors, as conventional wisdom sometimes suggests.

Computers and communications are both the agents and the wheels of change. We know from experience that the more diverse technology's components are, the greater the information exchange needed to master them. In this sense, *Interactive Videotex* fills a private and an organizational need. By providing visual communication between people and information, it broadens out horizon.

Users may be divided into two broad categories. The first is the internal business environment in which Viewdata serves information purposes. Applications range from telephone directories to sales prices, stock levels, parts lists, expedited items, accounts receivable, claims, and executives' diary appointments. Many potential user companies already have a computer. Why then, should they wish to buy Viewdata as well? The main reason is that Viewdata is designed to be much cheaper than most other computer systems. And it is a general-purpose, relatively low-cost, packaged service with terminals that support color.

Easy access and immediate response have their impact. During a four-month trial period in 1978-79—as basic computing service, an information provider reported—its pages were viewed 110,172 times by users. No wonder that by late March 1979, one month after the introduction of Viewdata in England, there had been 4,000 inquiries from parties interested in being connected to the service.

Both business and the home user can benefit from Viewdata. Of these two groups, surely the more far-reaching is that of the home user. The home user can communicate directly with the computer storing the information, as well as interrogate and get realtime answers. It is possible for a user to make a direct purchase simply by supplying a credit card number in response to an advertisement. Viewdata can also be used to send bank statements to clients of banks who are participating in the system.

This technology is a new experience. As such, it has a lot of appeal. It's an experience that could change our way of looking at just about everything. The private user with a personal computer can attach a machine to the system and communicate with databases. This user can send and receive electronic mail and do office work by remote control. With all this, it is hard to resist the conclusion that Viewdata will have a major effect on society.

Information exchange makes people more aware of things and sets the pace of development. Computers handle information, and information means knowledge; knowledge is power. Computers also mean automation—from transaction-processing to decision-making.

The expansion of technology has blurred the distinction between the haves and the have-nots. By bringing people closer together, computers and communications erase the argument that 90% of science and technology has been developed for the rich. Technology has turned the computer into a relatively simple inexpensive, and easy-to-use tool for everyone, and we should be ready for the coming changes.

Let me close by expressing my thanks to everybody who contributed to making this book successful: from my colleagues, for their advice, to the organizations I visited in my research, for their insight; and to Eva-Maria Binder for the drawings, typing, and index.

Dimitris N. Chorafas
January 1981

1 Technology

The first wave of evolutionary progress came when early humans abandoned caves to live in communities. This led to the agricultural revolution—the systematization of food production. The second wave was the industrial revolution, in which the rules of work were standardized and life in general became more rigid.

1980, with communications spread around the globe, affecting everyone's life to some extent, computers are ready to expand the human experience. With semiconductor capabilities incorporated in practically every electronic product, a new era has begun.

A movement is under way, however, to break up this centralized, rigid system of control. The aftermath could be immense: change may be accelerated many times over, and society will most likely become increasingly complex.

Speculation is mounting about many of the issues involved. The Age of Information, according to one school of thought, may raise personal income to a level 20 times that of the present level. Some experts predict a fiftyfold increase by the end of this century. Computers and communications are the crucial part of this change. For more than 25 years information machines were kept in offices and factories. Now they are swiftly being moved into homes.

The domesticated computer center of the future will consist of microprocessors running a variety of equipment from "whiteware" (refrigerators, ovens, washing machines) to video units, telephone stations, and digital terminals. Domesticated data-handling units may cost, at the start, between $1,000 and $2,000. But the cost will diminish even if the needed memory capacity increases because of expanding use.

Domestication is the issue. As human beings, we have always tried to domesticate our surroundings. We have used zoomorphic approaches to humanize the world around us, to make it more familiar and less formidable, more comfortable for people.

Humanizing means endowing inanimate things with a meaning beyond their connotations. Humanization is essential in establishing a habitat relationship among people, their environment, and their machines. And just because it is man-made, "humanization," under scrutiny, reveals some of the mystifying foundations of the mind, such as the need to reach for data and communicate them.

The advantages of computers and communications in the household range from the immediacy of information to the effective use of the other products of technology. By "immediacy" I mean access to a vast, updated database and the possibility of enlarging online capabilities by coupling a home computer to a telephone network.

A database is an organized, computer-run, orderly collection of data designed in an application-independent manner to serve data-processing purposes. In Chapter 4 we discuss the component parts of the database as information elements, as things known or assumed, facts or figures from which conclusions can be drawn, information, quantities that have been measured and recorded, digital communications.

Mail is one of the oldest forms of communication. As we will see in this book, all-electronic mail can both eliminate time delays and cut costs by reducing long-distance telephone charges. Products now under development will offer capabilities in graphics, including limited-movement television. Nevertheless, some people object to the computer as an "intelligent" machine. Machines, however, are neither intrinsically bad nor intrinsically good. As is true of any tool, what computers do depends on the people who use them. Computers have no regard for motive or intent, good or evil. This is also true of science in general.

The difficulty in domesticating the computer lies in the human interaction, where much depends on motivation. As information specialists, computer scientists have not done their share in motivating users in bringing them into the picture, in demystifying and knocking down the barriers between people and machines. If past history is any guide, the bringing together of people and computers is at hand. To appreciate what is in store for everyone in this information explosion, we must look at the long march of civilization, at how and when we acquired what we have.

Early Discoveries

Throughout history people have made important technological advances, only to discover that the consequences of their advances were not confined to the immediate effects. The first technological breakthrough—fire—influenced human development far beyond the expectations of early humans. Fire, and thus technology, allowed people to control their environment and tailor it to their needs. Metallurgy became possible only after humans learned to control fire. But metallurgy was developed thousands of years after fire was domesticated. (There is always a delay between a great discovery and its productive application.)

Another result of the mastery of fire was the discovery that food heated by fire tastes better and becomes easier to chew and therefore digest. As cooked food yielded pleasant new flavors, it became universally appreciated—a good example of the broadening effect of a crucial technological advance, the implications of which usually are not at first known.

Throughout history people have learned that technological developments do not produce only beneficial results; they expose people to danger. Campfires sometimes destroyed the shelters they were intended to heat and light. People died in fires. And fire has often been used as a weapon to kill others. Even a fire carefully used may have undesirable side effects. Smoke fouls the air and irritates the throat and lungs. Should we, therefore, abandon the use of fire? Endure the pollution? Or should we devise a way of using fire without some or all of these side effects?

Far from being an academic curiosity, technology and its effect should be of intense interest to everyone. Throughout recorded history, technology has had an immense impact on people.

Technology creates opportunities. But because of its scope and the immensity of its impact, it's like Gulliver in the land of the Lilliputians: every step ought to be studied thoughtfully. Not only scientists but the average citizen should understand the breadth of change involved in science and technology, and they should prepare for this change.

It is entirely likely that in the computerized society of the future, those who are unwilling or unable to use computers will be excluded from work positions of power. Also, because the computerized society will be leisure-oriented, this exclusion will mean that, as usual, the brighter people will work, and it will be they who will struggle for that power. What will happen to those who are less bright? They will probably have the time free to enjoy themselves, since there will be no work for them to do. The computer-based society of the year 2000 may contain a privileged class of "information providers," on one side, and, on the other, everybody else.

People make history, and people make science. But science is a peculiar creature. It is amoral; it has no morals or politics. It is neutral, neither good or bad. The goal of science is efficiency, in the pursuit of which friends and foes alike will be eliminated if necessary.

Scientific discovery brings new processes, and new processes result in new ideas that upset the existing order. Because of these processes and ideas, and the pace at which they develop, the person who is last today, but who nevertheless tries, may be first tomorrow.

All this must be considered in discussing the impact—social and economic—of the new scientific ideas and processes that occur. The agents of change do not always answer the curse of modern times: gigantism. The most intriguing agent of change in the short term may very well be the microprocessor.

The Next Vital Steps

With every important technological advance, we face a challenge. We know all too well that once we have reached a certain level of development, any retreat means a significant reduction of capabilities, as well as a lowering of the general standard of living, a reduction society will allow only reluctantly.

There is enough historical evidence to document this view. Look at the next great technological advance after the domestication of fire: agriculture. The systematic cultivation of crops began about 12,000 years ago in Egypt and Mesopotamia, and agriculture has been in use ever since.

Agriculture has had a profound impact on civilization. Its development led to farming communities—the first organized human societies. It also meant that, for the first time, a group of people could produce more food than was needed for subsistence.

Artisans, and then merchants, poets, and artists, could now exist. Later came thinkers, doctors, and scientists. The life of the mind began, not because people discovered that they needed an intellectual life but because the domestication of agriculture made possible professions other than the original one of cultivating crops.

The third great development was that of communication. Communication began with speech and was formalized when writing was invented. Through the development of language, then writing, and eventually printing, mankind moved out of its ancient ignorance, opening the way for science. Science actually consists of doing experiments and publishing the knowledge gained from them. Otherwise, science would not be disciplined human action but merely a hobby.

Speech and the methods for recording it have made a significant difference between humans and the lower animals. As long as direct speech was the sole means of human communication, however, communication was limited to an individual's hearing range. Writing changed this perspective. It was now possible to communicate without fear of distortion. Speech makes us human; writing makes us think.

Speech allowed experiences to be passed on. Writing made the experience cumulative. Both facts and vision could be recorded, on which new generations could build. Communication became synonymous with intelligence. Writing now permitted the transfer of abstract information among human beings. With writing, the process of communication accelerated. Knowledge could not only be stored but improved upon.

Quantification

With the thirst for expression satisfied, people needed a system of signs and rules with which to record and transfer data, as well as experiment with their thoughts.

Through mathematics, people's ability to calculate and think logically improved. Positional notation opened the gates in arithmetic. The discovery of the zero—making something out of nothing and giving it a name—ranks with the domestication of fire, speech, and writing as the most significant steps in civilization.

The next big step was printing, including the development of paper, ink, and metal alloys. The earliest storage media was clay, stone scrolls, or papyrus. With printing, mankind advanced to the stage of making multiple copies.

If agriculture made possible the first human community larger than the family, printing made possible the first community that included thinkers. A rapid scientific and technological advance resulted. The 16th-century revolution of thought became possible only after the establishment of printing on the continent of Europe.

The transmission of messages was for centuries limited by the physical problem of transporting them. Information sometimes had to be carried great distances by people on foot or on horseback. The steam engine, as it was applied in locomotives and steamships, sped the carrying of messages relatively little. Then came a genuine breakthrough: electricity.

Communications

The world began to be wired for the transmission of messages and their reception about the middle of the 19th century. By 1866, cables stretched across the Atlantic, enabling the Old World to communicate with the New World in terms of seconds rather than the weeks or months of the era of slow-moving ships, trains, and horses. Communications was the first great area where electricity was put to use. It all started with Michael Faraday's dynamo (1831) and Samuel F. B. Morse's telegraph (1835). In 1858 came the steam-driven electric generator, and during the 1870s Thomas A. Edison invented the incandescent light bulb and the phonograph and Alexander Graham Bell the telephone.

The era in which the breakthrough in electronic communications occurred started in 1887 when Heinrich Hertz learned to produce and detect radio waves. By 1901, Guglielmo Marconi was using them to send messages across the Atlantic. Radio made it possible to transmit wireless messages, thus creating the potential for a greatly simplified and expanded communications network.

By the mid-1890s, scientists had learned that electric current involves particles smaller than the atom. In 1897, J. J. Thomson discovered the electron. Under the proper conditions a stream of electrons sent through a vacuum can be deflected, started, stopped,

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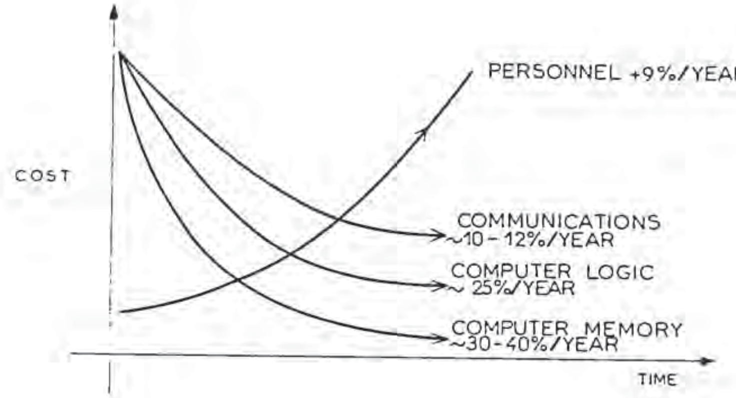
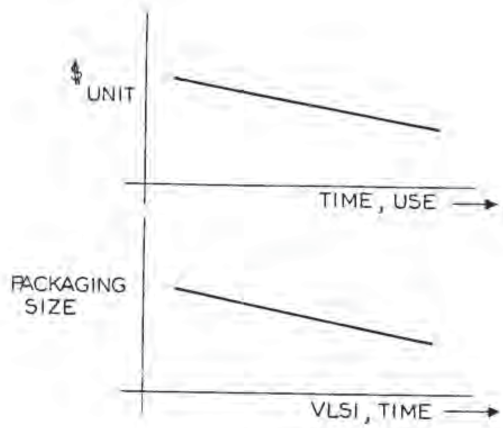
diminished, and intensified. Operations once requiring mechanical switches could now be performed by manipulating electrons in a vacuum. Because electrons are so lightweight, this could be accomplished with much greater speed, precision, and saving of energy. Development of an electronic switch by scientists such as John A. Fleming and Lee De Forest led to the development of the radio tube, which made possible a host of electronic instruments, not only for radio but for television and Datavision.

Satellites have opened another frontier in communications. In 1965 *Early Bird*, the first commercial communications satellite, was launched. Weighing 88 pounds, it had a capacity of 240 voice circuits and one television channel. In 1971 *Intelsat IV* was launched. It weighed nearly a ton and had a capacity of 6,000 voice circuits and 12 television channels. Today the *Intelsat* system has seven satellites in orbit and is used by means of 115 terminals on earth in 65 nations. The worldwide investment in this system and others like it is well over $1 billion.

Communications via satellites continue to cost less every year despite inflation. In 1979 the International Telecommunications Satellite Organization (Intelsat) credited improved technology and the efficiency of its network of satellites when it cut its monthly charge by 16% for a full-time, two-way telephone circuit. (The new price is $960. When *Early Bird* was launched in 1965, the same service cost $533. If the charge had risen at the same rate as inflation, the cost in 1980 would be more than $2,000.) Because of technology, the United States benefits from a 10% to 12% annual reduction in communications costs, a reduction of about 24% per year in computer logic and a decrease of 30% to 40% in computer memory. This makes an average decrease per year of 20%. Meanwhile, personnel costs are increasing about 9% annually in real terms (Figure 1.1).

Although communications costs are dropping, so is the price of memory devices. The ratio of the former to the latter is roughly 1:3.5. This suggests that we would be well advised, both in the home and the office, to substitute cheap memory for the more expensive lines. That's what Viewdata proposes to do. Such advances, it should be noted, come none too soon. Communications costs in business and industry are high and getting higher all the time, whereas, as Figure 1.2 indicates, both unit costs and packaging are increasingly attractive to users.





Inventions

In terms of functions, we are talking about network systems. In computer handling, office processing, home usage, even voice communications, we are moving toward all-digital service. One network will be able to handle all needs, be they voice, image, or data, whether they are destined for the factory, the sales office, general management, or the home and inventions are needed to make this true.

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About 18,000 patents have been issued to Bell Laboratories during its 50 years of existence. That is more than one patent per day. Among them are coaxial cable transmission, microwave radio relay, the modem (data set), the transistor, the laser, direct distance dialing, electronic switching, the picturephone, the commerical exploitation of domesticated radio transmission, the first synchronous sound motion picture system, the pioneering electrical relay digital computer, and the negative feedback amplifier.

Besides making possible transcontinental telephone transmission, for which the negative amplifier was developed, it paved the way for high-fidelity recording and basic computer circuitry. This is another example of the initially unknown effects of technological innovation. Recall that, in the past, as each scientific breakthrough became known to the general public, the new technology vastly exceeded people's ability to deal with it productively. As technology moves faster and faster, the gap grows between those who know about a particular development and those who do not.

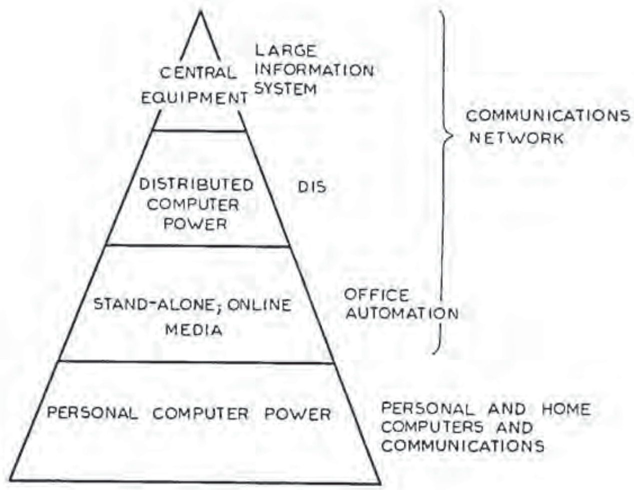
The Economy of Mass

Evolving communications facilities have opened a new industry standard: the economy of mass. Delivering a message from, say, Paris to Chicago by hand is much cheaper than constructing a telephone system. Nobody, however, thought of building a network for transmitting just one message. The investment will be made if it can be justified.

Once communication by wire became available, people discovered that they had a great deal to say and a great deal to hear. If few long-distance messages were transmitted before the era of electronic communication, it wasn't because there was nothing to say but because of the time, effort, and cost of delivery involved.

Computers and communications are fast becoming the basis of the economy of mass (Figure 1.3). Although computers and electronic communication have not followed parallel courses, they have been integrated into the field of data communications.

Data communications over the analog voice network available at the time began in the 1950s. At the time the U.S. government needed a way to transmit aircraft radar data to central locations. Commercial data communications service began around 1960, ini-



tially with speeds ranging from about 100 to 2,400 bits per second (BPS) (a bit is a binary digit; for explanations of this and other technical terms, consult the Glossary). (Telex operates at about 70 BPS and a modern voice-grade line at 2,400 BPS; the average and most common voice line operates at 1,200 BPS.)

In the late 1950s data transmission service was still slow; 600 BPS was typical. By 1960, however, reliable transmission at speeds up to 1,200 BPS had been established. Although the signal format (start/stop, or asynchronous) was not very efficient, it was the easiest format to implement, and is still in use.

We often fail to appreciate the impact of digital communications on the advancement of technology and the shaping of society in general. Yet this technological advance has been of fundamental and far-reaching importance. In the 19th century the new modes of transportation—roads, canals, and railways—made possible the acceleration of the industrial revolution, which led to a more industrialized society. In the 1970s we saw the forging of digital-communications links and the birth of a technology that promises to have a greater impact than 19th-century industrialization.

The computer itself has changed—in its structure, design, and capabilities—because of the needs of the communications industry.

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Gone is the time when batch processing was king. Today we speak of queries, on-line access, interactivity. This is where the main technical effort of the 1980s will be. Soon the history of the computer will be divided into four "epochs"—the paleolithic, the neolithic, the copper, and the iron, to use the metaphors of geology.

The paleolithic epoch started with the commercialization of computer power around 1950. Computer mainframes were the dinosaurs of this epoch. They dominated the field for some 15 years. Univac I opened the market, and IBM conquered it, eventually gaining 60% to 65% of the world market.

In the neolithic epoch, smaller, more flexible and efficient computers with greater capacity were designed that made the mainframes of the paleolithic epoch extinct. By 1965 the age of the minicomputer had begun. The age opened with the launching of Digital Equipment's PDP-8. Until the management of the giant companies got wind of what was happening, little Digital Equipment had a large portion of the worldwide market.

By the early 1970s information technology had entered the copper epoch. The microprocessor came along, soon to be upgraded to the microcomputer—all accompanied by a host of peripheral products. Intel's standard microprocessor of 1972 will one day be regarded as the turning point in the development of computing power. The trend toward making the computer available to the public started here, although it would be another 10 years before the practical results were evident. Strategic studies have demonstrated that innovative products, often produced by new firms as new entrants in the market, take business away from established firms that are not aware of, or do not care about, adapting their products and services to the latest developments in technology. The transition from the dinosaur epoch of the mainframe to that of the minicomputer is one example, although the advent of the minicomputer was not as drastic as that of the microprocessor.

For information technology, the iron epoch is the epoch of the 1980s. Far from being a terminal point, it is a new beginning that one day will result in many processes and products, with the systems concept as the basic link.

Just because systems and not single devices will be the focal point, the effect of the iron age of computers will probably have a lasting effect, in both the home and the office. White-collar workers will be displaced. The way management makes decisions will change.

Productivity will once again increase. Communication by image and data will link all parts of the globe. New forms of entertainment will be developed.

Every person—and not just engineers—will benefit from knowing about microprocessor technology, about its potential advantages and its impact on people. The most important thing that can be said about microprocessor technology is that, if we want to make a success of microbased products, we should get on with it. If we want to enter the iron age in businesses and homes, we should learn about computers and communications so that we can use them to our advantage.

Who would have thought 10 years ago that every man, woman, and child could have a calculator? Who in the late 1950s was talking about a mass market for electronic watches? What *is* the potential of the home market? While looking at the history of the computer, however, don't forget that radically new markets can take a decade to mature.

The time is coming when communications will be carried by laser beams, bare and unprotected in the vacuum of space but using fine optical fibers on earth. Made up of light waves, laser beams can carry far greater amounts of information than can radio waves.

Because adjacent light communications links do not interfere with each other, many more such links can be established. This means that a much larger number of separate channels and circuits can exist in a given region than was heretofore possible. With a virtually unlimited number of channels and circuits available, therefore, every person can have a portable phone equipped for sound, image, and data.

The printed word will be transmitted widely, accurately, and instantaneously. Through data communications technology, the distinction between broadcasting and journalism will be blurred. An individual will be able to receive mail and documents electronically at home on a television screen. People will also be able to tap computers for educational courses, emergency assistance, and the latest information.

The television set—backed by microprocessors, storage media, and programming products, and able to operate over telephone circuits, both stand-alone and online—will revolutionize society. The "living" database will make knowledge universally accessible.

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2 Interactive Videotex

Datavision is a system of communication between people and information, in which data, color, and graphs are presented. Datavision can be divided into two broad classes, centralized online and dedicated nearby approaches (Figure 2.1).

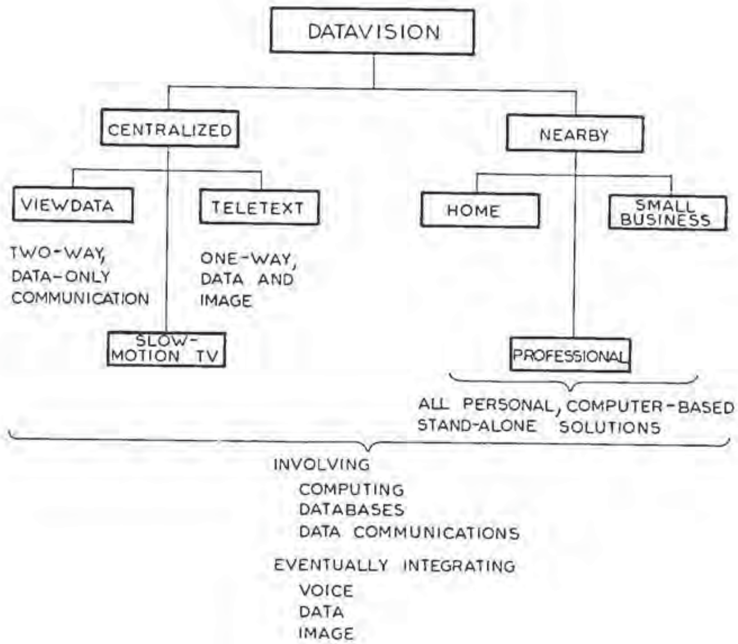
The first class involves online solutions provided through a central or regional resource, which may be long-haul and, most, likely, public; private, serving a variety of users; or private, dedicated to one user only (for instance, the Whitbread application discussed in Chapter 7). In all three cases we are talking about Viewdata. Viewdata is a simple, interactive protocol designed to help the user. It has been in operation in England since March 1979.

Long-haul, or wide-area transmission, is assured through a public utility (the classic telephone lines, in which messages travel over voice-grade lines—typically at 1,200 bits per second)—a telco, a value-added network, a company-owned and -maintained system that offers Datavision as a utility to business and home users.

A company that is implementing a decision-support system may want Viewdata for easy access by its middle and top management. Memory protection, an integral part of this approach, will guarantee privacy and security. If the job justifies it, the firm may dedicate a Viewdata system to one user only.

Long-haul solutions are often implemented through mainframes supporting large-scale memories; private approaches are typically implemented through minicomputers. The dedicated system may one day run on micro, thus becoming indistinguishable from the alternatives discussed here.

Similar solutions are based on *personal* computers. Because these solutions are discussed after Chapter 9, we will not elaborate on them at this point. It is proper to suggest, however, that nothing forbids hybrid approaches using distributed facilities when standalone machines are sufficient (whether at home or in the office),



and the user wishes to go online for part of the time, according to the user's requirements.

Whether online or nearby, computer power reaches into the home and affects the whole family, regardless of social position. Figure 2.2 an American family plays games with a nearby personal computer. In Figure 2.3 Viewdata provides the theater guide for a family. What do these two uses have in common? Both are examples of the use of a domesticated computer.

During an RCA stockholders' meeting in the late 1950s, David Sarnoff was asked: "What made the radio great?" He answered: "Its domestication." Now the time has come to domesticate the computer. During the 1920s the radio was virtually the exclusive toy of radio ham operators. Hobby radio still survives; there are still many ham operators, and they form an exclusive club. But in terms of numbers, radio hobbyists are a minor part of the mass market, the market that uses the radio for broad, popular entertainment. The same happens with television. This could well be the story of computers and communications.

Viewdata is for everyone. Current technology provides the means of coupling the telephone and the TV set, to make terminal capabilities available to any user. Any user can put this capability to work. The most common example likely to occur is the receiving and sending of "mail."

Entertainment, social events, business—all kinds of human activity in which communications are important—will benefit from Viewdata. Therefore, when we look at Datavision, both the public utility and the stand-alone personal computer, we must consider the entire range of services being domesticated. That is why we are discussing the management of change. Most experts expect change to occur fast and furiously. Microprocessor-based developments for both home and office will likely have an impact similar to the way people manage their personal lives. "Communicate, don't commute" might soon become reality instead of merely a slogan.

What Is Viewdata?

The online utility Viewdata is not a facility of the distant future. It has been in operation in England since March 27, 1979. The United States, West Germany, Holland, Switzerland, and Hong

Kong have signed up. In the United States the Federal Communications Commission (FCC) encourages the use of personal computers for electronic mail.

Considerable confusion, however, has developed over terminology. In this book we shall follow standard definitions. The term *videotex* is all-inclusive. The version that uses the telephone system is Viewdata; the broadcast version is Teletext. In other publications, because the terms are virtually synonymous, they are used interchangeably. Many terms are in use—some technical, others commercial: Télétel and Antiope in France; Bildschirmtext in Germany; Captain in Japan; Telidon and Videotext in Canada; Datavision, Extratext, and Telset in Scandinavia; Ceefax and Oracle (for Teletext), and Prestel (for Viewdata) in England. Whatever the term, though, the service differs very little. Interactive Videotex makes two-way communication possible; hence, it is interactive. The user can both receive and send data through the network as though the data were a voice transmission. Because the user sends data, his or her perspective of the system is quite different.

How fast the user's data can travel from the Videotex terminal to the network's switching center depends on the support facilities. Presently, data travels most often at 75 bits per second, using the return wire of the telephone network, or at 1,200 bits per second, though it occasionally travels at higher rates. Businesses need the fast rate, and private users the slower one.

What is slow? Let's not forget that Telex and TWX operate at about 70 bits per second, often enough for business purposes. On the other hand, not only the data transmission link but the terminal facility as well must be considered. In the case of Interactive Videotex, it's a TV set, the one used daily for news and entertainment, only here with some added hardware. A television cathode-ray tube scans the picture, 50 times per second in Europe, 60 in North America. The viewer is given data—accurate, timely, and precisely. So the reader won't be left wondering about the reference to "added hardware," let me add that this hardware consists basically of a receiver-transmitter interface. It is estimated that by 1982, add-on devices will permit individual users to buy such a system for less than $200.

The television set itself, as a receiver-transmitter station, will change. Microprocessor-controlled, it will offer the user much greater dependability, multifunctional service features, and finer images.

Worldwide television, with the exception of the United States, Canada, and Japan, has adopted a 625-line 50-frame standard. With a 525-line 60-frame standard, the digital display will probably be 32 characters a line, with 20 lines in the viewing area.

Let's repeat and then extend these references to ensure that the implications of the future uses of television are fully understood. Viewdata uses the speechband. The tools needed for implementation are currently available, and the cost fits a tight budget. Viewdata is a publicly available, computer-based information system that makes accessible a centralized information source. This source contains data (in the database) that the user is looking for. The stored information is subject to rapid changes, but the data can be updated as often as required by *information providers*.

Interactive Videotex (Viewdata) offers the digital recording and presentation of alphanumeric data and graphics. There is no TV image, but instead a two-way capability for data exchange. As such, Viewdata can be used for person-to-person communications, message services (electronic mail), social events, and conducting business. It can be used, for instance, to collect data from peripheral points and send it to a desired point.

In contrast to Interactive Videotex, Broadcasting Videotex (Teletext) is a one-way process involving both image and data. The word *image* implies the requirement of wideband transmission. (A wideband channel is a channel of any frequency broader than the one needed immediately for the purpose of transmission.) Typically, a channel 300 times wider than that necessary for voice transmission is needed; therefore, Teletext requires the broadcast facilities of a TV station or something similar. Successful Teletext experiments have been conducted in Philadelphia and Salt Lake City. England and Australia have Teletext programs as well. Holland uses the process to give the television viewer subtitles in two languages.

The advantage of Teletext over Viewdata is that the former makes feasible the simultaneous transmission of data and image. Teletext also permits the switching back and forth of text and TV image. Because of this capability, it is suitable for such services as teleconferencing. Broadcasting Videotex, however, is a limited one-directional system.

An Intriguing Possibility

Interactive Videotex is an intriguing possibility for the communications systems of the future, because of the potential of using a local *intelligence* as part of a two-way, interactive telephone line or a cable television system.

In the American home the domesticated computer will act as a local facility for computation, maintaining a personal database, handling stations for data transmission over telephone lines or over TV wideband, whether radio or cable television. For computation and as a personal database, it will operate as a stand-alone system programmed by its user or by software packages. For data transmission it will serve as a message center for friends and family members or for business purposes.

What's in it for you, the user? Viewdata can keep you abreast of sports scores, timetables, traffic bulletins, health advice, and stock market reports. It can continuously update information in a family database and provide minute-by-minute news, including providing a copy of the information when necessary. All this will be accomplished by using the family TV set (modified to accept Viewdata) and a telephone line.

Is Viewdata an alternative or a supplement to the personal computer? It is both—an alternative and a supplement. In both cases, a microprocessor is used, which answers communications needs and accesses databases (Figure 2.4). In both cases, too, devices are used that permit transmission of data to a television set.

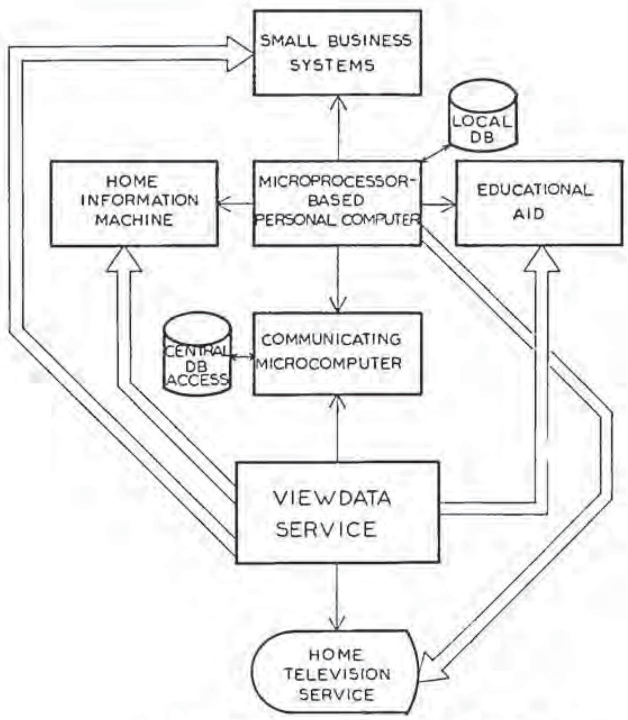
We have already noted that some adjustments will be necessary to adapt a TV set to a telephone line. From the subscriber's viewpoint, these adaptations include a small plug-in device that incorporates a hard-wired modem to the telephone line attached to the TV set. We also distinguished between Viewdata and Teletext. There is no reason why the TV broadcast system should be restricted to the transmission of pictures; the system's facilities can be used to show all kinds of additional information. The simplest form of information is straight text. Text transmission operates through coded characters, and once coding is used, we can extend it to pictures and graphs.

In England, for example, television sets with a special Viewdata and/or Teletext decoding module built-in are widely available on a rental basis. The set is connected directly to a household telephone line, so that when someone wishes to use the service, he or she simply picks up the phone, dials the Interactive Videotex computer number, and leaves the phone off the hook. Then the user employs a small, remote-control keypad similar to a pocket calculator, keys an individual user number into the system—and the system is ready to go.

As an information utility, Viewdata links the user to news, facts, figures, and answers. Because it is served online by large computers, Viewdata can extend the simple home computer beyond the confines of the living room by giving quick, easy, economic access to the kind of vast information network previously available only to large corporations.

Interactive Videotex channels requests from private users and small business firms through an information network that contains an impressive array of information programs and extends to hundreds of cities. As such, it has the potential of revolutionizing personal and family lives, as well as the way businesses have traditionally conducted their operations.

Recall that the consequences of an important technological advance are seldom, if ever, confined to the immediate effects of the advance. Two-way interactive information systems are potentially



2.4. Microprocessor-Supported Services.

commercially viable, but at the same time they are only the peak of the iceberg, in terms of the facilities that will be available to both residential and business subscribers.

Interactive Videotex has the potential of permitting the use of a wide range of new facilities to users of present-day telephone systems. Viewdata will allow a user to dial a local, central office and receive answers through a TV set connected to a telephone line in the form of a display. In the current British implementation, under the trademark Prestel, data appears on a 24-line, 40-characters-per-line screen with up to eight colors. Graphics and charts are presented as well.

Viewdata is designed for ease of operation. Only minimal subscriber training at the sending and receiving ends is necessary. Here is one of the differences between Viewdata and the personal computer. As we will see, most personal computer models now available call for extensive involvement on the part of the owner, particularly in programming.

The Early Years

Sam Fedida, then manager of Computer Applications at the Research Laboratories of the British Post Office (BPO), developed the concept for Viewdata in 1970. The original proposal, also made in 1970, focused on increasing inexpensive rate-time usage in BPO's telephone network. Approval of the proposal took considerable time. The feasibility study was begun in 1972, and the first public demonstration of the working system occurred in late 1974. Since that time, the service has evolved into a general application with broad uses.

In Britain the initial system ran on a Hewlett-Packard 2100 minicomputer. In September 1975 Teletext merged with Viewdata, and a trial run took place in January 1976. Meanwhile, Hewlett-Packard computers have been replaced by the larger General Electric GEC 4080. The American solution, marketed by INSAC, uses a PDP-11. The support equipment therefore changes, but that is a minor part of the story. For an actual application, it is best to return to the original experience in England.

Under the current implementation, each Viewdata center consists of two computers accessible by a local telephone number. It is intended that both computers will operate continuously, thus sharing the load. Up to 280 megabytes of storage are provided at each center, on four 70-megabyte discs. One megabyte equals 1 million bytes; a byte equals 8 bits. In terms of storage capacity, a megabyte is equivalent to about 1,000 typewritten pages of information; each page contains roughly 1,000 characters, and it takes a byte to code a character in digital form.

In early 1979, when Viewdata service became available to home users, about two-thirds of the 280-megabyte capacity were required. This is another way of saying that current storage requirements are relatively trivial compared to those of the typical large-scale system. The computer is given access to a wide range of information, including a personal statistical page for each Viewdata subscriber. Computer centers installed at the BPO telephone switching centers are designed to operate unattended 24 hours a day. The current version supports 200 incoming ports, each able to handle the needs of about 50 residential subscribers during the day. Thus one center can handle about 10,000 subscribers. This capacity will soon double, however; in fact, because data-load requirements depend on the mix of residential and business subscribers on each Viewdata computer system, business users will most likely be the heaviest users of the system.

As the system is developed, local Viewdata centers will be connected to regional centers which, in turn, will be interconnected, probably using a packet-switching network. A network control center (NCC) will control the entire Viewdata system.

Gaining Experience

As I mentioned, the first public offering of Viewdata was in March 1979. During the two previous years, Viewdata had undergone a trial run with satisfactory results. By early 1978, while the system was still in the start-up phase, 150 British companies had subscribed to the service. Public trial demonstrations began in June 1978, using approximately 1,450 television receivers as terminals.

The trial run produced favorable fallout, and market interest started to build up. As many as 1 million terminals in England alone may be in use by 1981-82. The BPO believes that Viewdata could reach half the British telephone market by the mid-1980s.

If this forecast is correct, in Britain alone the Viewdata market should amount to an installed base of about 9 million specially equipped TV receivers. In the United States, on the basis of half the present population of telephone subscribers, this could mean a dazzling 90 million TV receivers that are Viewdata-compatible—one order of magnitude greater than in England.

Product planning is the first milestone to successful marketing, and Sam Fedida should be given credit for it. As an inventor and former deputy director of research at English Electric, Fedida pursued a triple goal: a new step in technology, the capability of devising a system that would be easy for the public to use and at the same time provide the means of increasing Britain's sluggish telephone traffic. The third goal was the sugarcoating. For some time BPO management had been considering new services in terms of upgrading telephone traffic. The telephone was already a hundred years old, but its extension into the British postal system still seems far from meeting the BPO's goals. (In Britain, with home telephone coverage currently about 55%, home telephones are being used to place, on the average, only about 1.5 calls per day.

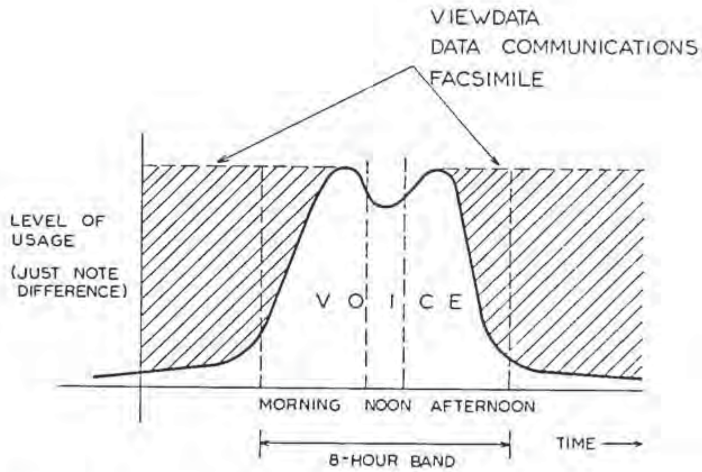
Approximately 70% of telecommunications traffic is generated by only 30% of the phones in use. Because business phones are utilized more intensively, the peaks generated during business hours are followed by rather deep valleys, a problem that, to varying degrees, affects all telcos, not just the BPO.

Figure 2.5 presents a typical level-of-usage curve to dramatize the fact that the peak of any telephone service lasts about eight hours per day. Then come the valleys. Ideally, Viewdata, data communications, and facsimile should fill these valleys at preferential rates.

It's no wonder, then, that in 1980, American Telephone and Telegraph (AT&T) expects to offer Viewdata to individual households at one location. It is rumored that the service will be offered in conjunction with a newspaper chain. We can reasonably expect that thereafter, AT&T will profit from the experience and extend service as widely and as fast as it can.

To recapitulate: a network is made; demand is sluggish in off-peak hours; an increase in home phone traffic during nonbusiness hours is needed to fill the valleys; and in England, at least, the classic telco compaigns to achieve this goal met with only minimal success.

Necessity is the mother of invention. First comes motivation, although the product remains the same. A new tariff is set up. However, even the use of a call structure for less expensive rates on weekends and between 6:00 and 8:00 on weekdays does not encourage users. Then comes the discovery of a new service. It starts with a simple observation: many houses have the prerequisites for Viewdata access—a television set (as a display device) and a telephone as a communications link. Now the project was turned over to research and development (R&D). In the case of the BPO, its Research Laboratories, assisted by the necessary equipment, set out to merge technologies, particularly with a remote computer at the switching center. The goal, correctly specified, was that the interactive computer system to be developed should be accessible by anyone.



2.5. Filling the Valleys in the Telecommunications Network: Viewdata, Data Communications, Facsimile.

This is only part of the story, however. The development of Viewdata service should be viewed in perspective, as a background factor in the BPO's relentless effort since about 1965 to establish a data-processing capability. The BPO aggressively acquired computers; since, unlike AT&T, it is not required to separate data communications from data processing, the BPO could offer both as a package.

The "grid" of the mid-sixties focused primarily on small and medium-sized businesses in England. The grid ran along the lines of the concept developed by Stafford Beer and the International Publishing Corporation (IPC), that of "data highways." Neither was much of a commercial success, however, largely because the technology wasn't yet ready. It will probably take another 10 years to popularize the microprocessor and bring prices down to the point where distributed information systems will be attractive.

Even if the grid wasn't particularly successful, the commercial data-processing service bureau of the BPO helped the effort to establish Viewdata. The fact that the BPO grid was developed for small businesses, and ended up being used primarily for work with government departments, gave some clear-eyed executives ideas.

Something new and imaginative was needed to bring the small business market out of hibernation. Sam Fedida put forth a plan for an information-retrieval system aimed at home users and small businesses, and that was the beginning.

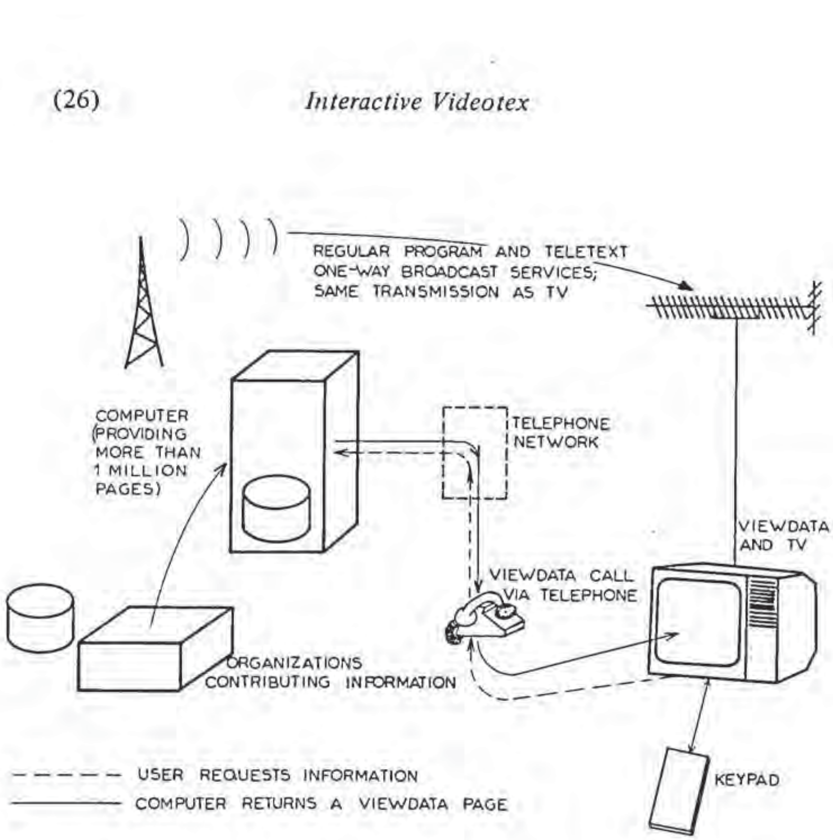
A man who does not have problems, says a proverb, is degenerate. Problems are opportunities for thought, and the birth of Viewdata brought forth many problems. Not only the service possibility but prices as well had to be set in a range acceptable to the mass market. Designers must clearly see that mass marketing is more likely to be successful if the price is right and the product or the service is simple enough for the average man or woman to understand and appreciate. The person who asks "What's in it for me?" must be able to understand the answer. To grasp the implications of a particular product or service is another matter.

Working with the System

For both Viewdata and Teletext, the principle is fairly simple: information sent by a transmitter or transmitters is received by every station (whether office, factory, or home) that has a storage and translation mechanism (Fig. 2.6). From this point on, the sophistication starts to increase. A station, for instance, can have a small black box for page selection. Voice and data may be integrated on the same terminal equipment (this is also true of image). Lines may be "intelligent," that is, perform more than simple carrier functions. Finally, intelligent stations can augment their data-storage capabilities, becoming complete minicomputers. Needs will dictate the proper course. Although some spoilage may occur during the process, more economic solutions should prevail.

Currently, sophistication is not the highest, but the groundwork seems solid. Successful experiments done with the British Post Office indicate that with fairly inexpensive devices, the average access time for 50 pages will be about one-half second per page. Larger storage capabilities have been investigated for home use. Although access time increases, the advent of the personal computer and of cheap-and-simple storage media such as optical discs should ease this constraint.

Remember that this technology is still in the early stages. Given the current technology, some 600 pages will require several seconds



2.6. Interactive Videotex (Viewdata) and Broadcasting Videotex (Teletext).

access time; using ordinary TV sets and an adjoining black box. Technology, however, changes fast. Besides, the requirement of a few seconds is not likely to disturb a home user.

The most important argument is the pervasiveness of the TV set. Next is innovation—the new uses to which we can put an existing system. Modern color television ensures good reception. With additional memory, a color TV can display, on a selected basis, alphabetic characters, both lower- and uppercase; numeric characters; graphic data; special signals; and variable character sizes. With the British Prestel the basic characters are generated using a 7-by-5-dot matrix. The character set includes the full alphabet, digits, and such special symbols as $ % & ' ( ) = * ! " # –: ↑ _ < > ? + @ → ← £ , . / and ;. The way to support graphics is by dividing the basic character position into a set of six small squares and then generating the possible combinations of these squares.

In Figure 2.7 are displayed the Viewdata transmission codes as implemented in England. The reader will appreciate the need for choosing a seven-bit code scheme. This offers the possibility of control activities such as cursor positioning, as well as the display of numbers, the entire alphabet (upper and lower case), and special characters. Displays can be provided in six colors- -red, green, yellow, blue, magenta, cyan, black, and white.

The Japanese solution shown in (Figure 2.8) uses an eight-bit code; thus the number of possible codings is doubled. This makes possible display of the Japanese alphabet, selected Greek letters, and some extra graphic characters that Prestel does not allow.

In both systems, reception can handle a complete set of transaction codes available in that offering. Transmission from the home or office is limited to the set of characters the sender has available on the keyboard.

Let's see how Viewdata can be used in the home, getting online computer experience from an easy-to-reach public utility.

Dialing Up

Using a keypad, call up the Prestel index for display on your TV screen. Every category of information shown in the index has its own numbers (as we will see in the next chapter). Press the number on the keypad, and the section desired will be displayed.

