INTRODUCTION

Thank you. Good morning.

I sincerely hope you've enjoyed your visit to Control Data. It's been our pleasure, certainly, to have you here.

In looking over the conference agenda, I noticed that "change" is clearly the dominant theme. Former Vice President Mondale talked to you about the impact of changing government policies and politics in the 1990s. You've also heard about future changes in small business, the changing role of incubators, and changes in education's role in business/economic development. Finally, my topic is change in computer technology and its impact on small business.

If nothing else, this conference confirms a statement once made by a man named Charles Brower. He said: "It is change, not love that makes the world go round -- love only keeps it populated."

For those of you engaged in business development, change is no stranger. You have always been in the forefront of change.
Although it has only been in the recent that small business development has become a truly understood and accepted alternative to traditional smoke-stack chasing. There has nevertheless been a permanent change.

Today I want to talk about change in computers. I'll take a slightly different approach to that subject that you normally hear, but, in the end, I hope you'll see how the computer age has changed from one where only a few select people and large corporations could participate to one that is open to everybody in every sized city. The "computer age" has become the "information age". And, the new wave of entrepreneurism will be built around information management.

**GENERATIONS OF COMPUTERS**

It's not unusual for people to ascribe human characteristics to inanimate objects. Especially those which are the tools of their trade.

Somehow, however, the computer industry seems peculiarly dominated by this anthropomorphic mindset. Consider the word "memory," which is commonly used to refer to a computer's data storage capability. One can only marvel at the wistful -- perhaps even wishful -- thinking that christened a device for recording the presence or absence of an electromagnetic charge as a memory.

But the epitome of all these technological malapropisms is the use of the word "generation" to describe this year's computer model.
Actually, to say "this year's" model is not quite accurate. The computer industry has not yet reached the cosmetic efficiency of the automobile industry. It has only been able to turn out new models every few years or so.

Anyway, according to the conventional view we are about to enjoy the benefits of the fifth generation of computers.

The first of these so-called generations was based on vacuum tube technology. The second, on discrete solid state technology. The third, on the integrated circuit. The fourth, on Large Scale Integration. The fifth is a mixed bag of advanced circuitry, new design structure and new software embodying so-called "artificial intelligence". All that is obviously a technologist's view of the world.

A societal view would be quite different -- and much more realistic. It would define a "generation" of computers more by their role in society than by the technology of their innards. Not surprisingly, the time span of such a computer generation is roughly 20 years -- about the same as that of a human generation.

In fact, the arrival of computers in society in the late 1940s can be viewed as another wave of immigrants analogous to those human waves that arrived in America from Europe in the 1870s through the early part of the 20th century. The process of assimilating those human immigrants into American society parallels very closely the process by which computers are being integrated into our daily lives.
THE FIRST GENERATION

Similar to the great waves of human migration, the computer "immigrants" were preceded by early "explorers" -- the calculating devices of ancient history, the inventions of Charles Babbage in the 19th Century, the pathfinding of Alan Turing in the 1930's, and so on. But the first true wave of immigration, as so often happened with its human counterpart, came in the wake of great social upheaval -- in this instance, World War II.

Out of the turmoil of that conflict, there arose a restlessness. First in a trickle and then in large numbers, the computer immigrants came seeking change and opportunity. The typical computer immigrant arrived on the shores of society just as did its human counterpart -- a thing of basic skills, little sophistication, and with a tremendous language barrier between it and the place where it took up residence.

Society, on the other hand, was busy with other matters and mostly ignored the newcomer. In certain computer ghettos, such as California, there was some concern as it proliferated. But, in general, the new immigrant was only tolerated. Meanwhile, it went about its cumbersome, sweatshop kind of work solving equations for physicists and stamping out payrolls. Unable to communicate, it stayed tightly cloistered in ethnic neighborhoods -- called computer rooms.
Teaching this immigrant new skills was a slow and arduous task. By and large, it was so busy earning its keep that only in off hours -- after sometimes working 140-hour weeks, pausing only for brief health checks -- was there time to improve its basic skills. Pidgin English dialects came into use. Although most were quite arcane and had strange names and sounds such as FORTRAN, COBOL and ALGOL, some degree of communication began to take place.

Over a period of 25 years following World War II, this tide of immigration grew. It attracted new and more powerful fellow immigrants, all of them sensing opportunity and seeking to make their mark. Many were quickly snuffed out in the accident-prone world of industrial America. Some survived and prospered.

All-in-all, these new immigrants were a rough-hewn crew. But like their early human counterparts, they increased the wealth of their industrial masters, and of the whole economy. They were a new and vital source of energy and productivity. But the computers were also an alien lot -- unintegrated and certainly incapable of serving any broad spectrum of economic need. These computer immigrants were, in short, the cheap manual laborers of the new information age.
THE SECOND GENERATION

By the late 1960s and early 1970s, the offspring of the first generation began to make their presence felt. Building on the economic and intellectual foundation of their forebears, this second generation has escaped the sweatshops of numerical calculus and clerical processes. Its members have won a secure place in society by applying a dazzling array of capabilities.

