Foreign vs. U.S. Computers: An Appraisal

BY JOHN E. GRIFFITH

Unclassified

Compares hardware, software and architectural concepts of the United States with those of Israel, Japan and the Soviet Union and shows the influence of the U.S. computer technology on the technologies of these countries. The emphasis is primarily on present and future technology.

I. INTRODUCTION

I will discuss foreign versus American computers for you from the viewpoint of systems design concepts.

First I am going to discuss the computer industries of three foreign countries: Israel, the Soviet Union and Japan—in that order. These are all characterized by significant capabilities with respect to the way computers are designed and built in this country, which seems, by the way, to characterize what virtually everybody does overseas. Foreign countries, so far as I can tell, are not distinguished in any particular sense of the word from the viewpoint of systems design or architecture. In my survey of the literature I was able to use a file of information at the National Academy of Sciences, which turned out to be very valuable, especially with respect to Japan. (For the past eighteen months, the Computer Science and Engineering Board of the National Academy of Sciences, has been pursuing a study of the Japanese computer industry vis-a-vis the U.S., but the report is not yet available.)

First I want to give you a picture of some of the background of the computer industry in this country. The significance of Fig. 1 is that the number of machines is growing exceedingly fast in this country. The point to be drawn from this is that the steep slope leads to low-cost products, due to the economies of scale in the manufacture and production of computing equipment.

Figure 2 illustrates the fact that technology has a long way to go with respect to making machines faster. This shows that the multiply time, which is a typical arithmetic operation, becomes faster and faster with new technologies. Based on theoretical results, it is known that there are still several orders of magnitude of speed available before a fundamental limit is reached. This justifies investments in searches for new and faster technologies.

Figure 3 illustrates that data communication facilities will probably cost less in the future. This is desirable for the expansion of teleprocessing systems.

Figure 4 illustrates a future trend; that is, as the size of the teleprocessing system increases, the number of circuits in the terminal equipment becomes a dominating factor. It seems that foreign countries have included the teleprocessing objective in many of their plans.

II. ISRAEL

Israel has about 250 computers installed at present. Very few of them are indigenous machines. Nevertheless, Israel is a high-technology country. They have over the past two years (1970–1971) made a study of what the future of the computer will be in Israel and for Israel. The conclusions are that, number one, they cannot allocate large sums of money to build plants for computers in Israel. Thus, they will not have large computer manufacturing plants available. As we saw from Fig. 1, that is a desirability.

Second, they do not have large pools of trained people in Israel. This includes manufacturing personnel as well as programmers, engineers, and system designers. All of these represent special skills, and to get into the computer business seriously Israel would have to have a large number of