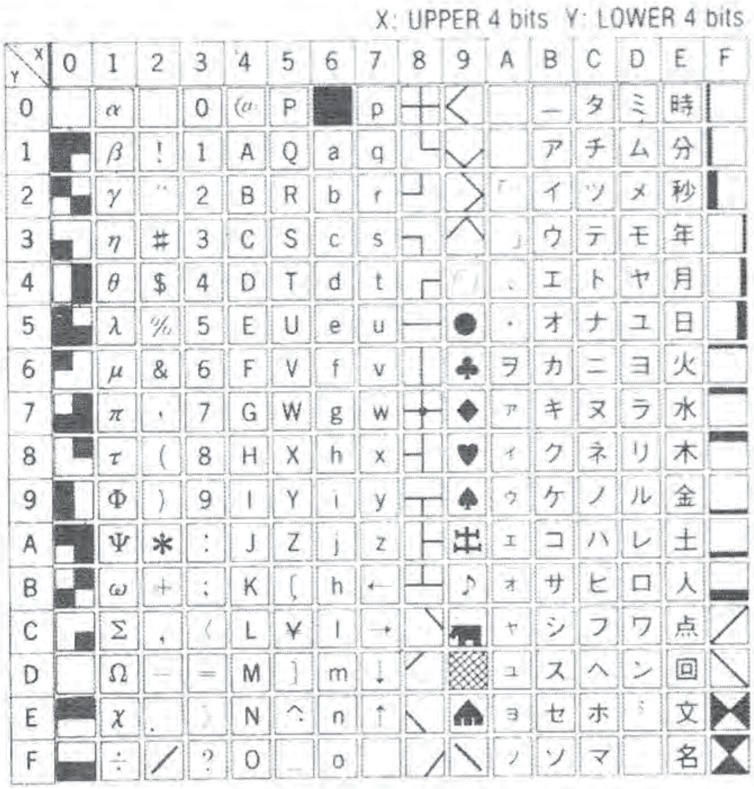
This interactivity is accomplished through the home TV set, with the telephone line as the data link. Once the subject has been found, you can continue to narrow it down (by menu selection) until the precise page needed is reached.

Printed directories will also help you reach the page required without using the screen index, much the same way as you use a telephone directory. All these approaches are designed to serve one of the prime goals of Viewdata: simplicity of operation for the general user.

The user does not have to learn command words or be familiar with computer programming. Simplicity is the watchword, as is versatility. Figure 2.9 brings together many aspects of the domesticated computer with optical disc video recording, satellite-

Bits	$b_7\ b_6\ b_5\ b_4\ b_3\ b_2\ b_1$	b_7 / b_6 / b_5	0 0 0	0 0 1	0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
		Row \ Col	0	1	2	2a	3	3a	4	4b	5	5b	6	6a	7	7a
	0 0 0 0	0	NUL				0				P				p	
	0 0 0 1	1		Cursor on DC1	!		1		A	Alpha" Red	Q	Graphics Red	a		q	
	0 0 1 0	2			"		2		B	Alpha" Green	R	Graphics Green	b		r	
	0 0 1 1	3			£		3		C	Alpha" Yellow	S	Graphics Yellow	c		s	
	0 1 0 0	4		Cursor on DC4	$		4		D	Alpha" Blue	T	Graphics Blue	d		t	
	0 1 0 1	5	ENQ		%		5		E	Alpha" Magenta	U	Graphics Magenta	e		u	
	0 1 1 0	6			&		6		F	Alpha" Cyan	V	Graphics Cyan	f		v	
	0 1 1 1	7			'		7		G	Alpha" White	W	Graphics White	g		w	
	1 0 0 0	8	Cursor ← BS	CAN	(		8		H	Flash	X	Conceal Display	h		x	
	1 0 0 1	9	Cursor → HT		)		9		I	Steady	Y	Contig Graphics	i		y	
	1 0 1 0	10	Cursor ↓ LF		*		:		J		Z	Separated Graphics	j		z	
	1 0 1 1	11	Cursor ↑ VT	ESC	+		;		K		←		k		¼	
	1 1 0 0	12	Cursor Home & Clear FF	SS2 (Single Shift)	,		<		L	Normal Height	½	Black Background	l		‖	
	1 1 0 1	13	Cursor ← CR	SS3 (Single Shift)	-		=		M	Double Height	→	New Background	m		¾	
	1 1 1 0	14	SO (Shift out)	Cursor RS Home	.		>		N		↑	Hold Graphics	n		÷	
	1 1 1 1	15	SI (Shift in)		/		?		O		#	Release Graphics	o		■	

2.7. The British Viewdata Transmission Codes.



2.8. The Japanese Viewdata Transmission Codes.

transmitted TV programs, video cassette recording, broadcast Teletext, and Viewdata.

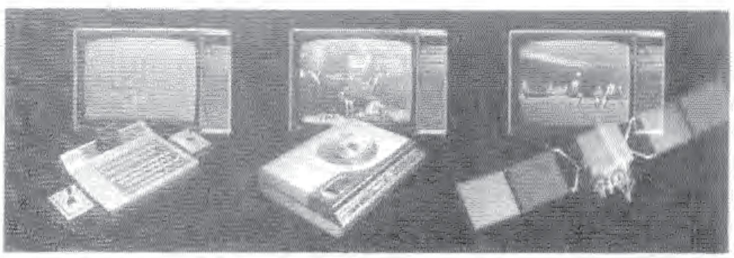
By using the keypad, which is about the size of a pocket calculator and contains the numerals 0 to 9 plus two function buttons, the user can go through the simple process of selection, guided by the instructions printed on the TV screen.

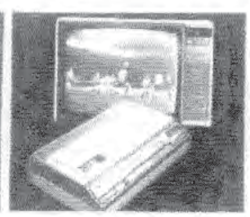
Viewdata will be linked to the computer, and the information called for will be shown on the television screen. Examples are given in figures 2.10 and 2.11. You will be connected to the Viewdatabase (VDB) (see Chap. 4), where the information is up-to-date. Online update capabilities have allowed the information providers to update their section of the database, using a Viewdata terminal equipped with a full alphanumeric keyboard or a computer of any kind.

The information providers have available to them the following facilities:

enter	a new page is created
delete	a page is removed from the data base
amend	the contents of a page are altered
overwrite	the contents of a page and the choices from it are altered
copy	an existing page is amended and placed elsewhere in the database

Users must follow a *calling sequence*. All frames are accessible to Viewdata users while the frames are being altered. Possible updates, however, are not made directly on the screen; the user must call again the frame being looked at to receive the updated version. A call-initiate button on the keypad is operated, and a dial tone is returned from the exchange. After the call button is pushed the second time, the dialing digits are automatically transmitted to call the Viewdata system. A ring tone is heard on the terminal loud-





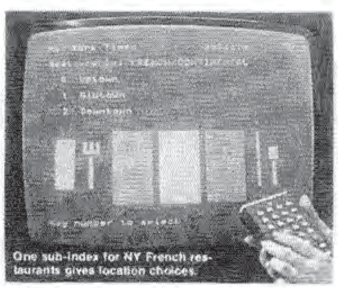
speaker; the call is automatically answered and a steady tone (1,300 Hz) is received on the terminal loudspeaker. The terminal is now switched to the data mode of operation, and the information search may begin.

System security is provided through both software and hardware. The hardware supports a terminal identifier number, but software-password enhancement is possible. Greater sophistication should result as more business and personal applications of the system are made.

Viewdata is basically simple. It requires no elaborate training, and it uses standard components. Yet Viewdata provides capabilities which so far have been possible only with expensive computer networks requiring a great deal of software and support by trained personnel.

Those interested in home insurance can read adv giving terms.

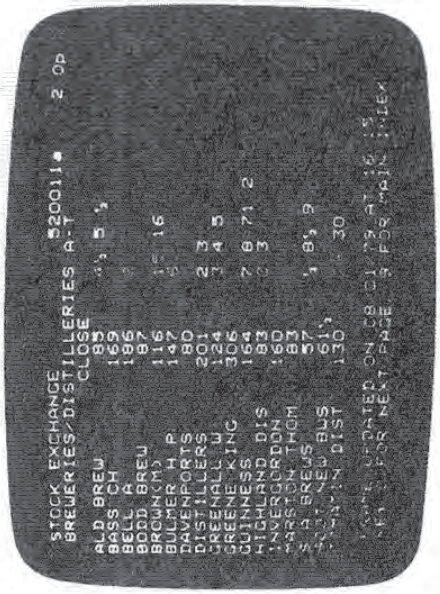

A color-coded NY City map would be helpful to foreign visitors.


One sub-index for NY French restaurants gives location choices.

A prospective traveler from London to Sydney can figure plane fares.


262a 0.5p
UCCA Guide to
University Courses
1 Undergraduate courses
2 How to apply
3 Entry requirements summary
4 Mature students
5 Post-graduate courses and research
6 UCCA statistics
7 University index


Careerdata 277a 0.5p
CAREERDATA
is presented by
THE NEW OPPORTUNITY PRESS LIMITED
Key
0 Employers Alphabetical Index
1 Types of Work Index
2 Application of your Discipline
3 Careerdata News
This Database is compiled by
APPLIED VIEWDATA SYSTEMS LTD


STOCK EXCHANGE 520011a 2.0p
BREWERIES/DISTILLERIES A-T
CLOSE


RECENT DEVELOPMENTS

3 Using Viewdata

The basis of the interest shown in Viewdata is that soon the new communications technology is expected to play a greater role in the home, the office, and everyday life in general. The market's potential has attracted numerous firms. At stake are at least $4 billion in annual revenues, a figure that is larger than the expected annual growth of numerous industries. Computer-assisted instruction in schools; 24-hour electronic banking; supermarket and chain-store computer terminals that can read labels, calculate discounts, update inventories, and prepare bills—all these have more in common than might be evident at first glance. All use, if not the same, then similar technologies.

The supporters of Viewdata, heartened by its success in England, are discussing these possibilities for using computers within the network: specialization by area of operation but sharing communications and database facilities, offering a wide range of applications, and carrying a considerable program library. Major banks have taken a careful look at these possibilities. The prestigious Barclay's may be the first to bring banking into the home, beginning an experiment with Prestel in which selected customers will be able to access information via their home TV sets. Initially, it will only be for inquiry, but the potential is there for paying bills at home, calling up outstanding bills and, with the press of a touchtone key, requesting that a certain payment be made.

Using this system, in which the systems are integrated into one telecommunications facility, a user will be able to stand at a terminal and phone a computer system for database access, then proceed with information retrieval, access another computer for calculation and still another for reservations. Viewed in this light, Viewdata networks should have considerable impact on the products and services now offered by computer service firms, computer manufacturers, and telcos. The entire industry will likely change. We can expect to see companies that have never been in this kind of business providing services similar to Viewdata in selected markets and to selected clients.

We have reached this stage step by step. By using computers at the switching centers, the telephone network is now both transmitting information and processing it. Processing means screening, formatting, arranging, storing, retrieving, selecting, and presenting data. Once that is done, data can be sent anywhere in any form. This capability, which is an integral part of Viewdata, has caused considerable controversy in redefining what, if anything, constitutes a "regulated utility." As communications technology has tended to merge with data processing, so computer technology has merged with data communications.

Much, of course, is involved. The tariffs the user must pay, and cost-benefit free-market competition are two factors. Competition, and a particular business organization's share of the market, are others. At issue is the dollars-and-cents question of how much is actual computing and how much communications. At issue also is routine service. The user wants fast, convenient, simple access to information. The user wants good visibility, which means a wide, fairly precise screen—something like the 1,000-line screen the United States is moving toward, compared with the 525-line and 625-line screens currently in use in the United States and Europe, respectively. Last but not least, the user wants all these services at an affordable cost.

Viewdata qualifies as an answer to users' needs because it is an easy-to-use mass-oriented, text and graphics, communications system capable of linking households and businesses via modified TV sets and telephones. The wide variety of services made possible by Viewdata are given in Table 3.1.

Use at Home

Viewdata is information, and it is for everyone. Remember David Sarnoff's remark about the domestication of technology. Let's see what can be done with the service at home. Prices can be checked before shopping is done. Files in offices can be checked. Schoolchildren can use Viewdata in their homework. Holidays can be booked using the system.

Table 3.1.

Current Viewdata Services.

General Information
news
sports
leisure
entertainment
timetables
general phone directories
yellow pages

Professional Information
business calculations
technical calculations
components data
technical information
literature retrieval
secretarial services
circulars

Business Applications
in-house information services
in-house phone directories
sales data
financial data
general business information
production data
inventory data
accounting information
personnel data

Message Capability
store and forward
electronic mail
voice connection
image handling
newspaper reprinting
phone for the deaf

Classified Ads
employment opportunities
articles for sale
new products
new offers
real estate news

Shopping Aids
market prices
special offers
mail-order possibilities
exchange mart

Reservations
hotels
cars
airlines
general travel
vacation offerings

Education
courses at home
special homework services
coaching
adult education
advisory services

Having all this information constantly available at home could mean that whoever you are and whatever your interests, your communications horizons will be enlarged and you can become better informed. The service potential of such a domesticated on-line computer as Viewdata is tremendous.

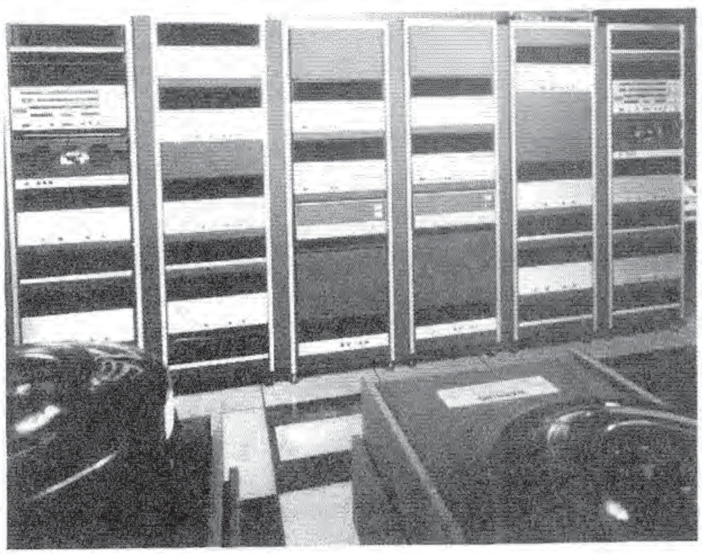
The computer resource is easy to use and understand. In Figure 3.1, a retired woman uses Viewdata to call the meteorological Office. She is largely unaware of the powerful computer gear at the switching center of the British Post Office, nor is she particularly concerned about it. This is one of the long-term advantages of Viewdata. The computer is being brought into the home via technology that is familiar to young and old alike.

In Figure 3.2, a father and his son in Dallas, Texas use a personal computer. Neither has any special programming know-how. Once tedious, specialized, time-consuming programming chores have been replaced by cassettes containing solid-state software. Both solutions are characterized by visualization. The end user has immediate access to a database, whether it is local or remote.

Although the kind of information available through Viewdata may be available from other sources, no other source can deliver it as quickly or as conveniently. One use of Prestel, for instance, is shopping "off the screen." A person can place orders for goods or services advertised on the screen and even pay for them by transmitting a credit card number. We should note at this point that around 1978 there was consumer resistance in the United States to the introduction of automatic teller machines (ATM) in particular and to the advent of the cashless society in general. This slowed ATM's acceptance somewhat. Although the problem is behind us now, it *is* an indication of the duration of consumer reactions.

The number of possible uses of the technology are many. With the computer offering far more information than any human teacher, and with their output available on an individual basis, computer-guided education can be adapted to individual students. Continuing education throughout a person's adult life will become increasingly feasible and appropriate as the rate of obsolescence of skills accelerates. The average effective life of a banker's knowledge is now about five years.

Looking into the decade of the 1980s, with communications satellites and laser beams and with computers organizing and supporting entire networks of services, we can expect to begin transmission of messages with an efficiency that will make ordinary TV and radio seem prehistoric.



Press the Button

With an unlimited number of voice and picture channels available, a person will have access to a portable picture phone, which will make possible dialing any number on earth. The printed word, in the form of facsimile letters, newspapers, magazines, and books, will then be easily and widely transmittable in a fraction of a second by merely pressing a button.

Is the average American family likely to accept Datavision? In asking this question, let us remember how the average American reacted to the telephone, to the automobile, to jet travel, and to television. Does the typical American read newspapers? The mass distribution of documents, at least, is coming of age, and with it, teleconferencing. In the business conferences of tomorrow, images of people sitting in their offices continents apart will be transferred instead of these people having to travel great distances themselves. Documents will be converted into signals and reassembled through facsimile at the receiving end. Businesspeople won't need to congregate in offices. With computers, automation, telemetering, and television monitoring, much work can be done locally. Most likely, however, the greatest impact will be in the educational and scientific fields.

As we see in Chapter 1, the invention of printing made scientific information readily available to scientists. If the domestication of agriculture permitted intellectual activity to become a respectable livelihood, printing enhanced the scientific community while both accelerating and augmenting technology. Instantaneous communication will probably advance know-how that much further. Scientists, even more than they have in the past, will benefit from the work of their predecessors. It was no accident that the industrial revolution began in Europe, where the printing press was invented. It will be no accident either that the information revolution begins in the nation with the fastest and the most far flung computers and communications facilities.

Through science we learn about the universe with increasing speed and in greater depth. Thus it becomes easier to put this knowledge to practical use. That is how technology moves forward. The transition from the steam engine to satellite communications was evolutionary, directional, consistent, and irreversible. People, materials, energy, and information are the key ingredients in achieving steady economic growth. Whether it is for home or business, Viewdata should be viewed as the forerunner of a worldwide communications system for voice, data, facsimile, and video, combined with sophisticated computing services—a cradle-to-grave communications facility designed to serve society's growing needs.

Signal Processing

Speaking of the transmission codes Viewdata can support, in Chapter 2 we saw that the home user can receive all codes native to the system, as well as send only those allowed by the terminal in exploiting Viewdata's two-way capability. This raises the issue of access arrangements, together with the concept of a home-based editing terminal, which can be used for inputting information before transmission. Transmission requires clear signals and, because it must serve a purpose, the sending and receiving ends must be defined.

At the sending end, data input can operate offline. Data is stored on an economical media such as an optical disc; then the telephone network is used to access the Viewdatabase.

Interfacing circuitry is necessary and, at the local level, includes an isolation facility to prevent television from interfering with telephone lines, a modem to convert digital signals to analog signals (and vice versa) for transmission on the voice-grade network, an input buffer for storing received signals, a central memory, and a character generator to accommodate the character string on the TV screen. This setup is used for both transmission and reception of data. Presently, the minimum storage device holds one page of information as it is received from the Viewdata computer. To appeal to the mass market, interfacing circuitry (the so-called decoder) must be inexpensive, which means that advanced technology must be used and the device must be mass-produced. This has largely been accomplished through the use of very-large-scale integrated (VLSI) circuitry.

Viewdata transmits video signals to the receiving end. Research on electronic signal-processing dates from the early days of radio, when signals were amplified, modulated, detected, and filtered in order to match them to the transmission medium and avoid interference with the desired information. The advent of integrated circuits has greatly increased the potential for signal-processing. Results have been more impressive in applications where the signals are in digital form. This makes a transmission relatively free from undesirable input, because of the limited number of signal values that can occur.

In recent years signal-processing has been used more and more for video applications. A good method of two-dimensional video signal-processing takes into account the relationship between the electric signals of two or more successive picture lines and successive pictures themselves. This requires using memory in which the contents of one or more complete television screens can be stored briefly. Storage devices can be used both for suppressing certain types of interference and for obtaining sharper images. Implementation costs in standard television sets, however, are still high.

Technical considerations dictate signal-processing requirements. The Prestel solution, for example, is to transmit data asynchronously at 10 bits per character:

1 start bit
7 data bits
1 parity bit for data assurance
1 stop bit

The coding of information is according to the American National Standard Code for Information Interchange (ASCII). Britain has adopted a double standard. Transmission to the user takes place at 1,200 bits per second, the maximum number that can be accommodated by the phone lines. Transmission from the user's location to the Viewdatabase is at 75 BPS. Thus the system can operate in both directions simultaneously, although the sending rate is slower. (INSAC, which markets Prestel in the United States, projects 1,200 BPS in two-way communication [send/receive]; hence it is full duplex. This is a necessary requirement, since the current primary requirement for this marketing effort is in the business community, not the home.)

We discuss the Viewdatabase in Chapter 4. In the meantime we must refer to the communications procedures that it involves. These may be described in the following simple steps:

1. Call the Viewdatabase (VDB) and wait for an answer.

2. The VDB acknowledges and asks: "Give your use number."

3. The use number is given; then the system asks: "Your PIN" (personal identification number).

4. After the PIN is received, and if the communication is accepted, the system presents the requested list of items from the data base.

5. The user selects an item and inputs the desired selection.

6. The system gives instructions on how to use Viewdata. (As we will see, Viewdata is built up with index pages.)

7. When a task change is required, the user must go back to step 4 and reselect. (The system will again give instructions.)

This is the present status of Prestel in England. Other systems are in advanced stages of experimentation. In addition, capabilities vary from one system to another.

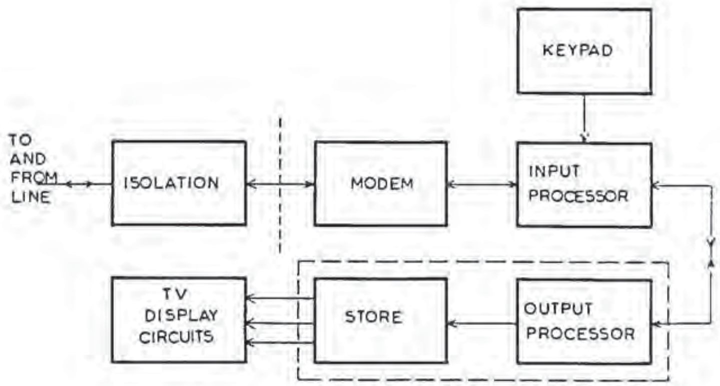
The Terminal Facility

The simplest way to think of the terminal is as a series of black boxes, each dedicated to a given function (Figure 3.3). This interface circuitry—(whether it is called in-box, decoder, or adaptor—connects a television to a telephone line, provides memory for storing transmitted information, displays the information on the television screen, and in general performs, through local intelligence, the jobs necessary for communication.

One of the black boxes in the adaptor circuitry provides for isolation in communications to and from the telephone line; the other is the modem. The third is the input processor, the fourth the keypad (that is, the user-oriented section of the terminal facility), the fifth the output processor. Then comes the storage, or memory, and finally the interface to the TV display circuits themselves.

The storage unit, as it is implemented in Britain, holds 8,000 bits of data, or one page. The decoder sends instructions to the Viewdata computer by use of a keypad, receives and stores data arriving via the telephone line, and converts the data, using a matrix-type character generator to form a suitable television display. The display is refreshed from storage. For identification purposes each decoder is programmed with a unique digital answer-back (identification) code for the terminal. The ID code is transmitted upon interrogation by the Viewdata computer. When the set is first placed online, the answer-back is received at the Viewdata center and stored in memory. It can be used in several operations, including those of administrative chores and billing.

The answer-back process permits the subscriber to directly dial into the Viewdata system and be identified without further action on the subscriber's part. For security reasons, however, subscriber passwords similar to the personal identification number can be used when necessary. The answer-back transmitted upon connec-



3.3. The Building Blocks of a Viewdata.

tion of the subscriber with the Viewdata computer at the central office is crucial to the connection, because it permits the subscriber to indicate the last time he or she was online. In addition, Viewdata sets are designed to automatically dial the programmed Viewdata telephone number when a button on a keypad is pressed. The stage of the connection is indicated by tones returned from the telephone exchange and broadcast over the TV loudspeaker.

When an add-on decoder is used, radio frequency (RF) modulator converts the data into television signals at the TV antenna jack. Line- and frame-synchronization signals, for controlling the stability of the television picture, are ensured by the decoder. Various special features are offered, including flashing characters and special symbols.

Because Viewdata is designed for message storage and transmission, the set has also been equipped with a special device—a light accompanied by a ring. This indicates that a message has been received by Viewdata in the subscriber's absence. The subscriber, upon returning, dials the Viewdata computer for the messages. Messages can also be recorded on a local storage medium such as an optical disc, a floppy disc, or a cassette recorder attached to the black box. Local capabilities are augmented by the incorporation of a personal computer at the user's end. Table 3.2 sums up the relevant information about the Prestel terminal and its use.

Getting Online

An easier way to explain the keypad is to look at the touchtone phone. Twelve keys are available—10 numeric and 2 functional (* and #). This layout is simplicity itself. All that is needed to signal the start of an operation is to push the buttons marked with the asterisk (*) and the number symbol (#).

Table 3.2.

Technical Information about the Terminal and Its Usage.

page format: 24 40-character lines; maximum per page—960 characters

character definition: 7 X 5 dot matrix normally presented in a variety of sizes

colors: red, green, yellow, blue, cyan, magenta, black and white

connection to telephone network: via jack plug and socket

user interaction: by hand-held keypad (numeric or alphanumeric) from a keyboard or a computer

automatic dialing: of the computer by terminal user at the press of a button

transmission: 1.2 KBPS received, 75 BPS transmitted from the user terminal

coding: start/stop asynchronous

character envelope: 10 bits (1 start (binary 0); 7 data, 1 even party, 1 stop (binary 1))

data modulation: FSK in both directions (standard to CCITT V23)

character set: ISO-compatible, including escape techniques for possible future international multinational networks

futures: easy connection to low-cost satellite dishes (when available); possibility of integrating into future voice/image/data networks

1. Once the user is online, a known page stored in the system is called up by pressing the * key (page number #).

2. Average search time is 2 seconds for the public, or Prestel-type service but only 1 second for private, in-house service.

3. The typical page requires 3 to 5 seconds to write on the TV screen, almost twice as long as with computer search. Therefore:

4. Each page should appear in less than 10 seconds, although the user can start reading messages after the first lines appear on the screen.

A simple, easily remembered set of controls has been adopted for the Prestel implementation of Viewdata (Table 3.3). The 11 operations given there may well become the standard, both for home and for office users.

Even simpler to use than the numeric keypad are functional keys. They also provide some preprogrammed options. Figure 3.4 shows a control box for the QUBE two-way TV system used in Columbus, Ohio. A slightly more complex form of this system is the alphanumeric one, in which data and test are input using the keyboard, as they are on an electric typewriter.

Table 3.3.

Prestel Controls.

** (page number)#* - takes you directly to any page; for example, *220# takes you to page 220

**** - cancels a direct keying instruction just made, provided that the instruction has not yet been acted upon, which means that you have not yet keyed the instruction page number

**#* - returns to the frame you saw last (may be repeated three times in succession)

**0#* - returns to page 0

**00* - repeats the frame displayed if the frame is spoiled by noise on the telephone line

**09* - repeats the frame displayed, including any updates that may have occurred while you were looking at a frame

**90#* - switches to normal TV broadcasts or Teletext

HOLD - disconnects you from the Prestel computer but continues to display the frame you are looking at

**3#* - is used for local information

**199#* - provides alphabetic list of information

**198#* - offers alphabetic list of information providers

Although neither numeric or alphanumeric keypads, nor functional keysets, allow sending complex data-and-graphics messages, the service is offered through an on/off personal computer. Here is where the marriage of computers and Viewdata bears fruit.

In the early Viewdata releases, pictures were input on the terminal by first creating a paper grid to guide the operator, then having the operator create the graphics, using the 64 graphic matrices or cutouts available for making a picture. It should be evident that this can be done more easily and efficiently with a computer program.

Whatever the method of input, we will address the Viewdatabase either by following a hierarchical tree structure (see the subsection below, "Menu Selection") or directly calling a particular page by keying in the page number required. The latter method is more economical, since there is a charge for each access. In other words, if we know in advance the number of the page we wish to access, we can go straight to that page by keying, for instance, *52347#. To repeat, *(page number)# is used to go to a given page number. If we do not wish to do this, we follow the standard sequence. In addition:

The English Viewdata facility makes it possible to return to the page last read by keying: *

An updated version of this page is obtained by keying: *09

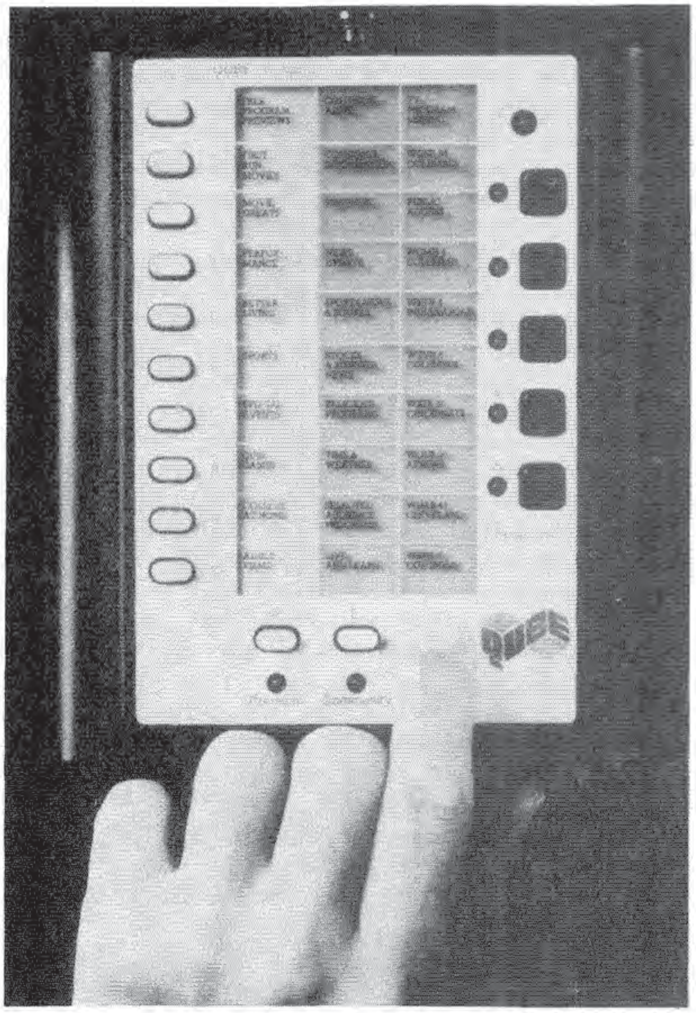
In case of a transmission error, if we wish the page to be retransmitted, we key: *00

Also, "#" is used to access "continuation frames" and "**" to correct errors in keying. We saw the combination we must use to go to a chosen page.

Identifiers are provided for notifying the user that *this* frame is only one of several. All the other frames in the sequence are known as *continuation* frames. They are accessed by keying "#".

We may also need "native faculties"—basic functions specifically supported by the system software. These are needed to change modes (alpha to numeric), apply functional keys to simplify the task at hand (these are microprocessor-supported), change colors, or start a communications process (send a message to another user).

To log out from Viewdata, we can drop the phone line connection or use a three-key code. With early Prestel terminals it was necessary to lift the telephone receiver and dial the computer. In



3.4. The Control Box for the Two-Way System Used in Columbus, Ohio.

that situation one way to end the communication was to replace the receiver. With the current public service terminals, however, an automatic dialer is included. All that is necessary to initiate the dialing sequence is to press the appropriate button on the keypad. The communication is ended by pressing keys on the keypad or by accessing a special "leaving Prestel" page, which automatically breaks the connection. (The actual keys to press—both for accessing the computer and for ending the communication—vary from one manufacturer to another, but in all cases the process is simple.

To summarize, in current service sets, the connection with the computer and the ending of communication is accomplished by using a keypad. It is not necessary to touch the telephone.

Menu Selection

We saw that, with Viewdatabase, the user can address the page needed either directly, by dialing the right number, or by means of menu selection. The last is jargon for proceeding page after page in a sequential manner, from summary to detail, until the desired page is found.

In a typical menu selection form the first page the user calls is the summary page. The second page gives the next level of detail, followed by more detail, and so on, until the desired page is located. Thus the analogy with selecting from a restaurant menu. Menu selection is a simple process of choice, guided by instructions displayed on the screen. The process itself is repeated until the required information is found. Therefore, the procedure is one of progressive elimination.

A user who wants to choose a restaurant would go through these steps:

First, call "Visiting New York" on the contents page.
Then narrow the possibilities down to "restaurants."
Choose among, say, American, French, and Chinese.
Gradually narrow the choices on the subindexes—for instance, by type of cuisine served, location, prices, hours.
Finally, pick a restaurant from the list of those left.

Say that the inquiry concerns the availability of educational courses in certain districts. The viewer would first select "Education" from the general index page. The response is a list of possibilities, which is "exploded" to the next detailed level until the search yields the information sought.

Once we have selected the district and indicated the particular course, the pages shown on the screen can be used to provide a comprehensive list of subjects in the chosen area, for example: the address where the course is offered; information, if any, on the instructor; the topics covered in the course; admission requirements; subscription cost; class size and age brackets; and hours the class meets. A sequential, menu-type selection process may require four or five pages to produce the desired result. If the number of the page of information required is known in advance, however, it can be accessed directly, thus bypassing the intervening tree structure.

Viewdata also offers several complete main indexes, by subject and information providers. Once the text is displayed on the screen, it can be read just as the page of a book can. When the user is finished reading the page, he or she turns to the next page—or to any page desired.

Sending information via Viewdata is not constrained by the organization or page content, but by the terminal facilities available. With a numeric keypad, the choice is limited to preformatted messages—making it a kind of multiple-choice system. With an alphanumeric keypad, Viewdata, in effect, makes available a blank page on which to write. Greater freedom is possible when we use a personal computer to prepare data and graphics. Computer-based communications have advanced a long way since the early Prestel experiments, in which only simple messages were available, such as: "I will meet you at—", "I shall be arriving at—", or "I will be home at—". Modern network facilities have made it possible to separate the sender from the receiver. Messages can be sent from a station not only in the form of data but also by voice. Messages can be stored on disc or some other media and sent at a later time. When the recipient arrives home, he or she can scan the in box, examine the messages, weed out those not wanted, and keep the important ones. As Viewdata increases in sophistication, memory protection may become possible, in which controls can be applied to make difficult unauthorized access to the same local Viewdatabase.

4 The Viewdatabase

The TV set, telephone, and interface connecting one with the other, as well as the procedures necessary to link the domesticated computer to the network, are vital components of Viewdata in the home. More than this is involved, however, if the user is to access the information elements stored in the Viewdatabase.

We discuss the database in chapters 1 and 2, where we briefly defined the term. To repeat: a database is an organized, computer-run collection of information elements designed in an application-independent manner to serve data-processing purposes. A Viewdatabase is a database dedicated to servicing Viewdata.

The basis of a database is the *information element* (IE). The IE can be a bit (binary digit); a byte (or octet, that is, a group of eight binary digits); a field; a record; a section of the database, or the database itself. In the general sense, an IE is an addressable entity.

The database should be kept in perspective. The database includes not only the automatic storage and retrieval facility but the formalism, or structure, as well. In the past, the different files and records were not organized collections of data. At that time, databases had meaning only if they were structured.

Both the needs of the computer and the simultaneous access by multiple users made possible by it created the need to rethink the entire database facility—to structure the IE, uphold the necessary formalisms, avoid undesirable duplication, provide access protocols, and integrate the IE into a coherent, comprehensive system.

Formalism is needed if the database is to be available to all authorized users and to all programs. No program should have its own files duplicating the elements contained in other files or databases unless the rules of security and efficiency indicate doing so.

To give the reader an idea of the possible size of a database, in mid-1979 Prestel supported 175,000 active pages, with each page containing 960 characters. The size may eventually grow to billions or even trillions of characters, depending on user demand and the structure of the system. Far from being an impressive memory capability, 175,000 pages is an early figure, a limited capacity, and as such, represents less than half the storage capacity of a modern disc drive for large-scale systems. Thus we can expect memory usage to develop fast and wide, not only because of extended usage but because of the declining cost of disc storage. Whether we are talking about a hundred thousand or a trillion pages of storage, it is best to keep in mind the huge amount of preparatory work necessary, as well as the rules to be observed, both by the user and by the information provider.

To open the way for integrating the database, designers must identify all IE, design the IE for portability, make them homogeneous, and guarantee authorized access to the IE. To organize the database in an adequate manner, we must ensure the integration process not only on a one-time basis but on the basis of steady upkeep. Database integration requires a concept, structure, meaning, homogeneity, avoidance of duplication, storage and retrieval capabilities, query, database management, and a data dictionary.

Pages and Screenfulls

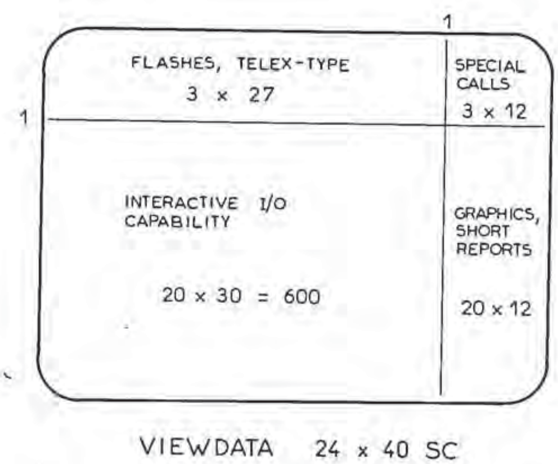
Access to a database by the typical home or business user is necessarily limited to the amount of information the system can transfer during a transmission. This amount is that that can be contained on a page. (A group of pages is known as a scroll.) In Datavision a page is a unit of information transfer and occupies a full TV screen. In the British Viewdatabase, pages are arranged in hierarchical form. We saw in Chapter 3 that this implies a tree structure, although the fact that a cross-reference ability is available to the user means that, in Viewdatabase, anchors and pointers are contained among the pages.

Depending on the drivers (the software used to run the hardware), each page may be split into several frames, or screenfulls; the exact size of a page is a function of the number of characters supported, which is related to the particular application of Datavision. One mechanism, for example, accepts 96 alphanumeric symbols—lower and upper case, numeric, and special. The dimension of the video is 24 lines at 42 characters per line (Figure 4.1). Prestel supports 24 lines at 40 characters per line, or 24 X 40. With either system, the flexibility of usage is impressive: games, histograms, and data, for example, can easily be displayed on a page.

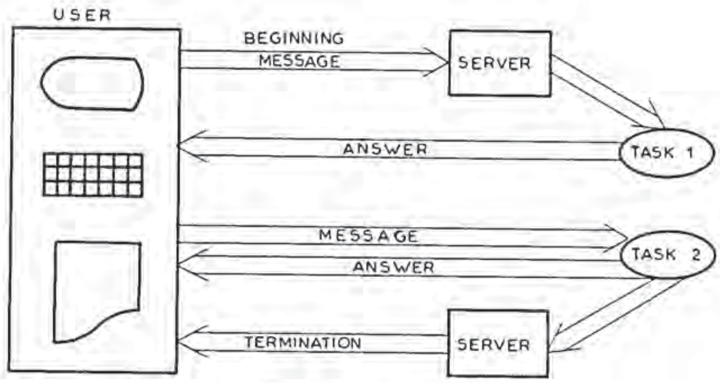
In the graphic mode a screenful provides formats such as dots and squares. It supports color. There is even a display capability for different background colors—again, on each page.

The definition of page size is important both because of the homogeneity of the video devices being supported and, depending on the technical solution being adopted, the local need for a dedicated memory to refresh the data displayed. This memory, commonly known as a refresher, can be part of the in box or a special television set, or it can be provided by a central computer.

Similarly, the size of the screenful affects the application of a given Viewdata system; vice versa, current or intended use affects the solution that is adopted. In Figure 4.2, for instance, four quarter spaces were chosen as the format for a project (still in design)—one for flashes and telexlike messages (in the United States the average TWX message contains 65 characters), one for special calls (coded presentation) as a replacement for the "beep" and other signals, one for graphics and short reports, and a 600-character matrix as the main map of the system.



4.1. Possible Division of a Viewdata Page.



4.2. Handling a Transaction.

In the British application, the top and last lines are utilities. The first 24 characters of the first row contain the name of the IP, which is automatically inserted in each frame. Columns 25 to 35 carry the page number and the frame letter, and columns 36 to 40, the price in pence (two cents). The last row is reserved for messages from the computer. The information provider thus has available 22 rows of 40 columns each. The IP must format the message accordingly. The theoretical maximum number of pages in a cascade is 26, although the BPO routinely advises the IP to use no more than 6.

Queries

The database is best viewed by considering it a collection of related data organized in pages that are accessible by the user. Pointers in the database allow access to pages belonging to the same logical group as well as to index data across files.

Queries to the database are posed by the user. They help establish a dialogue between people and information. The word *dialogue* is a generic one meaning planned people-machine communication. It implies the use of formal approaches for query purposes (for instance, specified characters on the keypad, as explained in Chapter 3); languages for interrogating a database (these are run by the system and are clear to the user); and less formal conversational interchanges, which take place in a transaction–oriented manner (Figure 4.2). Conversational interfaces may be designed for specific application in which case we speak of dedicated software, or applications programming or they may be generalized to serve a large number of users, as is done in the case of Viewdata. In either case the user must observe formal procedures, called protocols. The simplest definition of a protocol is a *rule of conduct*.

Because protocols can be complex, the designers of Viewdata gave extra thought to keeping them simple. Indeed, for the home user the Viewdata protocol is simple enough to be printed on the keypad. The user can be guided to the destination—the end page—by the number of routing pages. Each routing page contains up to 10 choices, numbered sequentially. All the user has to do is press the appropriate key for the desired page, and another routing page is presented. The procedure continues until the end page being sought is reached. This is known as menu selection. In British Viewdata jargon, routing pages are called *parent* pages. From them, *filials* are chosen. All this adds up to the hierarchical structure reviewed in our discussion of the menu.

Say the user is looking for an article in Viewdatabase. Two approaches may be taken. To locate the final, or end, page needed, the user calls up the routing page. If the user knows the number of the page sought, the end page is called directly. How does the user find the number directly? By remembering it, for example, as a phone number or by looking it up. Table 4.1 presents an extract from the Prestel directory. Incidentally, the user can store the directory on the home computer and avoid paying Viewdata for each access.

To recapitulate, a routing page gives only routing choices, whereas an end page contains information. Page 5002 of the Central Film Library is an end page, which can be reached directly by keying the proper number, or by proceeding through routing by first calling the parent page—33.

In the current Prestel implementation, eight hierarchical levels can be used—giving, at most, a nine-digit page number. Prestel also offers "free pages." A free page may have several filials but not in the sequence 0, 1, 2.

Finally, Viewdata pages may be cross-indexed. This has the potential of providing logical grouping, accessing different parts of the Viewdatabase in sequence, even supporting parts with another information provider.

Table 4.1.

Prestel Information Providers' Index.

	Prestel page
ABC Publications	223
A.P. Dow Jones	447
Austin Knight	525
Barclaycard Ltd	494
Benn Brothers Ltd	551
Berni Inns Ltd	2929
Birmingham Post & Mail	202
British Medial Association	588
British Airways	313
British Insurance Association	266
British Library	505
British Printing Corporation	243
British Rail	221
British Tourist Authority	220
Careers, Occupational Information Center	270
Central Film Library	5002
Central Office of Information	500
Central Statistical Office	571
Centre Hotels	369
Charities Aid Foundation	411
Commonwealth Agricultural Bureaux (CAB)	228
Communications Studies & Planning Ltd	323
Computing Services Association	210
Confederation of British Industry	466
Consumer's Association	334
Cosmos	464
Thomas Cook Ltd	502
Council for Educational Technology	211
Daily Telegraph	388
Datastream International	535
Department of Environment	331

Table 4.1.

Prestel Information Providers' Index. (continued)

Health and Safety Executive	575
Hotels	2925
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.	
.	
Insac	442
Institute for Scientific Information (SCITEL)	555
Institute for Terrestral Ecology	274
International Distillers & Vintners	2922
IPC Prestel	456
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.	
Parliament	5000
Press Association	585
Professional and Executive Recruitement	299
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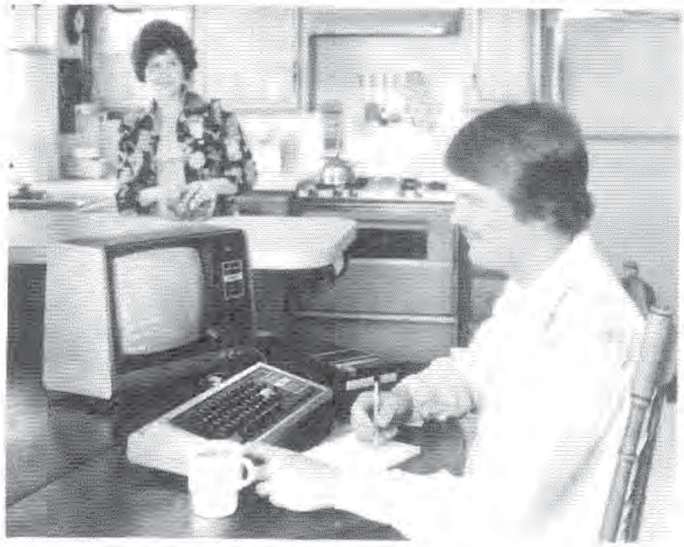
Time Out	441
Transport & Road Research Laboratory DoE/DTp	567
United Kingdom Chemical Info Service (UKCIS)	541
The Universities Central Council on Admissions (UCCA)	262
Utell Reservations Mini Holidays	2920
Westminster Press	444
Which?	333

Information Providers

An information provider (IP) is a person or organization that feeds data into the Viewdatabase. In the broadest sense of the term, an IP may be any user of the database to whom Viewdata serves as a message-switching system. In the first implementation, however, information providers have generally been businesses or governmental organizations. Prestel has made it possible to advertise, to inform, to make their services known to potential users.



As we will see in the discussion of costs below, information providers pay for the privilege of using the service. They must also follow systems requirements, the most basic requirement being simplicity in the structure of the data they feed in. Generally speaking, Viewdata must follow similar rules. The idea is to store data in such a way that it can be readily accessed, and when retrieved, presented unambiguously to nonspecialist users.

Information providers must also make sure that the end user can *send* messages. Viewdata offers an action, or response, frame with preformatted reply fields, which is most important for users with simple keypads. Those with alphanumeric keyboards, or with any type of computer, are given a blank page to fill in.

To assist the interaction between people and information, action frames may include data already available to the system—for example, the user's address, the date, and the time—whereas other data must be supplied by the user, who keys it in. The keying in of such data is terminated by a "#" signal. Response frames differ somewhat in structure from those accessible in Viewdatabase by the user. Although this is also true of the current Prestel implementation, it need not be the general case.

The procedure is important. After the system is notified of "ready to send," it will ask whether the user wishes to send the frame. After reception of the first frame, the user will be so informed and will be asked whether he or she wishes to continue. The Viewdatabase will insert the frame it receives in a pool of frames belonging to the IP. Then any authorized user can retrieve the frame from the pool.

Because Viewdata is interactive, it has the capability of sending messages to other Viewdata users. With a simple numeric keypad, this facility is restricted, but the user always has the option of alphanumeric implementation. Obviously, personal computers hooked up to a Viewdata network can afford much more—from graphics to the maintenance of personal accounts to TV games played over great distances. Interactive capabilities are further enhanced by the support of closed user groups (CUG). This service, assured by the current release of Viewdata in Britain, allows users effectively to use Viewdata as a private network. No user can access the data of a CUG to which the user does not belong. This is not yet, however, a typical implementation for security and protection services among major business networks.

The interactive facility makes Viewdata a good alternative to sophisticated, expensive networks, because closed user groups ensure protection of confidential information. On the other hand, the more sophisticated networks can tolerate a greater degree of operational complexity in data storage and in cross-referencing. As an example, Table 4.2 provides a glimpse of some information providers that were active when Prestel was first implemented in early 1979. The headings are those of certain services.

Gateways

Like most networks in the early stages of development, whether they be public or private, Prestel has a star structure. This structure includes a single update center for the Viewdatabase (although there are multiple retrieval centers for users). Plans are being developed to adopt a distributed topology, served by communications links, of 9,600 bits per second. Another interesting development is that of specialized databases capable of being hooked up to the system.

When these databases belong to other networks, access may be limited because of different protocols. For this reason, gateways are advisable.

Table 4.2.

Example Information Providers

Accommodation
British Tourist Authority
Centre Hotels
Eastel
English Tourist Board
Exchange & Mart
Which?

Careers
Eastel
Inspec
Sports Council

Gardens and Gardening
ABC History Publications
English Tourist Board
Exchange & Mart
Mills & Allen

Holidays
British Tourist Authority
Eastel
English Tourist Board
Exchange & Mart
Norwich Union
Thomas Cook
W. H. Smith
Which?

Leisure
Eastel
English Tourist Board
Exchange & Mart
Extel Sport
Mills & Allen
Sports Council
Sportsdata
W. H. Smith

Books
Caxton Publishing Co
Exchange & Mart
Inspec
Institute of Scientific Information
Macdonald Educational, Ltd.
McCorquodale Books, Ltd.
Tolley Publishing Co., Ltd.
W.H. Smith

Education
Inspec
ISI Scitel
Universities Central Council

Health
Exchange & Mart
ISI Scitel
Mills & Allen
Norwich Union
Optical Information Council
Royal National Institute for the Deaf
Which?