The more mobile of the new generation have moved out of the computer room ghetto and learned how to perform services in the general worksites of society. They work side-by-side with engineers. They are entering small businesses. They perform routine chores for air travelers. A few have even made it into the profession of teaching. Slowly, then, the offspring of the immigrants have made their way into society.

But as a whole, the second generation is somewhat torn -- eager to explore the new opportunities now open to it, yet still clinging to the old ways of the first generation.

Language continues to be a problem. While some can converse in the language of their adopted environment, most are more comfortable with their native tongue. Some computers and their programmer friends still hanker for the ethnic cabals of old and decry the defection from the old ways. And, if you'll grant me just a bit more poetic license, members of the first generation just shake their disk heads in bewilderment over the doings of their offspring.
No one observing the introduction of word processing into the clerical function of an organization -- much less the feeble attempts of executive management to use this tool -- could conceivably use a term like "fourth generation" -- much less fifth -- to describe the current state of affairs.

Still, the second generation is nearing the end of its time, and by the 1990s, the third generation will be fully with us.

THE THIRD GENERATION

This third generation will be better educated and more affluent than its predecessors, based on a spectrum of technology its "grandparents" couldn't imagine. It will be literate and articulate and completely integrated with its human partners. It will be capable of taking its place in every arena of human endeavor -- not only accepted but sought after.

The point of all this is obvious.

If the metaphor of generations is to be used at all, it should define the way people use computers. Based on this view, the dividing line between the generations is roughly 20 years, not five years. Those are the generations of mankind. And the introduction of computers is faithfully following that generational pattern.
SMALL BUSINESS--THE FUTURE

What does this mean to you and your clients, and to the process of economic development? It's not my purpose here today to paint some grand landscape of technological utopia -- although it clearly is possible to get excited about the many applications of future computer technology to both our professional and personal lives.

Rather, I want to deal with only one aspect of technology and economic development.

Economic development takes place most rapidly and vigorously at points of discontinuity in society's communication systems. Historically that meant at points of interruption in travel. In that sense, "stop over" may be a better word than "discontinuity." The most obvious example is the economic activity which developed around seaports -- where a switch from water to land transportation was necessary. Similarly, villages and trading posts developed at the confluence of rivers, at major river portages and so on. Waterfalls at portages also served the economic purpose of providing energy for mills. Minneapolis was born at the St. Anthony Falls of the Mississippi.

And so exactly is it with regard to information. Universities are sources of information "power" just as waterfalls are sources of kinetic energy. Silicon Valley, Route 128, or the electronics industries of
Mpls.-St. Paul are not accidents. They are the natural result of the "stop over" points of information which are a result of the great universities in those locations.

The greatest single change that computer technology can make in the next quarter century is that of its ability to create -- at any location we wish -- such focal points or "stop over" points in information flow.

A major change in information storage has come about with so-called optical or "laser" disks. The equivalent of the whole MIT engineering library can be put on a few disks that can be accessed by a computer on my desk. Actually even that's not necessary because by means of computers coupled with communications, I can have meaningful access to any information on any subject almost anywhere in the world. Let me give you an example of what this can mean.

Bricelyn is a small town in southern Minnesota. Until the '80's it was a bustling, small rural town providing goods and services to local farmers. By 1985, with the decline in farms, Bricelyn was on the all too familiar path in rural America to extinction.

But one person had an idea to develop food products made from a grain called Amaranth. With the aid of small grants from the McKnight Foundation and the State of Minnesota, in 1987 this individual established the not-for-profit "Institute for the Development of Amaranth
Products" -- in Bricelyn, MN, pop. 470. Soon there was a network of agriculturists, food technologists, and people with processing know-how: for example, a professor at Iowa State, researchers at Rodale in Pennsylvania, a retired food processing technologist in Mpls., a farmer in Kansas and interested people in New Zealand, Australia, Japan and Europe.

Knowledge flowed into and out of Bricelyn, just as surely as ships sail into and out of Sydney, New York or London.

By January of 1988, the first small company was formed. It opened up shop in a small, boarded up store which the town's last jeweler had closed four years before. By May, it had its first contract; by September its first profit. And, it has created jobs not only in Bricelyn, but in other Minnesota towns and cities: Wells, Albert Lea, Mankato and the Twin Cities.

This ability to create small centers of knowledge in Bricelyn, Minnesota -- or wherever -- through the use of computers and communications is one of the most significant contributions the coming third generation can make. Certainly it should make your efforts more exciting and more rewarding than ever.

Thank you.