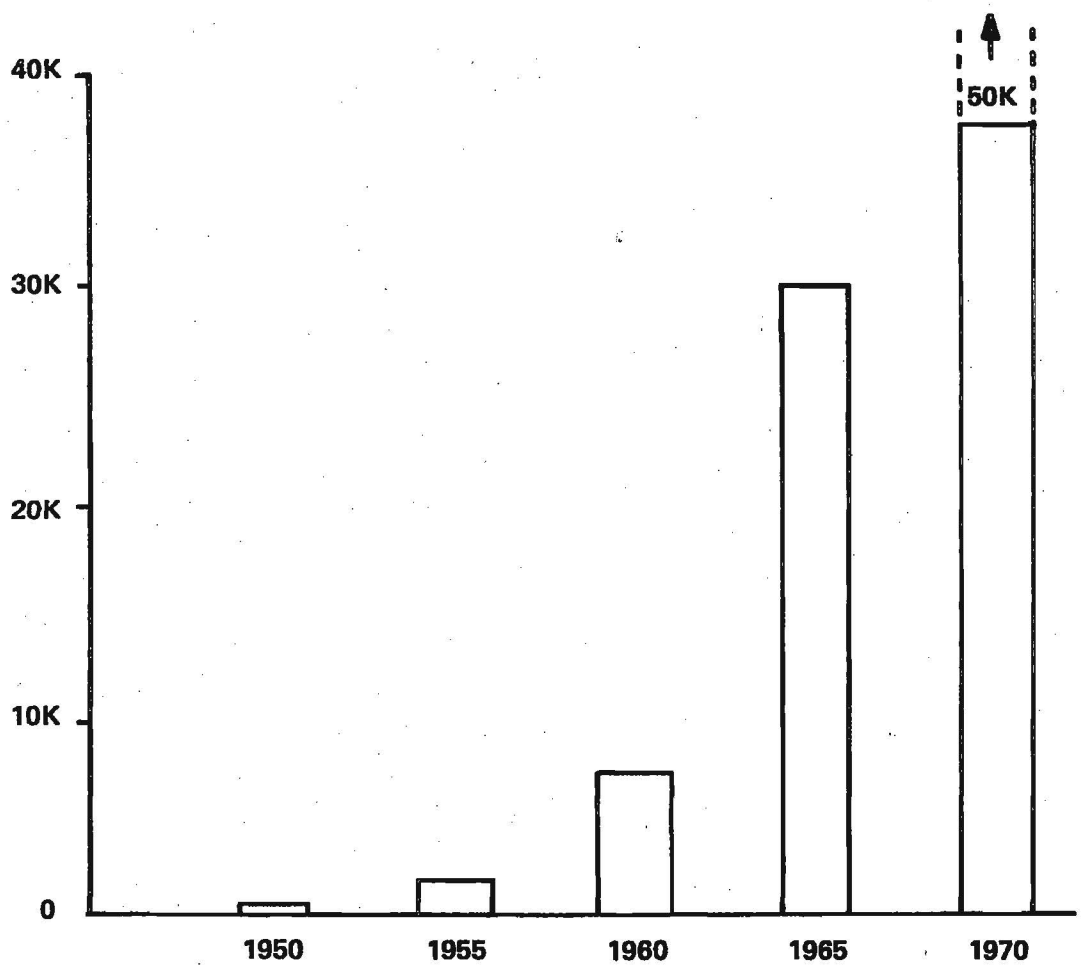

Fig. 1—Number of Computers in Service

them in order to support the industry in any viable way. Apparently, they do not have them and are not intending to assemble a large pool of these people.

Third, they do not have a large marketing and service organization, which they believe is necessary if they are to have a viable industry.

Fourth, they do not have large R&D efforts which can be devoted to the computer industry. The point here is that computers, because the growth rate of the industry is so high, require a significant effort in technological research and development. This is not to say that they can't depend on other people's R&D, but that is sometimes a very difficult position to operate from.

With respect to R&D, new technology may only be marginally useful to a country that is going to operate in a computer market. The marketing and service organizations are at least as useful, and they are very necessary if one is going to go into the world market as the United States has done. An example of this is the Japanese, who have designed to all appearances, large and successful machines which they are now manufacturing. They are not yet being sold widely in the U.S., probably because the Japanese do not yet have a marketing and service organization in this country.

Also, it is not absolutely necessary to develop new technology for your machines. It is often sufficient to make sure that the advanced technology is available to you when it comes out.