Housing
Eastel
Exchange & Mart
Milton Keynes
Network Data
Norwich Union

Gateways—technically, computer-supported interfaces able to do a protocol conversion—exist in many networks. In Prestel, for instance, the following gateways to specialized databases are being studied: an agricultural database in the United Kingdom, a database for the European Space Agency, and a database for the law library of the European Economic Community in Rome. Another interconnection possibility is Euronet, which includes member countries of the European Common Market.

Interconnection with other communications facilities will allow expansion of Viewdata network services or even its substitution for such message-switching disciplines as Telex. Undoubtedly, this will lead to convenient, reliable, computer-based service in place of the office communications systems that have been in operation for 30 years or more and that are in crying need of replacement.

Following is a possible scenario. An IP (in this case, a business firm) has set its various departments to work meeting the requirements of installing Viewdata service. Depending on the organization of the firm, one of two approaches may be taken: (1) data are prepared offline and mailed to a central department for input to Prestel; or (2) each department transfers its own data online (pages and/or frames) through the company's own network and then, through a gateway, channels the data to Prestel.

A change in format, in codes, or in speeds—all are feasible through intelligent devices. Such devices constitute the gateway. The appropriate gear at the user's end is one requirement, but an equally vital requirement are solutions that allow networks to talk to each other.

Data Integrity

The more Viewdata services expand, the greater the need to ensure data integrity in the Viewdatabase. Integrity is a key element in enabling online transaction-processing systems to meet user requirements correctly and dependably.

Data integrity should not be confused with privacy or security, however. The word *privacy* implies restricting access to designated information to certain users. Only those users who know the password would be allowed to look at, say, payroll information.

The word *security* implies that data cannot be corrupted by deliberate or unauthorized access attempts. A password may be used to control access to particular data, but security also must deal with controls to prevent unauthorized personnel from modifying or corrupting data already in the storehouse of the Viewdatabase.

Data integrity means that the database—the physical files—is always correct, up-to-date, and available to the user. Ways must be provided to ensure that nothing can happen that will cause data, one, to be inconsistent, two, contain misinformation, or three, be lost. If the system goes down or an error is made during a transaction, there must be recovery procedures to enable the system to return to a known condition of data integrity with a minimum of time, expense, and difficulty. Paralleling the implementation of data integrity, privacy and security must also be carefully reviewed. Table 4.3 identifies the security issues relating to a database.

Viewdatabase Organization

The Viewdatabase, like any database, is a dynamic model of a system. It must provide for concise, understandable representation of the state of the system; efficient access to information; and simple and consistent update of the system's changes.

Table 4.3.

Security Issues with the Viewdatabase.

Reference	Issue
processing unit	frequency of recording/check-ups
storage device	access, authorization
distributed data entry	dial in; central memory; auxiliary devices; network level
protocol	choice, control, compatibility, change
users	how many? where? for what purpose?
system level	who has access? what sort? how implemented? where? prevailing criteria?
network	nodes; linkages; database(s)
journaling	coverage; historical data; procedural design
recovery	policies to be followed, delays, dependability
security	higher-up authority, authentication keys, dynamic change of same

As Viewdata and other networks are designed, general principles common to all users become especially important for distributed databases. Questions of understandability, efficiency, and consistency must be fully resolved before a data communications/database system is put in operation. The database structure must be unified, to eliminate the high cost of redundant filing, to cancel or minimize the sources of mutations and errors, and to ensure that information is current.

Let's return to fundamentals. A distributed database is one whose geometry represents an organizational arrangement supporting the distribution and separation of applications processing to the degree necessary for satisfying user requirements. Examples are information for reservations systems, banking applications, multiplant manufacturing control, and utility grids.

A distributed facility such as the Viewdatabase necessarily (and simultaneously) enhances several key functions:

- the user—retrieve, modify, add, delete
- the database—check validity requests, check authorizations, locate data, lock data, order data, unlock data
- evaluation—positioning the function at both user and database levels, modularity, fault tolerance, control
- technical facilities—such as using a data dictionary (for file directory and providing message buffers) as a function of message size, message rate, transmission rate, and so on

Allocation of message and file buffers should be clear to the user. This must be assured by the software that is running the network. The same is true of the support facilities developed to handle the flow of file requests, of physical records, transmission rates and times (hold buffer), and various operating parameters, the most important being journaling.

The existence of these facilities is expected to bring information providers and users alike closer to the system by increasing their confidence in the way it works. The need for the eventual conversion to Viewdata of existing databases among information providers must be foreseen in the design of structures and procedures. BPO is preoccupied with this problem, and the Department of Industry has supported Langton Information Systems' preview package (a parametric software package capable of helping in the conversion of sequential computer files to formatted pages and storing them on a magnetic tape for direct input to Prestel). In the preview package, pages must be entered in hierarchical sequence, with lower-level pages preceded by the higher-level pages that reference them. That way, the Viewdatabase is created in conformance with system rules—a good example of the patience and care involved in computer work.

5 An Information Utility

Databases and data communications are the foundation of any modern, computer-based system. Having briefly discussed the Viewdatabase, we will now look at the other pillar—data communications—and how it can affect home and business activities.

Much is coming in the way of competition—ferocious competition for the consumer's dollar—the effect of which will be far-reaching. Companies that fail to devise effective product strategies will risk losing not just a lot of money but their very existence. Ford Motor Company's Edsel of the late 1950s is a classic example of company earthquakes caused by severe product troubles. The failure of Convair's 880/990 in the early 1960s rocked General Dynamics. A decade later came write-offs by RCA and General Electric, at nearly $500 million apiece.

Corporate-level misjudgment of market forces in the future will cost billions. Even big companies could disappear in a relatively short time. The star wars of the 1980s and '90s won't be fought in space, as popular movies may suggest; they will take place here on earth and will involve control over communications satellites, optical fibers, computer-based decision centers, and databases.

There was a time when American Telephone &Telegraph had a near monopoly of telephone lines and related services. But all that has changed. International Business Machines, International Telephone and Telegraph, Western Union, Tymnet, Telenet, Graphnet, American Satellite, RCA, and Xerox now offer communications services, and Exxon is preparing a document-distribution facility. Other industry giants are expected to follow suit.

Although the structure, impact, and perspective of the information utility remain controversial, business leaders are in general agreement on some basic facts. One such fact is that carrier facilities are still devoted predominantly to transmitting the human voice.

(It is reported that in the early phase of IBM's SBS satellites, at least 75% of the communication traffic will be voice.) In the past, with the exception of AT&T, the giants in the computer and communications fields concentrated on business and industry. Now they are tooling up for the home market.

Many other companies are entering the field. The domesticated computer has created a market for many personalized intelligent devices and a host of new gadgets. Datavision's course during the 1980s, however, will be influenced primarily by the policies of the Federal Communications Commission (FCC).

In October 1980, the FCC decided not to force GTE to set up a separate subsidiary to offer new services that combine data processing and basic communications. It also rolled back an earlier decision that would deregulate all telephones and other terminal equipment in 1982, deciding instead to launch a separate inquiry into Compunications—the blending of communications with existing technology.

The writers of the communications laws did not anticipate, any better than the average citizen, what a telephone line can be used for. Communications technology isn't just years ahead of the legal and social infrastructure, it is a whole century ahead.

Challenging the U.S. Postal Service and Ma Bell

A major area of activity and competition in the coming years will be electronic mail, in which processing, database, and transmission will be combined. Messages will be sent and delivered to any part of the world in less than 24 hours. Current estimates place the direct cost of sending a typical message at less than 2 cents, compared with the current figure of 15 cents for sending a message within the United States.

Even when the cost of all equipment is included, the full cost of sending a message electronically is only 7 cents in the United States and 15 to 20 cents overseas—still a bargain compared to the present-day postal rates. That would also represent a sharp reduction in cost compared with the voice communications. No wonder some far-sighted companies are beginning to rely more on electronic mail and less on voice communication.

An international electronic message service will soon be tested by the U.S. Postal Service through a contract with the Communications Satellite Corporation (COMSAT). The system will provide overnight delivery—and in some cases, same-day service—in linking the United States with London, Paris, Frankfurt, Amsterdam, Brussels, and Buenos Aires. One may ask: Why not link New York with San Francisco, Los Angeles, Seattle, Dallas, and Atlanta? The answer is, the shoemaker's kids usually go barefooted.

In data communications, competition with AT&T comes down to a question of equipment and long-distance transmission. While IBM and other Goliaths were getting into transmission facilities, it was a small ($100 million annual sales) David—Microwave Communications—that first challenged Ma Bell. MCI's low rates are the basis of its appeal to an increasingly cost-conscious business world. American firms have been using MCI's "Execunet" for placing phone calls to their offices around the country, for automatic ordering systems, and for interplant communications. Using a microwave network, Execunet carries a call any place, using a regular telephone line as a feeder.

Datran tried a similar system a few years ago and folded; nevertheless, this commercially disastrous but technically successful experiment opened a new horizon for microwave links. Recognizing the threat to its primary business, AT&T lodged a protest against MCI with the Federal Communications Commission, and the FCC ordered MCI to discontinue its Execunet service. MCI appealed the order, and it was subsequently overturned by an appeals court. The U.S. Supreme Court's refusal to hear the case was hailed as a victory for MCI and free competition.

Toward Economical Solutions

A stronger challenge than MCI's Execunet is Xerox Corporation's XTEN network. In December 1978, Xerox filed a petition with the FCC to develop a digital mail-communications system using microwaves. Meanwhile, it acquired Western Union, thus strengthening its hand in the communications field. Xerox is expected to have a substantial impact on data service with its network, scheduled to be operational in 1981. The company claims that its system will be able to deliver documents more cheaply than the U.S. Postal

Service can. XTEN would provide for document distribution, data communications, and other modes at rates up to 256 kc/s–substantially more than current telephone systems can deliver, even the T-Carrier system that Bell is now installing.

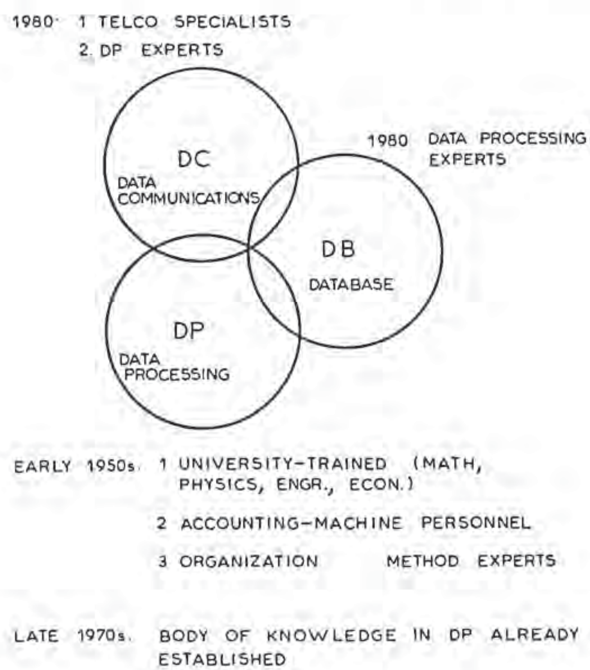
By all appearances, AT&T's strongest competitor is International Business Machines. IBM has, with Aetna Life & Casualty and Comsat, formed Satellite Business Systems (SBS) to produce a rooftop-to-rooftop, long-haul challenger. By 1981, SBS plans to have two satellites in orbit as the initial part of a comprehensive data- and voice-transmission service. Customer-oriented, the SBS approach is intended eventually to place an earth station at each customer location and beam directly into it. The Xerox approach uses the city as the hub and from there, the microwave party line. Both the Xerox system and SBS's are aimed at what is considered AT&T's "natural" market: the approximately 1,000 U.S. corporations (with more than 50 locations, several thousand firms (with more than 20 locations), small businesses, and the home market. As formidable as IBM and Xerox are as challengers, however, they are only two of many that are entering the field.

With RCA already heavily involved in the transmission of television and data via satellite, and with Exxon, General Electric, and Boeing ready to jump into the data-transmission business, the competition for the family, or home, market should be intense.

In tooling up to meet this goal, communications companies have succumbed to acquisition fever and begun buying computer hardware manufacturers. Northern Telecom has acquired Data 100 and Sycor, and IT&T bought Qume. GTE has purchased Telenet. Traditionally computer-oriented firms have diversified: NCR (Comten), Burroughs (Context), Honeywell (Incoterm), Univac (Varian), and ICL (Singer). Partnerships have been formed, such as Siemens and Fujitsu.

The standard carriers have reacted to these moves. GTE set up a group in early 1980 to test market a system similar to Viewdata for transmitting data over telephone lines to modified TV receivers in homes and offices. Texas Instruments is currently testing in Salt Lake City a home information system (Teletext) that sends data over regular broadcast channels. And the U.S. Postal Service has asked the U.S. Postal Rate Commission for authority to offer an online service called Electronic Computer-Originated Mail (ECOM). In this system the sender writes a "letter" at a terminal and sends it via telephone to the post office, which routes it to the destination post office, where it is printed and delivered in the conventional way. The system will be used initially for sending bills, overdue notices, and similar mail, but the service's potential extends much further.

Lack of skill and specialized people will be a problem at first, as service is expanded. Where will the specialists needed for large-scale implementation come from? In terms of data processing, the database and data communications industry today is as lacking in skill as it was in the early 1950s (Figure 5.1).



5.1. Development of a Specialization.

What Is a Utility?

The data communications facilities expected to be offered and implemented during the 1980s may be divided into five major groups: company-owned and -maintained networks (COAM), private utilities, business-partner utilities, utility facilities of the old time-sharing type, and value-added networks. Figure 5.2 gives details, on the basis of probable cost per transaction and type of network, private or public.

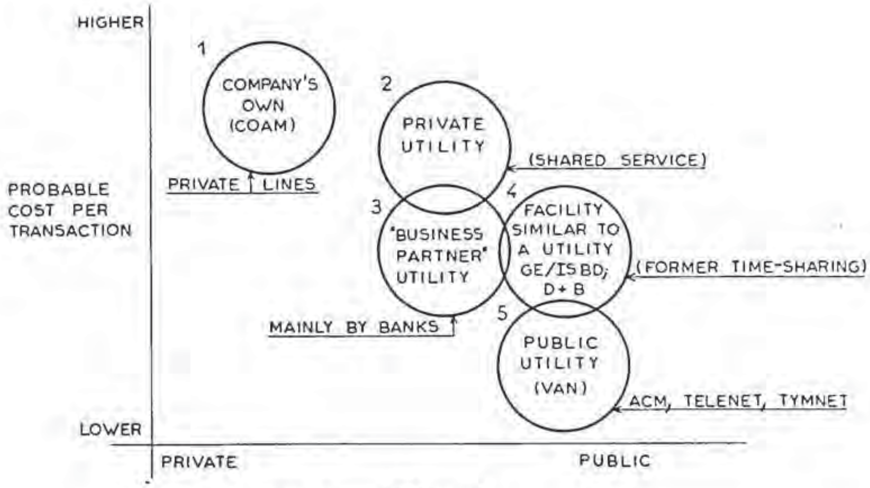
Company-Owned and -Maintained Networks (COAM)

The company-owned and -maintained type of network will probably be the facility of choice for large business, both for reasons of privacy and for prestige. Large banks, airlines, major manufacturers, and leading merchandising firms most likely will fall in this category. Citibank's CITINET is the best example to date in the United States. Two European examples of COAM are Société Générale de Banque (SGB), with a DATAPAC architecture, and AMRO's COMSYS. This DATAPAC should not be confused with the Canadian DATAPAC, which is a public utility, although both networks share the same architecture; SGB, however, has adopted a solution offered by Northern Telecom.

Private Utilities

This category will include primarily the smaller corporations, those that may be planning to go into shared services on a full- or part-time basis (for instance, night shift) to offset the cost of setting up and running their own networks. Typically, this is a limited user group, with both privacy and unit costs at a lower level than those for COAM but most likely higher than the costs for the categories that follow.

The control of financial holdings is a good example. Say that a parent firm makes the network and runs it as a separate subsidiary. A three-tier tariff is established—a day shift with high priority, an idem for normal-speed transmission, and a night shift—in which the parent firm uses the first tier, the subsidiaries use the second, and both the parent firm and its subsidiaries use the third, for facsimiles and telecopying.



5.2. Types of Networks.

A network projected, implemented, operated, and maintained by the First National Bank of Boston is an imaginative step in this direction. In 1978, "Money One" was serving 100 New England banks and 200 supermarkets.

Business-Partner Utilities.

This facility is offered mainly by leading financial institutions to their clients in corporate and retail banking. The facility allows them to reach the bank's database for direct orders and/or queries.

The same is true of customer-supplier relations. Modern industrial firms communicate with their subcontractors by means of ordinary documents. This involves typing, reading, transcribing to tape or disc, feeding into the computer, and correcting errors, usually many, which increase delays and costs. There is no reason why this situation has to exist, for a solution is at hand: data exchange by means of telecommunications. Because switching to the database means using the services of a data-transport network, however, the business-partner utility could easily become a data communications utility supporting closed user groups—hence a reserved service similar to the shared service but probably at less cost.

Utility Facilities of the Old Time-Sharing Type.

This type of utility can be converted to data communications while continuing to support the standard data-processing functions. General Electric's ISBB, the Dun and Bradstreet services, MIC, Southern Pacific Communications, Rolm, Graphic Scaning, Continental Telephone, and Womac may fall in this category.

Value-Added Networks.

Value-added networks were originally run by newcomers in the field of data transport, such as the successful Tymnet (which originated the value-added concept). Today they are increasingly used by such public utilities as AT&T's Advanced Communications Services (ACS).

The development of the value-added concept is interesting. Tymshare (Tymnet's parent) bought AT&T lines to hook up its service bureaus in the United States in order to gain greater use of available computer facilities. This done, Tymnet found itself with available line facilities and proceeded to market them. AT&T objected. The FCC backed AT&T but with a difference. It is rumored that it was suggested to Tymshare that it not market pure data-transmission service, that some value should be added—error correction, store and forward, and so on—then Tymshare would not be in violation of the communications laws. Thus a new service came into being. Again, necessity was the mother of invention.

Where does this leave the user? No matter which solution is adopted, the user must be aware that the efficiency of a communications network that incorporates geographically distributed equipment and that reaches multiple databases is highly dependent on the compatibility of hardware and software, as well as the ease of searching diverse databases.

Diversity can be reduced through standardization. Protocols (logical rules of conduct) have, to some extent, been standardized, but much work remains to be done in log-in procedures, operating instructions, and equipment types—to name a few areas. The new communications industry is at present in a nascent stage. The industry is also one with a promising future. The rush to implement network services clearly reflects a need.

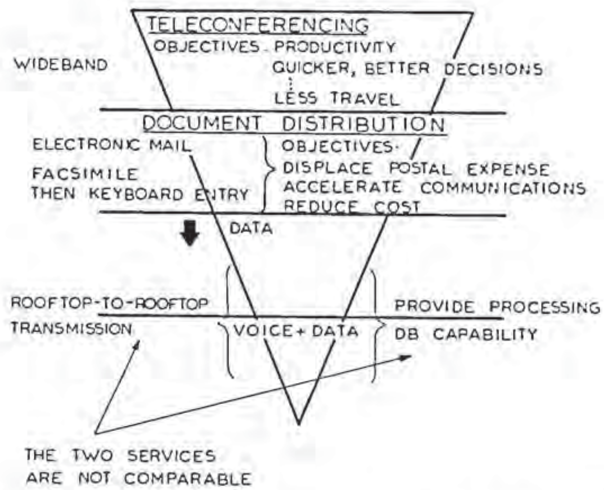
A Range of Possibilities

The range of new services possible is a major factor in the potential market for Viewdata. In-house systems similar to Viewdata, which are compatible with external Viewdata networks, are being developed by such manufacturers as ITT, Philips, and General Electric and by a number of smaller firms in the personal computer and communications fields.

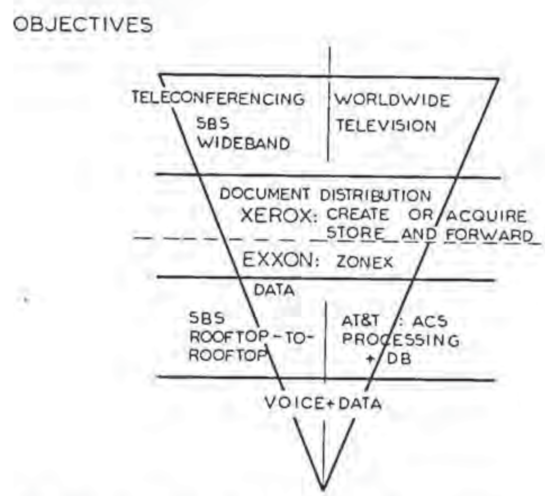
By the mid-1980s, IT&T believes, a third of all domestic color sets sold in Great Britain will be equipped to receive Viewdata. That would mean roughly 500,000 sets a year. By then, printer units, complete typewrite-style keyboards, and substantial memory units are expected to be sufficiently low cost to enable the transfer of applications from the business to the consumer market.

To better understand where this new industry is going, let us look at the two giants of the industry–AT&T and IBM. AT&T employs nearly 1 million people and has 3 million shareholders, assets of about $130 billion, and gross revenues that amounted to more than $40 billion in 1978. IBM has more than 300,000 employees worldwide, assets of nearly $20 billion, and a gross income in 1978 of $22.5 billion. These companies and their services are an integral part of a post-industrial economy. Telephony is basic to the conduct of business. Government, banks, industry, merchandisers, and the stock market, for example, could not function without the computers and communications facilities of such companies. AT&T, IBM, and similar companies constitute a large part of the central nervous system of the American economy.

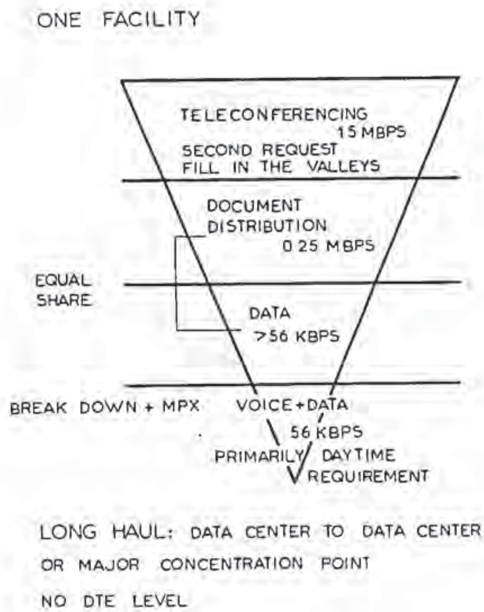
Figure 5.3 identifies the objective in establishing computer-based communications channels, Figure 5.4 divides them into quarter spaces, and Figure 5.5 indicates the approximate size of the channels needed to satisfy the communication needs of industry. In a facility such as Viewdata, the information provider time-shares these channels and, through them, reaches private homes and business in order to sell products. Cost is therefore crucial to formulating a budget. Three areas merge: direct sales, advertising, and communications. In terms of the facilities that can be supported, Viewdata will one day dwarf door-to-door sales. The catalogs of Sears and Montgomery Ward will reach consumers through video screens.



5.3. Broadband Allocation: Teleconferencing, Document Distribution, Text and Data, Voice and Data.



5.4. Objectives of the Developing Broadband Services.



5.5. Size of Channels Needed.

Viewdata fits well into the future we are discussing. For people equipped with such computing power, it will not be necessary for them to know anything about computer techniques, any more than they now know about how telephones and television sets work. For practical reasons, Viewdata has been designed primarily to do things the ordinary person is familiar with, in a manner supported by computers and modern communication technology. The less well-known (one is tempted to say "exotic") possibilities have so far failed to gain wide acceptance.

The Cutting Edge of Competition

Viewdata has been designed for an international market, and it is there that competition will probably be the most intense. Teleconferencing will allow salespeople to talk to prospects. Rooftop-to-rooftop, worldwide television, project (1980) in excess of 1.5

megabits per second (MBPS), will bring together producers and consumers a continent apart.

Let's look again at figures 5.1, 5.2, and 5.3. Document distribution occupies the next layer. Its main goal is productivity. To appreciate its impact we must think of it as a communications link that is far superior to standard, a link that has opened up a new frontier just as roads, canals, and locomotives did in the 19th century. Indeed, forging computer-based communications links should be viewed in this perspective, because they promise to be every bit as revolutionary, in both productivity and their social effect.

The quarter century 1955-80 provides insight. Comparing electronic data processing as it existed in the early 1950s with data communications as they exist today is like comparing horse-drawn transportation and the railroad. Not only is the user's perspective changing but so is the perspective of the provider, or information-processing industry, changing. In the United States, for example, an estimated 4,000 companies are active in communications and the manufacture of computers. Some 750,000 people are employed in the two fields. Computer companies do a $30-billion business in the United States and a $60-billion business worldwide.

The reduction in cost of information storage is best shown by the fact that over the past 25 years the price of stored information has dropped from $1,000 to $1 per bit (binary digit). This is not an across-the-board figure; if a similar development had occurred in the automobile industry over the same time span, we could now purchase an automobile for about $50, and by 1982 for $5.

We saw that Sears catalogs may someday be sent via Viewdata. Where will they be stored? Initially, because the price of stored information keeps dropping as new technologies are developed, the catalogs will be stored briefly at a central computer. The optical disc pioneered in the United States by Magnavox and RCA can store up to 500,000 pages, and a single disc the size of an LP record costs $16.

The information provider must think in these terms and in what they mean for the future. Rather than dismiss the treatment of information in this manner as a flash in the pan, the potential user should keep in mind that Viewdata will offer a record the user can conveniently look up, compare, and evaluate and then decide what use to make of the information. The user can then link this to other services such as banking, or even conduct family business from the user's home rather than queue up.

Paying the Bill

With computers and communications, as with any other man-made product, the price must be paid. That is why tariffs are set. As far as Viewdata is concerned, some answers to questions about cost can be given, based on the British experience. But first a distinction must be made between information providers and end users.

For the end user, an obvious cost item is the terminating equipment (receiver/transmitter). This can be an ordinary TV set, albeit a TV set with a difference. Add-on circuitry is necessary. Who pays for this equipment?

If Viewdata is to achieve the goal of allowing executives to work at home, a company must allow a subsidy, such as buying the in box or even a new set, and deducting the cost as a legitimate business expense. Clearly, a considerable part of the cost must be borne by the information provider, who can be large or small, a business or an industry, a private party, governmental bodies, or such institutions as colleges and universities—any organization that makes data available to the public. Information providers pay Viewdata for the privilege of inputting information in the system, of storing data in computer memory, having it transferred over a telephone network, and making it accessible to any user who inquires.

Querying is the main issue, since information providers benefit each time subscribers view a page. It is, therefore, proper that information providers determine a value for each page. In the British experience, this cost has ranged from zero, in the case of advertising, to 30¢ for pages with commercial value. A typical per-page cost is 1¢ to 8¢.

The charges paid by end users are discussed below. First, let us add another cost distinction. Because Prestel is an independent profit center within British Post Office telecommunications, and must be financially self-sufficient, there is a difference in charges between Viewdata and telephony. The BPO taxes both the information provider (for storing data) and the user (for accessing it). The cost to the information provider may be divided into three parts.

First is the standing charge. Each major information provider is allocated a three-digit number, which is the root of IP's tree in the Viewdatabase. IPs are charged $8 per year for a Class A standing charge (disregarding for the moment concessionary interim arrangements valid to April 1980).

Second is the charge per frame, and third is the factoring charge. The charge for commercial frames is collected from the user by the post office, which passes it on after deducting a 5% factoring charge to cover bad debts and the cost of billing. The standing charge is made as part of the contract, and covers one year of operation. But the BPO has been talking of fairly substantial discounts available with longer-term contracts, as is the case in the computer rental business. (During the trial period the standing charge was $500 per year; the charge per frame was $2 per year during the same period.)

The standard charge varies according to the type of storage. Two classes of service have been established—A and B. Class A applies to pages that will be duplicated in regional computers. Class B is for less frequently accessed pages, which can be stored in a data warehouse. The $8 charge is for Class A, plus an annual rental of $8 for each page of information stored in the system. This is referred to as the charge per page. (There is a 200-page minimum per information provider.) Discounts of 25% and 40% are offered for contracts of three and five years, respectively.

For Class B service the charge is $2, plus an annual rental of $2 per page. The BPO, however, levies a charge of 1¢ each time that a user inspects a page. The lower rate reflects the relatively low expense of a central warehouse.

The usage charge covers the expected cost of communication between the warehouse and the satellite computers. The warehouse will probably be used mainly for reference material, such as electronic encyclopedias that can be left unchanged in the system for considerably long periods and inspected only infrequently. The data warehouse is a large central storage place for pages that are infrequently inspected; therefore, it is not suitable for duplicate storage in all local computer centers.

Even in Class A service the BPO charges the information provider about one-half cent each time a frame is viewed, but this is deducted from the per-page charge in the free pages. Additional, as yet undetermined, charges are being proposed for such facilities as response frames and closed user groups. Because the BPO wants to encourage VDB updating, there is no charge at present for the frequent updating necessary to keep Viewdatabase current. Airlines could use free pages for their schedules. Advertisers could use them for various forms of communication, for instance, in radio and television programs. Government agencies could use them for public announcements.

One information provider will be Telco itself, which intends to use Viewdata to modernize its traditional services, for example, automatic directory assistance as an adjunct to the telephone directory. Beginning in 1981, all telephone subscribers in Ille-et-Vilaine (a French city of about 240,000) will no longer receive printed telephone directories. Instead, they will get a minivideo with keypad, which will enable them to query a remote computer and obtain the telephone number and data they need relative to any other subscriber.

Expansion of systems of this type requires capital. The BPO has approved a sizable investment program, and millions of dollars have been spent to place Prestel in London, Birmingham, Manchester, and Edinburgh. An additional $40 million has been earmarked for extending Viewdata service to Cardiff, Glasgow, Leeds, Liverpool, Norwich, Nottingham, and other important urban centers. To provide full nationwide service in Britain alone may require more than $200 million over the next three years.

Connection Charges

The end user also pays part of the charges, starting with the charge for installing the system. The installation charge is $30 and is paid to the telephone service, not to Prestel. To help the user know what the cost is, each Viewdata page carries a price tag in the top right corner. Charges appear on the monthly Viewdata bill, along with the telephone usage charge.

A uniform per-frame charge of 1¢ was suggested for all pages, whether routing or filials. Then someone got the idea that the user should not have to pay for advertisement pages; the information provider should. This creates problems if the selection is done by the end user, as opposed to routing advertisements to an in box. The way things now stand, the British Viewdata user pays the stated variable charge per frame of 1¢ to 8¢ but with a range of 0¢ to 30¢, depending on the type of service the user wishes to access. The user also pays for telephone time. Given the way data travels on the line, though, this is minimal compared to an equivalent voice conversation. Another way of stating this is that when Prestel is actually used in the home or office, the charge is at the local telephone rate. In addition, a small charge is levied for the Prestel service itself. The system, however, always indicates how much each page will cost before it is called.

We have already seen that, while the user is connected to the Prestel computer, three separate types of charges are incurred: a local telephone call charge for the period of connection, a timed charge for the period during which the user is logged onto the Prestel computer, and a charge on each frame by the information provider. The charge was 4¢ per minute when service began, but the price structure is likely to depend heavily on future usage patterns. The computer gives each user a running total of the amount spent on each call, as well as the total billing for the current quarter.

Home Computers and the Income Tax

As a new service becomes established, price structures must be revised. This is true of both utility charges and the equipment itself. Existing, standard color TV sets, for instance, sell in Britain for $600 to $800. Used with Prestel, a modified TV set costs about $1,000. The difference is reflected in the cost of the Viewdata black box.

The price structure, however, is rapidly changing as the technology advances and the market expands. At the same time that prices are dropping, the price of the all-important service features is increasing. Here are some examples. When Viewdata is first offered in the United States, the cost of the in box is expected to be $200 to $300. But as the market develops, the price may fall to the range of $100 to $150 or lower. Utility charges in the United States are approximately normal at this time. The cost of an hour's computer time with the Source (discussed in Chapter 8) during off-peak hours (6:00 PM to 7:00 AM weekdays, and all day Saturdays, Sundays, and holidays) is $2.75, or 4.6¢ per minute. The charge, however, is presently $15 an hour, and the one-time hook-up fee is $100.

Use time is automatically recorded by the source's computer center in one-minute increments and is billed directly to a major credit card account of the user's choice. Knowledgable users, however, can reduce these charges by using such devices as an on/off personal computer at home or in the office to supplement the on-line databasing this service provides. What is actually needed is a link to the telephone line, a microproccessor, and some local memory. A personal computer can be programmed to support these services. Because the user has a personal access code, the privacy of stored information is ensured.

As Viewdata service, and services like it, develop, manufacturers of portable terminals and communicating personal computers will likely be eager to interface their units with telephone lines and TV sets, thus providing the basis for a distributed home-information system.

Tariffs and taxes will play a major role in what happens next. Because subscribers are charged on a call basis only if they access the system, a locally installed system should be more efficient to the user—and, in the long run, cheaper. As almost everyone was taught in school, taxes are an essential part of economic life. For that reason, it is worth noting what view the Internal Revenue Service (IRS) takes.

Using Datavision in compiling income taxes is a good example of personal service that may qualify for special treatment. All the user must do is load records into memory and transfer them to a blank diskette, producing a permanent record of all the user's personal (or business) financial transactions categorized to make retrieval a simple routine at tax time. Such use of Datavision is cost efficient in several ways. The average family today is not well organized for record-keeping; it does not have the tools to properly fill in the myriad forms required or to properly file the necessary documents. That is why there is so much last-minute rush and confusion in filing income tax returns. Personal computers can store and retrieve updated information on tax deductions, and thus can save taxpayers money.

It appears, too, that the cost of a personal computer is tax deductible to the extent that it is used for computing one's personal taxes. Should the cost of locally installed equipment also be tax deductible if one uses a utility such as Viewdata? The answer would seem to be yes—if it weren't for the precedent of phone bills being part of a business but not being tax deductible for families. The tax laws should be changed to correct this situation.

6 Business Services

An advanced technology such as Viewdata could not have been developed without the growth of VLSI circuitry and the consequent decline in prices. The decoders, vocoders, modems, and other electronic equipment to be incorporated at each station cost something. For such technology to gain acceptance, the price must be right. Standardization is important to businesses; but standardization is not easily achieved. Thus far, no agreement has been reached on a keyboard for the message service. A decision on the type of allowable local intelligence equipment within terminals is still pending.

People with small businesses are not concerned about designing computer-based support systems—nor should they be. What they should be concerned about is a reliable, low-cost facility capable of taking advantage of technological advances that will make it possible for them to reach clients. Figure 6.1 shows a low-cost, small-business system for handling a payroll, with video, keyboard, floppy discs, and printers. Data entry, order-handling, credit-debit card-handling, cash management, authorization, billing, accounts receivable and payable—all are problems that occur in small businesses. Value-added networks are well advised to focus on them.

This is what Viewdata is doing. Efforts in the United States are being made to implement the British patents. Wholesaling resources are being made available to corporations wishing to support their own Viewdata service, whether within the firm or to clients and suppliers. These resources are intended to serve as a utility and to provide hardware and software support to users, leaving the Viewdatabase under the control of the organization that leased the resources. Retailing and home market resources are being offered not by British firms but by a "computer host"—a large, multinational firm yet to be announced.

Other American projects are aimed at the home user. Prestel, however, is not among them, having chosen instead to emphasize

the business market during the first phase. There seem to be several reasons. One is that there is no national PTT organization in the United States to support the effort, as there has been in England and Holland. Another reason is the U.S. regulatory situation, which has no parallel in Europe.

Retailing is what interests most people in small business, and it is to that concern that this chapter is devoted.

The Business Viewpoint

As is evident in the British experience, the introduction of Viewdata was significant for the business community. From marketing information to airline schedules, from manufacturing to service industry guides, foreign exchange rates, and product promotion, thousands of pages on the Viewdatabase have immediate, practical relevance to the conduct of businesses.

The business person with a Viewdata set in both the home and the office will have constantly available the information in the Viewdatabase. Because the service is based on existing telephone lines, it can operate two ways and reach many people. Therefore a company can sell goods and services off the screen to Viewdata users. This is equally true of individual consumers, as well as other businesses, suppliers, manufacturers, and service and marketing centers. Viewdata makes it possible for a company to have its own network-linked, programmable terminal. Assisted by solid-state software, these terminals are easy to operate. Programmable terminals can take programs directly from the Viewdata computer and make them available for regular offline use by employees and management. Programs are readily accessible for stock control, billing, letters to customers, accounting, and administrative tasks.

As countries adopt the Viewdata concept, the service will become a medium for international, two-way communication. By circling the globe Viewdata will access information stored on computers everywhere within seconds, through the wideband channels made possible by satellites.

Let's return to national—indeed, local and regional applications. Here, too, wideband communications will be ensured through advanced technology. With the capacity of transmission channels increased, and costs contained or even reduced, the following Viewdata-based, small-business transactions will be typically available:

account processing
credit-card handling
credit and collection
statement printing and mailing
remittance processing
invoicing
accounts receivable
preparation of management information and statistical reports
promotional mailings

These are services the personal computer can offer stand-alone, locally, and at reasonable cost. Viewdata and personal computers complement each other; they do not conflict. They are the two phases of Datavision and should be viewed as such.

A Case Study in Health Care

Health care is America's largest industry. Let's follow a Viewdata scenario for a pharmaceutical management and drug-interaction system. This study uses as a background a service launched about three years ago. Datastat, as the system is called, is the result of a four-year effort by members of the professional medical and pharmaceutical staff at the Medical University of South Carolina. When I visited National Data Corporation (NDC), Datastat pharmacy installations were already in operation in six states and in Canada.

Intended for the modern pharmacist who needed better management through a computerized system, Viewdata and similar services will enable pharmacists to maintain patient profiles, screen prescriptions, do private and third-party billing, control inventories, and analyze drug interaction. Viewdata service also offers unique features designed for modern medical and pharmaceutical needs.

A Datastat with add-on visualization capabilities Viewdata offers the drugstore manager a computerized guide to drug interaction, allowing the automatic screening of a patient's prescription for allergies and drug interaction and overlaps before the prescription is filled. When a patient presents a prescription to be filled, the computer has the patient's prescription record and medical history on file for instant reference. Compliance with the physician's prescription is enhanced by automatic notification to the pharmacist of patients due for a prescription refill or by screening those who attempt to have prescriptions refilled too soon.

Viewdata can help maintain a pharmacy's drug inventory. The system notifies the pharmacist when to reorder an item before the supply is exhausted. It also provides current cost information for inventory and pricing purposes. In addition, new prescriptions can be entered automatically in each patient's record file and in the complete inventory record. At the end of each month the service provides an itemized billing statement for each customer and gives a purchase summary (again, for each customer), which becomes an invaluable record for income tax purposes. The system can also handle third-party billing claims, yielding a significant reduction in errors and processing time required.

Following are demands faced by pharmacists, which Viewdata can answer:

1. *Economic control.* Inventory investment; consistent, positive pricing; efficient utilization of personnel; automation of third-party billing; profitable government programs; effective credit management; total financial knowledge.

2. *Health care*. Complete patient information; university health bases; numerous drug interactions; immediate patient instructions; continual medical revision; generally, screening of medication for patient allergies, overlap, and interaction with other medications.

3. *Online updating capabilities*. Updating profiles; correcting inventories and alerting of items in low stock; determining prices according to a formula based on current acquisition costs; producing accurate third-party authentication and pricing; placing charges in private accounts or in appropriate third-party claim files for producing automatic forms; providing suggestions for patient counseling; printing labels and receipts.

Both the drugstore manager and the person in small business will, through Viewdata, benefit from opportunities in the developing electronic funds transfer (EFT). The opportunities range from such applications as credit-card authorization (Master Charge and Visa, for example) to check cashing (verification and guarantee) and bank debit card usage (Entree and Signet) to data capture, credit card billing, deposit reporting, cash management, available balance, and wire transfers. Incidentally, NDC has already achieved such service through its network. This involves some 560 savings-and-loan associations with more than 4,300 branches.

In this program, travelers who have a Prestige Card (issued by individual savings-and-loan associations in more than 45 states) may call a toll-free number maintained by NDC. To obtain emergency cash, the traveler receives the name, address, and business hours of the nearest savings-and-loan office that honors the Prestige Card. Other services include authorization, cash management, pay by phone, and customer-oriented supports, such as phone ordering, sales and customer prospecting, emergency product services, consumer assistance, nationwide answering service, hotel and motel reservations, and embossing and mailing.

In effect, Viewdata can support any application that is practical on a terminal device. Among the options that could become a must for people with small businesses are the aforementioned financial services, provided at an acceptable level of reliability and availability, and modular hardware and software with access to multiple databases operating 24 hours a day. For small businesspeople, Viewdata marketing will parallel the growth in mass merchandising taking place in the United States. Consumers, reacting to television or print advertising as well as other mass-merchandising concepts, now order frequently via telephone. The telecommunications network is designed to serve this market, and Viewdata provides a way to put the network to profitable use.

Add-On Services

We have discussed some aspects of long-haul Datavision and have looked at a practical example of Viewdata effectively helping the manager of a small business. Throughout, the high points were to proven technologies; but there is also the possibility of using a broad line of other services once the transport network is in place, such as the following. The *scrivophone* permits drawing pictures and transmitting them by voice line (reception is by video screen). The *picturephone* requires 1-MHz channels, which are the equivalent of 300 voice lines. This is the main factor inhibiting the widespread use of the device. The *videophone* is broadbanded, but it can also use voice-grade lines with frame-freeze images. *Low-speed TV* is a kind of video-implemented facsimile currently marketed under two names, phone-line television (PLTV) and lone-scan television (LSTV). Present technology permits 80 lines and 8 shades of gray; development of the process should raise the capability to 525 lines and possibly 50 shades of gray.

The equipment needs for LSTV are fairly simple: a monitor, not necessarily microprocessor-supported; a compressor through which flows video information to weed out redundancies; a modem; an expansion module to bring the transmitted data back to video form; and a memory.

image
compress
transmit
receive
decompress
restore image
project

The market for these devices includes security and protection, field operations, and the transmission of documents, checks, and signatures. The reason why these procedures are being given so much attention today is that technology has made it possible to meet each opportunity as it develops. Microprocessors are adequate for dedicated applications, and, in contrast to mainframes, reduce costs. Specialized computer power in a specific application eases environmental constraints.

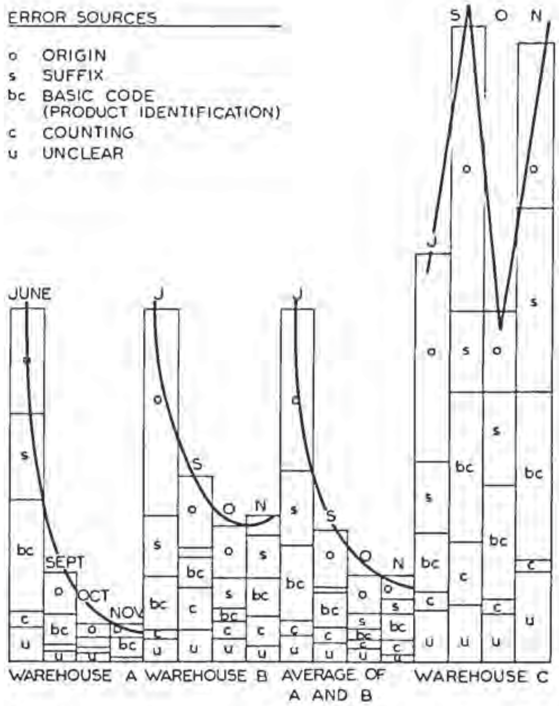
What has been learned through hard experience in both large and medium-sized enterprises is that quite often computer installation in a complex environment has failed because of difficult conditions and because the prerequisites for successful operation were not given. Complex software is difficult to produce, and problems are likely to occur. A central computer cannot efficiently handle simultaneously, both batch and online, terminal work stations, processors, copiers, and transmission units.

Microcomputers dedicated to one job, that communicate among themselves through network services, can be much more efficient. Even so, failure to follow the recommended preparatory steps is the best guarantee that a particular system will not work satisfactorily. One of the main reasons is errors. Error rates in data processing throughout business and industry have increased alarmingly in recent years. Rates of 7% are commonplace, and rates of 14% are not exceptional. The solution is both procedural and organizational. Computers only magnify the effect of errors; they don't correct them.

Figure 6.2 gives the results of a study in which errors were tracked and corrective action was taken at the source of the errors. The company (a leading electrical supplies manufacturer) was confronted with 35 million errors per year.

Facsimile

Facsimile is the process of copying, of reproducing information. The first experiments in transmitting fixed images over great distances occurred about the middle of the 19th century and preceded by some two decades the invention of the telephone. The original work was done in England and led, in chronological order, to telephotography, the transmission of meteorological and nautical charts, and document facsimiles over telephone lines. Basically, the pro-



6.2. Effect of Reorganization in Two Model Warehouses.

cess occurred in three phases: (1) scanning the image to be transmitted; (2) transmission over a telephone line; and (3) registration of the image at the receiving end.

Scanning involves a survey of the image or document, at 3 to 4 lines per millimeter. Modern techniques call for flatbeds, which permit higher speeds. The document to be transmitted—say, a 210-by-297-millimeter page (DIN A4)—is scanned horizontally or vertically at 3.85 lines per millimeter and at somewhat less than 1 million image elements. Developments in message transmission include, among other things, two types of facsimile messages—very fast (less than 10 seconds per page, DIN A4), and slower but high-quality, high-reliability units.

Products are coming fast. Xerox recently announced a transmitter/receiver priced at $3,000, which operates at 250 kilobits per second, with low wattage (4/100 watt) to minimize the potentially hazardous effects of microwaves.

Both in-house and remote copiers must be able to duplicate and transmit documents consisting of text and graphics. In new models, individual functions have been combined, in which the transmitting copier has been fused with local copying operations and with the work-station function. Text quotations can be generated on a word processor by using stored text segments. A data sheet with photographs and diagrams is prepared at the printer's. Then the text and data sheet are jointly enveloped through an electronic service, scanned, and transmitted successively by a remote copier. Photographs are treated like graphs; they are integrated with alphanumeric data and transmitted with minimal redundancy. Image processing, both local and remote, is an interesting development important, for example, in the assembly and inspection of products.

The objective in producing facsimiles is to interpret pictures in order to ascertain whether the shape or position of a product meets specified standards, and to detect faults that humans cannot detect by inspection. Image processing originated in the area of engineering studies. Handling was and is done by computer. Working with simple video sketches, design engineers produced complete documentation for mechanical components, which were then drawn up and filed. This is an excellent example of interaction between people and information. Data must be addressed and retrieved. The creative work of the designer is assisted by the computer.

Design automation has been developed over about 10 years. Once it is developed, information can be shared by designers far apart, with data transfer taking place by means of computer-based systems. Professional people will appreciate this capability. The handling of images was once a technology reserved for the few; it is now available to many people, and the impact will be widespread.

The Technical Angle

When a technology is confined to an exclusive group, it is easier and simpler to manage and is characterized by a lack of standardization. Widespread use of a process means that enforcable standards must be maintained, and that is now happening with facsimile.

For reasons of standardization, the International Coordinating Committee for Telephone and Telegraph (CCITT) has divided facsimile terminals into three groups: (1) terminals that transmit in analog form a document in about six minutes; (2) terminals that transmit, also in analog form, a document in three minutes by means of band compression; and (3) terminals that transmit in digital form in less than one minute. The devices in group 1 are currently the most numerous, although they are not compatible among themselves. No matter which group they belong to, however, facsimile devices are simple; the user does not have to code the information to be transmitted, and the machines do not require specialized personnel.

When the integrated data-and-voice network, with a capacity of 64 kilobits per second (kb/sec) or more, reaches users in the 1980s, transmission of a DIN A4 document should take no more than 3 seconds; this transmission could occur during short breaks in conversations—and therein lies the importance of group 3.

