

technology is that what seems impossible today becomes an accepted part of our lives tomorrow.

Development of voice recognition by computer, while rife with problems, also is yielding results. Despite all the difficulties, voice-recognition equipment can be purchased today. No serious forecast about computer systems in the 1970's can omit voice recognition systems with several-thousand-word vocabularies. If this sounds unpromising, remember that only a few years ago people used to have 2- and 3-day meetings to discuss the problem of keeping records on magnetic tape. How naive that seems to us now. Today, we already have machines that learn (they are called heuristic machines), that devise their own route to a goal or solution; machines that recognize patterns; and machines that can devise their own strategies—for example, winning at games with the men who design them.

Adding tremendous impetus to the technological explosion is the fact that, as computer capabilities are increasing, costs are decreasing. Between 1963 and 1972—a single decade—there will be a decrease of 85 percent in the cost of completing a typical data-processing job. During this period, the cost of storage by magnetic tape will go down by 97 percent; the cost of image storage by 96 percent; and communication line costs, because of increased speeds of transmission, will decrease by 50 percent. These changes in economics will mean that we will be able to do more with information technology than we now can even imagine.

Let me turn now to the problems of putting these machines to work.

Nowhere is the turn toward technology more obvious than in the way we manage. When we first started to apply computers to business operations in 1954, we went through a very difficult experimentation period and were faced with the most puzzling kinds of problems. We have largely emerged from that period, however, and today we are using computers in business for almost everything conceivable—and much that was not just a few years ago. Senior management has begun to realize that the application of this technology is too important to leave to technicians, and that dramatic things can be accomplished if people who know the objectives of a business will take the responsibility of putting these new capabilities to work. When this happens, you find remarkable achievements.

But along with this progress have come new questions and problems. There are, for instance, union negotiation questions. Throughout the country, a number of owners of newspapers have been willing to stake the very existence of their enterprises on the right to install a computer to prepare punch tape to drive linecasting machines. Just over the horizon, it is clear that this entire process will be bypassed. Is it worth risking an enterprise on a process that is disappearing?

There are many similar questions. What kind of men, for example, should be trained as managers in the new technological environment? How do we create an atmosphere that is conducive to creative people?—for more and more of our businesses must be staffed by highly educated and creative personnel. These are only a few of the problems we face.

Most important are the human aspects. They are related to every problem we have in this field: questions of fear and uneasiness when faced with technological changes; questions of education; questions of identification with an enterprise, with a profession.

But along with the question of how we manage are questions concerning what we manage—of new areas of business opportunity. Here, I will speak of four main new entrepreneurial opportunities. The first is the obvious one that has already taken form—the industry that supplies the systems and the equipment. It is already a multibillion-dollar industry, and this is only the beginning.

The second example, as yet nonexistent but about to bloom as an important basic industry, is the data utility field. This is analogous in some ways to the electrical utility industry: It is cheaper for many people to use a central utility than for each individual to have his own generator. The same economic reasoning applies to the data utility industry, where many people can use a machine simultaneously. The technology of real-time processing, time-sharing, and communication will allow this to happen. Small- and medium-sized businesses—and for some purposes large businesses—will just plug in for data processing as we now do for electricity.

The third example is the one now being called the inquiry industry—in some ways, the publishing field of the future. This will allow the sale of proprietary data over a communications system in answer to a query placed by the customer. The possibilities are unlimited; practically any information can be provided.