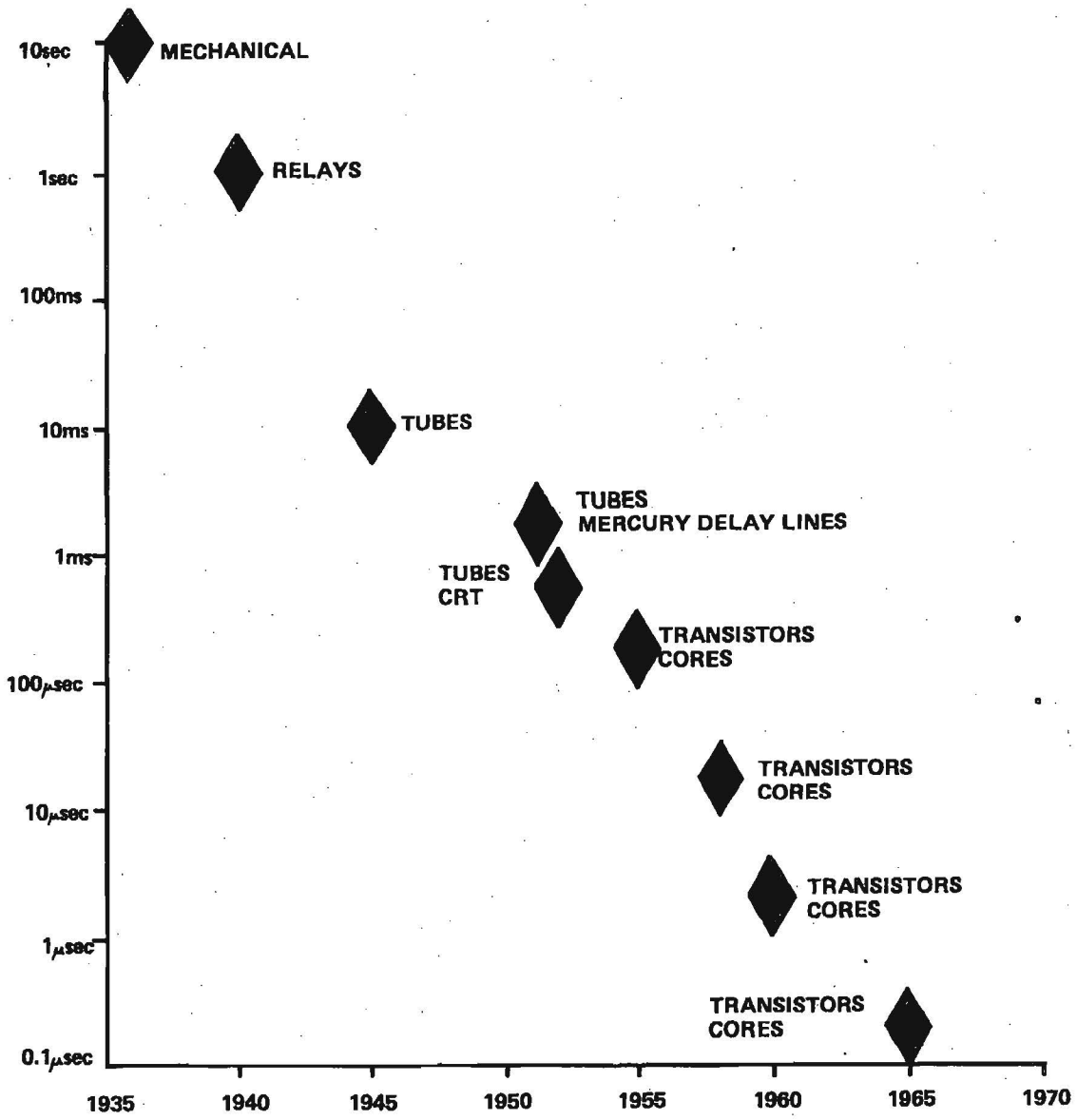

Fig. 2—Decrease in Multiply Time

In Israel's eyes, only the U.S. and Japan have a clear road to a large, profitable computer industry. They do not see that they can follow the same path, and what they do in the future will hinge on that judgement. In addition, they do not see that the British at this point have a clear road, or for that matter any West European country.

Israel has taken the attitude that the future will be the future of the user, meaning that machines will be characterized more by users than by applications. For this reason, Israel is going to concentrate on the user-oriented applications of computers both in and outside of Israel.

Israel plans to expand their consulting and service capabilities because these are salable outside of Israel, especially in underdeveloped countries. At the same time, they can learn a great deal about those countries themselves. Thus, they intend to expand their software efforts, which is