Facsimile transmission can be used to convey tables, drawings, signatures, diagrams, and figures. The modern digital facsimile (group 3) can be integrated with general data transmission networks. At the transmission level it can use the same lines and same modems. At the terminal level the facsimile device can be viewed as an economical, efficient printer. At the computer level it is possible to build up banks of images that can be stored along with numerical data. At the node level store-and-forward capability can be applied, along with message- and packet-switching.

Fascimile systems have been implemented in noncomputer-oriented environments. They are the foundation of electronic mail systems now in development and of tomorrow's automated office. Presently, about 160,000 units are in operation in the United States, including an estimated 100,000 low-speed transceivers capable of sending a page in four to six minutes. Virtually every major company uses facsimile to transmit advertising, engineering, and legal documents. Some, such as Bethlehem Steel, use several hundred facsimile units to enter orders.

In the office of the future, facsimile will be of prime importance in collecting, processing, filing, outputting data and images—in effect, transmitting any kind of document, whether text, photograph, or drawing. Ideally, text and image are handled by the same work station, using the same hardware and software components. To do so, office tools are required; more important, however, are the procedures that help make a system effective.

It should also be added that some of the companies exploring the usefulness of electronic mail are getting together to solve common problems. One such group is based in New York and includes Exxon, ITT, Citibank, Aetna, and Equitable. The companies meet informally each month to discuss electronic mail and the feasibility of automating offices.

Facsimile may be viewed as an adjunct of copying, in which a unit is reserved for local copying during the day, whereas, at night, a single copier receives a few hundred pages.

Wideband communication allows a copier to produce an image remotely at the same speed at which it produces a copy locally. The emergence of such a unit was inevitable. At the speed at which facsimile images can be transmitted, it is likely that electronic mail networks will spring up that may include, in the first phase, the top 200 American companies and a similar number worldwide. By connecting major operating centers, these companies can manage a communications network of unprecedented size. This development also has significant implications for the home market—which brings us back to Viewdata.

Britain is planning to implement a full-scale electronic mail system over the next few years that will operate when the telephone network is not normally used, from late night to early morning. We spoke of this in discussing the transmission of electronic mail over home TV sets. The user not interested in a particular mailing can easily identify and destroy it, while retaining the option of reviewing other messages. Messages the user is interested in can be displayed (in color) on the TV set in a manner similar to that of Datavision. When the user wishes a hard copy, a low-cost facsimile unit does the job.

Teletext

In Chapter 2 we define Teletext as the TV broadcast solution to digital information, a process similar, in its technical aspects, to Viewdata. The same principles are involved in Teletext, as is much of the circuitry. The difference between Viewdata and Teletext is that, instead of transmission over a phone line, in Teletext, it is through a television station, and instead of Viewdata's sent-receive, Teletext is one-way.

Besides not being interactive, Teletext has available only a limited amount of data for transmission. But no modems are necessary; transmission is synchronous. Data integrity is maintained through the use of Hamming codes in the control fields. In television transmission, a period is provided for field flyback in receivers. This requires 25 lines, some of which are used for such housekeeping purposes as testing. Two lines can be allocated to Teletext for transmitting data at the rate of 7 megabits per second. Also used is the television signal's vertical blanking interval. This transmission is picked up by a decoder and displayed on a screen. Teletext pages are broadcast sequentially at the rate of 4 per second. Each page is numbered serially, and there is a slight extension in the limited number of pages to be handled by subpages similar to Viewdata frames.

Both broadcast and narrow-cast (distribution-list) capabilities are easily handled through Teletext facilities. The merger of data, voice, and image has an evident impact on the processes that have so far been based on speech–for instance, news by announcer Teletext frames, which carry the time in the upper right-hand corner. This is a four-digit code that can be used as an alarm clock or for programming the TV set to acquire a page at a time specified by the user. Teletext also makes possible a "newsflash," which is superimposed on the usual screen, thus allowing the user to receive news immediately.

In spite of these facilities, Teletext service, because it remains in the hands of broadcasters, has limitations. The TV set is just a reception device; it is not a send-and-receive terminal, as is the case in Viewdata. The only interaction possible is the transmission of data to users. As we saw, the number of pages that can be broadcast on spare TV lines is limited; but Teletext is low-cost. An hour's service may cost $20, whereas time for a television channel may run more than $20,000.

Although the service is handicapped by lack of interaction, the possibility of imaginative usage exists–for example, the uses now projected by some American firms. The Microband Corporation of American intends to demonstrate its ability to transport business data in 1 of the 45 cities where it now distributes pay-TV programs by high-frequency broadcast. Their programs are broadcast over a higher part of the spectrum than is allocated for normal television channels. The signal is scrambled so that only those subscribers who pay a monthly fee can receive the signal. This channel could also carry business data. At present, Microband is a one-way service, but the company claims that firms requiring short responses to a heavy outflow of data to branches can be accommodated in the future.

Teleconferencing

One of the most talked-about business services in the computer era is teleconferencing. Although the adage, "communicate, don't commute," may never be fulfilled, and although teleconferencing's contribution to the alleviation of the energy problem may be minimal, the potential for teleconferencing is promising—a solid contribution to answering the needs of management for long-distance communication.

The main experience in teleconferencing thus far was Project Prelude, an experiment conducted in late 1977 and early 1978. It was a success, and both the participating executives and the technicians who organized and worked on the project were excited about it. The project manager was IBM; the satellite facility was contributed by Comsat; the computer was contributed by Hewlett-Packard; and some of the communications hardware (including frame-freeze images [FFI]) was produced by Japanese companies. Participating users were Montgomery Ward, North American Rockwell, and Texaco. The objective of the experiment was to integrate the mainframe and distributed system software with teleconferencing.

The operation was point-to-point. At each point, or location, all incoming users were registered. Copies of registered users were transmitted from computer to computer and kept in local memory. Remote retrieval of information was tested in order to evaluate the ability of future systems to: address databases, have information identified immediately, retrieve and transmit from one conference site to another, and to make files available to authorized network users. The bandwidth successfully tested was 2.5 megabits per second, and the effective data rate was 1.54 megabits/sec. Although this is 30 times faster than the current, typical data transmission rate of about 50 kilobits per second, the 1.54 is clearly possible.

On the basis of information gained in the project, the consensus is that technology once expected to be available between 1981 and 1983 is available now in 1981. The few technical problems that appeared were minor and had to do with ground stations and the diameter of the dish provided by Comsat. Perhaps the most interesting innovation was frame-freeze images, chosen for reasons of bandwidth limitation and communication costs. Teleconferencing can be conducted using full motion or frame-freeze images. Because an attempt was made in the project to optimize the transmission of voice, facsimile, image, and digital data through modems operating at 1.54 to 2.6 megabits/sec, it was necessary to conserve on the most resource-consuming item—the image. (The 2.6-megabits/sec modem is at the limits of technology and is used mainly by the military.) The FFI was updated each time something changed in the room (for example, someone coming in or a graphic display being shown). Each color FFI was transmitted via Communications Technology Satellite (CTS) in one-half second, versus two and one-half minutes for standard telephone lines. The frame-freeze process was controlled by a simple console at a conference table. Also available for transmission were prestored frames on video discs, since frame-freeze images show not only conference participants but charts and other visuals.

Another key component tested in Project Prelude was facsimile transmission. In the project, facsimile transmission took 20 seconds per page, but speeds of one-half to one-tenth that rate are foreseen for the 1980s—making facsimiles an important alternative to present methods of document distribution.

Visualization will play an increasingly important role in conferencing, especially among remote sites. Exxon is evaluating the use of video conferencing for its offshore drilling platforms, as well as for its offices in New York, Houston, Toronto, and Calgary. Various applications are possible. Some user groups may wish to review and discuss in detail reported financial results or a forthcoming budget. Other departments may wish to relay visual and graphical information from remote locations to headquarters.

As today's practice of distributing data-processing soft copies develops, video conferencing may eventually penetrate home and office markets to the extent that practically everyone will have a TV terminal. As costs drop with each technological advance, we can afford to have our own private visualization devices, attach them to a reasonably low-cost optical disc drive, and create an interactive unit with a sizable memory.

7 Whitbread

What we have been discussing so far is the Viewdata technology, how it works. Now we must turn our attention to the needs of the business community. I hope the discussion thus far has convinced the reader of the efficient structure and basic simplicity of the services made possible by the new technology. To present a well-rounded approach in terms of Viewdata applications, it is first necessary to present a real-life study.

The first company to use an in-house Viewdata system and gain experience with it was Whitbread, a brewer with depots and plants throughout England, who has served the British market since 1742. I visited Whitbread in September 1979 to get first-hand knowledge of its operation. The first application of the system was for management. It was the beginning of a decision-support system. Here is what people involved in the use of Viewdata over nearly three years thought of the system:

1. It is easy to use.

2. There are no complicated manuals to deal with.

3. Passwords can be implemented, thus making the system more secure.

4. Coded response is available when needed.

5. There is little resistance to computers.

6. Color and graphics are available.

7. The system has been proved successful in numerous applications.

8. A facility is provided for demonstration and presentation purposes.

9. Experience can be gained with management information systems (MIS).

10. The cost is reasonable, hence, relatively easy to budget.

An impressive list of benefits for such an early stage of a technology. Users, no doubt, will encounter problems. A large proportion of them will likely occur in bringing up the editing capability of the system and in setting databases in a rational manner. As with all information systems, it is not a question of equipment. In the case of Viewdata, the challenge is not to produce adequate software but to design the database and find the expertise. Industrial companies and financial institutions wishing to gain experience with Viewdata and to take a major step forward in developing their information systems should concentrate on tuning their databases. They should start immediately on a limited basis and expand as results come in.

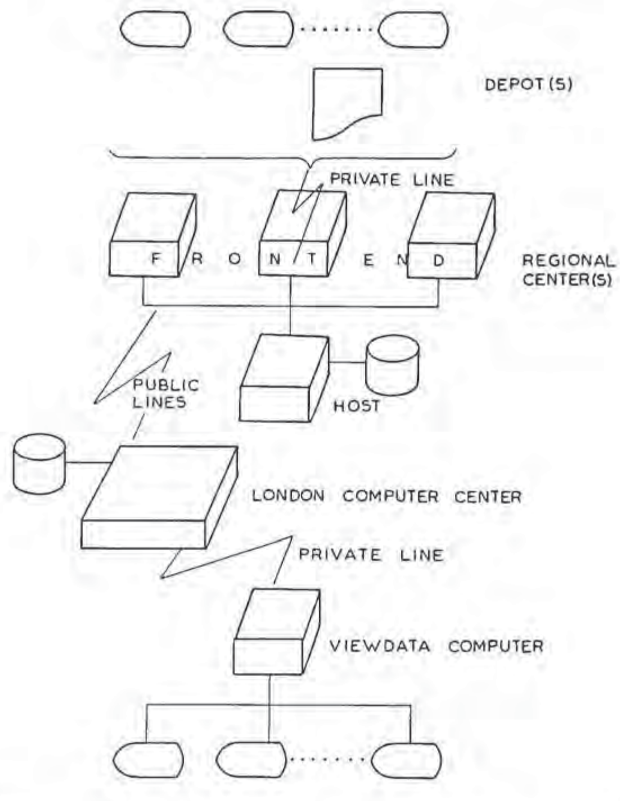
The Whitbread Structure

To follow the Whitbread experience correctly we must first look at the company's organization and structure and at the role information systems have played in this organization and structure. Whitbread operates seven plants in England, each with its own mainframe-computer center and three front-end computers, plus a spare machine. Whitbread also has 40 depots scattered around the country, each served by an online, computerized, order-taking system. At the end of each day the files are updated. The "stock by product" indicates: stock on the floor as of the end of that day; final orders for the day are packed for expediting the next day; tentative orders (that is, those awaiting completion of the previous day's orders); and new stock (essentially, new balances). The depots are connected through private lines to one of seven computer centers. Also, between two and six video units and a printing facility have been installed locally. The operations are interactive. In addition to reporting stock levels, the system ably handles client management. This allows salespeople operating the video to be active, rather than passive, order takers. They can call clients, tell them how much time has elapsed since the last delivery, the probability of their inventory being depleted—in general, do a good direct-sales job.

In operation since 1974, the system has served the depots and sales functions well. As with any information system designed for field operations, however, headquarters must also do its part, and that does not necessarily include the simultaneous use of modern tools. There are no exceptions to this rule; it is a general one. In most industrial firms and financial institutions, senior-management information has long been printed-batch output, with all the delays, errors, and lack of visibility that characterize computer-run, hard-copy reports. Management pays for the computers but rarely receives service that corresponds to the cost of the computers. All we have to do to see the truth of this is to look at any industrial product. Automobiles followed the design of coaches. The procedures used in accounting machines were used in early computers, along with the costs, errors, delays, and inefficiency that for a quarter century characterized computer usage.

For some time at Whitbread, the central function followed classic reporting procedures; that is, they were performed on paper. Nevertheless, the central function has an important task to perform, one that is largely interactive–root supply control. Root supply control involves the central department coordination at the national level of production requirements, including production planning and inventory control. This particular department concentrates on sorting out problems that may be due to the extra demand caused by a heat wave or that may be due to the breakdown of an information system or a production facility. In order to act, the central department must have information. The information available on realtime at each of seven computer centers must be transmitted to the London headquarters. Public lines are used (Figure 7.1). Until the introduction of Viewdata, implementation ended at the London computing center. Although the depots are linked to regional computing centers through private lines, the centers transmit to London over public lines. This was a good choice. Because the regional databases stand alone, the typical hour-long, updating message is sufficient, and makes feasible the use of preferential rates.

Data was sent to the center in the form of printed reports. As practically every industry and financial institution that uses printed computer output knows from experience, this form of transmittal is characterized by delays and errors. In Chapter 6, I mention a research project that I participated in with a leading West German company in the early 1970s, in which a 7% error rate due to data input was established. When I mentioned this statistic in a seminar a year later, the chief executive of the French firm involved remarked: "That's good. In my firm we experience a 14% rate." Swedish hospitals cited in a study done in the midsixties stated that roughly 7% of the laboratory analyses were erroneous.



7.1. Private and Public Lines: from Point of Sales to Top-Management Presentation.

A Crucial Problem

The crucial question in Whitbread's central department was, Where was the stock? Until 1977 all data exchange between headquarters and the depots was on paper, a situation that had to be corrected—and fast. An early demonstration of Viewdata by the BPO was timely. Although Viewdata's potential for internal use was clear, a complete system study had to be done first. Specialists at Whitbread correctly divided the operation of the system into two phases, which we will follow in some detail as we discuss interactive MIS. The first priority was to make sure the service would be not only guaranteed but improved; only then could features be added.

The experience gained in installing the information system was put to the fullest possible use. The stock file run by the front end was consolidated for that area on the regional mainframe. (Because of the preferential telephone rates, the file was transferred at midnight over public lines to the central mainframe, about two miles from headquarters.) At the central computing center the information was integrated with the entire span of operations, and stock positions were established.

Between 3:00 and 4:00 A.M. the consolidation program taking place in the central machine was completed, and the results were piped to the Viewdata computer at headquarters (for the use of management). This communication takes about an hour and a half over a private telephone line (a measure of the amount of data being channeled). The Viewdata software at headquarters is run on a Data General Nova machine. A DG Eclipse machine of identical configuration is available for backup and development work. This is all the equipment needed at headquarters to operate a well-equipped Viewdatabase. The 24-inch TV (videocolor) screens dedicated to the Viewdata system are online to the Nova machine. Each screen has a numeric keypad, and some have a badge (discussed below).

Developing an Interactive Management-Information System

The most difficult aspect of studying computers and communications isn't the hardware but the machine within the machine—the operating system, drivers, monitors, supervisors, and applications programs which together constitute the software. Viewdata's contribution to Whitbread's operation was the provision of a readily accessible, efficient, easy-to-use software package. It thus became possible to devote attention to a vital matter often overlooked: logical understructure.

Because the Viewdatabase structure is an integral part of the system, emphasis was placed on the next most vital problem: paging the data related to product analysis (quantity [how much?] and depot [where?]); the total deport picture; and the product within a production area. The resulting Viewdata-supported management-information system, known as DAISY (for "*da*ily *in*formation *sys*tem"), has been operating satisfactorily. Formatting and paging are done at the central computing mainframe in London before the Viewdatabase will be accessible long haul.

Five screens are available to senior management at headquarters. Since considerable experience has been gained, direct, online, Viewdata service is now being extended to outlying areas. Until the data load in a particular region justifies an installation for that region, the Viewdatabase will be accessible long haul.

At the beginning of phase 2, the thinking was that one person in each company should be responsible for that company. This would be the role of the seven video units located around the country, which were hooked up to headquarters. Each could dial Viewdata during the day. The system permits a regional user to access only those pages that belong to the user. That way, the data-protection option is maintained.

With this development, Whitbread, using standard batch and online information procedures and two levels of consolidation, could handle three levels of detail: national (consolidation and detail at headquarters); regional (consolidation and detail); and depot (detail). The foundation of the Viewdatabase structure has been demonstrated by the system's performance. Pages that go to the center are not the same as those that go to the seven companies. The latter pages relate only to each company's depots. Finally, the color capability of TV sets has been used to its fullest.

Management Reaction

Viewdata is a way to answer management needs for an interactive information system capable of presenting both data and graphics in an easy-to-access, timely, and accurate manner. As the Whitbread experience documents, electronic files for office automation, personnel information, business planning, management graphics, and financial information are good candidates for Viewdata application. More generally, everything in a computer file can be consolidated and shown using this system. In fact, phase 2 includes the implementation of business-planning and -management graphics on Viewdata as the system becomes capable of greater graphics support. Graphics are already used to produce stock data. Business data will require rethinking the presentation of graphs, since those currently used with paper do not fit a TV screen.

Whitbread Viewdata can access Prestel directly by dialing the computer number. Because this was an early requirement, the format is compatible with Prestel: 24 X 40. Whitbread's position today with regard to Viewdata can be summed up as follows:

1. Management requirements were satisfied.
2. A low-cost, interactive facility was provided.
3. The system is simple and effective.
4. Developments in communications, speed, screen size, and so on must be continued.

In short, the user must keep abreast of the movement of technology and steadily gain from experience.

What has been achieved so far is the development of an in-house Viewdata system that is fully self-contained and capable of extracting data and using the data at various levels of security. The equipment is diverse: color TV by General Electric; black-and-white screens by Pye; modems by BPO; minicomputers by Data General; front end and maxicomputers by Honeywell. To make the system easier to use, tests were made to determine how long the system should leave a page up before automatically removing it (five minutes). The period during which the screen stays on appears to depend on the amount of use. A slightly more sophisticated version is now available, which offers two and even three levels of cutoff. Other improvements have been made in such services as message-switching, to replace Telex. The in-house Viewdata system at Whitbread has a special page dedicated to messages.

The Viewdatabase at Whitbread

The Viewdatabase at Whitbread is currently 2,000 pages, with a maximum of 7,000 pages, which needs a 10-megabyte disc, including routines. Whitbread has on the Nova a 96-megabyte disc for compatibility with Eclipse; thus only a small part of the storage is needed to hold the Viewdatabase. A port is available for each regional coordinator, some 13 terminals are operating, and there is no bottleneck. If, say, 10 videos are on the same port, an "engage" signal can be provided.

Developed privately, the security system uses a magnetic strip called a badge reader for identification. To gain access to the system, the user must insert the badge in the reader, located next to the TV set. If access is not authorized, this message appears on the screen: YOU REACH UNAUTHORIZED INFORMATION.

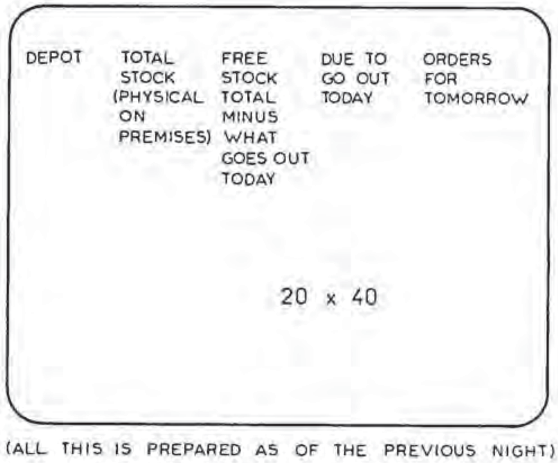
In its present configuration the system works well and the pages are secure. They can be available, as instructed, to one person, to one person plus selected people, to a group of people, or to an entire department.

Balancing Inventories

Let's take, as an example of the in-house application of Viewdata, the balancing of inventories. There are two ways of handling the inventories, actively and passively. In the morning, executives responsible for the inventories look for existing problems and try to solve them; in the afternoon there is more and different work. In the passive method, people call to state their problems, and the Viewdatabase permits a close look at possible solutions.

Figure 7.2 shows headings for inventory management. Color will be used if the inventory falls below a three-week level. When inventories are depleted (for order intake compared to expected delivery), the screen presents a color signal.

Histograms can be presented for the use of managers, one of whom identifies earnings per product in terms of materials, wages, management, distribution, taxes, and dividends and retained profits. This is equally true of graphs, which help management make decisions. In the case of Whitbread, because beer ages, it is efficient



7.2. A Viewdata Page for Inventory Control.

to plot barrels against time (the weeks ahead), based on mathematical extrapolations prepared at the mainframe.

All this adds up to a well-designed decision-support system based on easy-to-use software.

In-House Versus Public Viewdata Service

The prospective user of Viewdata systems has available three options. One, the user can subscribe to a national service when one is available, it now is in England and soon will be in the United States, West Germany, Holland, France, and Switzerland. Two, the user can purchase an in-house system and use it for all applications, employing the security and protection features available in Viewdata. Three, the user can buy several Viewdata systems and dedicate each system as needed, either geographically or by function.

These options are not mutually exclusive; if anything, they supplement each other. When an in-house system is installed, it is important that the choice of hardware-software package, and of the facilities that support the system, meet the information needs of management. Another way of stating this is that, although Viewdata systems are now marketed to the public, they are not necessarily compatible or even comparable with each other. Whitbread's Viewdata software allows a user to go backward and forward, which is an extremely useful feature. The backward-and-forward feature, as well as the ability to jump a page and enter the system either through menu selection or by directly calling the desired page, are important in making the system "user-friendly."

Many users are now accustomed to printed computer output that runs to as much as 132 columns of print. This amount of output cannot be squeezed into the 40-column Viewdata TV set or even into the larger 80-column, standard video unit offered by computer manufacturers. The video units need to be redesigned. To make the transition easier for the user, the units should include such features as a single functional key to provide continuity of page presentation. This situation suggests that standardization has not yet been achieved. Some Viewdata systems include routing frames but are less flexible than other systems in the design of their information frames. Still other systems lack such features as bulk updating; in addition, the database is configured differently, which means that the system is more complex.

All Viewdata versions currently available, however, allow response frames and the handling of television software, or "telesoftware." Telesoftware is important to the small firm and the private user, because it allows downline loading, usually of one-page-long programs upon client demand to handle local needs as they develop. Thus a combination of Viewdata and related solutions becomes feasible, placing in the hands of the user the benefits of both a public computer utility and a private system. Private systems permit greater control over user access. Although there are costs associated with both public and private systems, and although these costs are better distributed throughout a utility grid, public systems clearly have some advantages over private systems, in terms of options.

Many companies regard Viewdata as a field of continuous development in which system improvements are continually under appraisal. This activity includes research in personal computers, the incorporation of low-cost microprocessors, and novel approaches to terminal design, including voice-response technology and software distribution, combined with local intelligence for terminals.

British users with Viewdata experience emphasize the need of evaluating the cost of systems and frames. For a private system, total system costs—for example, processors, disc capacity, ports, peripherals, and staff costs—should be considered. Whereas costing for a public system is simpler, volume of usage is a big factor and can tip the balance.

The dichotomy between a public system and a private one isn't as clearly defined. It is well to remember here that the Prestel public utility, with about 180 information providers, supports 180,000 pages, for an average of 1,000 pages per IP, with a 100-page regulatory minimum. Whitbread, with 2,000 pages on its private system, is fully justified financially. This conflicts somewhat with the argument I heard in London that it is probably worthwhile considering a private system if more than 40,000 frames are required. Because so many more important factors are involved, however, the argument is virtually meaningless. We still have much to learn about cost effectiveness as the development and use of Datavision continues, for both Viewdata and personal computers.

Depending on the application, an important cost factor may be editing. Editing costs include the cost of staff, equipment, and time spent on the telephone network accessing computer ports. A possible area in which to reduce costs is for a company to use its own internal communications network for accessing.

The Security of the Viewdatabase

The security of the Viewdatabase must be ensured by providing password and user-access codes, a requirement that becomes mandatory when the Viewdata system is used to process a variety of information, such as personnel, budgeting, and management-planning. For instance, one manufacturer I know of has incorporated a number of security devices to ensure that access is limited to people authorized to access particular grades of information. An unauthorized user is prohibited from viewing pages of classified information or even to know that the pages exist.

Different advantages characterize the GEC 4080 private Viewdata system currently offered on a Data General Nova minicomputer. The system includes editing facilities for creating pages faster and simpler; for bulk update and retrieval of Prestel pages, with error detection and correction; for creating pages of characters in 24 European languages; and for file management, including page archives.

In gaining experience, the user will probably find additional facilities that are convenient for the user's purposes, which the available software does not support. For example, Prestel does not update a page on the screen, whereas Viewdata is kept current. It is handy to have a facility (not yet available) that allows a REPEAT operation to refresh a page from the memory. Equally handy is the provision for looking back at the preceding page and advancing the current page by giving the command, "1."

In some applications there may be a need to use intelligent terminals capable of accessing pages of telesoftware. These short programs, stored as Viewdata pages in a central minicomputer, would effectively convert a local terminal into a multifunction microcomputer adapted to the requirements of the end user. Another user requirement might be more sophisticated control of the Viewdatabase and related editing facilities. Both the minicomputer and the microcomputer can be configured to allow bulk updating and retrieval from a public utility computer, so that the user can maintain pages and edit them offline. Pages may also be created by direct input from a mainframe; the Viewdata system minicomputer should permit this capability.

As experience builds up, most users will wish to create their own Viewdatabases. The necessary software must be able to (1) interpret the input file and exercise a certain degree of selectivity, (2) create a Viewdatabase according to a set of rules, and (3) contain the output routines needed to drive the target Viewdata system. The major components are a report writer capable of translating logical, structured data into the Viewdata screen format and the capability of building and maintaining one or more indexes to the data and mapping everything into Viewdata tree structures. The report writer should be able to:

fully exploit the Viewdata screen format
present the data in a clear and concise manner
incorporate data headings
define multiscreen layouts
reflect color, character size, and background color

control record and field positioning
perform case conversion
control logical page and frame breaking
control line and page overflows
build spontaneous continuation frames for continuation data
handle graphics and alphagraphics

Another essential facility is an indexing and frame-mapping system capable of building one or more indexes to the data, with each index containing multiple key terms in addition to building sublevels where there are more key choices than will fit on one frame, creating an escape routing and a routing to response frames, mapping onto Viewdata page numbers, and ensuring housekeeping routines for removing unwanted frames.

This discussion of hardware and software is intended to be constructive, in the sense that the development of support equipment for Viewdata is far from over, that significant advances are yet to be made. The best way to start is simply to start, making improvements as you go along, although not too frequently, because stability is most important in system development.

The Challenge of Intelligent Terminals

The original concept of Viewdata was based in part on the use of the television set as a terminal. The TV set was chosen for two reasons—low-cost data processing and its potential for the mass marketing of information. Research is currently being done in adapting, modifying, and developing the TV set to provide a range of terminal hardware to meet the requirements of in-house systems and other office Viewdata systems. The best chance of sparking the domestic market is by introducing a terminal into the home for business purposes that, in addition, is capable of meeting the information needs of the customer.

New, 50-inch-wide TV screens for home entertainment will be introduced. Because of these screens, popularly known as "video wallpaper," TV sets will never look the same again. The flat screens will eliminate the bulky picture tubes typical of set design since the birth of high-definition television. Three-eighths inch front to back, the new screens can be used with virtually any size picture, from a pocket model to a 50-inch screen that can be hung on the wall. An alternative is desktop operations that should result in increased demand for small-screen color terminals (14- to 16-inch) suitable for use with plug-in peripherals, such as keyboards, ROM/ RAM memories, printers, and interterminal communicators. Some in-house systems are expected to incorporate the larger (20- to 26-inch) color screens.

Color and graphics will likely dominate client demand within a few years. The saving in cost of a black-and-white system is relatively small, although, if the receiver is located on a desk, screen size will be a factor, as will compactness and human-engineering design.

Pye is marketing a compact, black-and-white terminal that incorporates a keypad and offers such pushbutton features as top of screen, bottom of screen, revert, Prestel hook-up, and hang-on. The first two functions allow, respectively, magnification of the top and bottom halves of the screen. Because the terminal lacks a color capability, however, Pye will probably have to settle for the standy-by and monitor markets. Other custom-made keypads have keys for such functions as "add 1 to page number", "subtract 1 from page number"; "take back to log on page" (present password); and "add-on".

Intelligent terminals will include a wide variety of hardware packages, thus creating market opportunities for suppliers. Such terminals will be necessary for various markets, including business, entertainment, education, and security control. Editing terminals ranging in size and complexity will have three basic components: (1) a microprocessor with an editing program, (2) a set of color display electronics for a monitor, and (3) a QWERTY keyboard with an editing program. The microprocessor is capable of controlling various peripherals—a floppy, for low-cost data storage, a printer for hard-copy documentation, and other editing peripherals. Frames are created on the monitor; when completed, they are assembled and moved to the local storage medium. When all the frames for updating have been completed, the Viewdatabase is called up and all the data is transferred to it.

8 Homevision

We have already discussed the information utility and the types of business services it can provide. If our experience with the telephone is any guide, the impact of the information utility on both workplace and the home will be profound. In this chapter we consider in greater detail those features of current facilities that are directly related to the family-based information utility: a data warehouse marketed by a network developed in the United States, and a related feature—the next generation of television. Then we take a look at integrating the Viewdata utility, merging home and office into a well-knit information service.

In the nation's capital, for example, the day of merging home and office has been brought nearer through the agreement signed by WETA-TV, Washington's public broadcasting station, with the Canadian authorities. The Telidon system has been selected for the Videotex trial which is about to begin—a half-million dollar contract won be Telidon over competitors such as the British Prestel and French Antiope.

A mistake often made in assessing the future impact of a new technology is to examine, separately and in isolation, its possible effect in the home and the office, leaving aside the relationship of one to the other. From this relationship, however, springs the great variety of support that Viewdata can provide. Another mistake is to view information services as they exist today, ignoring, for the moment, the fact that they are increasing in number, size, extent, and sophistication. That is why, in Chapter 9, before discussing the cost of the bill the information provider and the ultimate user must accept, I offer a perspective of the direction these services may take. A price is paid for certain facilities; success or failure may depend on whether the help offered the user by these facilities exceeds the cost of the facility.

Still another mistake often made in assessing a system has to do with the privacy made possible by the system. A service so intimately a part of the home or the office should have provision for privacy and security. When the user realizes that success is likely to depend on how certain the user is of the exclusivity of the data, he or she may begin to view the data as a vital resource.

Whenever a database is publicly accessible, there should also be the impetus to improve security and dependability. As a public offering, Viewdata will have millions of authorized users when it reaches the public. At that time the need for privacy will be tremendous. Therefore the basic steps must be taken now. Under normal conditions, password arrangements such as the personal identification number (PIN) may be a sufficient deterrent to improper access. Inevitably, however, cases of truly sensitive information will occur that are best handled in as secure a manner as possible. If this is not done, the drive to implement such a system will be hampered by a lack of confidence.

The Source

The facilities of Viewdata are likely to have a profound impact on American life. Once such facility, a service of the Telecommunications Corporation of America (TCA) called "The Source," is designed to tell users practically everything they need to know—whether it is energy-saving suggestions, theater guides, horoscopes, wine guides, weather information, financial data, sports, information about hobbies or biorhythms, help with schoolwork, information about continuing education courses, advice on home finances, instructions on repairing a car, or up-to-the-minute news. Through the facilities of United Press Internation (UPI), TCA's "Source" will help prepare income taxes, find the best buys in local stores, or give advice on how to cook a gourmet meal. Like Prestel, Source provides all kinds of information.

TCA will make available throughout the United States some 2,000 computer programs, to be distributed to homes via Telenet's packet-switching network. The service is already operating in the Washington, D.C. area—the area nearest Silver Springs, Maryland, the base for Source. Source has been taken a step further than

Prestel, as far as home use is concerned. It will present electronic games, including Star Trek, backgammon, Monopoly, chess, football, baseball, basketball, blackjack, and roulette. In the sciences, Source will provide a valuable learning experience for computer hobbyists and students, who can design and run their own programs in several programming languages, including expanded BASIC, FORTRAN IV, and COBOL. Small businesses can use Source to handle various accounting and management functions, such as accounts payable and receivable; general ledger; payroll; inventory control; prospect, customer, and sales lists; order entry; sales commission reports; and cash-flow analysis.

The reader may ask why, if TCA's Source offers these services, we did not start with this example of Viewdata and not with the British Prestel. The answer is: years of experience. Source was first announced at the National Computer Conference in June 1979; indeed, the service became available on June 5. For Prestel, the feasibility study was done in 1972, and service has been offered to a controlled user group since 1976 and to the general public since early 1979.

The Source is Viewdata. As with other online utilities, the user can gain access to Source's facilities and the information programs it offers by having a personal computer hooked up to a network operated and supported by TCA. All the user needs to do is dial a special toll-free telephone number and place the telephone receiver in a coupler next to the computer terminal. As a prerequisite to gaining access to the utility, the user must have a home computer with a keyboard terminal, screen, and telephone coupler; the printer is optional.

Viewtron

One system already in operation in the United States is QUBE, a Warner Communications subsidiary. Operating in Columbus, Ohio, the system is a combination television set and computer. By pushing a few buttons on a small control box, the subscriber is connected online via a two-way television system. A two-way TV is also in operation in Berks County, Pennsylvania. On cable BCTV viewers are linked via their sets. Farmers can get answers to specific problems from experts, and students can talk to teachers. In 1980 AT&T expects to offer a service similar to Viewdata to households in a major metropolitan area. This service is expected to be offered in cooperation with the Knight-Ridder newspaper chain, which in 1980 will begin testing a two-way, interactive, home information system to determine whether the public is interested in such a service. Knight-Ridder plans to invest $1.3 million in the project, called Viewtron, involving 200 Miami families over two years. Teletext system tests are under way at KSL-TV in Salt Lake City and at KMOX-TV in St. Louis. Apple Computer recently announced its intention to join Dow-Jones in a venture. Dow-Jones will provide access to its archives of stock exchange quotations and similar data, and Apple will provide the network software. This service reflects Apple's penetration of the market. A program soon to be launched by Apple will allow the user to obtain stock quotations for all shares listed in the six major U.S. exchanges. Apple and Dow-Jones foresee an initial tariff, as well as a service charge (as a function of usage duration).

Other companies, including publishers, newspapers, and radio and television chains, are contemplating similar steps involving Viewdata. The service may soon also be used for databanks by such companies as Dun & Bradstreet, AT&T's Yellow Pages, and market research organizations. Telidon, a Canadian Viewdata project, uses a PDP-11 as its computer gear. The pilot phase has about 3,000 pages, and the Canadians use a different image technique than does Prestel. The user inputs the information, and the computer composes the image. The disadvantage here is that it is not possible to use a home TV set; one must have a special CRT unit (a similar format to Prestel's first offering in the United States).

In the British implementation (and thus the American, German, Dutch, Swiss, and Hong Kong implementations), Viewdata uses a character-oriented protocol. Telidon, however, uses a bit protocol. The difference is fundamental. The British developers point out that bit protocols are more flexible but much more expensive, that byte-level approaches still have a competitive edge. Character-oriented systems, the Canadians maintain, restrict the information displays to fixed-format, textual messages and are limited to the display of rudimentary graphic images. Once a large number of terminals using these character-oriented communications and display techniques are in homes and businesses, it will be difficult to change the communications methods, even if they allow the transmission and display of higher-quality images.

PCNET

The personal computer network (PCNET) is operated under the auspices of the PCNET commission. The commission has fixed communications protocols among personal computers that use modems and telephone lines, and has provided a set of rules governing the functioning of the network.

The first effort in this area was by a personal-computer group, the Chicago Area Computer Hobbyist Exchange, or "Cache." Other PCNET user groups are functioning in San Francisco, Los Angeles, and Atlanta. The idea behind Cache is simple and appealing. Computer hobbyists have long wanted to link several computers in order to exchange information and programs. This is much more a desire to establish tribal communications digital style; once rules were established, a bidirectional, structured communication facility could be set up that is capable of providing a standard for personal computer networks throughout the United States.

Another approach to personal computer networks is that of the Amateur Radio Research and Development Corporation (Amrad) in McLean, Virginia.

Although technology is marching straight into the American home, the laws and regulations governing the technology in the United States remain an obstacle to Viewdata and similar services. It is easier and faster for Viewdata to gain acceptance in countries where a communications carrier has a virtual monopoly and is not barred from offering computer facilities to users. In Chapter 5 we discussed regulated communications and services and the nonregulated computer products that are important in the development of Viewdata. In network design we must make sure that users, whether they are specialists or end users, view a computer and a communications network as a single machine. Such a machine is better planned and implemented when designers, rather than regulators, determine how it works.

This coin has two sides, however. In American business, regulation and competition must coexist. There is always the possibility of computer equipment manufacturers, computer service firms, manufacturers of TV sets, publishing companies, the Bell System, GTE, and other carriers, as well as organizations with large databases, competing for the potentially huge home market.

The Next Generation of Television

The coming battle for the personal-computer market won't end with data communications. The ultimate market has hardly been touched, with most developments lying in the future. Today, 90% of the telephone business is voice and only 10% data. But the volume of data communication is growing rapidly, according to some estimates, at the rate of 50% a year. Beyond data and voice communication is image communication, and that means another domesticated product: the next generation of television.

Cable and satellite transmission are attractive. New superstations could broadcast nationally by using satellites to relay signals to cable systems. Audiences could record shows for later viewing. Low-cost, prerecorded programs may be purchased. Along with the new data capabilities, a video revolution is on its way, with experiments in two-way television being conducted. Such systems should be capable of providing up to 30 channels, broadcasting first-run movies and educational shows, supporting all-day programming for preschoolers, transmitting live sports events, and ensuring uncensored adult entertainment. All broadcasts will be provided to users without commercials.

The day when satellites broadcast television directly into the home has drawn closer with the development of a mass-produced, low-cost receiver. Satellite receive-only dishes have been designed that will sell for about $70. In the planning stage for home use is a dish-shaped antenna that can pick up signals from communications satellites and thereby receive programs broadcast from anywhere on earth.

A unit delivered by the Hughes Tool Company to the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center has been used with an antenna and amplifier to receive TV signals from a particular transponder of a broadcast satellite. The unit is a prototype of the inexpensive models expected to appear during the 1980s. Rooftop terminal gear is expected to become commonplace in many countries by the mid-1980s.

With a two-way capability, and using telephone lines, viewers can participate in television games, shows, and political debates. Professional people with special interests will be able to receive programs specially tailored for them, in addition to communicating with the sources of the programs. Development of VLSI-based communications technology will continue throughout the 1980s, and many personal-computer systems should emerge. Computers will become a standard part of the operations of companies, as well as becoming commonplace in the daily lives of individuals. Computers will be used as the first stage for further development, while maintaining daily routines.

Improvements are already coming fast. The next generation of television, announced in West Germany, includes stereophonic sound. Also, a system now available in Japan permits viewing two programs simultaneously by patching a small black-and-white picture into the corner of a large color screen. The small picture can be used to pick up another TV channel or to monitor an apartment building lobby, an office entrance, or an infant's room. Cable TV has shown the way: clear signals. Clear signals can be used everywhere—in the home or office, by families and business, for security purposes and for the transmission of data, voice, and images. Cables used to distribute TV programs—both broadcast and pay—can also be used to expand communication facilities, thus paving the way for microcomputers that can communicate with each other.

No emerging market in recent memory has excited industry more than the home computer market has. This market is expected to have annual sales of $1 billion by 1982 or so. The market faces competition, however, from cable TV and from the makers of programmable video games, all of whom are searching for a profit niche.

Programmable Video Games

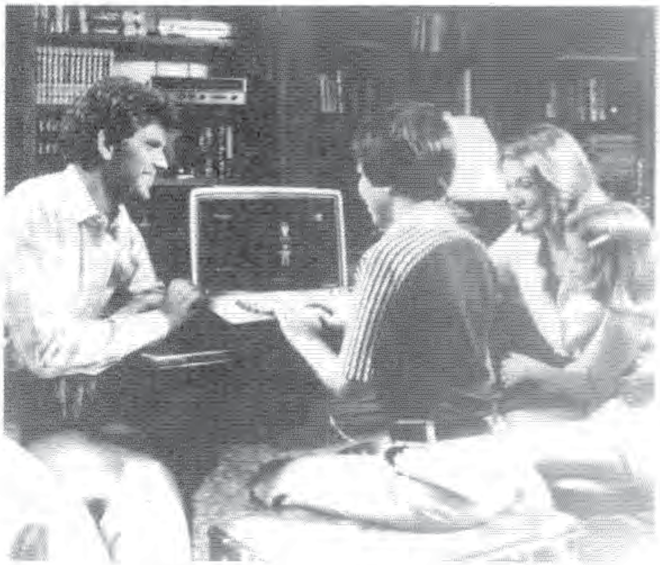
The programmable video games industry has been striving to expand the market for products that plug into TV sets. Mattel and General Instrument Corporation have developed a system called

PlayCable, which will be used to distribute games and informational programs to home terminals via a cable TV channel. PlayCable was test marketed using four cable TV systems. The initial offer included some 20 programs, not all of which were games. Included, for instance, were educational aids for children, foreign language courses, a physical fitness plan, and a tax preparation guide. A library of about 40 programs will be made available to consumers, with some packages changed each month. The programs will be transmitted in a loop over a cable TV channel.

Manufacturers in the field are developing comprehensive program libraries to, for example, serve the adult market and teach children (Figure 8.1). Changes of great social significance are approaching. Fairfield University, in Fairfield, Connecticut, has projected a "new rural society" assisted by electronic services, with the object of revitalizing America's rural areas. Microprocessor-supported games are an indication of things to come. In 1978 fewer than a dozen such devices were on the market, and most of those were designed for young children. By late 1980 there will be numerous games and instructional programs for adults as well. The latest generation of electronic games does not tie up a television set, as did the earlier generation of video games. Battery-powered, the new ones are highly portable, and many of them can be used by individuals playing alone. Sales of hand-held electronic games at the manufacturing level increased from $21 million in 1977 to more than $400 million in 1979.

Electronic games and programs are being purchased because they are, as one person in the field said, "electronic with a certain light-and-mirrors excitement." The impact of this technology may not at first be clear. Simplicity is the guiding principle; all the user must do to select a program is turn to the designated channel which, like Viewdata, displays a menu of available software, and make a choice by keying in the code number on a hand-held 12-kay pad. The microprocessor-based terminal takes the program the next time it is transmitted and stores it in its memory for later use.

Mattel views the home terminal as a springboard to the home computer market. In November 1979 the company introduced a full-keyboard microcomputer unit priced at about $250 that can be combined with a terminal to form a home computer. Atari, a Warner Communications subsidiary, is working to develop a sys-



tem similar to QUBE. The QUBE interactive system, which gives the user the capability of instantaneous communication, could make Warner the leader in the field. Meanwhile, General Instrument and Atari have joined forces to produce a one-way service for home users.

Eventually, cable TV could lead to cable operators supplying information services similar to those supplied by Viewdata to individual people over the operators' networks, in competition with Telco wire services and broadcast facilities. Again, the home market is the target. The next generation of television will make generous use of do-it-yourself facilities in the form of home video recorders. Although this facility is growing in popularity, its potential is more distant and has yet to be realized.

The video display disc is a useful add-on communication system. Costing about $600, video disc recorders have become popular among American consumers since their introduction in late 1978. The cost and quality of recorded television performances have contributed to their popularity. As we will see in Chapter 14, the key to this new market is economical storage media. An optical video disc is similar to a long-play record; only, in the case of the video disc, both audio signals and visual images can be stored and broadcast using a TV set. The recording and replaying of video programs will become as commonplace as owning a TV set. Within easy reach will be a data-communications facility to serve people and businesses.

Merging Home and Office

With an interactive facility, and on the basis of computer and communications technology, Datavision should become the foundation of many new services in homes and offices. Some examples are electronic shopping; electronic message-sending; electronic polling; communication for the ill; personal computing; paper copying; automatic reading, for example, of electricity, gas, and water meters; automatic triggering of fire, burglar, and accident alarms; transmittal via mobile sets from automobiles, trains, and boats; and connection with terminals.

As described in this book, Datavision is a microprocessor-based service that allows a broad, instant choice of information in some ways more intimate than the mass media has known to now. The mass market for Viewdata is the servicing of residential and consumer applications. Two-way interactive utilities, however, also present many business opportunities. Both residential and business markets may expect convenience, the availability of vast quantities of information. Information providers will make sure that the data stored on the computer at Telco's switching center can handle subscriber requirements and keep information current.

The computer-managed storage capacity of a Viewdatabase permits comprehensive files to be accessed. People at home or at work will be able to make inquiries. While online they can input to the computer their own data for use by other business or residential users. True, in the early stages, much of the information to be accessed online will be available in printed form. But computer and communication systems may be substantially less expensive compared with the price of a book or a periodical, which must be updated regularly to remain current, and then must be distributed. With Viewdata, the user pays a few cents for a page of information.

The Viewdata system is also available online when needed; users do not have to call only at certain times or wait for the distribution of a newspaper, periodical, or other printed material. The argument can be made, of course, that a newspaper, book, or periodical is cheaper for the publisher—and it can reach a broader user market. But what about the user?

The virtually unlimited storage capability of computers permits handling a great variety of information needs. Nor is Viewdata limited to simple information requirements; programs have also been designed to focus on step-by-step problem-solving, including tax problems, financial requirements, and social services. With its ability to break down information into small, cross-referenced divisions, Viewdata has a much greater potential than would at first be evident, particularly for small businesses, which cannot themselves afford expensive, complex computer systems. That is why its impact is likely to be greater than was perhaps envisioned in the original concept developed in the early 1970s.

Let us also not underestimate the range of applications available by accommodating closed user-group services, which permit access only to those users whom the information provider has authorized to have access to a particular service. Financial and commercial news services; brokerage networks; travel agency bookings; and insurance, banking, and similar business requirements fall in this category. Closed user groups are potentially a major market for Viewdata services, allowing organizations with common interests to access part of Viewdata on a restricted basis while, at the same time, sharing a common database. This kind of service is applicable to several problems, among them the transfer of funds electronically. Using Viewdata, British Airways and Barclaycard are devising a plan whereby users may pick flights or vacations by scanning the appropriate database. Users are then given the option of direct booking, using their Barclaycard numbers, which can be handled online immediately.

The potential is great. If public systems have a significant potential, so do private systems. Viewdata may soon permit mass merchandisers regular access to pricing changes. The same technology may be used to bring suppliers and consumers closer together or to make more convenient and efficient such functions as money transfers. Viewdata has made possible a broad range of new applications and new jobs, a range that is limited only by the human imagination. The microprocessor will not destroy jobs; instead, it will transfer them from, perhaps, manufacturing to various forms of intellectual activity.

9 The Personal Computer

We have already seen the impact of the domesticated computer on our lives, and have looked at specific examples. Until recently, however, we have focused on Viewdata—the central information utility. Now it is time to take a closer look at stand-alone computers. In this and succeeding chapters we will be concerned with the other side of Datavision—the personal computer.

Personal computers make possible the distribution of computer intelligence at the individual level, that is, the level of the ultimate user. In late 1978, Dr. Julius Aronofsky of Southern Methodist University drew the parallel between the pocket calculator explosion of the early 1970s and the advent of the microcomputer in the 1980s. Will personal computers experience the same public acceptance? The answer was "Why not?", given the capabilities of current computers, their accessibility and availability to everyday people, and their size and price. On the basis of cost alone, personal computers will likely be the bargain of the decade.