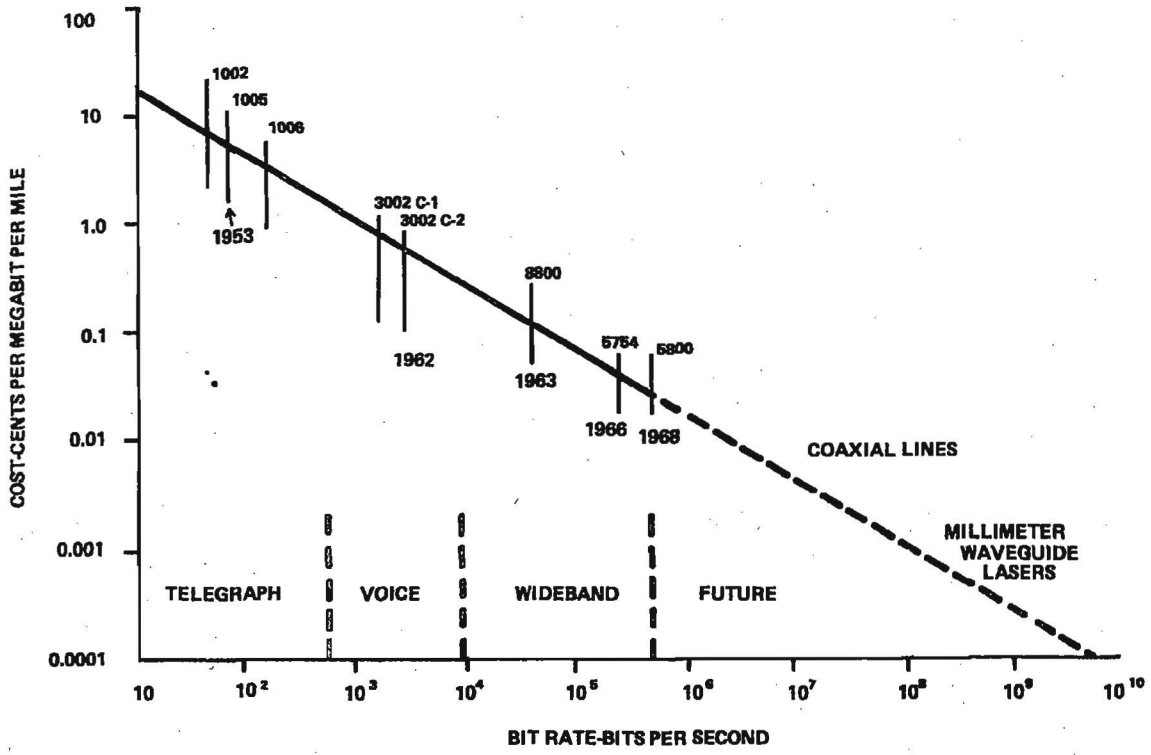

Fig. 3—Common Carrier Network Data Facilities

part of the consulting and the services and where one needs large pools of software people. They seem quite capable of training these, or getting them trained, as the case may be.

They are also going to produce technology; this will be large-scale integrated circuitry (LSI), principally for their own military needs. They hope to sell any excess to other countries that want to make computers out of LSI. This assumes that the large-scale integrated circuitry that they are going to sell will be a competetive type of technology.

Probably the biggest problem that Israel has, insofar as using computers themselves, comes from the fact they do not have a good teleprocessing network; their standard telephone system has a bandwith of about one kHz, which is inadequate for serious use in future data transmission nets. They apparently plan to build themselves a new data-transmission grid so that they can utilize computers at a distance.

In summary, Israel is going to focus most of their effort on the user area; and that, of course, is where everybody else is going to focus his effort in the future, because that is the area where there is a large shortage of immediately useful knowledge. Israel does not intend to compete on a large scale either with Japan or the U.S., or for that matter with Western Europe.

III. SOVIET UNION

Turning to the Soviet Union, we find that a different problem occurs. There the biggest problem is the fact that very little is known about the computer industry in the Soviet Union. You can find tables of machine performance specifications, but it tells nothing about how they design their systems, which is the more important matter.

Apparently the number of computers in the Soviet Union—people quote various numbers—is bracketed by the range of 6,000 to 7,500. This figure seems plausible and generally reasonable. They have announced a five-year plan in which they want to install 15,000 more computers in the

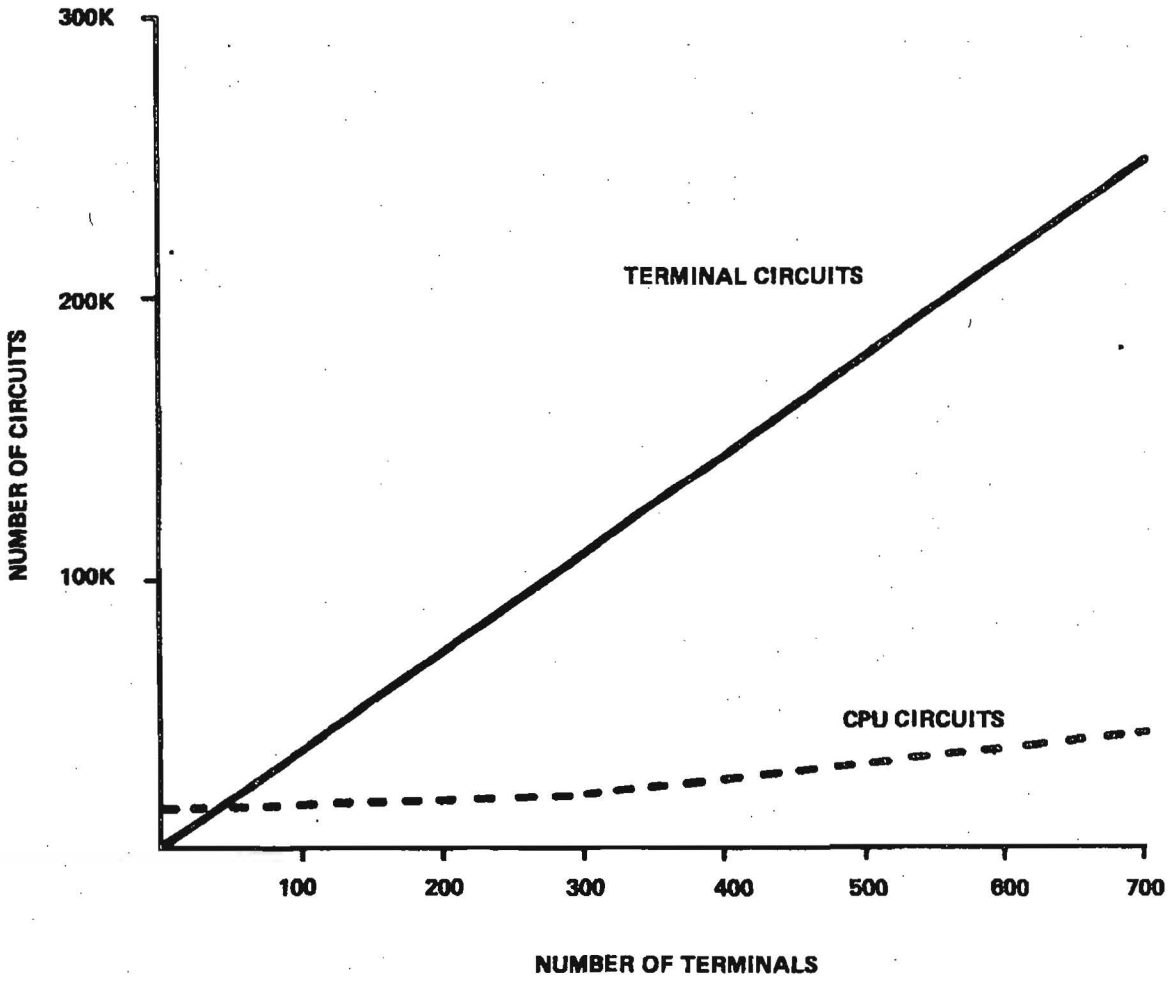

Fig. 4—Circuit Distribution in a Teleprocessing System

Soviet Union by 1975. I do not see from what I have been able to read and understand that they will be able to do that.

They have high technology available in the laboratory and it is evident that they know how to use it. They have large R&D organizations, and they are competent. On the other hand, it does not appear that they are able to move this high technology easily from the laboratory into the plant. The most successful example of what they have actually done in this regard is in their space program.

Their present production of machines appears to be equivalent to S/360's in many respects. The design is now eight years old, but is proven.

The production system that they appear to have, however, is a very loosely integrated one. Every year in this country the production system gets tighter and tighter. Thus, people have to have more "peripheral vision." Systems designers and even software people are having to learn more about hardware than in the past, and the hardware people have to understand software concepts. The Soviet Union seems to have a shortage of programmers. Their software appears to be produced by small groups of people rather than by a large centralized organization.

In the past there has been too much emphasis on theoretical mathematics vis-a-vis applied mathematics. Nowadays one sees references to their shortage of mathematicians to work on appli-

cations, as is also true for the Israelis. I trust that this will be corrected. This did not happen in the U.S., fortunately, because after World War II there was a resurgence of interest in applied mathematics. Hence, we have been well off in that regard. Computers require many special-purpose parts, and because of the large scale of production, one can often justify their developments. At this point I do not have any good feeling for where the Soviets are getting the special-purpose parts which they must require for their machines too. My guess is that they are learning that machines will not be produced except by very tightly integrated production systems. When they look at integrated production systems, people very often miss the fact that special-purpose parts, such as precision resistors, are par for the course.

The designs of Soviet computers appear to follow U.S. style; not only that, the designs of their hardware appear to be less coordinated with the designs of their software than is true in this country. That is a failing that they will ultimately have to correct.

The Soviets seem to have good people in the computer field. I was able to find out very little about most of them, but some of their leaders are well known. I point out to you that Andrei Ershov, among their professionals, is their leading software theoretician. He is an exceedingly good man.

An estimate of the Soviet attempt to build computers is that they are in a position now to start learning the things that were learned in this country ten years ago. The question is whether they will spend ten years learning them like we did. I rather doubt it. I anticipate that they are going to catch up. They are farthest behind us in areas such as support services and programming.