Because many terms in the literature on computers mean different things to different people, let's pause a moment to establish a working terminology. What is the difference, say between a *micro*computer, a *mini*computer, and a *maxi*computer? A microcomputer is essentially a chip connected to a microprocessor designed to perform a certain function. In this sense, it is a machine-within-a-machine and has preprogrammed features that microprogram at the bit level. This microprocessor may take the form of read-only memory (ROM or PROM) or of random-access memory (RAM or live memory) but be driven by another machine. The microprocessor has no stand-alone capability. It is a component of a channel, disc drive, camera, sewing machine, microcomputer, and so on. A microcomputer is a complete system that is programmable by human users. It has input and output devices, arithmetic and logical units (ALU), a central memory (even multilevel with megabytes of RAM), a communications capability, interrupt features, display or displays, control functions, and a bus (usually of less than 1 MBPS).

We have spoken of the difference between a minicomputer and a microcomputer in terms of cost. Technically, a microcomputer is slightly less complex than a minicomputer, although in the late 1960s it was difficult to tell the difference between the structure of the minicomputer and the microcomputer. Microcomputers are more densely integrated than minicomputers, as well as more modern in design. This is also true—and important—when minicomputers are contrasted with maxicomputers. Because most mainframes are designed according to architectural principles dating from the late 1940s, the latest principles—those that strongly influence circuitry—have not always been used to full advantage. In the new architectural concepts, use has been made of know-how that yields greater efficiency. Design philosophies have become interactive. The use of higher-density components permits new approaches. Definitions of machine capability change with time because the technology is changing so fast.

What, then, is a maxicomputer, or mainframe? Among other things, it is a complete system, but one with a difference. A maxicomputer is programmed by a specialist. It drives other machines, such as minicomputers, microcomputers, peripherals, and terminals, with full input/output (I/0), with a central memory at *n* megabytes (soon to be 8, 16, or 20) and multilevel memory (discs, tapes, and mass storage), usually at more than three levels.

A maxicomputer is supported by sophisticated software, including operating systems, virtual storage, multiple high-level languages, and networking. Its central processing unit (CPU) can handle several million instructions per second. Its bus runs at the rate of two, three, or more megabits per second. Unfortunately, its relatively expensive resources are, more often than not, misused.

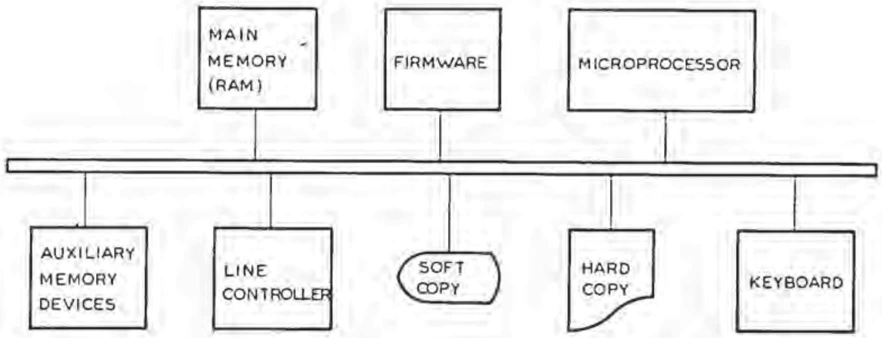
The Size of Personal Computers

Due primarily to the tremendous advance in semiconductor technology, the maxicomputer is becoming the minicomputer, and the minicomputer is becoming the microcomputer. Soon it will be the picocomputer, which will be capable of doing what microcomputers do today.

In the late 1960s computer designers were still working with 1-kilobit chips. Then came 4- and 16-kilobit chips and, in 1978, the 64-kilobit chip. The 1-megabit chip is now being discussed as a possibility, albeit a remote one. Between the 1-kilobit chip and the 1-megabit chip lie three orders of magnitude. By the late 1970s the density of components was doubling every 18 months. In the decade of the 1970s, disc capacity tripled every five years.

If computers in general have resulted from technological advances, the microcomputer (read: personal computer) has been the child of the semiconductor. The first microprocessor was developed for use in a small desk calculator designed by Intel for a Japanese company in the early 1970s. The aim was to build a calculator from a custom LSI chip. As so often happens in design, the result was a small, general-purpose computer component, the Intel 4004, which, through programming, soon became a special-purpose device. The 4004 was a four-bit chip and served a special purpose. Given this success, however, Intel went no further. The next microprocessor product—the 8008, an eight-bit device—was packaged and along with RAM and I/0, by Control Logic.

Thus was born the microcomputer (Figure 9.1)—a microprocessor with a clock, control circuits, memory, and I/0 devices. A new machine based on the microprocessor has been built, but with the capabilities of a computer. The key components of a personal computer are a microprocessor (the basic machine); a bus; a keyboard (basically alphanumeric, with function keys as an option); a main memory (RAM) variable in size between a minimal and a maximal configuration; firmware or hard (solid-state) software; auxiliary memory devices, such as cassette, floppy disc, cartridge, or even discpack drives; serial (or even line) printers; television video monitor and display capable of supporting upper- and lower-case graphics and gaming elements; and a line controller (for communications). The main memory usually consists of semiconductors, but bubble memories (first marketed in September 1978 by North American Rockwell) will soon take their share, especially since March 1979, when the developers of the bubble memory, Bell Telephone Labo-



9.1. The Microcomputer.

ratories, announced significant improvements. Step-ahead speed has been surpassed by one order of magnitude and density by a factor of 4.

The Do-It-Yourself Kit

The first microcomputers were introduced as do-it-yourself kits. The industry began in 1974 when MITS, of Albuquerque, announced the Altair 800. The unit cost less than $400. Interest ran so high that several thousand were quickly sold to hobbyists, along with the Imsai 8080 (at $440). The pioneering Altair 800 was soon replaced by an improved 800a and 800b. Between 1974 and 1976, numerous other kits were introduced. The most popular were based on either Intel's 8080, Motorola's 6800, or Zilog's Z80. An early kit was the Poly-88, produced by Polymorphics Systems. Originally called the Micro-Altair, its name was changed because of trademark infringement. In those early years of the microcomputer, two other products based on the 8080 were introduced—the MM-1 by E + L Instruments and the MCEM by Hal Communications. The MCEM-80 wasn't a kit; it was marketed fully assembled and tested, requiring only a terminal and connection to a power supply. It had 1 kilobyte of RAM and 1 kilobyte of ROM. MCEM-80 featured

TTY I/0 and ASCII/Baudot terminal capability—all for $375. Digital Group and Technical Design Labs offered Z80-based processors for a similar price.

One of the lowest-cost 6800 kits available during this time was American Microsystems EVK 99, which sold for $135 in basic form. And there was KIM-1, a fully assembled and tested microcomputer with a hexadecimal keyboard and display, cassette interface, and two programmable internal timers. Apple Computers has marketed a computer similar to KIM-1; but Apple's is on a single card. The base price of $666 included four kilobytes of RAM, a video interface for convenient plug-in with a TV, and some other popular features, such as a cassette interface, which by 1980 were standard. Finally, Southwest Technical pioneered TV typewriters.

The first personal computer as we know it today was introduced in 1977. In 1978, 250,000, worth $350 million, were sold. It is estimated that by the end of 1978, 500,000 personal computers had been purchased and installed. This figure, however, represents only 1% of American households. Sales for 1979 were approximately 500,000 personal computers, with an estimated value of $500 to $600 million. With more than 40 companies making microcomputers, competition is fierce. For users comes the inevitable problem of choice. In response to such a bewildering array of personal computer systems, users—both current and potential—have joined to form the Association of Small Computer Users. The association plans to provide benchmark comparisons of competing systems, a users' information exchange, and publications aimed at helping users assess the personal computers that are available.

The personal computer is based on the microprocessor. Trends at the microprocessor level are, in themselves, amazing. In 1978 about 1 million units were produced, and for 1980-81, 5 million units are expected to be produced. A sharp reduction in prices has affected the picture, however. We have already noted that, in the case of maxicomputers (mainframes), between the early 1950s and the late 1970s, the cost of one bit of stored information dropped to one-thousandth its original cost, while storage volume dropped to one-eight hundredth. By 1984, one megabyte of central memory will cost $400, against nearly $1 million in the early 1960s. By late 1979, Intel had brought to the market the power of the once-potent IBM 370/138 on chips connected via a bus line. IBM itself has announced a machine with the power of its smaller (and older) machines: the 1401 on a single chip.

The same situation exists with respect to minicomputers. The cost of a configuration has gone from $40,000 in the early 1970s to $10,000 in 1978 and to roughly $5,000 in 1980. Costs, particularly, those that are dropping, are the primary impetus to the market's explosion relative to a certain product.

What Is a Personal Computer?

In the current perspective, which could change under the impact of technology, a personal computer is essentially a stand-alone, general-purpose system small enough to be used at home or school or in professional work. As a stand-alone device, it is interactive with its terminal or terminals. The machine is personal, both in terms of its application and in the sense that the user need not be a computer professional. It is a general-purpose machine because there are no special restrictions on its use. The main difference between a personal computer and a minicomputer is the cost of the device relative to that of the other device. In the 1960s, DEC defined the minicomputer as a system costing less than $100,000. Today, a fairly well-equipped personal computer costs less than $5,000—and a basic one costs less than $1,000 (Table 9.1).

The cost of all such devices continues to drop. The personal computer, however, like the minicomputer, is a complete system, not just hardware, consisting of facilities, hardware, and software (programming products), and the necessary maintenance facilities. If the emphasis is on cost, it is there to underline that the private user can justify the purchase of a personal computer on the basis of benefits already established, whether they are financial, recreational, or educational. Clearly, the cost will not be the same if one considers different configurations. And that depends on several factors, such as intended application, exact facilities (input, output, central memory, auxiliary devices, visualization), and the time frame of the purchase (as prices continue to drop).

Because the user often pays separate prices for hardware and software, and because these two prices are the basic components of a computer system, it makes sense to define them properly. Hardware consists of the mechanical, magnetic, electromagnetic, and electrical devices that constitute a computer. Software consists of the logical sequence of operations to be performed by a computer in solving a problem and in monitoring the computer's operations. In other words, the same world is used to denote the coded instructions, or sequence of commands, whether they are for handling an application or driving the computer components. All programs written to run on a computer are usually referred to as software. This is a simple way of contrasting logical, programmed operations with hardware.

Users may take advantage of both hardware and software. If hardware has an impact on costs and prices, so does software. We look more closely at software problems in Chapter 15. In the meantime, let's identify the two classes of software as *basic* and *applications*. Basic software includes: (1) the operating system, which drives the various devices, as well as becoming more complex as the system configuration increases; (2) programming languages, for instance, COBOL, FORTRAN, BASIC, or Pascal, and the compilers of the language or languages being supported; and (3) utilities, which are designed to help in certain functions, such as sort, merge, and edit. Applications software, also called applications programs, include applications and programming products for the home, for such purposes as games, learning aids, tax calculations, and budgeting, and for business purposes, such as payrolls, inventory control, production planning, handling customer orders, billing, and accounts receivable and payable.

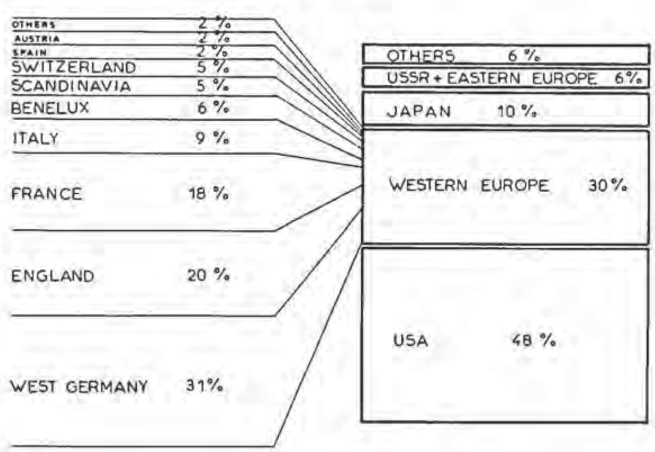
It is the writing of applications software—its testing and maintenance—that poses problems for the nonspecialists. These problems can be overcome in either of two ways—by learning how to program or by using packages provided by manufacturers. That is why, when choosing a personal computer, the buyer must pay considerable attention to the available library of programming products—both current and in development—as well as to the maintenance these programmed applications receive in terms of steady update and improvement and the assistance given the novice user in getting started.

It should be emphasized that software is tricky. Well-written software is scarce; duplication, inefficiency, and poor documentation are the rule rather than the exception. This is true not only of personal computers but of larger machines. It has been true for years, and companies have lost fortunes because of it. Parenthetically, software becomes all the more important to the private user as it becomes more like its mainframe counterpart. This is also true of databases and communications programs, because microcomputers use the communications technology developed for large machines.

The Coming Years

People in a position to know are speculating that by 1990, about 80 million personal computers may be in operation. Predictions—professionals' informed guesses based on the Delphi method—indicate that by 1990, some 35 to 40 million microcomputers will be installed in homes, with another 10 to 12 million as work-station supports in large companies, operating within a network of larger machines; that 4 to 6 million machines will be installed in small businesses; that 3 to 4 million machines will be in use in education, for both teaching and administrative purposes; and that another 12 to 14 million machines will be in use in various other fields. A special class of computer may come into use in large organizations, not necessarily with the approval of data-processing departments. These machines may neatly bridge the gap between home and office, and may be dedicated to jobs that deny the organization's data-processing service the all-encompassing, central function it has long exercised.

These are American statistics. If the current distribution of computers—in the United States and around the world—shown in Figure 9.3, serves as a guide, by about 1990, Europe, Japan, the Soviet bloc, and other countries may account for another 80 million machines. Today, because of technological advances, the life cycle of a personal computer is three to four years. This does not mean that computers will be thrown away, only that they will be traded in. Most owners will buy add-on equipment. The market will be dynamic, and so will the business opportunities.



9.3. Current Worldwide Distribution of Computer Power.

Six Markets

A question that may occur to the reader is: What are we trying to place a value on? The personal computer is not merely a number cruncher. It is not measured in terms of the tons of paper it prints. Although this has been the policy with mainframes, it is, fortunately, obsolete, even though the policy is still followed by many users. Therefore, we need different criteria. The first thing to be said is that the personal computer is a capable tool for people, one that costs less than a nonintelligent terminal and that can do much more than a nonintelligent terminal.

In speaking of personal computers we must think small and scale our thinking to that level as we did in the 1950s after the advent of the Volkswagen. Most jobs are of reasonable size. It is the users in a business environment dominated by giants who destroy the jobs. If we think small, we can view applications clearly and calmly.

In terms of impact and orientation, the personal computer market is showing signs of dividing into six sectors—computer hobbyists, professionals, small businesses, dedicated usage, education, and the home market. For the time being, however, these sectors are not clearly defined; personal computer devices can serve all six sectors with only minor adaptations. (Keep in mind that the personal computer is a general-purpose machine.)

Computer Hobbyists.

The computer hobbyist got the market for personal computers going in the first place, but this sector is declining in importance. Its share of the market will shrink rapidly as other sectors increase. Remember that, at first, some 25% to 30% of early computer hobbyists were ham radio operators.

Professionals.

The sector called professionals is made up of statisticians, accountants, engineers, consultants, and so on. Here, specialized, not generalized, hardware is the answer. Usually, professional people are absorbed in their professions. They don't have time to devote to computer programming even if they wanted to. Thus the personal computer will be that much more appealing to them.

Small Businesses.

The small-business sector consists of firms with annual sales of $500,000 to $1,000,000. The smallest of these firms may employ no more than three people. Once more, we are speaking of people who do not have time to program a computer, nor, probably, the patience. Programming products will thus be of the essence, although they will be different from the products needed by professionals. To appeal to this market, products must be highly standardized and virtually foolproof, since untrained people will normally be using the machine. At this time, hard (solid-state) software seems to be the best answer. Eventually, small mainframes will be aimed at the upper levels of this sector—the level consisting of microcomputers and service bureaus. For example, in putting a personal computer to effective use, a small New York bank replaced a system that cost $20,000 a month to operate with one whose purchase price was $15,000.

Dedicated Usage.

In large firms, distributed information systems (DIS) will be used to handle well-defined jobs at a lower cost than those for minicomputers. The office is the likeliest place for personal computers, because office automation will probably spread throughout business and industry as an effort is made to increase productivity and control costs. Personal computers are the best answer to these requirements, and they will typically be geared to word processing and communications. Here, Datavision is not a hobby or a pastime; it is in the mainstream of a business and should therefore be given full consideration. Along with the home market, this sector will probably have its greatest impact on telephone networks, transmission facilities, and switching systems. Let us not forget that the home and the office are interconnected, in terms of what one may wish to say to the other. Multipoint personal-computer usage will probably increase the load of facilities. It is conceivable that in some areas, telephone systems will break down because of the constant use of personal computers. The introduction of electronic switching and wide-band technology, such as optical fibers and satellites, should ease this problem, as will the introduction of universal message usage.

Education.

The concept of using personal computers for education has been around since the late 1950s, but the time wasn't right until now. Many subjects can be taught, using computers, from languages to geography and mathematics. The computers can be designed to operate interactively between students and teachers.

The Home Market.

Most likely, the home market will be divided in two parts, household management and entertainment. Here, the possibilities are most interesting: video and board games, text editing, programming microcomputers to operate automobiles, appliances, energy systems, refrigerators, stoves, washing machines, television sets, radios, and telephones. Microprocessors may also be used in babysitting, education, electronic mail, and metering.

Before long, millions of computers may be in the hands of private users. The microprocessor is an appliance component, or, if you wish, another appliance.

Coinvolvement

Personal computers in homes will not only be concerned with household management. They will also involve the educational system, the business community, and the government. Many of the personal computers originally bought for home use will soon begin to be used outside the home. Of the six market sectors examined above, the home market has the greatest potential.

In part, this is a matter of numbers: there are so many more home than businesses or professionals. In a much broader sense, however, involvement will be the major force. The personal computer will occupy a large part of people's leisure time, and the proportion will increase in time. Personal computers, which a few years ago might have seemed an expensive frill, will before long be a necessity. Considered dollars and cents and time and effort saved, in terms of computers will prove as indispensable in homes as they already are in government and business.

What makes a computer economical in the long run is that, unlike most machines, it can easily be adapted to accomplish an infinite number of tasks and in an intelligent manner if the user becomes involved deeply in the work. The home is the market to begin with, because it holds the greatest promise. Both the home market and the small-business market will grow as technology helps reduce both the size and the cost of personal computers. The advent of the personal computer should increase the usefulness of computing devices to people and machines at home. A wide range of new services will become available by using Viewdata to connect the domesticated computer to the telephone network. The implications of this technology have not yet been explored sufficiently to make hard-and-fast predictions. To some extent, therefore, such predictions are likely to prove conservative.

Computers and Users

Simplicity of operation and ease of understanding have been discussed as two of Viewdata's greatest assets. It seems reasonable to choose personal computers, using the same criteria. The user should look for these characteristics rather than adopt complex solutions that are difficult to install, develop, and maintain. The personal computer, whether in the home or in the business, should complement the service the ultimate user may obtain from a network, and vice versa. That is why people with a personal computer should be interested in an online service such as Viewdata as well.

We are well aware that the information we receive is often out-of-date. On the local, stand-alone level, the difficulty of ensuring that information is actually up-to-date tends to inhibit making changes. And the results of out-of-date information can be costly. Why not update the personal computer's memory regularly, with less difficulty and at reasonable cost?

A new market is opening up, one that will surpass the old computer market. Remember that in 1978, in the United States alone, total spending on computer services (hardware, software, service bureaus, and consulting) amounted to $45 billion, or $200 per capita. Another way of stating this is to say that, even excluding home computers, per capita spending on electronic data processing may increase to about $670 by 1985. By then, the computer industry will probably account for nearly 10% of the gross national product of the United States. And personal computers will contribute to pushing up these statistics. Experience has shown the way.

A Range of Services

We need to increase the opportunities for innovation, to get out of the old routine, abandon paperwork for the sake of paperwork. The best thing to do in answering this need is to ask ourselves whether we really need a personal computer.

Several years ago, I was brought in on a case involving a small bank in Monte Carlo. There we introduced a minicomputer with four terminals and several megabytes of disc memory for realtime banking. We trained every employee. Interestingly, one-third of them became expert at operating the computer, including start-up, restart, and recovery; one-third passed the test with fair grades; and one-third failed.

Computer literacy is at stake. Much of what has been said about the current resistance to computer programming will, in time, change. Children educated in and by computers will view these machines differently in the future. But will they be literate in computing? A best-selling book in 1990 might be "Why Johnny Can't Program." Computer education is vital. Are we to develop a class of informational underprivileged? Is technology leading to an upper class of computer specialists who will keep others in ignorance? The answer is no, not as computers become easier to access and use, replacing flexible (general-purpose) systems with dedicated, appliance-oriented systems. Eventually we may see millions of people working with intelligent machines. The nature of society itself could very well change because of this phenomenon. Some 30 years ago, when television came along, many people were skeptical. What is the future of television, they asked. But television took over where the radio had left off. The situation today isn't very different. What we are witnessing is terminals being connected to telephone lines and databases, and data being used to substitute for and complement the voice and the image.

The home computer will become a useful appliance only if a database is available. As we have seen, Viewdata can support this facility. Viewdatabases are coming, but not all applications need a large database; in some cases, local media will suffice. Each user must discover in his or her own way how the personal computer works. Just as the individual brain is different from any other, so the brain's capacity is extended by individual effort.

10 The Microprocessor

The modern computer is based on the new industry of microelectronics, in which the integrated circuit, the descendant of the transistor, is so vital. Since the microprocessor has made Datavision possible, we should devote some thought to its development and functioning.

In the years to come, we may look back on the microprocessor as one of the greatest inventions for liberating human intelligence and ingenuity. The microprocessor's main contribution does not lie in the cost reduction it makes possible, nor because it is an aid to miniaturization; it is its potential for taking computing power and placing it in the hands of ordinary people. As we will see in this chapter, microprocessors have opened up exciting new prospects—for both people and machines. In doing so, they have become a critical factor in the success of industries, businesses, and individuals. Technological progress during the next 20 years will probably depend more on the microprocessor than on any other single technology.

Integrated Circuits

Integrated circuits make it possible to combine on a tiny chip of semiconductive silicon, various electronic components called bits and gates. It is possible to put as many as 100,000 transistors, resistors, and other bits of circuitry on a chip no larger than a fingernail.

Transistors act as tiny valves, turning on and off to allow bursts of current in the form of binary digits (bits). A bit has binary value; that is, it is either zero or one. Switching occurs between these two values—back and forth—thus enabling millions of computations per second to be made. Integrated circuits can store data for later processing, or they can perform arithmetic and logical operations, retrieve the data, and present the result according to instructions.

The race has been on to increase chip capacity and thus increase the market for this capacity. In 1978 approximately 10^{12} bits and gates were manufactured. For the semiconductor industry to survive, by 1983-84, this number must be 10^{18}, a difference of six orders of magnitude. If the figure seems almost staggering, we should remember that with each price cut, the market grows another 10% to 20% in dollar value, with the result that the number of bits shipped almost doubles from one year to the next.

Bits and gates are not the same measure. A gate contains several bits. In the case of computing equipment, however, an appropriate correspondence exists between bits and gates, and this helps us evaluate production capacity and market penetration.

What potential markets are there? The auto industry is one such market. Some 30 million cars worldwide are manufactured each year. With, say, 10 microprocessors per automobile, times 16 kilobits per microprocessor, we come up with 4 trillion 800 billion bits, which is more than all the computing capacity currently produced annually. Is it too much to put all this computing intelligence in such an ordinary product as an automobile? Perhaps, but let's not forget that roughly 90% of the installed energy-producing capacity in the United States is represented by American automobiles—under the hoods of American cars.

Then there is the home market, at various levels. Here again, we are talking about 10 microprocessors per household, and the number of private users is a high multiple of that of automobiles. Japan is an example of microprocessor support for numerous household products. Microprocessor support for such consumer goods as tape players, copiers, typewriters, microwave ovens, and air conditioners was introduced in that country in 1977, and for such items as ice-makers, refrigerators, sewing machines, 8-millimeter movie projectors, videocassette recorders, and timers in 1978. It is significant that new applications for microcomputers are still emerging. New applications account for about half the current market, and the potential is great.

The Impact of VLSI

We are discussing the impact of VLSI in order to emphasize that the personal computer is not an isolated product of technology. Although personal computers are fast replacing minicomputers (with 20% of the replacement in offices), the real challenge lies in creating new markets for personal computers.

The replacement of logic circuits has been given high priority in communications systems, especially in transportation and mechanical controllers, where they have made significant inroads in a market once dominated by electromechanical and electronic devices. A new market with interesting potential is that of consumer electronics. Here one finds a strong trend toward microprocessor-controlled products, because of the volume production and low price of consumer products made possible by single-chip microprocessors. Industry leaders cite as reasons for the increased use of microprocessors, reliability, power consumption, speed, functionality, environmental tolerance; ease of hardware design, and suitability for realtime use.

Undoubtedly, another reason is novelty—the breadth of the anticipated change, the conceptualization of the product, the results obtainable. We have already discussed some of the reasons for this. As the cost per function decreases, the possibility is created of reducing more at the same basic cost. VLSI also makes feasible the implementation of new functions, particularly in programming and maintenance, which are the big cost items in machine operation today. Tremendous pressure on semiconductor prices has built up as well, forcing innovation in many types of electromechanical devices.

The semiconductor industry, which is directly responsible for creating the tools for implementing these changes, thus set the competitive pace. Each generation of semiconductor products produces leverage in at least two new fields: the products themselves and the systems, machines, and devices that use semiconductors.

Computer electronics is by no means the beginning and end of the semiconductor market, although it does command about one-third of that market. The Department of Defense (DOD), for example, is reported to be purchasing each year nearly 5% of the semiconductor products manufactured worldwide. The world market in semiconductors is dominated by American companies; Europe, represents only 20% of this market. That's why, to start a business in Europe, one must plan with U.S. competition in mind, in order to build enough strength to protect the home market.

Market potential is the reason why 80% of the semiconductor parts imported into Europe are produced in American factories. (Whether the factories are in the United States or Europe, they are still American-controlled.) It isn't just research and development, but manufacturing and marketing capability, that matters. Statistics such as Defense Department purchases of semiconductors are one reason why each generation of semiconductors–which are increasingly complex–is accompanied by a growing desire on the part of various countries to possess their own semiconductor capability.

The governments of West European countries and of Japan feel that they must establish a viable independent semiconductor capability or risk becoming second-class powers in the computing industry. Governments, however, are not necessarily good planners. The proliferation of processes and techniques, particularly in Europe, reduces the ability to optimize on the bases of new technologies, which results in a lack of semiconductor production capacity. To remain independent and viable today, a semiconductor company must have annual sales around $100 million. This is called momentum. To maintain the momentum, a semiconductor company must produce nearly twice as many bits and gates each year as it did the year before. This requires not only innovation but manufacturing momentum and market demand.

Something often overlooked in the development of technology is that the laws of physics and chemistry are the same whether the technology is developed in Los Angeles, New York City, Paris, Frankfurt, Moscow, or Tokyo. This is not true, however, of the laws of the marketplace. A competitive edge is governed by market forces. Regardless of whether we are speaking of a planned economy or a free one, the market, and the market alone, determines success or failure.

Miniaturization

Microminiaturization has been accomplished by steadily refining the methods of etching circuitry on chips. For years, scientists have been experimenting with computer-controlled beams of electrons that etch the circuits on silicon. The process allows the creation of wire just 3 microns (1 micron equals 1/125,000 inch) wide, rather than the 5-micron thickness possible using conventional manufacturing methods.

The thinner the wire, the closer together the circuitry can be and the less time it takes for electrons to travel from point to point. The result is faster, more powerful, and cheaper microprocessors. Microprocessors and related components are built on these integrated circuits through advanced fabrication processes. Among the products expected to be available by the early 1980s are microcomputers with as much as 256 kilobits of electrically erasable memory—four times the density available on a chip in 1979-80. Integrated circuits of high complexity will be closely linked to microprocessors. With this flexibility, these devices will make possible large-volume applications. The peripheral chips of the 1980s may contain components for direct memory access, a bus arbitrator, memory segmentation, and various peripheral processors, including communication protocols.

I mentioned the importance of the market. Producing more powerful computing machines does not, in itself, create a market for the machines even when the cost decreases. More powerful information machines make it possible to ask questions never asked before the advent of VLSI, questions about what computers can do for people. That is where the market begins to grow.

In a discussion of rapid change in the computer industry, the interplay of technological capacity and market capacity is significant. Chips of ever-decreasing size, packaged with connecting wires, perform arithmetic and logic functions, as well as store and retrieve data; they are the heart of the processor. The uses to which they will be put are limited only by the human imagination, which means both human know-how and expanding equipment capability.

The next generation of microcomputers should feature architectures structured for programming simplicity rather than program length. These machines will likely be programmed by user-oriented languages. They will simplify human-machine communication. If the current rate of progress continues, one chip will soon be able to store 250,000 bits, and then 1 million. The number of logic, or decision-making computer circuits on a chip is expected to climb to about 25,000 by mid-1980 and to 250,000 five years hence. Leaving development costs aside for the moment (since they will be absorbed by savings in mass production), ultradense circuits will probably be manufactured for less than $100 apiece. By comparison, the large computers of the 1960s, which sold in the $4-to-$6-million range, contained less than 100,000 logic circuits and a central memory capacity of 1 million bytes.

Reliability will almost certainly be enhanced as cheap calculating power makes it possible to duplicate the critical parts of circuitry so that, if a component malfunctions, a computer will be able to continue operating. Among computers, particularly realtime systems, downtime was once a major problem. Because of the threat of downtime, redundancy became an important design consideration. Simpler, more conservative design rules and standardized interface conventions became necessary for the success of a VLSI fabrication facility.

The low-cost duplication of present-day large-scale computers is an area with vast potential. Users will be able to buy an IBM-type processor and, as optional equipment, for a few hundred dollars more get a Burroughs- or Honeywell-type processor wired in. Next will come the polymorphic machine, a computer that can imitate another computer. As the semiconductor revolution penetrates to the computer level, many other products, from office machines to home appliances and automobiles, will be given more intelligence. The intelligence of these products will be enhanced by VLSI.

Looking to the future, in the decade 1990-2000, we can envision VLSI chips with well over 1 million devices, in contrast to the 64,000 today. These chips will operate on a 0.5-volt power supply, versus the 5-volt power supply used today, and will have gate transit times of 50 picoseconds, versus 1 nanosecond in the present state of the art. A development further in the future is the use of cryogenic (supercold) materials. Computer circuits, or switches, generate heat as they open and close. The faster they do this, the hotter they become. Some give off so much heat that, to continue operating, they must be kept apart. Thus the speed of a switch is offset by the relatively sluggish rate at which the power reaches the switch, although the current travels at about half the speed of light. Researchers, therefore, are turning from semiconductors to superconductors, metals in an environment so cold that they have lost their normal resistance to electricity. One superconducting circuit, the Josephson junction, operates while submerged in liquid helium, at temperatures more than 400 degrees below zero Fahrenheit. The Josephson junction may some day be used to build a computer 500 times more powerful than current ones.

The New Automobiles

Because of the regulations on motor vehicle pollution, fuel consumption, and driver protection, microprocessors will probably play an important role in future automobile design. Almost every automobile manufacturer today is working on control systems in cooperation with a semiconductor company.

On-board computers on more expensive automobiles already give instant read-outs of miles per gallon and expected time of arrival at the push of a button. To provide this information, data is picked up by electronic sensors and fed into microprocessors, which monitor the data through such variables as speed and rest stops, data which is furnished by the microprocessor. Following are highlights of the use of microprocessors by American automobile manufacturers. By 1985, automobiles may have considerable computing capacity. Automobiles will get better gas mileage, and motorists will drive simpler, safer cars that can be maintained more easily. Emissions will be cleaner. (This should be a bonanza for the electronics industry, which, according to some estimates, will capture $1 billion worth of auto business in 1981-82.)

The principal device involved in automobile computers is the microprocessor. Let's look at some things that have been going on. General Motors put a microprocessor on its 1977 Oldsmobile Toronado that reads engine temperature, altitude, and other operating conditions and adjusts the spark timing accordingly. An electronic "feedback" carburetor has been tested successfully on 30,000 1978 Ford Pintos and Bobcats in California. The carburetor monitors the oxygen level in exhaust gases and continuously adjusts the fuel-air mixture to the proper ratio for efficient burning of fuel. Fewer pollutants is the result. Engineers say that the carburetor, as it is known today, will become obsolete. Ford's 1978 Lincoln Versailles has a computer that regulates both spark timing and the rate at which exhaust gases are recirculated, thus cutting down the amount of nitrogen oxide emissions. Chrysler refined its "lean-burn" system, beginning with the 1976 models, by using a microprocessor that regulates the firing of spark plugs.

Decreasing memory costs and increasing processor functionality are key ingredients in the widespread use of microprocessors in automobiles. So, too, is firmware that simplifies the size and complexity of microprocessor programs. Prices vary from $160 to $360, depending on the unit and what it does. In the latest automobiles, microprocessor-based electronic ignition systems are used to control fuel flow for optimum gas mileage, optimally firing spark plugs for precise engine performance, and advancing timing for quick acceleration when needed.

Centralized automobile systems will use several microprocessors interconnected by a high-speed data bus. The microprocessors involved will be dedicated to specific tasks, such as combustion, automatic transmission, indicator control, and antiskid braking system. In a design concept of distributed functions (as with process-control systems), each microprocessor will be assigned control loops, with or without a central computing authority.

System developments aimed at making the automobile a safer machine to drive are expected to continue, because they involve not the overcoming of fundamental technical limitations but the evolutionary improvement of existing processes. As cost benefits are demonstrated by prototype, microcomputer-controlled models, a force behind these developments will be market demand. It is the same in all industries: once started, the demand for microprocessors in applications not foreseen only a few years ago becomes its own motive force.

Integrated Video Terminals

The early microprocessor manufacturers could not predict the many uses that would be found for their devices. Nor can today's designers clearly envision more than a few of the eventual applications of microprocessors. Sometimes the market is ahead of the planners.

Developments in the home computer and the videotape recorder, for instance, led to the integrated video terminal, or IVT, which is capable of combining the Datavision features we have been examining, such as the home telephone, the calculator, the TV set, the radio, the cassette recorder, the videotape recorder, and the personal computer. To take one example, the Sharp Corporation recently introduced a unit combining a radio, cassette player, television set, calculator, and personal computer. Taking the concept of multifunctional electronics equipment a step further, Sharp has combined an AM-FM radio, a cassette recorder, and a keyboard in a unit that can function as a calculator or as a personal computer—all in a package no larger than a portable radio.

It is now projected that within 10 years IVTs will be a billion-dollar industry that will result in significant changes in publishing, consumer electronics, broadcasting, telecommunications, and mail delivery. At present, the Japanese seem to be ahead in the terminal-integration race. Although this lead may not last long, an oligopoly of IVT sourcing will likely arise that will parallel the automobile industry. The main market will soon divide into subsidiary markets, such as the stylus surveillance system recently announced.

In high-fidelity audio components, the needle plays a vital role in producing good sound and avoiding damage to records. Sanyo Electric has introduced a turntable with a built-in clock to keep track of stylus wear and a miniature electronic scale to measure the tracking force of the stylus on the record. Both instruments are connected to a digital display on the turntable's control panel. When a record is playing, the clock records the amount of time the stylus is in use and stores a running total in a microprocessor memory. By pressing a button, the user sees at a glance how many hours the stylus has been operating.

Texas Instruments and Boeing Aircraft are at work in this field, and IBM recently tested a voice-storage unit that could have wide applicability, both in the home and in the communications field as a whole.

As the personal computer market becomes better established, new demands on technology will be created—for example, voice input and output. Although microprocessors were among the first products of this industry, the need for small, cheap mass-storage devices will probably stimulate the development of memory capacity, which, in turn, will affect microprocessor design: the number of registers, the data path width, the power of the instruction set. Also, the pace of developments will increase as technology makes it possible to support more features on one chip.

The Microprocessor and Houseplants

At a conference in 1979, a lecturer told me that he writes numerous programs for personal computers, but that he is fondest of using a microprocessor to care for his houseplants. This man, who has about 360 plants in his apartment, said that he had encountered problems in maintaining the plants. He also liked to know at any given time what his plants were worth. What he did, therefore, was write a program for his personal computer.

The lecturer immediately ran into a challenge known to computer-intensive industry for years. To input the price of each plant, he had to give the plant a name, and to do that in a meaningful way, he had to classify the plants. He decided to classify the plants according to their need for light, water, humidity, and temperature.

He ran the information on the computer. Now, whenever he wants a list of all the plants that are light-sensitive, all he has to do is ask his machine, and the data is made available. Because he travels frequently, he uses process-control solutions to maintain proper environmental conditions for the plants. This practice has resulted in new challenges. Humidity control requires one or more input transducers, whose variable resistance is converted to voltage and measured by an AC/DC converter. At this point, typical process-control functions come into play. To adjust humidity, the computer must turn the humidifier or dehumidifier on or off, using an amplified digital output. And the computer may generate a variable analog output via an AC/DC converter that controls the humidity.

The computer can be programmed to control the temperature of each room according to inputs from thermocouples and potentiometers. Using digital signals, it can run the furnace, air conditioner, and ventilator. The computer signal must be amplified to drive a relay switch, which handles the current requirements of the functional units being controlled.

Greater energy savings are easily added. If humidity and temperature sensors are placed outdoors, the computer can determine whether increased ventilation will increase the humidity indoors. After receiving data on the outdoor temperature, it can determine whether more energy is required to heat or cool the air, and if it is needed to run the humidifier or the dehumidifier. Feedback control allows adjustment of the controlled outputs in response to input signals. For the latter, a sampling frequency must be established, which is easily handled by the computer's time scale. Signal conditioning is required for most inputs and outputs, to make them compatible with the computer. Multiple inputs and outputs must be handled simultaneously.

These are feats easily performed by the personal computer. In industry, machines are handling much more severe situations all the time. Computer-run optimization may well be the best energy saver available. The family budget stands to benefit; and governments hard pressed to find workable solutions to energy problems should not pass up such an opportunity.

Portable Terminals

Many of the personal computers on the market today are actually portable terminals that help the user work better and faster. Portables are light, quiet, and easy to use—which explains why consumers in the United States bought some 50,000 units in 1979. Indeed, portable electronic typewriters with memory and an editing facility, such as Texas Instruments' TI 765 portable terminal with bubble memory, suggest another means of introducing personal computers into the home market. Although new, the market is promising. Tomorrow's typical user will have a microprocessor-based terminal that displays information on a TV monitor and allows the user to print selected information on a small hard-copy printer. For this operation, the user will not need a complex personal computer; an "intelligent" terminal will suffice (Figure 10.1).

Coupled to a communication utility, the intelligent terminal will perform digital broadcasting, do party-line networking, and access databases. The user will be able to reach information channels for fast queries or to transfer data to the database. The intelligent terminal will also be capable of managing the data effectively.

If this sounds far in the future, it is, nevertheless, this is what executives of manufacturing and merchandising companies equipped with portable terminals are already doing. They can, for example, expedite the negotiation of loans, taking their terminals right into bankers' offices and answering the bankers' questions over a direct link. Perhaps the best-known and most easily explained applica-

tion of the portable terminal is that of the traveling salesman. In increasing numbers, companies want sales orders forwarded to their headquarters or to distribution centers as fast as possible. J. C. Penney, for example, uses 2,500 intelligent terminals manufactured by Texas Instruments.

The use of portable terminals will have an impact on small suppliers who receive orders by mail; for large vendors, magnetic tape is still the medium. J.C. Penney, again, is a good example. By consolidating orders on magnetic tape, the company avoids having to print long lists. Because suppliers now do not have to key data in their computers, the order cycle has been speeded up. By eliminating the magnetic-tape stage and communicating the data over phone lines, the cycle has been further shortened.

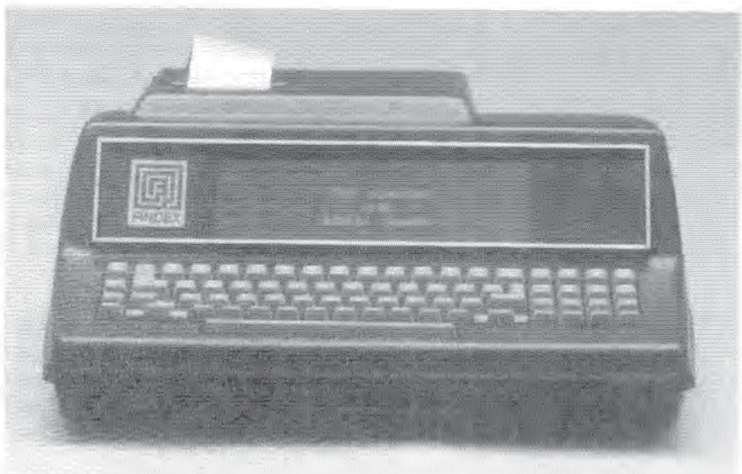
In another example of cost cutting, Telex has switched from an order-entry system to network processing. A senior Telex executive said: "If the current volume of 100 million characters a day were still handled by teletypewriters, the data center would be a zoo." Said another executive: "All of our communications lines have been justified for just one application, and that is to transmit order data back from our many locations to headquarters. If we can shorten the order cycle, we can reduce inventory."

At points of sales (POS), a major effort has gone into conversion from conventional, mechanical cash registers to electronic devices with online capability, with many department stores now using POS terminals linked to in-store computers. Special-purpose microprocessors that can be added to existing systems are particularly attractive for increasing the power and applications range of personal computers and communications and for controlling the interface tasks associated with the use of long-distance phone lines.

New technologies are the power plant of the portables. The bubble memory in the TI 765 terminal is large enough to hold a reporter's story until it can be edited for transmission to the newspaper's city desk. There is also the bubble-based Findex (Figure 10.2), which weighs only 20 pounds without its carrying case.

Portable terminals will continue to use online services, taking advantage of the growing demand for such services in computer technology. Size and weight are expected to drop as manufacturers consolidate components in a single, printed-circuit board and new printing techniques are incorporated. To date, weight reductions in printing terminals have been limited by printing mechanisms. Although terminal printers do weigh less than their mechanical counterparts, the power supply needed to drive them is heavy. Electrostatic printing offers a solution, as do printers with fewer moving parts.

A unit that may be workable is the acoustic coupler, which, though not heavy, is bulky. Board-mounted modems are now available, and manufacturers and vendors alike are considering the modem-on-a-chip for incorporation in the next generation of portable terminals.



11 Speak, Spell, and Videopaint

Computer technology and color have been combined in an experimental learning program used to teach basic reading, writing, and other language skills to deaf, preschool children. A color capability has been added to the computer terminal because teaching color is where one starts teaching language to the deaf. Words are presented by gradual association with a color. For instance, blue is associated with a manual sign for blue until only the written word is shown on the screen. Color is also used to code the grammatical parts of a sentence. Thus color becomes an aid in the proper placement of nouns, verbs, and adjectives in forming simple sentences.

In a pedagogic methodology, a child is initially presented with simple teaching techniques. As long as no error is committed, a linear progression occurs through the remaining sequences. If the child makes a mistake, the computer directs the learner to remedial instruction. The program requires a branching-type educational sequence that includes teaching, assessment, and remediation. By use of a digitizing tablet, the terminal generates pictures of objects, two-dimensional drawings of hand signs, and finger spellings. Numbers, letters, words, and colors are the instructional means of the program. The terminal utilizes a simplified instructional format in generating complex graphic displays. Patterns include a variety of colors and are presented as FORTRAN statements to the computer.

Color—not only for the deaf but for a wide variety of purposes—is a new addition to computer-assisted instruction (CAI). The projects of the mid- and late 1960s demonstrated that computers can perform effectively as teachers; because it was based on large central systems, however, this approach proved too costly for widespread use. The hundreds of thousands of dollars needed to set up a CAI program kept nearly all the computer mainframe manufacturers out of the market. (After six years of operation, Control Data Corporation (CDC), with its centrally controlled Plato system, is still operating in the red. The company remains optimistic, predicting that it will eventually break even on Plato.)

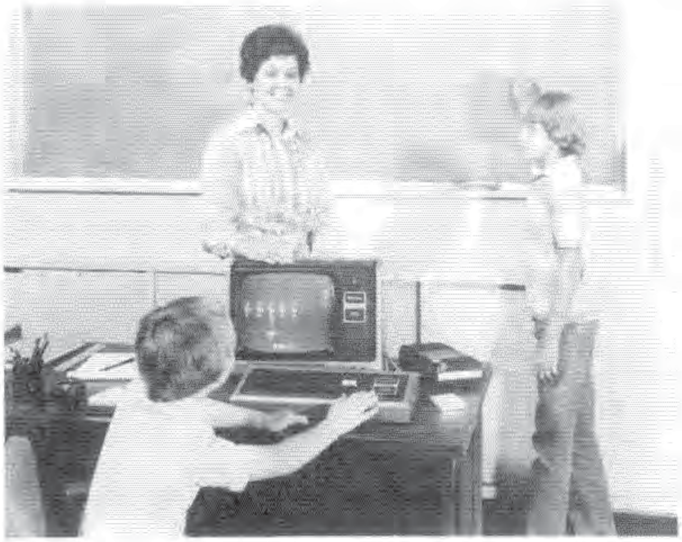
A point often missed by many in the computing profession is that, in terms of what computers can do in education, there has been virtually a revolution. Two developments responsible for this revolution are the microprocessor and its successors, particularly the speech analyzer and the synthesizer, and a process which we will call Videopaint. Videopaint is a color-graphics system for people-machine communication. Whether in engineering design, management reports, Viewdata services, or education, it is a process with great potential.

Computer-Aided Instruction

The advent of low-cost microcomputers and videocolor has turned the economics of computer-aided instruction around. Microcomputer companies now believe they will succeed where the large firms have failed.

After a 15-year lull, research in computer-aided instruction is gaining momentum. Apple Computers is donating $250,000 in cash and personal computer units to a newly formed nonprofit foundation set up to promote the use of computers in education. The company scored something of a coup when the Minnesota Educational Computing Consortium adopted Apple's machine as its standard microcomputer. Partnerships have been developed to exploit the new market. Among them has been a marketing agreement between Apple and Bell & Howell, a supplier of audiovisual equipment. As part of a major compaign, packets of promotional literature about the TRS 80 (Figure 11.1) have been sent to every school district in the United States. The Dallas Independent School District, a pioneer in CAI programs, bought nearly 60 TRS 80 machines and has invested a great deal of programming time in developing a mathematical instruction program for the district's elementary schools. Through a local foundation, Dallas is selling the program to school districts around the country at a cost of less then $1,000 per cassette.

Speaking of costs, one school has found that, with minicomputer and CRT terminals, the cost per student per contact hour was ap-



proximately $2.25–almost twice the cost of a regular classroom contact hour. This cost has since dropped to $1.50, near the price of a live teacher-student contact hour. Some pioneering school districts speculate that with the microcomputer, the cost per student hour will go down to something like 40 cents, including machine maintenance. If it does, that will be a virtually unbeatable bargain.

Will this improve the quality of education, though? We discuss this issue in Chapter 10, in comparing the answer with experience in higher-level programming languages. In some ways computer-aided instruction will not surpass personal contact with a good teacher, but how many good teachers are there? On the basis of this thinking, Dallas expects eventually to have 20 or more microcomputers as teaching tools in each of the district's 138 elementary schools–for a total of about 2,700 microcomputer systems.

Opportunities abound. A pocket-sized personal computer has been marketed that stores words and translates them from one language to another. The user enters an English word on the alphabetical keyboard, presses the "translate" button, and the equivalent foreign word appears on the display. The choice so far is among German, French, Italian, and Japanese–with each language containing a vocabulary of 1,200 words.

A similar piece of equipment uses four frames of reference: frequency, spelling, category, and alphabet. In frequency, words are sorted out according to how frequently they appear in normal conversation. Each word is flashed on the display for a few seconds, and the user speaks the correct translation.

In the spelling frame of reference, a word is flashed in English and the user guesses the spelling of a foreign word, which is then entered on the keyboard. If the word is entered incorrectly, the microprocessor so informs the user and then flashes the correct answer on the display.