IV. JAPAN

It appears that Japan now has installed about the same number of computers as the Soviet Union, about 7,000. Japan has many advantages, some people think, over the U.S. Number one, they are also a high-technology country. Number two, they have a form of government-industry alliance that is unlike anything else in the world. It appears to be formidable, in that they can mount large-scale organizations and efforts to produce high technology products and do this very well. Their small and medium-sized computers are fully competitive with machines made in this country right now. We don't see them because the salesmen and the maintenance people aren't here.

The Japanese have a proposed long-range plan, a plan based on an ideology. The computer and its application in Japan will, in the future, become a matter of ideology as much as anything else. Some of their reports talk freely about the "information society," the same one which Peter Drucker discusses in his book. They also talk about something called "a computer mind" that is to be achieved by a fairly significant percentage of the population by the year 1980.

The lead time, the time from design to first shipment, of machinery right now in Japan appears to be something like three years for computing equipment. In this country it is about five years, typically. In the Soviet Union and Israel it is something like seven to ten years. Three years is a very good time; it remains to be seen whether they are going to be able to take advantage of that or not. This illustrates that the combines of government and industrial organizations can be effective.

The Japanese are apparently taking, instead of space, social development as a national challenge and product. Every evidence is that they are serious about this. They foresee networks that will combine local and urban areas, and networks of computers within cities. They foresee networks to combine large, major cities. They foresee networks to cover broad areas of Japan, both industrially and socially and they see nationwide networks. This view is a very advanced one, and from the amount of money and the élan they are expressing in the design and construction of their equipment, they are serious.

They intend by 1980 to have popularized computer services, that is, they intend to have computer services in the household, cheap computer service much like our telephone service, which every housewife or worker will have available. (The popularization of computer services is something which some people foresee also in this country in 1980. It remains to be seen whether it will come to pass or not.)

The computer is seen in Japan not only as a major element of domestic policy, but also as a major element of foreign policy. It is anticipated by some people that the Japanese may be the ones to beat before we are all done.

The Japanese have some research underway on lasers, magnetic bubbles, reversible photomaterials, etc. Some of the work is known to be good; however, some of the university work in computer science appears to be weak. Their major universities have rudimentary computing facilities, with sometimes as much as two weeks' turnaround time. They are, nevertheless, moving forward and have set up a joint program at the University of Hawaii at which by now six Japanese computer science people are supposed to be in residence. The idea is to couple into a good university system, such as that of the United States.

They have a shortage of software. They are designing and building machines, but are finding out that they need more software people.

The Japanese are as yet exporting little of their machinery. The reason is that they have to satisfy a high domestic demand before they can go out into foreign markets. And this is the reason they are not yet training sales and maintenance cadres to send out into the rest of the world. It is anticipated that it will take another three years to fill the domestic demand. One can foresee that when that time comes, the Japanese will begin operating in the worldwide market in a way that may be familiar.

There is only one thing that I can see that is really odd about what the Japanese are doing, and that is that they are emulating the U.S. It is not clear why, except that nothing succeeds like success, and that is exactly what they want to emulate. To me it is interesting that the Japanese are just now converting their economy from an agricultural economy to a manufacturing economy, whereas in this country we are converting our economy from a manufacturing economy to a service economy. There is a vast gulf between the two, and what is suitable and best for one conversion may not be suitable and best for another. It is not clear where this is going to lead them.

V. CONCLUSION

In conclusion, I want to leave you with a few last thoughts. In my opinion, each country must interpret computers in its own terms and criteria; otherwise it will not have the freedom to move ahead on its own.

The challenge of low-cost technology in the future may surprise some people. The advent of large-scale integration will without a doubt have a profound effect on computer design in this country and very likely in foreign countries also.

Management is the key to success at all levels of the computer business. If foreign countries cannot manage their particular computer industries as well as we manage ours, they will not catch up with us. Management is going to be more and more prevalent in computers, not only in their production and design, but also in their use. And here I think the National Security Agency has done very well by starting some years ago to train people in managerial techniques. This policy may turn out to be crucial in the future; that is, when you talk about a frontier to be breached, it will be breached by management techniques as much as anything else.

Many crucial decisions remain to be made in the design, production and use of computers. Many of these decisions will be made in the future by line professionals and managers right in this agency. This agency has greatly influenced the history of computers, as I am sure you all know. The influence of this agency and the decisions made here by your managers will continue. I do not think that there is any chance whatever that NSA will not meet this challenge; however, in several respects it is a far greater one than any of the past.

With that thought I thank you very much; it has been an honor and a pleasure to speak to you, and I wish you Godspeed over the next ten years.