In the category frame of reference, the user learns by selecting a subject and accessing the associated words alphabetically. Say that the user is preparing for a trip. The personal computer is used to help learn words related to travel.

In the alphabet frame of reference, the user learns by using the alphabet, beginning with any letter. The unit will display all the words beginning with that letter, which are stored in its memory.

When one enters an English word that has two meanings in the foreign language, the microprocessor asks which meaning by listing the possible choices. The user selects the correct meaning by pressing a key, and an interactive conversation begins.

Human-Machine Communication

Microprocessors can efficiently handle the correction of human errors. When a misspelled word is entered, the display flashes a question mark. By pressing a key, the learner instructs the unit to find the right spelling. The display then flashes a series of words that the processor thinks are correct. The learner then merely selects the one he or she thinks is correct.

Hundreds of words are available, and with plug-in modules more can be added. Such equipment is flexible. It lets the user call up the desired words simply by typing them in, providing, for example, a speak-and-spell, electronic learning aid for children. Furthermore, the translator will accept user data. Eventually, users will be able to store statistics, recipes, learning programs, and entire dictionaries. A pocket-sized information-retrieval system will display the data on request. This is user-level computing in the broad, imaginative sense of the term; it is not mere number-cruncher computing.

There is some early evidence which suggests that computer-based activities for young children can be a source of motivation to learn new concepts and skills. Microprocessor-based approaches both compete with and support other, standard media devised to help in problem-solving. Programs that can be adapted to a child's skill level are now available. This is also true of learning software interfaces with audiovisual aids, such as audio output for voice messages—important for children who do not yet read with ease. Further results can be obtained by combining videodiscs and personal computers to create accessible databases. Also, video and sound files can be successfully used in education.

Finally, speak-and-spell machines and voice analyzers will enhance education, as we will see in the next section. With 3,000 to 5,000 words of speech recognition available, one can dictate drafts into a home computer and have them printed.

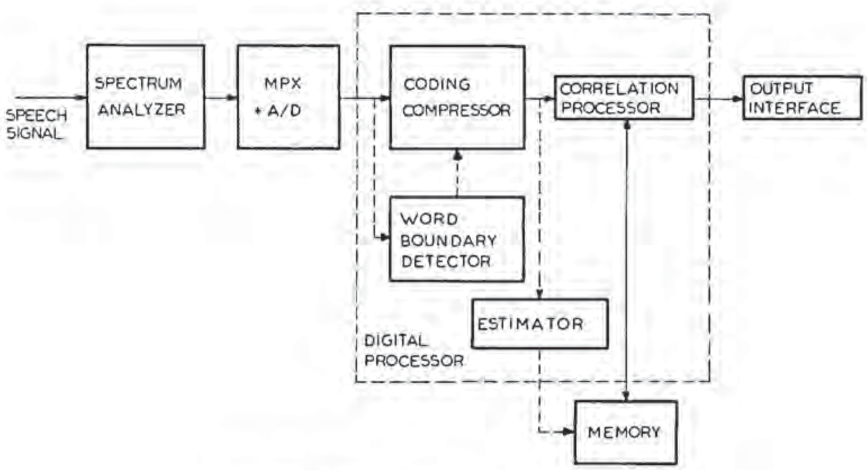
New Concepts

As much as 30% of the cost of operating a data-processing center used to be key-punching, key-to-tape (or disc), and similar data-entry work. Pools of young women performed the data-entry jobs.

Today, tapes (or discs) are run on computers: lists are printed with the errors still in (that's the rule) and are sent for error correction. Delays mount. In the last analysis, the errors are never corrected; if anything, they are even greater—in both scope and effect. In the area of programming, we still work with languages designed more than 20 years ago. In the meantime, we have been through four computer generations and a semiconductor revolution; but we are still burdened with software-development methods that center on the now-obsolete concept that all processing takes place in a central point and that various facilities compete for this resource. We still write our programs and documentation in longhand. Although computers were recently called on for online programming, we still follow the procedural solutions of the 1950s. We dream of user-friendly languages, but somehow don't go beyond the dream.

Why are we discussing such a topic in this chapter? Because we have not been able to talk to computers in plain English. Until that is done, people will continue to do sophisticated work with oldfashioned methods. This situation may be changing, however. We have seen Texas Instruments' work in speech recognition, and a few products have either been announced or are now available. Not only TI but IBM, Univac, Bell Laboratories, and some Japanese firms have developed programs that enable computers to recognize continuous human speech. (Although work on voice recognition began in the 1940s, the technology—in the form of electronic computers—wasn't available.)

In several artificial-intelligence projects around the United States, computers have been programmed to follow instructions and answer questions put to them in ordinary English sentences (Figure 11.2). In some of these projects research into what is known as pattern recognition resulted in machines capable of a crude vision that enabled them to discriminate among various shapes and to read some free-form handwriting. To my recollection, the first work of this nature was done by RCA as part of a military project in 1958. The research was in automatic tracking. Mechanisms followed the movement of the pupil of the eye, automatically adjusting the balance. Because of the crude devices available at that time, no usable solutions were developed, and the researchers were left with the human eye as the best medium for tracking.



11.2. Block Diagram for Speech Recognition.

Most artificial intelligence programs still have serious limitations, but research continues, with breakthroughs propelled by semiconductors expected. One of the most promising techniques is "isolated word recognition." The technique has been used in education and for various industrial tasks, such as data collection, client communication, quality control, and inspection of assembly lines. Current systems are speaker-dependent, but the price seems to be reasonable.

Once again, VLSI and the microprocessor have made possible such projects. A number of small companies have taken the lead in developing machines that respond to a highly stylized, preset vocabulary. Examples are Threshold Technology Corporation (Delran, N.J.); Centigram Corporation (Sunnyvale, Cal.); Dialog Systems (Belmont, Mass.), an affiliate of Exxon Enterprises; and Interstate Electronics (Anaheim, Cal.).

Let's Talk

Because the machines I have referred to must become familiar with speech characteristics, the user must first "train" a terminal by reading the desired vocabulary into the system's microphone, and repeating each word. The system then classified a word or utterance according to three criteria: (1) the intensity with which the sound is spoken; (2) the time it takes to make the sound; and (3) the frequency of the sound, which the microprocessor computes on the basis of the sound's intensity and duration.

Frequency is converted into a spectogram and digitized. The intelligent unit identifies the pattern of the sounds, which are compared with digital templates of the words stored in memory. The microprocessor then displays the word, usually on a cathode ray tube (although Dialog Systems has a unit that uses the telephone). Speaker-independent, this unit was developed by collecting voice samples from around the world.

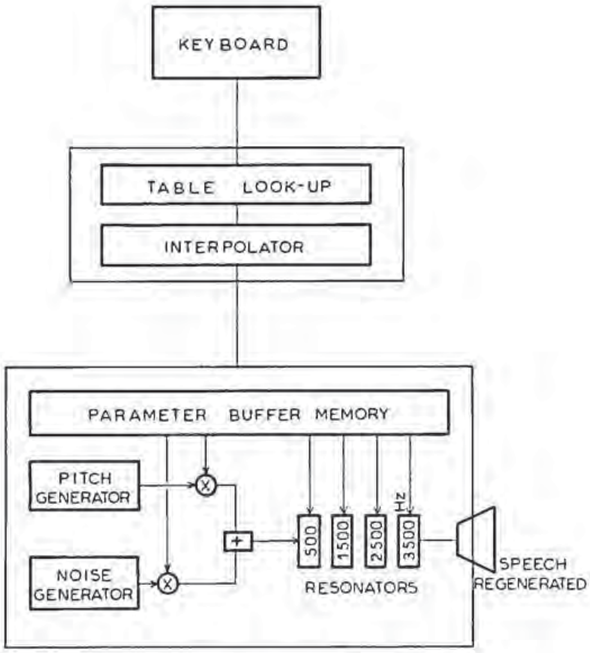
The device developed by Dialog accommodates eight users simultaneously, as well as validating data. An advanced voice-input terminal, it allows users to communicate directly with a computer by talking to the machine over the telephone. Consider for a moment the possible impact of such a system. Every telephone becomes a computer terminal. Data collection can always be at the point of origin. A 24-hour, 7-day data-entry capability can be extended to any party. The effect on education could be incalculable. Because the unit operates by receiving spoken words over a line, proceeding with a conversational voice dialogue appropriate to the given application, people can talk to it as easily as they would a friend.

At any point in the operation, input can be verified by voice response, which repeats the data before initiating any action. Simple error-correction procedures are available. Applications in education, banking, retailing, transportation, manufacturing, and government lie wide open.

Computer voice-recognition terminals will be an important starting point for future solutions. The units available today support user identification, inquiry and response, and other capabilities suitable for applications—for example, account status inquiry; credit card verification; inventory query; order entry; telephone answering; toll management; and bill-paying. But voice-recognition terminals are also limited by past constraints on human-machine interaction. These constraints are on their way out, however. Dialog Systems' voice-input terminal incorporates a word-recognition processor, an optional voice-response unit, an efficient I/O interface, a telephone link, and appropriate memory and control devices. The heart of the unit—a microcomputer—coordinates audio and data I/O as well as internal terminal operations. The voice-response unit produces audio output equivalent to human speech, and single words, phrases, or short sentences are provided. At present, the response vocabulary is expandable up to approximately 256 words.

Acting as a computer terminal, devices of the type under discussion typically feature I/O interfaces that operate either online or offline. Standard and custom word recognition and response vocabularies are provided for specific applications and user needs, including education. The aid computers can provide to both business and education is all the more valuable, since the semiconductor revolution permits developing machines that understand the spoken word. The next challenge is to store speech on nonmechanical devices, where it can be regenerated. The aim is to achieve immediate response, use, store and forward technology, and substitute mechanical devices in order to reduce costs and increase reliability.

The block diagram of a speak-and-spell machine is shown in Figure 11.3. Execution of algorithms for such tasks as speech recognition and synthesis, digital recording in audio signal processing, and



11.3. Speak and Spell Machine.

picture handling is in an advanced research stage. The reader will appreciate that not all speech-recognition and speech-synthesizing equipment is at the point where it can be fully exploited. Laboratory work is proceeding, and some possible breakthroughs are in sight, which could soon make it both feasible and desirable to use direct voice input to the computer.

Videography

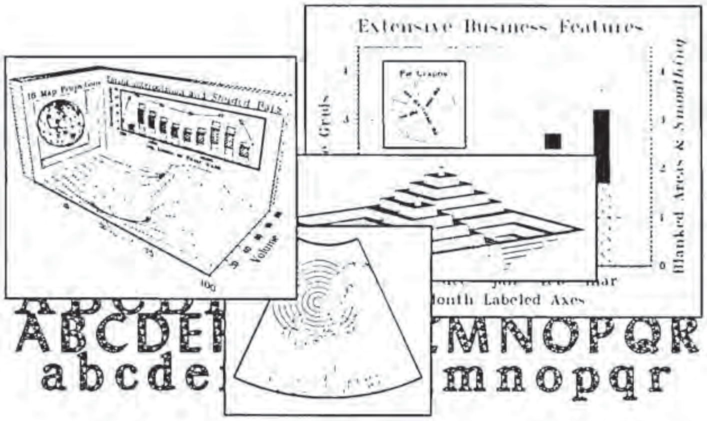
We have mentioned the use of video, particularly color, as the best output medium available. One picture is worth a thousand words, or so the saying goes. With computers, one picture can be worth a million numbers or more. Personal computers can be used to generate an unlimited number of images on a video display, and vice versa, and still convey the input information to a computer. Solutions capable of answering computer output requirements effectively call for a means by which a user can select one of the images displayed.

A light pen can do this. It contains a photodetector which, when held close to the desired image on a CRT screen, generates a signal to the processor. Thus the machine determines the position of the light pen relative to the screen, and therefore, the image being pointed at. A light pen, a keypad, or a full keyboard will permit data to be input to a microcomputer. With appropriate graphics software, the keyboard and light pen can help manipulate visual images to create new images. Used extensively in engineering design for several years, the light pen now enters the personal computer field.

Videographics are becoming an interesting growth area. Datavision will be established as an important stand-alone discipline whose facilities can be augmented by online and offline alternatives as the user desires. There seems to be a good market for this kind of product. About $250 million worth of computer graphics software and services is being sold annually, and the market is expected to reach the $1-billion mark by 1985.

In the current state of the art, graphic systems remain complex and require considerable expertise. This is a limiting factor. Industry must build systems that the business user can afford, something Integrated Software Systems of San Diego is doing. Integrated Software Systems' latest product is Tell-A-Graf, a software system that enables business people to sit at a terminal and conversationally call up graphs, charts, and plots (Figure 11.4), using Englishlike statements. The aim is to lure busy managers into looking at a curve rather than sales listings.

To ably communicate using curves, the entire approach to business decisions must change. Working at a video display terminal and using everyday English, a decision-maker must learn to give instructions to produce simple plots, to analyze the varying conditions of a company's operations through regression lines and confidence intervals, and to read graphs rather than data, whether the data is technical, commercial, or financial. A pie chart, a histogram, or an XY diagram are current alternatives. The basic thinking is that many charts can be produced in large size for formal presentation or as camera-ready art for page-size illustrations.



Integrated Software Systems is not alone in this thinking. Hewlett-Packard is another believer in business graphics as a profitable marketable product. Management sees a trend in this area; executives want to translate computer-stored information (particularly financial) into graphs.

Easily portable, videographics can be stored on tape cartridges or minidiscs and mailed to any destination. In addition, the price is rather reasonable.

Superpaint

Originally, videographics were developed to meet the needs of engineering projects. As we know from discussing other cases, once a process is established, it finds uses in many different areas. This is true of both graphics and color.

Let's look at the uses of videographics. An experimental, digital video system, known as Superpaint, was designed and built by Xerox in 1973. The system, an experiment in digital picture composition, can be used for interactive manipulation of simple graphics and animated figures. The process is a powerful research tool that can be used for a variety of projects. One of the most imaginative of these projects concerns NASA's Ames Research Center. Separate red, green, and blue video components encoded in standard broadcast video form serve as the system's output. An attached, laser color printer provides hard copy as desired.

By manipulating a standard tricolor monitor, the videopainter confronts the picture. Another picture is the control panel; it shows various brush shapes, a palette of available colors, and images of the editing operations the videopainter has available. The hue, saturation, and brightness of the selected color is indicated on slider scales.

Texas Instruments offers videographics, solid-state software designed for people who want to try out their artistic and creative abilities. A handheld, remote unit is required, which functions as an electronic paintbrush. The user can create fine-line color drawings, design mosaic patterns, construct objects with special video "building blocks," and develop charts, graphs, and various business-oriented patterns and designs—all in color.

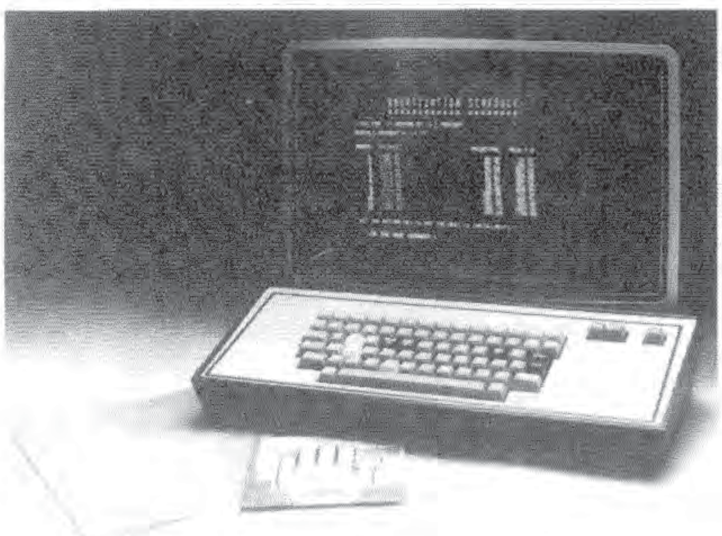
We have come a long way from the time when only three colors were possible on a display. Nor does the process end there, in terms of operator support. At the operator's choice, the videopainter can be guided by the computer through pointed messages, which permits learning the system and discovering many of its features.

Viewdata has not been forgotten either. It offers a different facility: alphagraphics, consisting of letters, digits, and some special characters. Their height is fixed at three times the ordinary character height, with a variable width that restricts a full line to a maximum of about 20 alphagraphics. These are available in the colors red, green, yellow, blue, cyan, and magenta, as well as white and black, which can be changed by the use of a select color code that appears as a blank on the screen. Although curves cannot be generated, the potential for graphics is interesting.

Whereas alphagraphics do not match the versatility of videopaint, both have common characteristics, such as adding text on digital fronts, scaling objects as desired, and storing pictures and data in memory for future use. Videopaint, for example, provides for automatic drawing of straight lines of variable width, filling in closed outlines with a selected color, easy creation of charts and graphs, alignment of items, and dimensioning.

Microcomputer-supported color art systems are no monopoly of Prestel or Xerox, however. Improved color-tube technology, along with the availability of inexpensive memory, has made possible market entry by several small firms. The Apple II microcomputer can be interfaced with a color TV. Its firmware includes graphic commands and a variety of colors. Chromatics also offers a color desktop system. It has up to a 19-inch color video and can support a light pen and XY digitizer tablet. Keyboard-accessible graphics are available, including arc, vector, circle, and line.

Intelligent Systems Corporation markets a complete line of color terminals with built-in, programmable microprocessors. And Compucolor II (Fig. 11.5) features a color display with 32 lines at 64 characters per line, two character sizes, and special graphics codes. A variety of computer programs can be run, using the programmed diskette albums. Figure 11.6 presents a sample of game albums. Each one contains two to six games, programmed and set to go; Figure 11.7 gives applications examples from six different areas, and Figure 11.8 identifies the special effects that can be produced on video. With color graphics displays becoming a new industry standard, many systems can add movement to a visual communication. Motion in an image produces a far more effective visual communication than still images, and current technology permits a simple but interactive form of animation.



Interactive video presentation—whether alphagraphics or videography—is an exciting possibility on its own merits. This is equally true of digital images, a new technology that is finding a wide range of uses. Digital image-processing is a kind of filmless photography, in which images are put in digital form, stored and retrieved from computer memory, and visualized as data inherent in an image.

The Office of the Future

Early attempts to achieve computer graphics occurred years ago, but only recently has the subject evolved to the point where its implementation as a desktop solution for education or office duties is sufficiently inexpensive or fast. Humans think in terms of images, and that is why graphics will have such an impact. Every aspect of office work will feel it. Although there is still much to be done in office automation before it becomes widely accepted, speak, spell, and videopoint can help make acceptable in a few years, processes that might otherwise have taken a decade to take effect.

The automation of offices has not yet truly begun. Of all the possible innovations in office procedures, automated task management potentially has the greatest payoff. The thing to do is focus on professional and managerial personnel and make systems easy to use. That is the goal of Interactive Videotex.

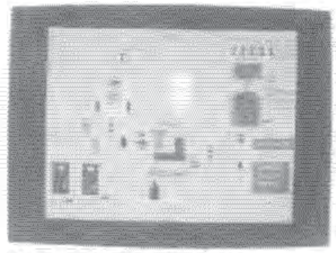
There is an emerging market for the "office of the future," in which computers, word processors, and other office equipment are electronically linked. IBM, Xerox, DEC, and now Exxon are expected to enter the competition, along with such firms as Olivetti and Wang Laboratories. The market is promising; it is expected to be one of the most active markets of the 1980s, reaching sales of about $30 billion by 1990.

Office-automation needs will be demanding, and their fulfillment will be selective. To compete successfully in this market, let alone master it, companies must be eager to introduce new generations of products that combine word processing, data processing, and user-friendly peripherals in a single system capable of handling anything from office data entry to management queries. Companies that are serious about entering the market for office automation must look at integrated information systems as one of the pillars of their corporate strategy during the 1980s. Speak, spell, and videopaint—the *new* output media—is the other. Those companies willing to establish a position of leadership in at least some of these sectors will survive.

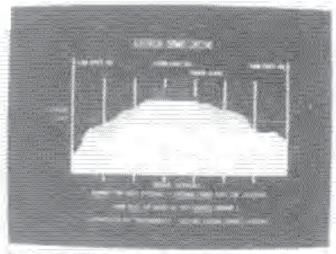
Objectives must be defined. A basic—perhaps the most fundamental—objective is that of human-data communication. Automation or not, people will remain at the center of things. Take electronic mail: Filing, retrieval, distribution, forwarding, message discard, and presentation all involve human interaction.

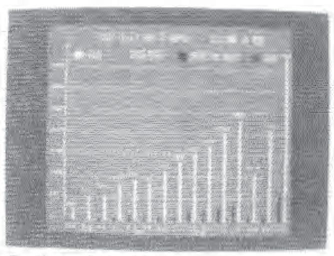
If electronic mail replaces telephones, the time saving could be enormous. As a survey has shown, managers spend 50% of their time in scheduled meetings and another 20% in unscheduled meetings and on the telephone. Telephone calls are time-consuming. In-


Financial Analysis


Process Control

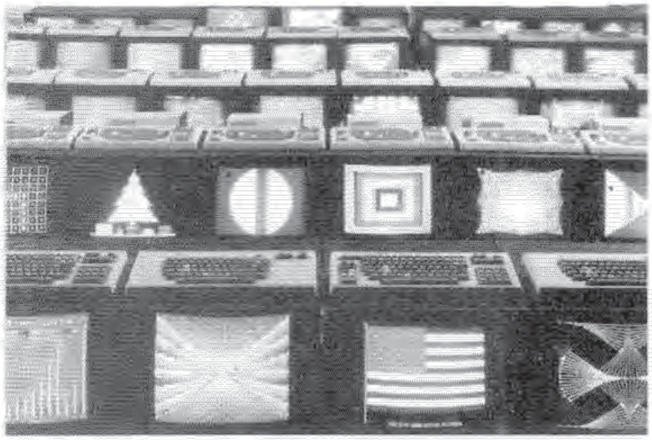

Order Entry


Energy Management


Sales Chart


Foreign Languages

coming calls can be distracting. Furthermore, studies done by AT&T indicate that only 28% of all business calls succeed; that is, it takes 3.5 calls to reach someone. Executives, however, will not willingly switch to a new kind of thinking and visualization unless there is a compelling reason to do so. And that reason is *proper support*. The prerequisites are a color visual display; an easy-to-use



language; local mass-storage units, such as video discs; and a user-friendly environment. To satisfy management requirements, terminals must have large screens and be able to display several kinds of information, including graphics, preferably color graphics (Figure 11.9). Color makes clearer and easier to comprehend, the relationship of display components. The user must be able to manipulate words, data, and graphs on the same machine, and do it smoothly. In doing so, the user will obtain a service he or she never had before.

The transition to the office of the future need not be traumatic. Word processors, intelligent copiers, electronic mail, facsimile systems, work-at-home terminals, videopaint, speech-recognition devices, portable personal computers, and word- and data-processing interfaces are all within the reach of current technology. The market waits; meanwhile, largely manual office procedures cost American business $200 billion a year—80% of it for salaries.

As a *Computer Decisions* panel of experts chaired by Mel Mandell aptly concluded, the trend is toward greater electronic support, with great potential for raising the quantity and quality of work. But improper preparation and obsolete organization can ensure that the evolving office-automation equipment will be misused or even abused. Lack of preparation does not make for fruitful investments. The user must be educated in the new technology, and the know-how for doing this is already at hand.

12 New Perspectives in Transmission and Storage

In Chapter 5 we said that databases and data communications are the two pillars on which rest modern computer-based systems. Both areas are in the process of major evolution: cable TV, optical fibers, and satellite transmission are changing the way we have communicated for the last 100 years. New storage media make it possible not only to send and receive voice, image, and data economically over wideband, but to store the information received in low-cost, easily accessed supports. That is the story of the optical disc.

We are becoming accustomed to the fact that technology holds surprises and that it sometimes fails to accommodate change. Those of us who recall the size and cost of computer devices can remember that the functional equivalent of hardware, which once filled a room, can now be held in the palm of the hand. The growth in the capabilities of microprocessors and microcomputers is likely to continue for some time.

When we speak of computer marvels, of databanks and communications channels circling the globe, let's not forget that these are services, and that, like all services, they carry a cost with them. The more efficient the system is, the better it is for all concerned.

For both factories and residential buildings, we must simplify communications gear and reduce costs. Several industries have until now had the experience that every time a new communications, control, or information system is installed in a plant, nearly half its cost is in wiring. Coaxial cables (and soon, optical fibers) are a good answer to this problem because a single copper conductor can carry 50 TV channels or 500 data channels simultaneously. There are fewer wires to hook up, and the installation is cheaper—about \$1.50 per foot, as of mid-1979. Once the cable is installed, we can add audit channels, video channels, and thousands of data channels as needed merely by connecting the cable.

Cable TV

The use of coaxial cable for private data communications is an active subject among American businesses today. Coaxial cable is a new product that, by all indications, will enjoy an excellent market. One of the first projects in this direction is that of Manhattan CATV on Roosevelt Island. A coaxial cable system—consisting of panic, intrusion, and fire and smoke detection devices—provides security and surveillance. Another project is under way in Manhattan, which, in addition to the features of the Roosevelt Island installation, includes audio communications, energy control, and meter reading.

Let's not forget that Manhattan CATV was established to offer pay television service to viewers. That is where the company made its first profits. As time passed and experience accumulated, it became apparent that a host of other applications are possible with cable TV.

For firms in the communications business, the product is, again, clear signals.

Clear Signals

Clear signals, long important in U.S. business and industry, are becoming increasingly important to private individuals, as is exemplified by the impact of Nielsen, the TV rating service, on American viewing habits. Cable is playing an important role in the rapidly changing video environment. In 1978 the number of subscribers grew by more than 10%, and by mid-1979 cable TV was being used by an estimated 70 million American households, or 18% of the number with television sets.

We must view clear signals as part of the whole system. By the mid-1980s the videodisc will probably be as common as the color television set is today; the same will likely be true of Datavision. Large-screen television, sometimes called "video wallpaper," will be the favored output for TV entertainment and for Datavision. Television itself will change radically with the new communications sciences.

A basic requirement of information systems is clear signals. Information transfer must be free of noise (any unwanted input, whether white noise, burst noise, or other interference), and coaxial cable constitutes a new and efficient way to accomplish this.

Physically, coaxial cable is a flexible, plastic-covered aluminum tube one-half inch or less in diameter. It contains a central wire and an outer aluminum tube as conductors. Electrically, the cable has the unique features of high-fidelity signal transmission, simplicity, and speed of repair. Large circuit capacity is crucial. A single coaxial cable used in cable television has a transmission capacity equivalent to more than 100,000 voice-grade telephone circuits—hence, a wide bandwidth. As we have seen, the bandwidth of a channel, whether wire or wireless, is a measure of the range of frequencies it can transmit without distortion.

The cable's capacity provides space-saving and cost-saving advantages over telephone lines. A half-inch-diameter coaxial cable utilizes a transmission capacity equal to 30,000 twisted pairs of telephone wires. (Just one good-sized user needs the equivalent of 2,800 pairs.) Copper phone lines carry only video signals over a short distance. Cable, furthermore, can interface with virtually any data network.

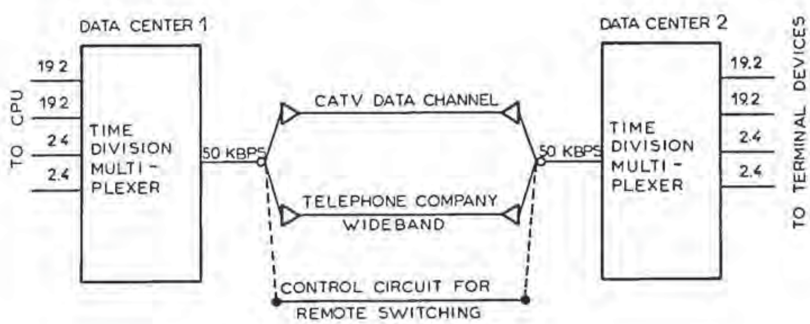
In the past, data-communications transfer applications had to be conceived of and cost-justified on the basis of the availability, price, error rate, and reliability of telephone circuits. With coaxial cables, however, the user can take a new look at the design of an information system, whether it involves circuits point-to-point, multidrops, remote terminal to computer, computer to computer, pay TV programs, Viewdata, video circuits for management conferencing, or security monitoring. Solutions can be found for practically any kind of fast facsimile-information transfer. High-speed facsimile machines, when used on wideband cable circuits, make the economics of large-volume graphic information transfer quite attractive. With the advent of high-speed facsimile machines, letter-size documents can be sent in a matter of seconds, although high-transmission bandwidths are required.

Once a cable link is established among apartment buildings or a firm's offices, many different applications can be installed and handled on the same cable at low cost. In addition to intracompany communications, it is now feasible to exchange large volumes of data with other companies. Indeed, whereas coaxial cable usage might seem an awfully far-out thing to the typical EDP manager, it is actually an innovative data-transmission medium for wideband communications. Coaxial cable is inherently one of the cleanest ways to transmit computer data. It is a particularly good solution where expensive computer printout and reentry of data are involved.

The block diagram in Figure 12.1 identifies the telecommunications configuration, with three alternatives: CATV data channel, telephone wideband, and control circuit for remote switching. Because of the frequency bandwidth capacity of the coaxial cable transmission system, it is possible to carry this number of signals to all customers on a single coaxial cable. This capacity is so large that the cable system can accommodate transmission of thousands of circuits carrying commercial data. Medium- and high-speed data circuits (4,800 bits per second to 230.4 kilobits per second) can be provided on a coaxial cable network for firms operating within a given area, or they can be provided for branch offices of the same firm. The same is true for residential installations.

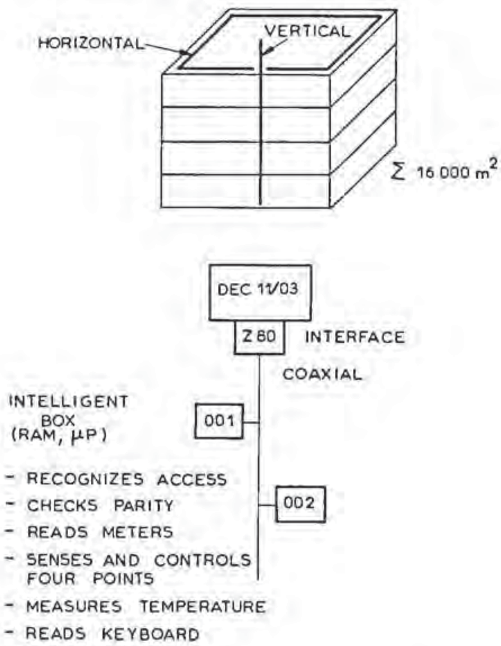
The Roosevelt Island Experience

Roosevelt Island was an interesting case study because it identified an area of possible application with broad market potential. At Roosevelt Island the entire set-up was computer controlled. Each device was polled every second.



12.1. A Telecommunications Configuration with Different Transmission Channels.

New projects now include plans for audio communications between the lobby and individual apartments, energy control, and meter reading electricity usage, in which a distinction is made between daytime and nighttime use. The internal network is vertically structured in a given building, but at each level it is horizontal (Fig. 12.2). Locally a DEC 11/03 microcomputer controls all devices hooked up to the system. CATV, however, has developed the Z80 minicomputer interfaces as terminal drivers, to enlarge and manage the terminals to be attached to the microcomputer. Up to 16 Z80 microprocessors, with 8-kilobyte memory, can be attached, or interfaced, to the 11/03. A microprocessor handles one building, and a single Z80 can manage up to 250 intelligent terminals. These are good examples of the use of microcomputers and microprocessors, which we discuss in Chapter 13.



12.2 General View of the Alarm System at Roosevelt Island.

The system is hierarchical. A central control is operated using a PDP 11/34 (with 128 kilobytes and 10 megabytes of storage), with 11/03 interfaces used as pollers and message writers; internally, the network operates on packet switching. Discussions about interfacing it with Telenet are proceeding.

The following describes the general view of an alarm system. The system consists of sensing devices such as fire, smoke, intrusion, and flood detectors, all of which are connected to transmitters in businesses and homes. The transmitters are permanently online to central offices or a master station at an alarm bureau, using intraexchange or interexchange facilities. Data-station selectors in central offices are sequentially connected to each monitored location, establishing an exclusive channel that carries the alarm signals back to the alarm bureau. Although straightforward, this set-up requires a fairly sophisticated procedural approach to be successfully implemented.

Existing systems have several limitations. In one arrangement, cable pairs linking a group of protected customer premises are connected in a series, like Christmas tree lights, at the serving central offices. Alarm messages are coded to tell the bureau where the trouble is. However, cable-pair trouble can leave most or all the premises unprotected until the trouble is cleared.

In another type of system, separate lines from each of several points in an area are connected in parallel or bridged at a central office. The alarm signals are sent on one data channel to the alarm bureau, increasing the permissible service distance and reducing the need for numerous long phone lines between remote sensors and central locations. At the central location, minicomputers or intelligent terminals produce audible and visual indications and a printout when a signal, indicating trouble, is received from a monitored location. A selector control unit is the usual interface between the master station terminal and the data station selector in the central office.

Most problems concern the data link. Excessive noise on one line masks authentic alarm signals on other lines, making it difficult for the alarm bureau to receive the signals. Trouble-shooting requires disconnecting each line, one at a time, to find the faulty one. However, using dedicted coaxial cables and new high-speed solid state switches, the better system repeatedly and in rapid sequence connects the alarm bureau to each of hundreds of remote terminals, one at a time. Then the data station selector starts scanning all over again at the first store.

The system can simply pick up an alarm signal, or it can transmit an activating signal to a remote terminal, causing the terminal to return a report on, for example, the present temperature of the premises. Because individual channels are isolated from each other, trouble on one channel does not affect others, nor does noise build up.

It is a relatively simple job to determine whether a problem exists on one or more channels. If it occurs on all the channels, the problem is in the switch, the data link between the central office and the alarm bureau, or in the common equipment at the alarm bureau. The alarm bureau may use any modulation technique, message format, or signaling method to suit each alarm system and meet safety requirements. Technology provides ample tools to reach this goal.

Optical Storage

Once transmitted, signals must be stored. Let's look at the most efficient way of handling the storage, which is made feasible through the video recording disc (VRD). Once a frontier of research and development, VRD rests on the practical application of laser-based recording, which, through further development, can be used in various fields, such as storage for data and facsimile.

The principle is simple. Diode-laser-activated optical systems can put data on a recording material, such as a plastic disc. One approach, using a long-playing record (30 centimeters in diameter), provides for 10^{10} user bits. This is Philips' solution. An RCA solution is said to permit 10^{11} user bits on the same disc dimensions. The two solutions, however, are incompatible. This is also true of both the digital approach under development and the analog approach for TV video units. And let's not forget IBM's entry into the promising market, through an American-Japanese venture: Discovision Associates.

The 10^{10} user bits stored on one side of the record correspond roughly to 500,000 typewritten pages. Although not a read/write device, VRD storage is still an attractive possibility. It provides much higher recording density than magnetic media while being nondestructive—a technology that lends itself to quality replication. The disc is divided into 45,000 tracks and each track into 128 sectors. This makes more than 5 million sector addresses, since each sector track is individually addressable.

Communications technology over the years has decreased the cost of storing and transmitting information by shrinking the amount of material necessary to support storage and transmission. Cuneiform tablets carried about 10^2 bits of information per gram. After the invention of printing, paper records could carry on the order of 10^3 bits per gram—in terms of efficiency, an increase of 100,000 times.

Microfilm and microfiche—in general, microform—storage represents an improvement of nearly two orders of magnitude, to an average of 10^5 bits per gram. Magnetic tape storage carries approximately 10^6 bits per gram. Engineering advances have resulted in optical discs with nearly 10^8 bits per gram—and with random access. This is three orders of magnitude better than microform and some 100 times more efficient than magnetic type storage. The advance is even more impressive when we view it from the perspective of printing. From 10^3 to 10^8 is an increase of 100,000 times, the same jump that occurred between cuneiform tablets and printing—or 10 billion times greater than cuneiform.

That's the coming revolution in data storage. At the present time, optical discs for video recording have been successfully marketed in the United States by Philips, Magnavox, RCA, Sony, Matsushita, IBM, and Victor/JVC. Atlanta, Los Angeles, and Miami were the first test cities. The discs, either smooth or grooved plastic, come in boxes or sleeves and are sold prerecorded. With them, you can view in high fidelity or stereo the latest movies, rock concerts, or opera ballets. There is no wear and tear, because the laser principle results not in little wear but in no wear.

At the analog recording stage currently being marketed, the machine is a playback component. It must be connected to a TV set to display the picture and to a TV speaker to pick up the sound.

Videodisc players, it is projected, will change the entire entertainment industry, not to mention business and education. No longer will rock bands be able to merely make a record; they will now have to visually perform the songs on an album. Discs of first-run movies will be available at relatively low prices.

Videodiscs are somewhat different. There is talk of newspapers being transferred to videodisc. Educators are exploring the use of two separate sound tracks for teaching such subjects as foreign languages. And General Motors has its system, Pioneer, on 24-hour call, with 7,000 industrial videodisc players in operation.

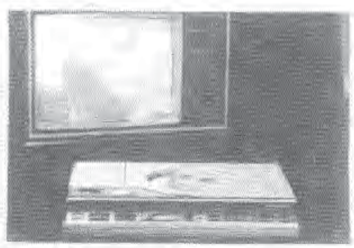
The Digital Option

Digital discs are in an advanced stage of research development. Sometime around 1981, a commercial digital model is expected to be introduced that will revolutionize data storage.

Figure 12.3 shows experimental use of the videodisc in data recording, alongside commercial use in video recording. The disc reader unit is presented in Figure 12.4.

A major attraction of optical memories is the low cost of mass-produced discs. We are talking about costs less than \$16 for 10^{10} user bits. Although the memory is nonerasable, the capacity is so great and the cost so low that the entire concept of read-only has been changed radically.

The enormous storage capacity of optical discs makes them suitable for archival storage. Half-a-million pages of printed text can be recorded. To put this in perspective, the current edition of the



Encyclopaedia Britannica would require some 250 million bytes, or about half of a 30-centimeter disc. A single disc can hold sophisticated course-referencing software, which enables the user to quickly find a desired item or collection of information for display.

The unit cost of producing these discs should be considerably less than that for producing printed books. Those who argue that few owners of personal computers will need memories with that much capacity overlook the versatility of databases. Optical disc recorders will likely be most successful in the television market. There they will be coupled with personal computers to provide high-quality video images for computer-based games and educational instruction. As the technology becomes more popular, optical discs will probably take over the market for video cassette recorders.

Applications

Obvious areas for application of digital discs are tape/disc dump, electronic mail, voice digitization, handwriting, design scanning, word-processing buffing, facsimile production, Viewdata, message switching, and office automation. Either analog or digital versions would be used for home entertainment. To a great extent, optical recording can substitute for microfiche (MCF). One of the advantages of MCF is that it makes possible a central data storage unit that can be accessed by several users.

Another interesting application is "scrivophony," a process based on ultrasonics, in which optical recording is used in connection with a writing pad and a pen (which serves as a capacity pick-up). The writing pad is a two-dimensional array. The process can be used for recording general requirements, for telecommunications, and for signature recognition.

Because both words and images can be recorded and retrieved using fast, random access, optical systems will almost certainly be integrated into word-processing systems to provide an electronic filing cabinet for all documents, including images received through various devices, networks, and communications lines.

Another large applications area is electronic document filing, on which work is reported to be progressing rapidly. IBM, Texas Instruments, Burroughs, and Hewlett-Packard are working on electronic document filing processes to handle not only the data on the documents but to process complete documents. Electronic document filing should have a dramatic impact on the level of paperwork in offices.

Combining Optical Discs with Intelligent Copiers

To fully exploit the potential of the low-cost, high-storage-capacity optical disc, intelligent copiers will be required. Recall what an intelligent copier does or is supposed to do. It uses a scanner to digitize and mail documents to any location, or to put them in electronic files in the form of optical discs, so that they can be retrieved and manipulated on a CRT. During the 1980s this technology is expected to expand greatly into businesses, offices, and homes.

Texas Instruments, Hewlett-Packard, and IBM are developing personal computer systems specifically for these applications. The structure of the office will be radically changed by these systems. Each office desk could be equipped with a keyboard, a video display, and a disc and processor and would be able to do word processing, sorting and merging, and handle mail. Mail-handling, of course, would be controlled by computer and therefore include automatic addressing, priority routing, multipoint delivery, automatic transmission of previously stored messages, message scanning, and so on. If such items as newspapers, magazines, and bills are to be delivered directly via personal computer systems, it is necessary to provide the personal computer with a low-cost, reliable, high-capacity, compact, and readily accessible medium such as the optical disc.

Let's not forget the range of developing services that are designed to support each other. The communications revolution will be given impetus by the new advanced communications service (ACS) of AT&T. This service will lower costs by sharing communications facilities and thus making possible the interfacing of herefore incompatible terminals and computers. For example, 12 European countries are scheduled to offer public data networks by the end of 1980, all with access to packet-switching services. The effect on business costs should be substantial. It is already eight times cheaper to send data from London to New York by the public packet switched network than by Datal services.

Advance tariffs indicate that the costs of using public data networks, whether in America or in Europe, will be up to 10 times cheaper than for existing public services. Lower tariffs will help promote both business and personal data communications, and we need the storage media to handle messages.

13 Software

In any computer system—large or small, maxi, mini, or micro—the central memory and auxiliary storage facilities hold data and programs. The computer's distinctive characteristic is its ability to store data and programs interchangeably, operating on one or the other as commanded.

We are not concerned here with programs and the art of programming. A discussion of computers, however, must make reference to what a program does or can do and to what purpose it can be put. Operational, technical, and financial issues fit into this category. True, the cost-performance ratio of computer hardware has improved by a factor of 200 in each decade since 1953. But unlike Viewdata, computers must be programmed, and programmer productivity appears to be improving at no more than 3% per year. That is why the user must be offered the possibility of a new understructure on which to build efficient systems, for both the home and the business.

A computer is a stored program machine. It stores a set of instructions in its memory and reads, interprets, modifies, and executes them. Programs are usually written by programmers on the basis of an analysis made on the functions to be performed. Such analysis specifies step by step what should be done. Until machines became intelligent enough to write their own programs, the only way to write programs is for humans to write them. I am not overly concerned about artificial intelligence, no matter how scientifically exciting this subject may be. In my view, solid-state software, and languages such as DMS able to write the equivalent of 50 to 80 COBOL statements in a single instruction, have had greater impact in modern computer business.

Because programs are a vital building block of any computer system, the usefulness of personal computers and home-learning devices increases when programmed applications are sold by retail stores. The consumer can sample on the spot and buy off the shelf the software needed without becoming overly involved in writing lines of code. During the next few years several user-friendly, job-oriented languages will probably appear—a language for teachers, one for students, a language for musicians, a language for graphics, languages for engineers, accountants, sales people, doctors—languages for practically anyone with a problem.

To make personal computing a powerful tool for the nonspecialist of all ages—the man or woman who does not have the time, patience, or interest to do the programming job—applications products sold to the typical personal-computer buyer should be well documented, tested, catalogued, critically reviewed, and updated by specialists. In speaking of the personal computer in Chapter 9, we reviewed the fact that programs kept in memory may be divided into two classes, basic software and applications software. Basic software (OS, languages, and utilities) usually accompanies the machine and performs housekeeping functions and executive tasks the way operators used to do in the early days of computing. For small, inexpensive microcomputers, OS comes compact and can be contained in central memory, typically 8 to 16 kilobytes. Recently it has been included in solid-state software (firmware). Disc-based operating systems are usually found in larger, more expensive, personal-computer equipment.

Basic software is made by the computer manufacturers, whereas applications programs (AP) are, as stated, written by the user or are sold by computer manufacturers, software firms, or retail outlets. Examples of applications programs are family budgeting, programmed games, learning aids, inventory control, billing, accounts receivable and payable, and payroll. The user of a personal computer or terminal will be concerned primarily with applications that must be programmed or purchased. To avoid redundant effort, however, it is wise to spend some time learning the available library of utility routines. Similarly, getting acquainted with the operating system will reveal to the user the capabilities and limitations of the equipment, since software contributes as much to overall performance as does hardware—and maybe more.

The Software Challenge

Computer programs are written to serve a goal. For example, someone working at home wishes to plan a menu on a personal computer, including dimensioning of recipes. The machine's calculating capability is used. If the recipe available serves only six, the machine comes up with the right proportions for eight people. The cook can also determine exactly how much food to buy by ingredient. The next time around the computer is put to work on personal and home finance, on recordkeeping and budgeting, on making decisions about an auto or a home. The same equipment that was used for recipes can be used. Although the personal computer is general-purpose, it sometimes becomes specialized. The available programs can be dedicated to particular jobs. This helps explain the importance of an application: program library.

Texas Instruments offers a program similar to that on solid-state software (Figure 13.1) that provides valuable assistance in helping people cope with inflation. It can assist the user in implementing a budget—monitoring expenses by category, month, and year. The user can better foresee the effects of new purchases or of income or expense changes, and thus develop a workable budget.

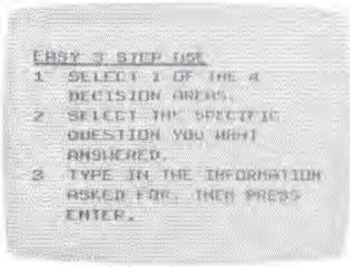
Other home-finance programs can be invaluable tools in helping people do more with their money when it comes to making decisions about loans, housing, automobiles and savings (Figure 13.2). These programs help explore and analyze available alternatives, as well as take the guesswork out of questions such as, Should I lease or buy a car? Should I pay off a loan early? Is it more advantageous to buy a home or to rent? Should I keep my current house or buy a new one? Is one house a better investment than another? Other programs can handle personal calendars, phone directories and address books, catalog stamp and coin collections, and help control home appliances and environments.

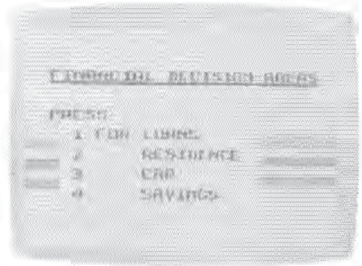
Let's look at an application that may interest both businesses and home users. A program is needed to keep a log of mail sent and the information pertinent to it. It should be possible to handle the sender's name and location, document title, dates sent and received, the date a reply is required, and the date the reply is received. The

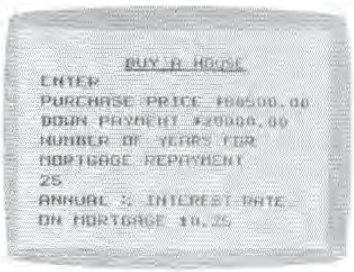
mail log this program will keep on computer can also be used as a convenient file to provide an accurate record of information flow that can be used for chargeback, budget control, and activity analysis. The other vital component is the data. This is a job the user must do. For any of these tasks the information must be in the computer, along with instructions on how it should be handled. Although instructions can be written or purchased, data collection is the user's responsibility. On the other hand, purchasing AP packages is not overly simple. If the decision is to buy, the user must take certain fundamental steps and meet certain requirements.

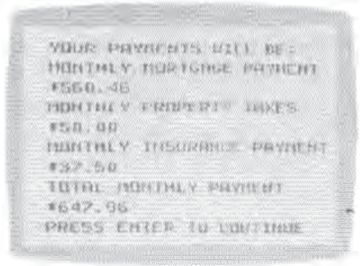
The first requirement is, know your job. What's the need? Data entry, inquiry, file update, learning aids, a payroll? What is the available facility? Can the machine selected do the job? Does it have the necessary devices? If not, what is needed to upgrade it? Is its OS able to handle the extra resources?

Let's say a personal computer currently available can do the job. Do you have the needed applications software? Can you find the programming product at the retailer? Does it fit what you want to do? Can you change *your* procedures? In the final analysis, would you rather buy a personal computer (which, if it exists, is usually









the thing to do) or write your own? This requires a long, hard look. The nonprofessional user can learn the sometimes intricate aspects of the computer job and learn them well; but the user must train for it. The nonprofessional user usually finds it more difficult and challenging to master software than to learn how many megabytes can be stored on this or that disc.

Like any machine, a computer has its limitations. One limitation may be in the hardware; another may be in the software or the cost. As hardware costs drop, and programs continue to be written by people, software may become the bottleneck. The new user is advised to address himself or herself first to the software challenge and only then look around for hardware to support it.

Not only program development must be looked at carefully before plunging into it, but program maintenance and the greater chance of coding errors must be considered. To change a few lines of code requires generating up to fives times that amount of coding.

Each time a new line of code is written, another opportunity for errors entering the computer is created.

As professional programmers know from experience, one presumably minor change often generates six to seven new problems, especially on programs that have not been robust and are already deteriorating. With each change comes another increase in software costs.

BASIC, PASCAL, and Other Languages

On more than one occasion we have referred to the main Viewdata advantage of user-friendly interface. To work with a system, the user needs no programming capabilities at all. The Viewdata dialogue protocol is so simple that it can be written on the keypad—a feature also offered on hand-held calculators.

From the foregoing discussion, the reader has evidence that personal computers do need programming support. We have emphasized that the nonprofessional computer user will be well advised to stick to the packaged (programmed) products offered by manufacturers or specialized software firms. This advice is equally valid in most professional cases. The possibility of having to program a personal computer is there, however; here, Pascal and BASIC are good choices.

BASIC was designed as the programming language of early personal computers. Hence, considerable experience has accumulated in BASIC programming. Also available is a significant amount of software for microcomputers written in BASIC. However, the software is not portable from machine to machine without extensive modifications, which make portability difficult and transfer unwise.

Pascal, a newer language, has some interesting features and is considered a coming language. It has well-structured data types and good readability, and it is modular, which means that, other things being equal, a Pascal program is more responsive to changing needs than is one in BASIC. Pascal has been adopted by the Department of Defense and by several personal-computer manufacturers as their standard language.

A good programming language is one that achieves an acceptable compromise among the conflicting goals that have plagued programming since the early 1950s. It provides the programmer with sufficient flexibility for programs to be written in a natural, logical way. And it gives a program a highly predictable structure, so that compilation can be fast and efficient. When a statement must appear on its own line, the maximum length of the statement is limited to a fixed number of characters. This feature reduces wasted space in programs with many short statements.

In Pascal, the statement separator is a semi-colon, which allows several short statements to be compressed onto one line or a single statement to overflow onto several lines. The compiler, however, can rapidly sort out one statement from another.

Documentation of a program within the text itself is also important. Program documentation provides the reader with additional explanations beyond the bare lines of essential code. In Pascal, the primary method of documentation is ensured by the use of a highly flexible naming convention. Every identifier, whether it is the name of the program itself or that of a variable or other element within the program, may consist of an unlimited number of characters. The restrictions are that the identifier should not be a reserved word (one of the native instructions of the language), that the first character should be a letter followed by an unbroken string of alphanumeric characters, and that only the first eight characters are recognized by most of the compilers. Additional characters are there for the benefit of the reader, to explain the functions of the named object.

Good programming requires much documentation in whatever language computer programs are written in. With Pascal, documentation efforts are usually concentrated on the various identifiers, using correspondingly fewer comments than, say, in BASIC, which has naming conventions that are more restricted. Yet both PASCAL and BASIC are relatively simple (if they are learned well) and can be easily taught to nonprofessional programmers. They have the added advantage that, with a small amount of central memory, reasonably good programs can be developed. There is, however, a problem of standards. The American National Standard Institute (ANSI) and the International Standards Organization (ISO) are currently working to avoid the situation BASIC finds itself in, where a large number of the statements for one machine will not execute on another.

Both standards and simplicity are at a premium. Languages should be simple, particularly for the beginner. But even beginners often want to kill several birds with one stone. The more demands that are placed on a machine, the more sophisticated the programming language must be.

There are also prerequisites to be observed. Graphics software is a good example, since it demands a structured hierarchy. At the bottom level are device drivers and primitive devices that interface software with graphics units. A driver is hardware that runs software, and a primitive device is a basic command that is supported by the system. At the top level are the user's applications programs. In between are subroutines, various sorts of utilities having to do with the construction or manipulation of figures and objects.

The current trend—and a good one, I think—is to put at least the lower-level routines in firmware. But the more advanced applications will always make demands on programming languages, demands which not all the languages are equipped to handle. Guessing which programming language will survive the test of time is like making any other prediction. Survival depends on many things: adoption by manufacturers and users; investment of time and money in a language (this was especially true of FORTRAN and COBOL); the appearance of more efficient programming tools capable of meeting user demands as they occur—for instance, the DMS language for IBM's 8100 minicomputer.

As we move toward firmware-supported programming, the assembler-level languages specific to this or that machine—which characterized early minicomputers and then microcomputers—will probably become obsolete. The same may be true of very compact, hence difficult-to-learn, languages. Like primitive devices, programming languages should be user-friendly; if they are not, their application will be difficult.

English-language programming in the so-called natural languages, presently in the research stage, will in the long run prove best for nonprofessionals. Menu programming might become the means by which nonprofessional users control their computers in the 1980s.

Finally, we should mention the online capability of transmitting software, both basic and applications programs, to the end user. This software could be written in a standard language, such as Pascal or BASIC or in machine code, whether for a specific personal computer or for an entire class of microcomputer.

In England, Viewdata research is continuing in cross-compilation of a user's program. Data, programs, and commands travel upline and downline. Standard programs can be transmitted, using the same channels. Telesoftware service awaits exploration and development.

Don't Rush

Most computer applications evolve gradually. Generally, changing an application often results in altering routine procedures for the many people who use it. Business procedures, for instance, are usually discussed among users, computer specialists, and consultants. Knowledgable users have requests, demands, and ideas that should be reflected in analyses.

As the domesticated computer is used more and more widely in homes the practice of taking the procedural side into consideration should also spread. Consulting other members of the family on how a program affects them may become a requirement. In other words, whereas programming challenges are expected to increase the demand for easy-to-use applications packages, programming products are not providing a procedural solution. This is what the user must do.

The typical, potential computer user today doesn't know much about computer programs or how to write a procedure. (If it is any consolation, neither do many professionals, that's why analysis and programming is in such a mess.) It is crucial that we understand computers and human-machine communications. Market research organizations estimate the current market for household computers at 18 to 20 million by the mid-1980s, and at more than 50 million when, presumably, prices are driven down by production levels. (These statistics do not conform to those presented in Chapter 9, because they are from different research organizations.)

To help the potential microcomputer owner evaluate new tools, let me briefly outline the software developments that the user should be on the lookout for, in terms of logical capabilities. The logical capabilities designed for the machine—and for future equipment, for which a computer may be designed—are described in terms of operating system, language processors, file-management system (or access method), graphics facilities, and text-processor monitors. (This is not an exhaustive list, nor are these features always applicable.) As I have emphasized, user-oriented, logical capabilities are included in applications programs. Here, the reference is to procedural prerequisites. We will follow an example in the next section.

Whereas the beginner should pay the most attention to the applications processor, the more sophisticated user will be looking for the *aim* in the original concept for the component, including the extension of existing system software and optimization of time-memory constraints; *installation directives*, which are described in terms of memory requirements for the object code, for tables, and for work and common areas; *description*, in terms of a component's structure, algorithms, and the data formats used; *user interfaces*, precisely, the logical supports necessary and an explanation of how to use a component, as well as which are its input parameters and which are output parameters, which are control parameters, and so forth; *documentation*, a listing of all the available documentation of the logical component and its environment (the documentation should be kept in the library and should be updated regularly). Logical design features that optimize hardware include segmentation, paging, time sharing, scheduling, multitasking, dynamic linking, and loading. Design features that optimize the user's capabilities are the available programming languages, debugging tools, open-ended or user-defined systems, file-handling systems, communications, interactivity, and responsiveness.

In the general case, home, educational, professional, and small business users need to take a careful look at how well programming products are explained. As always with computers, there is a considerable gap between what computers can do and what people can make them do. Programming products make sense from the manufacturer's own business viewpoint. Software is the only product other than the film industry in which, once the initial development cost has been paid, a product can be manufactured, or reproduced, in thousands of copies at an inconsiderable additional cost.

Interactive Software

The mainframe originally designed in the early 1950s and soon revamped was batch-oriented equipment. Since its origin in the mid-

1960s, the minicomputer has become an online machine. By the late 1970s, the microcomputer has become a truly interactive system. It should, therefore, be supported by the appropriate basic software—which is the manufacturer's job, not the user's.

Basic software typically performs data-entry checks. In cases of data error the cursor is positioned in the corresponding field, and an error message is displayed in a special field. Screen formats must be created in a dialogue manner via an ordinary video terminal. All the user should have to do is type the data directly on the display and define the starting position on the screen, as well as the length, format, and position in the input-record for each field. A message-control table is used for each form. Its job is to connect the terminal's function keys with an applications program or a new screen form. Master forms are needed for starting terminal routines. Routine codes are defined during systems generation. When a new form is created, it is immediately entered in the form library. An error message must be displayed on the screen, for instance, when there is an error in an input terminal or when a program error is discovered.

With the more nearly complete microcomputer systems—for instance, those designed for business applications—all error messages should be stored in a library on discs. Since all references to the library can be logged together with form number and user identification, it is possible to get useful statistics about error frequencies for different terminal routines.

Message are directed to applications. The routing depends on the function key initiating the message and on the current screen form. The processing of a dialogue step is easily divided into more program modules by a special call statement, which transfers a message record to the next applications program. Formatting, correction, and sending and receiving messages should be independent of processing in applications programs. Hence, the program areas are automatically set free when an output message in record format is ready for formatting and transmission to the terminal. Programs can be created, tested, changed, compiled, and linked by users with authority in these functions.

"Save areas" must be provided. They will usually vary in size, depending on how they are used. Again, for the larger, business-oriented systems and for security and authentication purposes, each terminal user must be identified in order to gain access to the system. The identification should be followed by a password.

Unauthorized attempts to update a file, or the unauthorized use of a form, must interrupt the terminal routine and give an error message on the screen. Furthermore, for auditing and recovery purposes, all calls resulting in any kind of file update must be logged on a special recovery file.

Software for Home, Education, and Entertainment

One of the many capabilities of the home computer is the adding of a new dimension to entertainment, from chess to football. Unlike ordinary home TV games, the microcomputer can be a patient instructor in a variety of games. And the user can use firmware or program it. Generally, manufacturer-supplied APs for lower-priced machines tend to be limited to game-playing and personal finances of the checkbook-balancing kind. However, new software components can be added to a personal computer if they are compatible with it. This is done more easily than adding hardware modules.

Educational programs can help students sharpen their math, grammar, spelling, and reading skills. The computer guides the student through activities at his or her own pace. Colorful pictures and sound effects aid learning by providing encouragement and assistance. As an educational tool, the home computer can be more useful than even an encyclopedia. Children can play with a computer and learn something, yet still think they are only playing.

Nearly all personal computer manufacturers offer educational programs, from simple number games to advanced mathematics. Texas Instruments, for example, has a beginning grammar program to help school children at grade levels 3 to 5 learn the parts of speech and how they are used in sentences. The program combines color, sound, and pictures in activities that make the learning of grammar basics more gamelike, enjoyable, and rewarding. The computer guides the student through activities at his or her own pace, providing encouragement with pictures and sounds. Another program in "early learning fun" is a learn-by-doing package, combining shape, number, and letter-recognition activities with exercises in counting and sorting. Children can learn by matching and identifying shapes and by sorting and counting objects that appear on the screen. This program also uses colorful pictures and sound effects. Like instructor manuals, parents' screens are provided, so that a parent can read simple yet precise instructions to the child on how to perform an activity. Still another program, "number magic," helps teach addition, subtraction, multiplication, and division with an easy-to-follow, gamelike approach. The computer states a problem, and the child gives the answer or answers. Scores are kept automatically. Visual and audio rewards for good scores help maintain the child's interest. The child can race to solve problems against one or more opponents or against a built-in timer that appears on the screen.

The household has not been forgotten. As the case study presented in Chapter 12 helps document, adequate environmental control is possible using microcomputers. The same is true of running household appliances by switching an AC power line on or off. By placing a simple, computer-controlled switch in the power line and equipping appliances with appropriate sensors, their control can be assigned to a personal computer. The appliance and the microcomputer can communicate through high-frequency signals transmitted via the existing wiring in an apartment. In addition, the personal computer can help select menus and provide an instant guide to calorie control. It can prescribe a schedule of exercise or chart biorhythms.

I cannot overemphasize the need for comprehensive software libraries. Games and other forms of entertainment are part of home usage, but the user does not need a computer if all he or she wants is to play games. New, imaginative programs are necessary to satisfy home users.

Programming Products

Having spoken of prerequisites, let's now see what the market has to offer in terms of packages and prevailing prices. By mid-1979 readily available programming products (for the applications level) typically ranged from $6 to $30. The following lower-priced software is available:

Business Programs
Advertising
Address Book
Annuity
Bar Graph
Bond Evaluation
Break Even Analysis
Checking Account
Interest on Loans
Inventory
Loan Finance
Personal Calendar
Programmable Calculator
Ratio Analysis
Salary
Savings Account
Statistics
Straight and Constant Depreciation
Trend Line
Uneven Cash Flows

Game Programs
Battleship
Blackjack
Bomber
Breakout
Cryptography
Destroyer
Etch-A-Sketch
Frustration
Hectic
Hide-and-Seek
Kaleidoscope
Lunar Lander
Monopoly
New York Taxi
Star Trek
Star Wars
Tic-Tac-Toe
Tiger Tank
Torpedo
23 Matches

Educational and Home Programs
Add Game
Bar Graph
Base Ten Converter
Basic Math
Biorhythm
Calorie Counter
Continents Quiz
Counter
Definite Integral
Electronics Equations
Kitchen Aid
Math Blitz
Mathink
Math Introduction
Powers
Solar System Quiz
Spelling Quiz
Trend Line
Tutor

These programs are normally on cassette, which, while not the best medium, is a cheap solution. The user should remember that cassettes are subject to the effects of static electricity, which can make them unreadable. Cassettes may also become demagnetized if they are placed near a magnet. Or they can break if they are run back and forth too often.

For instance, Texas Instruments' "Video Chess" was developed with the help of the international chess master David Levy. The program allows the user to play chess against the computer or against another person. Special chess problems can be set up for study purposes, or the computer can play both sides of the game. Not only does Video Chess conform to the rules of chess, it provides a capable opponent or a friendly, patient instructor.

In the higher range of software products ($30 and up), the user will find, on minidisc or cassette, advanced mathematics; arcade-type video games; assembler editor; BASIC tutor; checking, savings, loans, investments; depreciation and return on investments; educational games; extended machine code monitor; mailing and address lists; and tests, drills, tutoring. Finally, operating system supports come in two-tier prices. Microlevel operating systems sell between $30 and $50 (for example, Ohio Scientific's OS-65D V3.1, with named disc files and support, sells for $49). Texas Instruments' software is typically priced at $20 to $70, and the speech synthesizer will be $150. (Remember, these prices are as of mid-1979; almost certainly, they will rise.)

More sophisticated operating systems, with data files and extended BASIC (which, in some cases, can run even satellite computers), sells for $200. The same price range characterizes software for word-processing systems, with character and global editing, paging, text justification, proportional spacing, and hyphenation. These programs are suitable for general office use, such as letters, reports, manuals, and manuscripts.

Up the price list are the complete, small-business accounting packages, including inventory, invoicing, A/R, A/P, general ledger, and profit-and-loss statements. They typically sell for slightly less than $1,000, which tends to make the software as expensive as the hardware.

14 Marketing

As manufacturers of all types know from experience, it is not enough to make a product; it must also be sold. Harold Koontz of UCLA, a former vice-president of Trans-World Airlines, used to say: "Flying airplanes is no problem. Filling them is!"

Personal computers are consumer products—but with a difference—for a least three reasons: software support, user education, and maintenance. They can't be sold through, say, mail-order houses without a network in the field to give clients the necessary assistance. Since the product is not yet packaged to sell like an electric blanket, customers must be able to speak to someone who is familiar with personal computers.

Minicomputer users are different from the users who, for 25 years or more have been managing computer technology. User-friendly environments, simple designs, low marketing budgets, fast delivery, and speedy production of add-ons are at a premium—and so is the competent, local computer shop.

Shopping for a personal computer resembles the practice often followed for other appliances. As is true of any consumer goods, such as a car or a television set, information is gathered by talking to other users, by reading and collecting published material, and by visiting stores that carry the product. People in an EDP environment are good sources of information about personal computing. One must, however, be forewarned that computer experts rarely if ever think small, tending, instead, to think big—and that is just what the personal-computer user cannot afford to do.

What add-on features am I referring to? First, when you buy an automobile, it is assumed that you know how to drive. That should not be assumed in the case of the personal computer. In fact, the situation is usually reversed. IBM earned huge profits in the 1950s by educating users before installing machines. That is still a good rule to follow. IBM used this policy again with its systems for small businesses. Seminars are offered around the country by software firms and independent consultants, who suggest that "since the world of computers is often a strange and confusing one, a half-day seminar will solve your problems." (Half a day is inadequate, half a month might do it.)

Selecting a Personal Computer

Selecting a microcomputer is easy or difficult, depending on the goals. If you view it as a hobby, it's easy—assuming that, as a hobbyist, you know what you want, and look for it. But if the personal computer is to be used for business, you should begin with the software, not the hardware.

Once you have found the applications programs you need, look at maintenance, the manufacturer's reputation, and, finally, the price of the various alternatives supporting the software that fit your needs. Hardware should be far down on the list of priorities. Manufacturer reputation, or dependability, is a key consideration in the purchase of a machine, not only for usage but for trade-in. That's what makes strong companies stronger. Will the manufacturer under consideration be in business 5 to 10 years hence?

The leaders in the microcomputer field will not necessarily come from the established minicomputer companies. Similarly, minicomputer leaders did not come from the mainframers nor autos from coach manufacturers, airplanes from automobile manufacturers, or missiles from aircraft companies. IBM has in progress five parallel, personal-computer projects; but there is as yet no product. Will IBM eventually provide home computers and communications services to households? By way of answer, one IBM executive said: "If we find that we have the technical and marketing capabilities, I would expect that we'd be in that market. We're not writing off the home market."

One day the personal computer will come of age, and a market for it will develop. But what will be the price of this product? Where will the competition stand by then? Current manufacturers are organizing thousands of computer outlets around the United States, many of which display several different computers, as well as carrying useful reference books. It is a good idea for the novice user to visit as many stores as possible to see hardware, ask questions, and gather brochures and other material. The marketing experience with microcomputers is just beginning. Sales mushroomed in 1978 and 1979, and another large increase is expected.

Today, personal computers are sold through several hundred specialty computer stores, as well as directly through manufacturer, electronic, and stereo-equipment outlets, office-equipment suppliers and department stores.

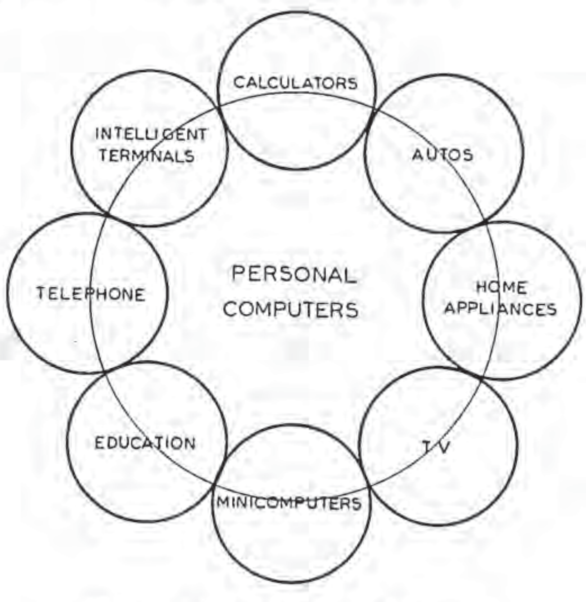
Computer Shops

We have been discussing computer shops that are nearby and easy to visit. These stores represent one of the fastest-growing sectors of the retail industry. The number of computer specialty shops is likely to increase sharply despite the failure of a certain percentage of marginal businesses. It is widely anticipated that, of the current microcomputer outlets, only about one-third will survive. Enough new ones will open, however, to supply the needs of the growing U.S. population. In 1978 computer retail stores generated revenues of about $165 million. With an estimated growth rate of 40% a year, they are expected to produce $945 million in revenues by 1983. But that is only part of the picture. It is expected that greater retail revenues can be generated by distribution outlets other than specialized stores, for instance, office-equipment suppliers, distributors of electronic equipment, firms specializing in computer systems, and mail-order businesses that handle machines which are well established in the field.

This merchandising technique is controversial, however. Some support the view that standard office-equipment suppliers do not have the capability of moving aggressively into the personal-computer market. If we look at the mid-1960s minicomputer experience, and that with electronic accounting machines, the argument holds up. Dealerships intended for a different market are often difficult to convert to outlets capable of pushing new technological products. Tandy Corporation is an example of successful marketing of microcomputers. In 1978 the company had higher sales than all other microcomputer manufacturers combined. Tandy became the third company to reach the top level (in terms of units sold) of computer manufacturing and shipment. Also in 1978, Digital Equipment Corporation achieved the same sales level, but with more expensive equipment.

In spite of the occasional success story in microcomputer marketing, everybody is still searching for a way to sell this new animal: the low-cost computer. Sales margins are slim and the competition is intense. The retail computer shop in its present form evolved from the mail-order, computer-kits industry, an industry that catered to hobbyists. That is why the early stores were usually staffed primarily by technical people. These stores usually sold consumer video games and other applications software.

Computer stores, however, must convert to meet the demands of the marketplace (Figure 14.1). The hobby and video game sectors are shrinking in terms of share of the market. Virtually none of the big-name microcomputer manufacturers supply kits any more (kits are still available from such electronics distributors as Heath). The wave of the future isn't kits; it's assembled products sold through specialty stores. Of all the schemes that have been tried, the retail specialty shop—which understands the commodity it is selling—seems the best approach to the market.



14.1. Possible Uses for Personal Computers.

The Economics of Distribution

As an executive of a computer shop once remarked: "The economics of distribution tell us that there is an electronics sales revolution in the offing—that is where the odds will be played." The coming machines will be simple to operate and will offer a great variety of solid-state software. To sell these sales products, though, sales outlets must be prepared to help the user.

The big change has been the shift among personal computer buyers from computer kits to a reliable turnkey system with a blanket maintenance contract. Buyers want training and advice, and that, office-equipment outlets cannot furnish. The successful computer store of the 1980s will sell packaged *solutions* to personal and business problems that will include hardware, software, installation, training, maintenance, and the ability to upgrade a system as the client becomes more involved in personal computers. In 1978 computer shops sold $35 million worth of products and services, or 21% of their total sales. By 1983 this may increase to $330 million, or 35%. As we see in Chapter 15, the ability to provide good maintenance will be essential to success, preferably through diagnostics executed online at the customer's location and ensured by means of a reliable maintenance contract. Maintenance revenues are expected to increase from a relatively insignificant $5 million in 1978 to more than $50 million in 1983. Given the range of services possible by then, personal computers will be both a complex and a rewarding experience.

The business opportunity for the independents lies in the fact that the market will also demand stores with variety, with products from different manufacturers to choose from. That will push forward the different manufacturer-independent chains, and the customer of the future may get a better bargain while at the same time taking a somewhat greater risk.

Other choices are necessary. Either a marketing outlet, of whatever origin, sells its products off-the-shelf, or it must give the user turnkey support. At less than $1,000 per unit, there isn't enough profit left over to spend on customer support—unless the unit and the support are priced separately.

Another aspect of the market is the advertising media. Eventually Viewdata and electronic mail will be the mediums of choice. In 1978, Radio Shack spent $2 million on an advertising campaign and sold 100,000 computers. Computerland opened its first shop in late 1976 and, through promotional campaigns, had 75 shops by mid-1979. This brings us to the subject of franchising.

Franchising

Technology has created a demand for microcomputers, but distribution is the key to the future of the market. Good franchising calls for decisions about whether there should be centralized functions at the national support level, including selection of lines and types, purchasing, advertising and help for ad formats, negotiating, and studies of who would survive, as well as decisions on decentralization, whether there should be independent outlets doing the aforementioned work on their own, apart from selling.

A centralized organization is a national or international organization with dealers operating under license in a relationship that allows the establishment of an effective sales network. A decentralized organization is one with franchise holders that have more independence (and thus a harder job at the level of the individual outlet). Such questions are of interest not only to the client but to the manufacturer of the equipment, who has to decide if it will handle sales on its own, directly to retail stores, or through franchised dealers. Dealer management must make many decisions, not just once but constantly. First, the target market is not evident. As the clientele develops, today's strength could easily become tomorrow's weakness. Another decision, one that precedes the choice of equipment, concerns the price range.

Computerworld, for example, has decided to handle personal and business microcomputers for somewhat less than $2,000 to about $15,000—a range that is relative to the market goal. The importance of making the right choice is clear. The chain planned an additional 20 stores by late 1979.

Decisions about price range and mix are important. Prices currently range from Mattel's $50 machine to DEC's $20,000 unit. One good mix, *Microage* said, is 50% the low end and 50% at the high. But that range is too broad, in my opinion.

Still another decision faced in franchising—one that the manufacturer's outlets are more or less immune to—is, Who will be making the software? The clear-cut answer is: the manufacturer.

What is involved are objectives and relative strength. To be successful, a franchise chain must ensure continuity. It must drop products that aren't selling and manufacturers who are failing. Stocking the latest equipment is appealing, but that only compounds the franchiser's support problem. Choosing the machines that must be dropped is one decision that must be made; the other involves an assessment of the manufacturer's dependability. In terms of product, software is a better bet for profits than hardware.

Other decisions must be made. For instance, will there be a market for used personal computers? Dealers now take trade-ins, and magazines run classified ads for used machines. But people tend not to sell their personal computers. Tomorrow this may change. If it does, what will be the impact on the franchiser?

Careful planning must be used to ensure that any time a store is opened, the sales potential is there. The mere presence of a store will sometimes help create a market. The market will likely expand as more outlets open. A creative marketing strategy is necessary, both to bring out products and to keep them before the public.

Learning from Experience

The future of the personal computer seems to lie in the computer-shop solution. Professional interest suggests taking a closer look at this problem, using case studies. To keep the study in perspective, let us look at how the executives of two chains viewed themselves and their businesses in 1979.

Computer Store operates as a wholesale distributor interfacing between manufacturer and retailer and running a network of shops owned either by the company or franchised. Positioning itself in the market, it identified as its target, hobbyists, personal-computer users (said to be the group most difficult to define), and people with small and very small businesses. The vertical markets to be confronted included hardware, software, training, and general expertise.

How well has Computer Store's strategy worked? "To evaluate the potential," a senior executive said, "you have to consider changes in all facets of this market: communications, telephony, and television."

Market position is also under study. We cannot successfully serve a market if we do not understand the market. To gain control of operations, a store manager must understand that market—not just here or there but the total market. The manager must know the store's clients, for example.

Microage is a franchise dealer whose management has taken the view, rightly so, that the economy is changing and with it, the marketplace. "This puts tremendous pressure on small computer stores," one executive commented.

Whereas site selection is critical, product selection is both critical and difficult. The chain must be able to choose a winner. Good products have a long-term impact. A solid product (something more important to small business systems than to hobbyists) must be chosen; sales and maintenance people must be chosen; spare parts must be stocked; and a client base must be developed and supported.

New products are introduced and run their course. The Apple II minicomputer was developed by two young men in their early twenties; today it is an established product, a microleader with good profitability. Such success isn't guaranteed; the less known the product is, the more important is the selection of manufacturer. Emulating successful minicomputers through firmware is a strategy with merit. Amdahl, Intel, and CDC have done it, using IBM mainframes. Heath uses PDP-8 components and software.

New markets mean service. Hobbyists do not emphasize service; small business systems do—and continuing service, at that. Called transitioning, it is valid for hardware and software and the whole applications orientation, including demonstration software to show customers.

A chain must survive. Sales goals must be achieved and profits made. Sales volume depends on the kind of store, what it sells (concept, not just a product), and the margin. A margin of 15% to 20% seems reasonable; profit margins of 35% to 40% are uncommon. Profit margins vary over the country. The forecast is that margins will drop in time but that volume will increase. As matters now stand, the break-even point for a new store is $20,000 to $25,000 per month. Even at that level, it's difficult to operate a store. In other words, a sales outlet might survive with sales of $250,000 a year; but it must reach $500,000 a year or more to achieve profitability. It takes an investment of $100,000 to open a store, plus $60,000 to $70,000 in inventory. The balance is working capital. To handle accounts receivable, the store must have money or be able to borrow.

The Industry Giants

Microproducts are not a monopoly of microcomputer companies. IBM has announced a chip with the power of its 1401, introduced in 1960. National Semiconductors predicts a chip with a computing power of an IBM 370/158 by 1985. Intel has introduced the 370/135 on a chip. And there is talk of a modem on a chip, which could change the shape of communications. IBM, Texas Instruments, Digital, General Electric, RCA, and Hewlett-Packard in the United States, Casio, Sharp, and Toshiba in Japan, and Olivetti, Siemens, and Nixdorf in Europe have shown signs of entering the personal-computer market.

Among the leading microcomputer firms, DEC took the first step in retailing. As of mid-1979 it had two stores; the one in Manchester, England is mainly a catalog shop and demonstration center. Each new development in the field, a DEC executive suggested, reduces the price of computer power, broadens the market, increases the customer base, and requires new marketing approaches. Simple, inexpensive machines, DEC contends, require different retailing concepts. This particularly true of the small-business market and the personal computer.

All of this activity has had an interesting effect on the big companies. These companies are well aware that a product that costs so little does not yield the profit margins to pay salespeople. It is too expensive to make repeated calls to sell a device costing $5,000 to $20,000. The nonsophisticated user likes retailing as it has long been conducted. Let no one forget how easy it is to lose ourselves in technology and do less than our best to sell that technology to consumers. Computer retailing is also the solution for the large companies, which are reportedly retooling and redirecting their sales efforts toward software, consulting, and assistance, but marketing their hardware through catalogues.

Selling to Small Businesses

Today's small-business person has an option: stay with paper and pencil or move into the computer arena and use turnkey products. The latter course is indicated, for reasons of competition. The question arises: How do we define a small business? DEC's answer is that a small business has less than 200 employees, whereas a very small business has less than 20. There are also sales opportunities in the 5-to-20-employee market. For both the small and the very small business, there are prerequisites. Four of the most important are reliability, programmed applications, training, and keeping an open mind. The first prerequisite is self-explanatory. As for programmed applications, the user probably will not want to program a computer. On this assumption, DEC offers both BASIC programming and menu selection of applications.

Regarding the third—training—because the typical personal-computer user will not be familiar with these machines, it may be necessary for companies to set up small classrooms in their stores. Fourth, the producers of microcomputer products must keep an open mind about future developments. Quite likely, new names will appear. According to DEC, however, those outlets that are factory-owned or at least factory-franchised have the best chance of succeeding.

The magnitude of the market and the millions of machines to be sold to small businesses and home users all indicate market segmentation. Such a strategy would allow manufacturers of take advantage of mass economies.

Contracting for a Personal Computer

Those who have had the opportunity of writing contracts with large computer manufacturers remember the experience. Usually, one of two courses of action were followed. In the first—the most frequently occurring course—the user is presented with a neatly printed contract and asked to sign at the bottom righthand corner of the third page, this committing the signer's company.

Computers have been known to fail. Any machine does. But because the contract was written by the computer manufacturer and signed only by the user, there was no clause guaranteeing the system's uptime. Neither was there any penalty for poor maintenance.

The second course of action is a long negotiation period in which the user dictates the terms rather than bowing to those of the manufacturer. Users who take the negotiations approach know that they have the upper hand. It is their money. The manufacturer must give in, accepting uptime, the penalties for poor work, replacement criteria for units—and some hefty discounts.

The message for the personal-computer prospect should be clear: take time to study the terms. Define—in writing—exactly what will be furnished to you for the money you pay. This takes effort, but it is worth it. Include everything the manufacturer or retailer owes to you, from computer reliability to the number of copies of documentation to be furnished. Do this *before* you sign a contract, before any money changes hands. If you plan to get your training at the retail outlet, figure out how much time you must spend and what the charge will be per hour for time over and above the free amount. If development work is involved, and you depend on the timetable, try to get the retailer to commit himself or herself to time-penalty clauses for delays. Also, protect yourself against sloppy, applied programming work. Because there are numerous manufacturers, you don't have to reach a decision immediately. Write down your criteria before the visit; then use them to test different machines and different shops.

You may think there isn't much of a problem in support if you are merely going to buy a microcomputer on an install-it-yourself basis. This is not true. If anything, you must get applications programs, which will probably not be at the shop when you make the purchase—at least not all of them. Will they come in time? Will the documentation be complete? Are you sure there are no strings attached when you take delivery? Don't overlook bargains. Some promotional campaigns come and go. On the other hand, if you are going to use the personal computer in your profession or business, you will need reliability, and this comes at a price.

15 Maintainability

Reliability and maintenance are a preoccupation of any manufactured system. Viewdata and personal computers are no exception. What users do not always appreciate, however, is the complexity of the problem, which is compounded by hardware, software, communications, environmental conditions, and the operator.

By the year 2000 every community in the United States may have "computer vending" machines. If there are computer stores and repair shops as we know them, they will disappear. The nanocomputers sold from these machines will be built to last about a year (planned obsolesence), to be thrown away when defective. Until that day comes, though, personal computers need maintenance. Reliability and maintenance problems are shared by end users and manufacturers, but for different reasons. End users suffer from downtime and have to pay for maintenance. The manufacturer must guarantee reasonable availability, which, with old methods, means more personnel, hence difficulties in controlling maintenance costs.

Reliability is the probability that a system will give satisfactory performance for a preestablished period of time, under operational and environmental conditions defined in advance. For a personal computer, reliability can be calculated thus: reliability equals system usage time divided by the total number of interruptions. What interests the user is the availability of the system. By definition, availability is the probability that a machine is running at any given time. The calculation is: percent of availability equals 100 times system usage time (uptime) divided by scheduled time; and uptime equals scheduled time minus system downtime. Unscheduled interruptions are caused mainly by hardware failures or software malfunctions. Whether it is scheduled maintenance or failure maintenance, maintenance is labor-intensive. Its cost follows the rising cost of personnel. Maintenance is also capital-intensive, because of the need to keep inventories of spare parts, test tools, and other equipment. Online diagnostics is thus a good solution; but it is also a complex task, given the number of circuit combinations to be checked.

Regarding reliability and maintenance, microcomputers have fewer components and use less power. Hence, they are subject to less stress and have lower failure rates. Microcomputers are often relatively easy and inexpensive to maintain. Fewer components and single boards mean less downtime for maintenance. If the personal computer has been designed properly, it is easier to isolate a fault at the replacement module level and cheaper to maintain an on-site inventory of spare modules, which effectively perform self-maintenance.

Products must be projected for online maintenance. Reliability and maintainability have to be built into the system at the design stage. Furthermore, the availability of inexpensive technology makes possible increasingly sophisticated diagnostic procedures. The cheapest way to organize for future maintenance is to make substitutions on the assembly line–at the chip or board or entire peripheral level. This is the policy of the standard exchange already successfully applied with other products such as wrist-watches. Whatever expense it represents is part of the life-cycle costs.

Reliability Statistics

While reliability engineering is not the aim of this book, some basic statistics help the user understand how well a personal computer is doing. When we speak of hardware failures, we are referring to MTBF (mean time between failures) or MTTR (mean time to repair). These are the oldest procedures carried over to computers from guided missiles. All are measured in hours. Because some failures occur for other reasons, the recovery procedures necessary in computers have made these procedures inadequate. In recent years, therefore, two other yardsticks have come into use: MTBSI (mean time between system interrupt) and MTOSI (mean time of system interrupt) MTBSI and MTOSI are much better for evaluating the service obtained from computers and data communications systems, because they reflect the combined negative effect of interruptions.

These statistics have to do with the total system. It is proper to bring to the user's attention the fact that most failures are not failures of the central processing unit, but of peripheral devices (mainly conventional), such as discs, cassettes, and printers. Manufacturers of peripherals are making interfaces that are easy to attach to personal computers. As peripherals multiply, so will maintenance problems for the user increase. The kind of reliability that should be the goal will depend on what the user wants to do with a personal computer. If it is for hobby and entertainment, some downtime is not catastrophic. But if the aim is environmental and energy control in the household, or in small-business applications, then we are talking about a different problem altogether.

In a professional environment each component of a personal computer has different requirements with respect to availability. For instance, the availability of the central processing unit is more important than that of a terminal; a system control is more important than a language compiler; and so on. The professional user cannot afford low reliability. The data is locked into the computer in a manner similar to that of large businesses. Downtime means loss of contact with the data and, most likely, with customers, personnel files, and bank accounts.

Preventive Maintenance

Preventive maintenance has been associated with hardware since the first generation of maxicomputers. The preventive maintenance required for various classes of components varies widely, depending on the components. A unit without moving mechanical parts, such as semiconductor chips or bubble memories, needs far less preventive maintenance than a mechanical unit with moving parts, such as a disc drive. But the first requirement for proper maintenance of hardware is that the component be designed for preventive maintenance.

Standard components for all interfaces are a must for quick changing of failing parts or the immediate isolation of problems.

If a personal computer is to be operated continuously, preventive maintenance must be performed without disrupting the entire system. Getting the cooperation of a computer shop (or a computer manufacturer) for such simple items as coordinating preventive maintenance can be beneficial to the user. But it is also advisable to guarantee it contractually. The rule with computer maintenance is that the sooner the malfunctioning component is detected and the failure corrected, the better it is for all concerned, for both the user and the repair shop. Depending on the application, the effects of a malfunctioning component can range from a simple temporary nuisance to catastrophic conditions. There is also the possibility of drift, of one malfunctioning unit affecting the others.

Another crucial issue is the production of a feedback-reporting system to determine the scope and detail of sending reliability statistics to the manufacturer, and the relative benefit to the user. There should be a log of component malfunctions that pinpoint units needing additional preventive maintenance or replacement. To examine such a log for each component, the computer shop should possess the skill to identify the units that are malfunctioning frequently. Diagnostic routines must be able to run in the normal job stream without disrupting the entire system. This permits testing and checking a newly installed unit to see if it is failing. The diagnostic routine used in preventive maintenance should also specify which component in a series is failing. For every basic component of a personal computer, maintainability can be expressed as MTMA (mean time per maintenance action). The critical variables, all closely related to preventive maintenance are, troubleshooting, testing, and location.

As for the effectiveness of the maintenance effort, this is a function of the training of field engineers in doing their job properly.

The user should note that the cost of maintenance, whether for preventive or repair, is steadily increasing. Maintenance costs are influenced by personnel and spares, roughly in a ratio of two to one.

With maxicomputers and minicomputers there has been a certain ratio between the yearly cost of maintenance and total equipment cost. In the case of the former, the yearly cost, as a percentage of the sales price, varies from 3.5% to 5% for the latter and from 7% to 8.5% for the former.

Maintenance Policies

At Radio Shack, the TRS-80/Model II is marketed with an extension of the original 90-day warranty, priced at 15% of the list price of the system and covering parts and labor for 12 months. Under the contract, a user may bring a computer or peripheral to a comouter center or a Radio Shack store, or the computer may be mailed in. But the contract does not cover peripherals not sold by Radio Shack. Nor does it cover any item with user modifications or a CPU with non-Radio Shack RAM. Furthermore, maintenance is not supported at each sales outlet but through an established network of 55 repair stations throughout the United States. Of these, four are regional repair centers employing up to five computer technicians; the other 51 units are satellite repair centers supervised by regional coordinators. The repair centers are in addition to technical repair facilities Radio Shack operates in each computer center.

Texas Instruments offers maintenance service through flexible accords, which allow the customer to choose the "basic agreement" for Monday through Friday, 8-hour service; optional coverage up to 24 hours per day, 7 days a week; or on-call service.

The manufacturer that offers better service is the one who sees to it that each maintenance engineer is backed by product specialists and skilled technical people belonging to engineering support groups. All maintenance engineers should be professionals of good standing with technical education, formal equipment training, and field experience. The personal-computer manufacturer should implement a continuing educational program to ensure that the technical abilities of his maintenance people are current. And the appropriate control procedures should be implemented to guarantee that maintenance people are dedicated to keeping customer machines performing.

Good service means rapid and effective solutions to customer service requests, prompt repair, and professional follow-up. Every effort should be made to maximize equipment availability at the user's site. Spare-parts inventories need to be maintained at several levels to ensure the services of the maintenance engineer. Texas Instruments, for instance, maintains multilayered spares, from inventory on wheels to local service offices, distinct parts depots, parts banks, and dedicated, factory-inventory warehouses.

Given the variety of user demands to which such inventories are subjected, inventories ideally should be maintained by computerized inventory-control systems capable of keeping records on parts usage and ensuring adequate spares levels through automatic restocking.

Repairability can be enhanced through steady, effective preventive maintenance. The units with the movable parts—by and large, the mechanical devices—are more prone to failure and should be watched carefully. Although it is in everybody's interest to have well-run systems, contracts are needed to increase reliability. Contractual provisions usually stipulate that costs are to be supported. Some policies call for payments at an hourly rate; others establish a flat rate. Still others contain general statements to the effect that a company's first obligation is to support its direct customers before extending such efforts to others. Their last is the weakest type of provision.

The best solution for personal-computer users is not to be as dependent as they are today on the supplier's service personnel to diagnose malfunctions and repair hardware. With improved and simplified diagnostic facilities, plus some training in the use of tools, the user should be able to determine whether a malfunction can be repaired without resorting to supplier help.

Telediagnostics

The self-service approach can be implemented through improved system and components design and better diagnostic tools. A diagnostic plan is important. Statistics, error messages, oscilloscopes, and so on are expensive; to discover a problem, there should be a rational way to synthesize symptoms and employ sound techniques. In some ways we have returned to the programming argument. Most personal-computer users do not have the time nor the interest to do diagnostics themselves. Thus they should ask the help of a diagnostic center.

Because personal computer experience in the field of telediagnostics is virtually nonexistent, we will review, by way of example, the aims and functions of network control centers that have been established for such computer and communications firms as Tymnet, Telenet, Datapac, Transpac, and Citinet. Online diagnostics are so much more important for personal computers than for large mainframes that microcomputer manufacturers usually don't make house calls. If they do, it usually takes three to four days for their maintenance engineers to get there. Even third-party maintenance is not often offered for small computers.

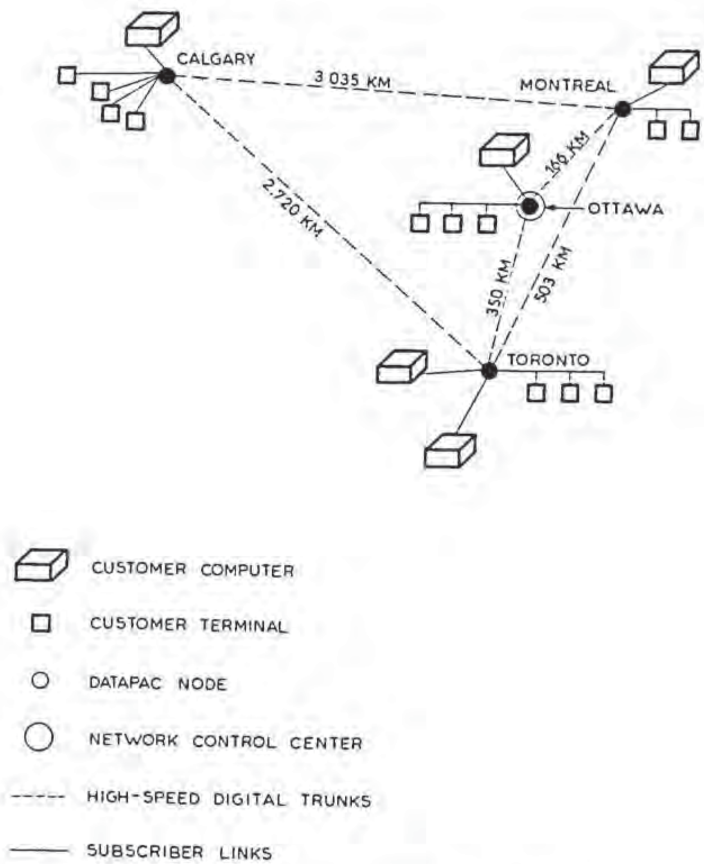
The overall objective of a network control center is never to go out and diagnose; all diagnoses of hardware and software malfunctions must be done online. Hardware-level diagnostics include computers, terminals, and communications. The major aspects of the software effort must cover operating systems, utilities, and application programs. With diagnoses done online, the user should be instructed to replace boards, thus leading to self-maintenance. Maintenance engineers should perform the complex functions the user can't do. For these, the engineers need a maintenance database, which is also handled through telediagnostics.

At the level of the network control center, test procedures must be continuously applied and logged. An NCC must centralize online operations relative to the management and supervision of the network; the analysis and interpretation, for network surveillance; the dispatching functions, for maintenance engineers and spare parts; and test and control functions, including sectionalization. Clearly, the personal computer user cannot take the steps needed to ensure such services, although personal computer networks might. This is an excellent example of the assistance personal computer networks can give users.

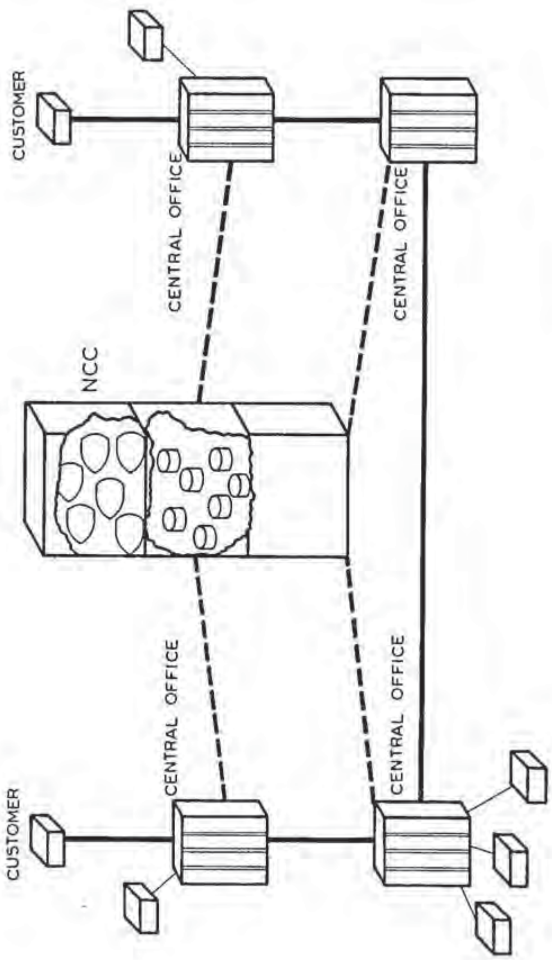
Ideally, telediagnostics are provided by computer manufacturers. It's an approach some computer manufacturers have tested with success.

Network Assistance

Figures 15.1 and 15.2 present the network control center set-up for the Canadian Datapac. In its original implementation, Datapac had four nodes (Toronto, Ottawa, Montreal, and Calgary). The Ottawa node serves as the network control center. At the center, a database is kept on all operational issues, with data on lines,



15.1. Original Datapac Node Locations.



15.2. A Computer Communications Network Control Center.

modems, terminals, and computers. Tests are made by means of loopbacks, which means sending signals to the above online devices, receiving these signals, establishing if there is any difference (hence, an error), and storing the results for further study and reference.

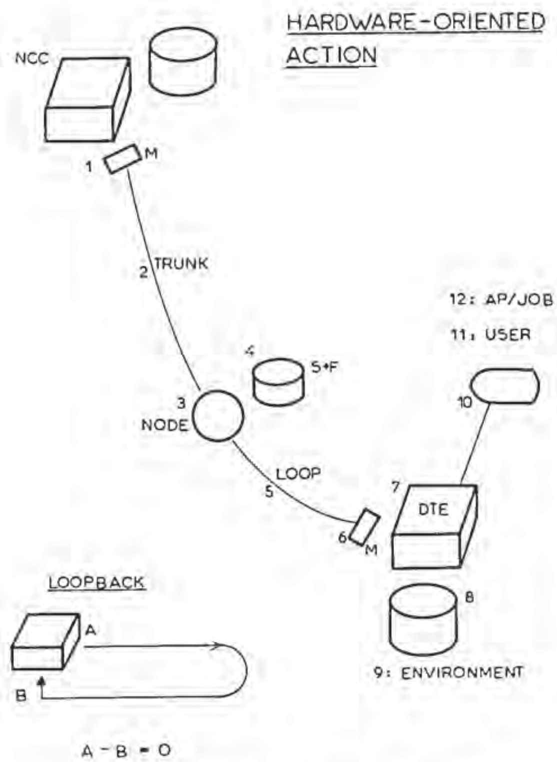
The NCC can call into action control programs as a function of processes (lines, modems, and hosts) being controlled; check end-to-end the operation of the network and the data-terminating equipment it supports; control record-file transfers; ensure restart; and, in general, control every phase of network operation through remote diagnostics and maintenance procedures.

At the minicomputer level, Texas Instruments' Care system is a nationwide, realtime, computer network and field-information system. Its objective is to permit timely and cost-effective direction of TI's customer engineers in all phases involving remote diagnostics and the ability to track service requests and monitor reliability.

TI's field information system (FIS) has been used to implement Care. FIS is a private, distributed, transaction processing network whose objective is data collection, scheduling, and resource management of any service call in the United States. Prior to implementation of this system, customer response time was 9 to 12 hours. The need for the dispatcher and the manager to know the location of each customer engineer and the current status of each customer request led to the development of Care. Data is collected on all activity as it occurs, and it is used to derive indexes which the field service managers can use for planning. Client service reports are generated on a current basis, which provides day-to-day information vital to the management of field support.

By means of sensors established at a client's site, NCC investigators can carry the facilities of the center into the automatic tracking of temperature, power, downtime, and other factors. The control database includes the quality-control variables, as well as the results of the tests being performed. Both are necessary for future reference (figures 15.3 and 15.4).

NCC services should complement and augment the rather limited capabilities of hardware diagnostic programs supplied by the microcomputer manufacturer. By and large, manufacturer-specified preventive maintenance is of the check-adjustments-lubricate-drives variety. Instructions and tools intended for maintenance must allow checkout of the CPU and the peripherals (discs, video, printers,



15.3. Online Testing and Loopbacks.

and communications gear). Maintenance advice must be written fairly comprehensively in a "bugbook" in anticipation of actual needs. Journals such as *Byte* and *Personal Computer* carry useful hints on how to use a multimeter, logic probe, chip tester, and oscilloscope.

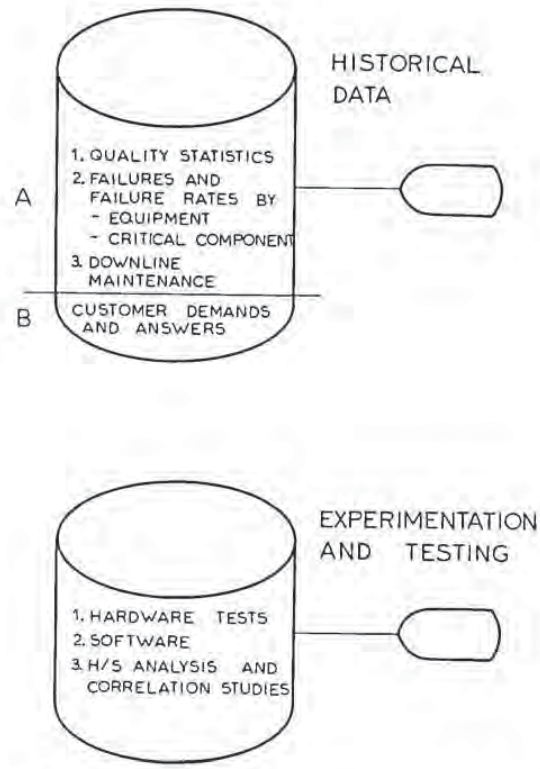
Diagnostic features should allow the user to do much of his or her own testing, either locally or remotely with the aid of a test center. Troubleshooters should look at the CPU, the disc drive, the printer, and the cables connecting modules. Both local and remote diagnostics are helpful in detecting faults, since the tests can be repeated as long as necessary. Tests and diagnostics, however, are more valuable when they match the manufacturer's policy.

Software Reliability

If the objective is to make software at least as reliable as hardware, much emphasis must be placed on designing for prevention of failure rather than for repair. Software is always subject to long repair times, which has a severe impact on a user's operation. On the other hand, since software does not deteriorate under usage as hardware does, if it is delivered in reliable working condition, there should be no need for preventive maintenance. Thus, good initial system design, implementation, and testing are of paramount importance.

Software must be designed *defensively*. That is, the designer must assume that the worst can and will happen, that invalid data will be presented to the system, that unforeseen usage will occur, and that modifications will have to be made. Programs must be designed and implemented in a modular fashion—modular by end use, as programs are viewed by users. When a failure occurs in software residing in the hardware, it must be possible to replace only the component that failed. Software repairability must be viewed from two perspectives: supplier-developed programs and user-developed application programs. Frequently the user finds that supplier-developed programs do not support the claims made for them, that they give meaningless error responses, that the bugs have not been located and corrected soon enough to preclude wasting many precious hours trying to solve problems others have already solved.

Contrary to logic and good practice, software is rarely designed for convenient repair. Worst of all, though, is documentation. Without adequate documentation, the user rarely understands how the available facility works. Because documentation is not an independent end item, but must at all times reflect an exact correspondence with or representation of an end product such as hardware or software, it must be changed whenever the corresponding facility is changed. Thus even if documentation came from the place of purchase; buy software at the same store; avoid overloading the machine; and use easy-to-maintain devices, such as slow-speed



15.4. The Control Database: Historical Data, Experimentation, and Testing.

printers, for example: a daisy wheel. The simpler machines tend to remain on the market longer and to be more reliable.

We have said that users must handle their machines carefully, including magnetic support media. Some people have paid $20 for programming products in which the tape mysteriously erased the first time it was used. In the manual the user would have seen that the power-supply box generates a magnetic field and that magnetic fields can erase tapes. The electrostatic effect of carpeting is a common trouble spot. Or a nearby traffic light may cause tiny particles to be injected into a cassette recording every time the light changes. An elevator will almost surely be a disturbance if a computer inadvertantly uses the same power line as the elevator. Even home appliances can be a source of trouble.

Say that Viewdata, a personal computer, or both are on and that the black box has a power supply regulated by a magnetic amplifier. When the line voltage drops because a vacuum cleaner is being used, the regulator opens. When the voltage returns to normal, it cannot shut down fast enough. As a result, the voltage on the computer overshoots.

Manufacturers design personal computers on the basis of standard household voltage—115 volts, plus or minus 20%. But this is not a broad enough range to allow for "spikes," which, we often forget, inductive components can generate. Air-conditioning units are the most common spike generators. High current loads from heaters, refrigerators, coffee pots, or mechanical adding machines are other trouble spots. Even a spike as brief as 2 milliseconds at 110 volts is sufficient to travel through most power supplies and thus adversely affect a microcomputer.

These aren't the only examples. Other unwanted inputs are impulses (no matter how transient), sags, and voltage swings. To find out what is affecting a microcomputer, the user is advised to get a power line disturbance analyzer. There is a good chance that the problem will turn out to be the result of environmental conditions.

The usual advice is to control the environment. Don't do things
out what is affecting a microcomputer, the user is advised to get a
albeit an appliance that poses its own demands.

16 Know-How

In any organization, know-how is the key to successful change. In the 1980s, the United States will move from a mass-production and mass-consumption society to one in which the predominant way of gaining wealth and improving one's condition will most probably be through the manipulation of information. This transition promises to be every bit as dramatic as previous transitions in human society—when fire was domesticated and agriculture began, when printing speeded the process of learning, and eventually when the industrial revolution changed civilization forever.

In humanity's subsequent search for knowledge, Viewdata and personal computers—the broad area of Datavision we have covered in this book—will play a prominent part. They follow a long list of technological advances, which have broadened and deepened the human experience.

Within the range of options that have been considered and adopted through the British implementation of Viewdata, two factors were uppermost in design and marketing: cost and ease of use. Viewdata is not a system for the computer professional, but for the ordinary person. From terminal design to Viewdatabase access, Viewdata is designed to be user-friendly. That's one of the reasons why no standard alphanumeric keyboard has been offered to the user, although such a device will be introduced as an option. Emphasis was placed on the machines, tools, and processes domesticated before the introduction of Datavision.

I have often said in this book that Datavision is only one step in the process. As such, it follows a long line of timing and communications devices, beginning with the clock. The clock and not the steam engine is one of the key machines of the modern industrial age; and the computer is the electronics-information extension of the clock. The orderly, punctual life first took place in the monasteries. Today, the West is thoroughly regimented by the clock. The measurement and observance of time is the basis of civilization. "Time is money." The same will one day be said of the capabilities extended through Datavision.

The Age of Videotex

Videotex not only involves Viewdata services, personal computers, and communications, it also puts major emphasis on know-how. And know-how rests on experience and education. Education—the transmission of experience—is multifaceted. In the past three decades the educational process has been vastly enhanced by electronics and information machines. Although we are still in a period of miniaturization, a refining perspective is not far off. I view this process as a user-friendly environment, with Datavision as the major force.

Every major advance in science and technology has had both desirable and less desirable effects. An example of an undesirable effect is what we perceive as unemployment. We have long regarded machines as a means of eventually avoiding work, not as a means of radically rethinking human skills. Since the beginning of the 19th century, at the beginning of the industrial revolution, people have hoped that machines would ease their burden of work. And machines did. But they have done so selectively, primarily in the factory, handling materials, loading and unloading, sorting, stacking, transporting, and assembling. During the last 150 years, machines performed many of the monotonous, hot, disagreeable, and dangerous tasks formerly done by humans, as well as new tasks that people with more primitive tools could not do. Machines worked thousands of hours with relatively little downtime. As jobs grew in size and importance, however, the human operator stayed (from a control angle) by the machine. By 1980: the number of work hours per year had been reduced to less than 2,000; each person has only so much horsepower—from electrical power production to motor vehicles—dedicated to that person's needs; and the purchasing power of an individual in the Western country has increased threefold over the the past 30 years.

In looking at these statistics, one might be driven to the conclusion that these developments have led to a state of political and social euphoria. Nothing could be further from the truth. Nor will Datavision make possible such a state. Objectively indisputable technological progress is not enough to sustain human happiness. Let's not jump to the conclusion that progress in informatics will provide happiness for everybody.

The Knowledge Worker

The use of computers is one way to revamp and eventually eliminate human-intensive labor. To achieve this goal requires computer-oriented education. People are interested in utilizing computer-based data. But if they have a different concept of what is involved in the use of this data, it will be like talking in incomprehensible languages. Education is the key to providing computer users with a common background. What I have said about business is equally true of the personal use of computers. If business experience is any guide, the domesticated computer will not cancel these differences; it will blow them wide open.

Peter Drucker predicted in 1968 that by the mid-1980s, half the U.S. gross national product would be dedicated to the production, distribution, and consumption of knowledge. And it is happening. We are developing a knowledge industry that is the driving force of the computer and semiconductor industries. Drucker also coined the term *knowledge worker*. We're just entering the era of significant tools for this knowledge worker: terminals, Viewdata, new communications, personal computers, and the beginning of a mathematical understructure that will revolutionize the way we view the world.

With the facilities of the new technology, a person will be able to look at several different aspects of a system or concept simultaneously. He or she will be able to use a system to reach decisions, to work interactively rather than just enter and receive information. But if the procedural and organizational prerequisites are not there, these newfound facilities may well turn out badly.

Human Resources

Lifelong learning is the key to the development of common understanding, and learning is one of the most difficult things to accomplish. It calls for self-involvement and for effort—usually a painful effort, since misconceptions and preconceptions must frequently be changed.

People often say that they have used their common sense. An old proverb states that common sense is the most universally distributed quality; that's why everybody has so little. Common sense, therefore, has to be turned into rational thought, intuition into analytical thinking. We must change our thought processes, our way of doing things and thinking about them.

A basic characteristic of the information environment—one that distinguishes this environment from any other—is that, if we give information, we share it. Something new can come out of shared experience and know-how, which is not obtainable otherwise. This is in contrast to the concept of proprietorship. If we give our property to someone, we lose ownership of that property. If we give that person information, however, we *increase* the information. Yet how often have we treated knowledge as though it were property? Bankers will find a parallel to this in the valuing of paper money. We have learned through study and practice that paper money is backed up by gold reserves. Today, however, we see mighty governments, such as the United States, selling gold to gain foreign paper money with which to back up their own paper money.

Advancing technology and new economic criteria have led to a change in concepts, and a rapid one, at that. Quite often, the human mind is compared to a machine. This is wrong. The human brain works quite opposite to the machine. With no input at all, the result is hallucination—making up for the missing input. With too much input, it shuts off. This has received little consideration in sociological and educational studies, and even less in information science.

Today such notions do come under consideration as we experience the structural changes of the knowledge-producing labor force. Shifts from physical workers to knowledge workers happen in every occupation. Knowledge is anything that is known by somebody; production of knowledge is any activity by which someone learns something not known before. In this context, dissemination, acquisition, communication, and utilization are knowledge-producing activities. If full-time students are added to the labor force of knowledge-producing occupations, the percentages of the American population are 13.5% (1900), 34.4% (1940, 44.3%

(1960), and 53.1% (1970). The point that is often missed is that information systems are a knowledge-production industry, both for the developers and for the users.

The Information Needs of Society

As no previous product has demonstrated to such a degree, information creates a demand for more information. Information means knowledge, and knowledge is central to human society. Data can take the form of almost anything, from major events to tiny price signals in the market.

The opportunity to meet the information demands of society has three aspects: technological, economical, and sociological. It is said that by the late 1980s, transistors, diodes, and other vital electronics components will cost roughly 1/20th of today's prices. The market will grow because of the service potential. Multibeam communications technology, pocket telephones, direct-broadcast TV, electronic teleconferencing, and dozens of other developments will become practical and cost-effective. The following are highlights of the market in the 1980s.

The most exciting electronics product in history may well be personal, online communications. Viewdata's advantage over conventional means of publishing, for example, is that it is interactive. Its advantage over voice communications is its visualization capabilities, which can reach into local and remote databases. We have been discussing this topic all along. Just compare the first 100 years of telephony with the first 30 years of computers to see what the market may be.

The next most interesting product in the coming decade will be the personal computer. Retail sales of personal computers, for home and nonhome use, are expected to rise to nearly $3.5 billion by 1982 or 1983. This is a lot, considering the unit price; it may well mean 4 to 5 million units a year. Personal computers are a new market, and new markets call for meticulous planning and test projects. To turn the personal computer into a high-volume, low-cost, profitable enterprise, it will be necessary to rethink and redesign the computer business.

Hard (solid-state) software is a specific example of growth capabilities. It becomes more prominent as computer hardware becomes cheaper and software more expensive. Manufacturers such as Texas Instruments are working to mass produce software. The idea is simple. Tiny modules with a permanent semiconductor memory are used to turn a general-purpose computer into a special-purpose machine.

The very-small-business computer now taking shape will grab a share of the minicomputer market. Typically, these systems today cost upwards of $3,000, but a machine in the $700 to $900 range is expected by 1982. It will be sold off the shelf by retailers, with enough storage to handle inventories. The potential market is vast (more than 600,000 firms in the United States alone).

Personal communications (in contrast to computing) may reach annual sales of $3 billion by 1982. Electronic autodialer business, pocket telephones, and transaction units are examples.

A projected, big market is learning aids. This market includes calculatorlike mass trainers, game players, spelling machines, and foreign-language tutors. The typical, current product can store more than 200 words in LSI memory. It employs a one-chip voice synthesizer for answer-back. Low-cost ($15 to $20) plug-in modules should enhance this market. Another product for the voice answer-back market is the voice synthesizer. It is intended to replace warning lights as safety devices in factories, autos, airplanes—any place where recorded messages and answering systems are necessary. Voice recognition is the other side of speech synthesis. Recognition devices with the ability to understand thousands of words are projected for the 1980s. Essentially, the new business environment will be communications-oriented. It will be modular, expandable, and interlocking. To succeed with this product, a company will need foresight, insight, and a willingness to take risks. This company must tool up in order to cover several fields and to give clients overall service and support.

A Learning Curve

We have all been in a learning curve during our early years. Technology sees to it that we live in a constant learning curve. And that involves products, markets, and applications. According to Texas Instruments' strategy, as output expands and producers gain experience, costs and prices should come down fast, creating a constantly growing market. Such is the case in the retail price of a calculator, which dropped from $1,000 to $10 within a few years. Translating the learning curve into markets and products calls for progressive management. Products must be planned even before the technology has been developed. For the consumer (including the information provider), this means test usage, in contrast to test marketing.

Service capability, like market reaction, can be tested, on the assumption that sharp cuts in costs will open new horizons. For business and industry, the domesticated computer has become a matter of strategic planning. The salient problems in strategic planning call for an answer to such questions as:

What is the real significance of product strategy?
What will an organization be doing 20 years hence?
Where will the profits come from?
Should a company be a product leader in every field? If not, in which fields?
What are the effects of competition? Of opportunities?

Both for the manufacturer and the user, solutions will be increasingly based on information.

Viewed in this perspective, Viewdata is a vital link between producers and consumers, particularly for companies geared to steady market expansion. Datavision is no mere device; it is an applications solution. Device technology is necessary. Unless a company has the applications capabilities, however, leadership will not be assured.

Real Issues in Personal Computers

The development of systems augmenting human physical energy, in particular the sector of transportation, provides an historical perspective from which to view the development and design of systems created to augment human intelligence. Mass transportation media and personal vehicles share an infrastructure. So do the maxicomputers, minicomputers, and microcomputers. The communications field is another example.

It is fairly safe to predict that in the coming years: there will be a common use of infrastructure by mass-information systems and personal information machines. When the computer becomes just another home appliance (the controlling one), the "black art" of systems analysis and programming will vanish. There will be a behavioral impact as a result of the domestication of information systems. Hobbyists and owners of home computers will become sophisticated users of computer-based systems. Maxicomputer systems will evolve into plug-in utilities. Cheap, abundant computing capability will mean the end of time-sharing services. Originally intended to provide each user with time on a large computer, time sharing will make no more sense. Such services will survive only as long as the software already developed remains operational. Personal computers will replace minicompters, particularly at the low end of the price range. To stay competitive, manufacturers of maxicomputers and minicomputers including IBM, will have to lower their prices sharply. Changes in marketing approach, the reduction of marketing cost and the slicing of prices will be prerequisites for entering the personal computing market. The interaction between mass-information and personal-information systems will set the pace for future developments. The assessment of data will become a highly desirable intellectual activity. As the public becomes more literate in computers and computing, systems specialists will change radically. Computer professionals will become advisers to the users rather than substitutes or interfaces. New, user-friendly, job-oriented, interactive, more powerful languages will be required. The horizons opened by the personal computer will radically change our ideas about computers.

Information equipment will become widespread, finding uses in automobiles, home appliances, and the entertainment field. But the first large wave of change will be in the office. It is time for this change. The white-collar worker in America and throughout the Western world is underequipped. The average capital investment in the American office is now about $2,000. In the banking sector the average is $3,000, and in the most automated office jobs, $5,000. But in American agriculture, the average investment per worker is about $30,000.

Machines Create Progress and Jobs

The contribution of science and technology to people's understanding of their world should be evident in reading this book. Research and development have resulted in the tools we use today. In all walks of life we use machines.

For some 25 years we have been misusing our information machinery, however. Only now are we beginning to understand that the real object of computing is not the automation of numerical calculation; it is foresight, insight, analysis, and design. Research has opened new horizons. If it weren't for machines, for example, an automobile would cost about $100,000. The auto industry simply would not exist. The telephone led to growth in transportation, not to a decrease. Jobs were created.

Computers have not yet reached this level, but they are moving toward it. Data communications (computers and telephony) show signs of becoming the fastest-growing industry in history. Statistics may sometimes indicate the opposite, however. A report published by the French government warns that automation is likely to cut employment in banking and insurance by 30% over the next 10 years. Such statistics overlook the growth of the home- and personal-computer industry. These markets, together with the standard computer market, will eventually employ more than 15% of the population.

Of course there will be some job displacement and unemployment. Fewer people may be doing the work now done by many. But people who keep abreast of technological development and who prepare themselves for new advances will run less risk of being out of a job—even if 40% of the office work now done manually is done by machines in 1990.

Society has passed a milestone. Science and technology, as well as some socioeconomic indicators, are well under way, but the "knowledge era" is not. It is a coming development we will all experience by the end of the century—and we must get ready for it. *Knowledge is becoming the measure of all things.*

Glossary

abort A frame-level function invoked by a sending primary or secondary station causing the recipient to discard and ignore all bit sequences transmitted by the sender since the preceding flag sequence.

access time A time interval, which is characteristic of a storage unit and is essentially a measure of time required to communicate with that unit; access time may be either the time between the instant at which information is called from storage and that at which it is delivered, or the time between the instant at which information is ready for storage and the instant at which it is stored.

accumulator The register and associated digital electronic circuitry in the arithmetic unit of a computer, in which arithmetic and logical operations are performed.

algorithm The precise prescription defining the computational process leading from variable input to desired information results; a completely specified solution procedure, which can be guaranteed to give an answer if the prescribed steps are followed.

alphanumeric A set of characters including both letters and numbers.

analog computer A mechanical, electrical, or electronic computer in which variables are represented by physical magnitudes as the amount of rotation of a shaft or a quantity of electrical voltage or current; contrasted with digital computer: differences sometimes expressed by saying that an analog computer "measures," whereas a digital computer "counts."

applications program A program specified by the customer that carries out some portion of the information-processing activities requested by the customer.

architecture A specification of the system functions needed to support applications programs and the protocols and interfaces by which these system functions coordinate their activities; not a product but rather a unified set of rules governing the development of products.

assembler Assembler (or Assembly Language) is an intermediate language between a higher-level language and a machine language; usually provides simple, easily memorized codes (called mnemonics) that can be quickly translated into the language the computer understands; the word Assembler is also used to indicate the computer program making the translation from assembler language to modern language.

asynchronous transmission The transmission of data, where time intervals between transmitted characters may be of unequal length; in this form of transmission, each character is preceded by a start bit (zero condition) and followed by a stop bit (one condition); all bits except for the stop bit are of equal duration, which may be one to two times as long as the other bits.

automatic check The verification of information that is transmitted, manipulated, or stored by any computer unit or device.

bandwidth A continuous sequence of broadcasting frequencies within given limits.

basic A simple computer language, used for various applications and particularly suitable personal computers.

BASIC-in-ROM A term standing for Beginners All-purpose Instruction Code, indicating that a computer is equipped with BASIC computer language on ROM memory.

batch The quantity of anything produced in one operation, or lot.

baud A unit signalling speed equal to the number of code elements or signals per second; when each signal represents only one bit condition, baud is equal to bits per second.

binary Of or pertaining to the digits or numbers used in binary notation.

binary digit A two-value numeric system; a bit can thus have a value of zero or one.

blank The character that results in memory when an input record (such as a card column, which contains no punches) is read; the character code that results in leaving a position blank.

block A group of words or characters considered or transported as a unit, particularly with reference to INPUT/OUTPUT; a term sometimes used as a synonym for RECORD or to refer to GROUPED records.

block access The characteristic of transferring numbers in groups or blocks from one position to another.

BPS A unit of transmission, meaning "bits per second" and used to indicate the speed at which information is carried through lines; see also BAUD.

Broadcasting Videotex The official CCITT term for Teletext.

buffer Small storage capacity dedicated to the unit to which the storage belongs; in the case of a terminal, it is between the manual keying in of data and the transmission to central resources.

buffering The process of temporarily storing the results (output) of an operation or device before forwarding the results to the next operation or device.

bus A path consisting of a set of parallel wires within the machine over which a number or "word" may pass from one section of the computer to another.

bus driver A conductor or group of conductors serving as a common connection for circuits, in the form of a bar; also called a busbar.

byte A sequence of adjacent binary digits operated upon as a unit and usually shorter than a word; also called an octet.

capacity A measure of the maximum amount of material or energy that can be stored or transmitted.

card column A vertical line of punching positions on a punched card.

card punch A device for recording information on cards by punching holes in them, representing letters, digits, or special characters.

card reader A device that senses and translates into internal form the holes in punched cards.

Ceefax The BBC version of Teletext.

central processing unit The unit of a computing system that contains the circuits which control and execute instructions.

centralized system An information-processing system consisting of only one information processing node and, optionally, terminal control and network switch nodes for providing end user access to the node via remotely located terminal devices.

character One of a set of elementary symbols that can be arranged in ordered groups to express information, including the decimal digits 0 through 9, the letters A through Z, punctuation symbols, special input and output symbols, and a code representation of the symbols.

check A means of verification.

check digit One or more digits carried in a symbol or a word that is dependent on the remaining digits, in such a fashion that if a single error occurs (other than compensating errors), the error will be reported; sometimes called a parity digit or simply "parity."

circuit switching The establishment of a physical circuit between the nodes of a telephone network before the start of a transmission.

circuitry The schematic, or system, of an electric circuit; also, the element encompassing such a circuit.

clock A timing device in a system that provides a continuous series of timing pulses; any device that generates at least one clock pulse.

closed user group Software-supported guarantees that a specified group of users will have access to data unavailable to other users of the database.

COAM An abbreviation for "company-owned and -maintained network."

code A system of letters, numbers, or symbols, a combination of punched holes, or a combination of magnetic spots representing information and rules governing the representation; also, a set of signals representing letters or numerals used to send messages; the conversion is done through a program that translates high-level language into machine language, such as assembler, compiler, or interpreter.

code (verb) To write instructions for a computer, whether in absolute machine-level language, in a symbolic language, or in a higher-lever language.

compiler A program that translates a high-level language into a machine language; a computer cannot execute a program in a high-level language directly; the compiler makes it executable, as well as helping the programmer by incorporating into the program subroutines called through macro-operations.

compunications The blending of voice and data communications with computer technology.

computation The process by which different sums or items are numbered, estimated, or compared; comparison is an example of a logical operation; computation includes the basic arithmetic operations and other composite operations offered in pocket calculators.

computer Any device (but usually an electronic one) capable of accepting data, performing arithmetic and logical operations, then supplying the results in acceptable form; the major elements of a computer usually include input and output facilities; the term *computer* often means "*digital* computer."

computer language A programming language necessary for communicating with a computer; for computer-language instructions to be executable, they must be translated by a program, such as Assembler or Compiler in the computer into the machine's internal language; computer languages are classified as machine language or as a higher-level language.

computer network The complex of control systems and special processes for coupling two or more computing systems into one system.

controller An instrument that holds a process or condition at a desired level or status, as determined by comparison of the actual value with the desired value; the function of a controller is to ensure that the right thing happens at the right time in a computer.

cross-referenced page A page to be selected from another page, one not its parent.

data See INFORMATION.

database (1) a computer-run and -organized, orderly collection of information elements designed in an applications-independent manner to serve data-processing purposes; (2) the sum total of master files; (3) the storehouse of information having to do with settlements, allocation and optimization, and top management decision; consists of information elements stored in an organized, planned fashion.

data communications network The facilities that support the transport of message text from one site to another, and including communications equipment (lines, modems, etc.), as well as that part of each node which implements the communications functions.

datagram The section of a message or of a long block of characters—typically, at the 256- and 512-character level—that is individually routed through a packet-switching network; datagrams are used to divide long packets into small packets, which presents routing advantages but alos includes the risk that sections of a packet may arrive at their destination out of sequence or be sent to an endless loop of nodes.

data-handling system Equipment operated automatically for the manipulation, reduction, and simplification of input information.

data processing Data is processed in the sense of being sorted, merged, or selected in an orderly manner, according to precise rules of procedure and preestablished criteria.

datavision A system of communication between people and machines with which data, graphics, and color are presented; can be divided into two broad classes, long-haul (provided through a public utility) and nearby (based on personal computers).

decoding Internal hardware (or software) operations by which the computer determines the meaning of the operations code of an instruction.

degradation Gradual deterioration in the performance of equipment.

descendant pages All pages below a specified page.

desk checking A term covering all verification efforts performed manually during program checkout; usually refers to doing arithmetic calculations to verify output value correctness, or manually simulating program execution in order to understand and verify program logic and data flow.

discrete units Distinct or individual units of computer equipment.

distributed data system A data system consisting of two or more information-processing nodes that can share capabilities and exchange messages via communication facilities; the control functions may be centralized or they may be decentralized among the system nodes.

distributed processing An approach in which the total customer-processing task is divided into subtasks, with each task assigned for processing to a different information-processing node of a DISTRIBUTED SYSTEM.

distributed system An information-processing system consisting of two or more information processing nodes, which are cooperating in the solution of a set of related problems by messages exchanged via communication facilities.

document Any representation of information that is readable by humans; the word document is typically used in connection with information of interest to the originator or a data-processing activity, rather than to the operators of the computer; the word is more commonly applied to input information than to output.

dynamic behavior Describes how a control system or a unit system performs with respect to time.

editing The arranging of information—deleting unwanted data, selecting pertinent data, inserting information before printing, zero suppression, and so on.

end of message The specific set of characters indicating the termination of a message.

end page A page that normally contains a restricted set of routing choices.

end use The purpose for which the END USER employs a device.

end user A person who interfaces with an application system within the customer's information-processing system.

entry The point at which control enters a routine.

equipment Electronic equipment–usually subdivided into set, unit, assembly, subassembly, and part–consists of those installed electronic articles that constitute the system configuration.

error In formation theory, error is viewed not as an extraneous, undirected event but as an integral part of the process under consideration; an error indicates a discrepancy between an object (true) value and a processed, or recorded, value; all discrepancies are not errors, as error presupposes knowledge of the true, or exact, value.

exit The point at which control leaves a routine.

failure A detected cessation of ability to perform a specified function or functions within previously established limits on the area of interest.

field A set of one or more characters, not necessarily lying in the same word, which are treated as a unit of information.

files An orderly arrangement of papers, cards, and so on; a collection of papers arranged according to data or subject, for ready reference.

filial A page immediately below a PARENT PAGE.

fixed-program computer A computer in which instructions are permanently stored or wired in sequence; the computer PROGRAM is not subject to change, either by the computer or the programmer, except by rewiring or changing the storage input or by making new "firmware."

floppy disc A storage device (alos called a diskette) resembling the discs in a juke box; a thin, plastic medium used for data storage, similar in appearance to a 45 RPM record but thinner and bendable, hence the term floppy; loading time is usually less than one second.

format A predetermined arrangement of characters, fields, lines, page numbers, punctuation marks, and so forth, referring to input, output, and files.

frame (1) the sequence of contiguous, bracketed bits, including beginning and ending flag sequences; a valid frame contains at least 32 bits between flags, as well as an address field, control field, and frame-check sequence; a frame may or may not include an information field; (2) in viewdata, a frame is one screenful of information displayed by the system; the "frame ID" (a lower case a to z) is the letter identifying a frame within a page.

free choice A routing page with choices that are not FILIALS, or in which the filials are not numbered sequentially.

front feed Inserting paper through a special pocket between the printer and the carriage, for instance, a receipt a bank teller would give to a client.

function The name of a process used to produce a specific number of outputs from a specific number of inputs, according to certain rules.

garbage Unwanted, meaningless information in memory or on tape; also called wash.

gateway A path provided between two information-processing systems with dissimilar protocols, which allows the exchange of information; provides the necessary transformation from one protocol to another.

generation A technique for producing a complete routine from one which is in skeletal form under the control of parameters supplied to a generator routine.

hardcopy A human-readable document produced at the same time information is transcribed into a form not easily readable by human beings; also called page copy, usually when associated with another type of output, such as type.

hardware The mechanical, magnetic, electronic, and electrical devices that constitute a computer.

hash total A summation of the field used for checking purposes, which has no other useful meaning.

header A field preceding the user data field used by the packet-level interface for controlling and addressing information.

hertz A unit of frequency equal to one cycle per second.

hierarchy A specified rank, or order, of items; a series of items classified by rank or order.

host computer The computer in which user programs are executed.

index page A frame containing entries for routing the user farther down the hierarchical structure of the Viewdatabase.

information A collection of facts, data, numerical and alphanumerical characters, and so on, processed or produced by a computer.

information element A data set, or building block, of a database; it can be a bit (binary digit); a byte (or octet, that is a group of eight binary digits); a field; a file; a record; a section of a database; or the database itself.

information-processing network (1) an interconnected collection of work stations that carry out handling functions; (2) a system of computers, communications equipment, and terminals that supports such functions.

information provider A Viewdata entity, providing information to be stored on the Viewdatabase, where it can be accessed by users.

information retrieval The process of automatically extracting desired categories of data from a database by means of abstracting, translating, or regenerating data, or producing guidance profiles.

infrastructure The basic, underlying framework of something, especially of a technological kind, such as a military installation, communications or transport facility.

Interactive Videotex The official CCITT term for Datavision, Viewdata.

input Introducing numerical or alphabetical data and instructions into a computer; the most commonly used media are magnetic tape, magnetic disc, cassette, or punched cards.

interface A shared boundary, usually of hardware components often assisted through software routines; the set of rules governing the relationship of dissimilar functions within the same node of an information-processing system; computer interfacing is the synchronization of digital data transmission between a computer and one or more external input/output devices.

interleave To insert segments of one program in another program so that the two programs can be executed simultaneously.

I/O device Any digital device—including a single, integrated circuit chip—that transmits data or receives data or strobe pulses from a computer.

input-output A general term, usually abbreviated I/O, for the equipment used to communicate with a computer, and the data involved in the communication.

interpret To translate a stored program expressed in a given code into machine language and perform required operations as they are translated.

interpreter A program residing in a computer, which takes high-level language statements and leads the computer through the steps necessary to perform operations specified by a program; an interpreter does not translate the source program into an object program, but merely parallels the source program, interpreting.

interrupt A break in the formal flow of a system or routine such that the flow can be resumed from that point at a later time; the source of the interrupt can be either internal or external.

K A unit equalling 1,000.

key The field or fields of information by which a record in a file is identified and/or controlled; keys may be alphabetic or numeric, or they may represent arithmetic and logical functions.

keyboard A row or set of keys, as on a typewriter or computer terminal.

keypad A small keyboard, such as a touch-tone set, containing the characters 0 through 9 and a number symbol and an asterisk. A complete keyboard contains the full alphanumeric character set; either can be used to access the Viewdata system.

keypunch A keyboard-operated device that punches holes in a card, which represent data.

limited choice A routing page from which less than 10 choices are available, all of which are FILIALS.

link A full duplex synchronous communication line capable of transmitting data from one node to an adjacent node in an information-processing system.

linkage A technique for providing a reentry to the routine from which a closed subroutine was called.

loading The process of originally entering instructions, constants, tables, and so on in a stored-program machine.

logical connection A "pipe" through which message groups are conducted from one mailbox to another with respect to the topology of the underlying communication network.

logical operations Basic operations that are not arithmetic nor part of input or output.

machine sensible Information represented in a form that can be read by a machine; for instance, cards are machine-sensible, whereas handwriting ordinarily is not.

magnetic strip identification Typically, a magnetic strip on a standard credit card.

magnetic tape A flat ribbon, usually of plastic, which is coated on one side with a material that can be magnetized; information is stored on the tape by combinations of magnetized spots in given patterns.

mailbox An addressing, queuing, and security mechanism for the exchange of message-group text among processes; each mailbox is assigned a system-unique name and may be used by the processes of one work station.

main memory Usually the fastest storage device of a computer and the one from which instructions are executed; contrasted with auxiliary storage such as provided by MAGNETIC TAPE, disc, or drum.

maintainable software A SOFTWARE product is maintainable to the extent that it facilitates changes to satisfy new requirements or to correct deficiencies.

matrix A collection of numbers arranged in rows and columns.

memory Also called storage, memory is any device that can store logic ones and logic zeros in such a manner that a single bit or group of bits can be accessed and retrieved.

memory address The storage location of a word of memory.

memory data The memory word occupying a specific storage location in memory, or the memory words collectively located in memory.

memory word A group of bits occupying one storage location in a computer; this group is treated by the computer circuits as an entity, by the control unit as an instruction, and by the arithmetic unit as a quantity.

message group A string of message records exchanged by a sender and a receiver and consisting of a nest of enclosures that contain a header (commitment, address, recovery) and a record and trailer (concellation, reentry, data quality, and so on.)

message path The administratively specified conditions under which a logical connection may be set up between a pair of mailboxes or work stations; these conditions apply both to the logical connection itself and to the message groups that use it, including security, integrity, and presentation-control specifications.

message switching The process (usually called "store and forward") of receiving a message, storing it until the proper outgoing circuit is available, and then retransmitting it.

microprocessor A semiconductor device that is the heart of a personal computer; a CPU on a chip; a microprocessor is stripped down to a chip and connected to a machine to serve a given function, and in this sense is a machine-within-a-machine; a microprocessor has preprogrammed features or stand-alone capability, and should not be confused with the microcomputer, which is a complete system.

microwave A very-high-frequency radio wave essential in handling information; the higher the frequency, the more information that can be handled; it is possible to achieve more than transmission of information at these frequencies, for instance, performing logical operations such as adding and subtracting.

millisecond One-thousandth of a second (.001 second).

modem A unit designed to modulate a voice frequency carrier signal (for a data transmitter) and to demodulate the signal (for a data receiver).

modularity Modularity provides flexibility in the expansion and use of a system, and simplifies installation and tailoring to meet specific customer requirements.

module A modularly dimensioned assembly.

multidrop A circuit connecting several locations, where information transmitted over the circuit is available simultaneously at all locations.

multiframe page A page consisting of at least 1 FRAME and as many as 26.

multipoint circuit A circuit interconnecting several locations where information transmitted over the circuit is available simultaneously at all locations; also know as Multidrop.

multiprocessor An interconnection of data processors sharing central memory and peripherals and run by the same operating system; a machine with multiple arithmetic and logic units for simultaneous use.

multiprogramming The interleaved or simultaneous execution of two or more programs at the same time by a single computer; multiprogramming capabilities is the processing of several programs simultaneously corresponding generally to several users.

network An interconnected or interrelated group of NODES.

network switch function The functionality needed to support the routing of blocks of information (usually packets) in a communication network; the functions are communication and message management, process management, store and forward, and system management.

node Computer equipment to which bit strings can be directed via communication facilities by using a unique destination address, or node name; there are three basic node types supporting information processing: information processor, terminal control, and network switch.

noise Also called "disturbance," noise is any unwanted input; a signal other than reference input, which tends to affect the value of the controlled variable; noise reduces, or tends to reduce, the amount of information in an instruction.

object code Also called an object program, object CODE is the same program after it has been translated into machine language, usually implying that it is now in a form that can be executed directly.

offline The status of a machine that is not connected mechanically, electrically, or electronically to another machine; operation of input/output and other devices not under direct computer control; most commonly used to designate the transfer of information between computer via magnetic tapes or other input/output media.

online The status of a machine that is directly connected (electrically or electronically) to another; the operation under programmed control of an input/output device (or terminal) as a component of a computer system; online data processing is typical of realtime (no time lags) operations.

operating system Abbreviated "OS," a set of programs that aid the computer and the computer operator in gaining and maintaining control of a CENTRAL PROCESSING UNIT and its peripheral devices; operating systems are important in all computer systems; a disc operating system is abbreviated "DOS."

optimization The selection of optimum operating conditions among alternative possibilities, subject to predetermined criteria.

Oracle The British ITV version of Teletext.

output device The part of a machine that translates electical impulses processed by the machine into reporting media, such as printed forms (hard copy) or punched cards, magnetic "writing" on magnetic tape, or visualization on a CRT (usually referred to as soft copy).

packet A bit string of fixed maximum length, usually 2,000 to 8,000 bits, which is transmitted unaltered from the source, passing through one or more intermediate nodes with network switch functions.

packet-switched network A communications network, which employs packets as the basic unit text transmission.

packet switching A communication discipline in which blocks of data (at 2,000 to 8,000 characters per block) are used as the basic unit for text transmission.

packet terminal A terminal that communicates with the network at the packet level.

page In the Viewdata system, a unit of information that can be accessed by the user through its page number; a page in the Viewdatabase may have up to 26 frames.

parallel operation A computation mode in which operations corresponding to the various digits of a number are carried out independently and usually simultaneously, each in its own separate channel.

parameter A quantity to which arbitrary values may be assigned; used in subroutines and generators to specify item size, decimal point, block arrangement, field length, or sign position.

parent page A routing page in the Prestel system immediately above the FILIAL (specified).

performance An operation with some degree of effectiveness; by "functional performance" is meant operation within specified limits.

peripheral Pertaining to, situated in, or constituting the periphery.

parity check A type of REDUNDANCY CHECK.

personal computer A complete computer system based on microprocessors.

polynominal An algebraic expression containing two or more terms, for instance, $ax^2 + by^2 = z$.

Prestel Trade name of the Viewdata system supported by the British Post Office.

private line A phone line reserved for the exclusive use of the organization that has rented it; also called a leased line.

procedure A precise, step-by-step method for effecting a solution to a problem.

process A series of actions or operations leading through predetermined steps to a solution.

productivity In computer software, a rate of production normally measured in terms of the quantity of tested code and documentation produced.

program A collection of one or more computer-executable procedures, usually consisting of a main procedure and several subprocedures.

programmable read-only memory A read-only MEMORY that can return information only as long as power is applied to the memory, abbreviated "PROM."

programmer A person normally capable of performing all software development activities, including design, code, test, and documentation.

protocol A formal set of conventions governing the format and control of input and output data, and comprising well-defined procedures that are clearly understood by all parties.

pulse train An electric current or voltage which exists only for a brief period of time and is shaped in accordance with the composition of the message, for instance, 1,1,1, 0,0,1.

queue An ordered set of items, each member of which is awaiting the same service; a queue is usually constructed so that items can receive a process or resource and use it as it becomes available.

random access memory A semiconductor MEMORY into which logic-zero and logic-one states can be written (stored) and read out again (retrieved); abbreviated "RAM."

random/ access storage A storage technique in which the time required to obtain information is independent of the location of the information most recently obtained.

raw data Data that has not been processed, but which may or may not be in machine-sensible form.

read To transmit data from memory to another digital, electronic device.

read-only memory A semiconductor memory from which digital data can be repeatedly read out but not written into, as it can with RANDOM ACCESS MEMORY.

realtime The direct access to computer memory for fast updating of a file or to retrieve a small amount of information (called integration).

record Data describing or relating to a single enterprise, event, or transaction; a record consists of a collection of one or more logically related fields stored in any type of computer-processable medium.

recovery The ability to retrieve data or information from a support medium.

recovery time The period needed to reestablish a data-processing capability after a failure.

redundancy The existence of more than one means of accomplishing a given task.

redundancy check The summation of bits, or check digits, to ensure accuracy.

register A short-term, digital, electronic storage circuit, the capacity of which is usually one computer word.

reliability The probability of a component or system operating free from failure within a specified operational time range and for given operating conditions.

repeater A device used to amplify and/or reshape signals.

response frame A FRAME from a user, to be forwarded by Viewdata to an information provider.

retrieval The act of obtaining data stored in the memory of a computer.

routine A sequence of coded instructions directing a computer to perform a specific operation in the solution of a problem.

routing Determining the proper route a message should take from origin to destination; involves identifying the message or operation, its sequences, and the type of work station at which it is to be performed.

routing page A page with several choices, allowing access to FILIALS.

semiconductor A substance, such as germanium or silicon, whose conductivity is poor at low temperatures but which is improved by a minute addition of certain substances or by the application of heat, light, or voltage; used in transistors, rectifiers, and other equipment.

sequential operation The performance of operations one after the other.

serial operation The type of operation within the arithmetic section of a machine, such that a number is handled one digit at a time; a mode of computation in which the operations corresponding to the successive digits of a number are carried out one after the other in a single channel.

simulation The representation of real-life systems by mathematical models, computers, or other means; essentially a working analogy.

site A geographically compact region in which equipment can be interconnected without communication facilities–for example, a room, a building, or a building complex; a site may include one or more nodes (which are included in their entirety at a site).

soft copy The presentation of data or media permitting visualization, using such equipment as a cathode ray tube, liquid crystal, or a plasma unit.

software The totality of programs and routines used to extend the capabilities of computers—for example, compilers, assemblers, generators, and libraries of application programs, utility routines, and subroutines; see also HARDWARE.

source code Also called a source program, a source CODE is a program written in a language that must be translated into machine language before it can be run on computer.

special-purpose computer A computer designed to solve a specific class or narrow range of problems.

storage medium Also called memory, the capacity or space used to preserve data.

stored program computer A COMPUTER capable of performing sequences of internally stored instructions, and usually capable of modifying those instructions as directed by the instructions.

strict choice A ROUTING PAGE from which 10 FILIALS are available in the right sequence.

subroutine That portion of a ROUTINE that tells a computer to carry out a well-defined mathematical or logical operation, a small routine that can be incorporated in a larger one.

support medium Media such as punched cards, magnetic tape, or magnetic disc, which can be read by a computer; *see also* STORAGE MEDIUM.

switching To operate manually, mechanically, electrically, or electronically the switch of an electrical circuit so as to connect, disconnect, or divert a transmission.

synchronization To lock in an element of a system so that it is in step with another element; the operation of a system under the control of clock pulses, in step or in phase, as applied to two devices or machines; when used with reference to a computer, the term identifies the performance of a sequence of operations controlled by equally spaced clock signals; when used in connection with data communications, it prescribes a procedure of character transmission under the control of a timing device.

synchronous pulses Pulses originated by transmitting equipment and introduced into the receiving equipment to keep the equipment at both locations operating in step.

system An assembly of components united by some form of regulated interaction to form an organized whole; a collection of operations and procedures, people and machines, by which an operation is carried on; a group of pieces of equipment integrated to perform a specific function, for example, a fire-control system, which includes a sensor for tracking, a monitoring computer, and a battery of guns.

system program A program usually provided by a vendor, which supports the execution of applications programs and the attachment of terminals.

telematics The science of incorporating computers and communications into a single, integrated system able to handle voice, data, text and image—addressing itself both to the office and to the home.

Teletext A method for data transmission in the blanking lines of a TV broadcast; the data must be decoded and shown as frames on a television screen, superimposed on the TV image or as a screenful.

temporary storage An area of working storage not reserved for one use only, but used by many sections of a program at different times.

terminals Equipment on a communication channel which may be used for either input or output; a device which permits a person acting as an operator to input or output message text into or out of an information-processing system; terminal devices include a keyboard, printer, CRT, and card equipment.

terminal control functions The functions needed to support work stations with manual procedures (supplied by terminal operators), such as communication management, message management, terminal management, process management, and system management.

time-division multiplexing A technique for combining several channels into one facility or transmission path in which each channel is allotted a specific position in the signal stream based on time.

topology The study of those properties of geometric figures that remain unchanged despite radical variations of the figures considered.

transliteration A change of character sets.

update To modify a master file according to current information—often the information contained in a transaction field—according to a procedure specified as part of a data-processing activity.

value-added carrier A communications network that employs common carrier facilities for transmission and that provides such services as path selection, error detection, retransmission, and buffering.

velocity The rate of change of displacement; "peak velocity" is the maximum value of the instantaneous velocity.

Viewdata A long-haul Datavision service provided through a public utility, such as a telco, a value-added network, or a company-owned and -maintained network.

virtual circuit A point-to-point, switched (or permanent nonswitched) circuit, over which only data, reset, interrupt, and flow control packets can flow.

virtual device A terminal device for which device-specific transformations occur in the terminal controller, and not the sending application program or information processor; the transformations create standard virtual device protocols, which allow greater independence between terminals and applications programs.

volatile memory Any memory that can return information only when power is applied to the memory; the opposite of nonvolatile memory.

wired-program computer A computer in which instructions that specify operations are themselves specified by the placement and interconnection of wires, usually held in place by a removable control panel.

work station Any place to which work is routed and at which direct labor is performed; a place where work can be done in accordance with manual or computerized procedures where data can be stored and retrieved and where messages can be created and exchanged with other work stations.

write To transmit data to a memory from some other digital electronic device; see also STORE.

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