Thank you and good morning. It's a pleasure to be able to share with you Control Data's experiences in the critically important matter of a more vital high technology industrial base. I'm not going to spend any time on our country's need for a more vigorous effort in that regard or in quantifying the benefits it can yield. That we can taken as given. Rather let me start by simply stating that, if we are, in fact, to succeed in developing a more vital high technology industrial base, then our approach to the problem must change. It must change to embrace more widespread and more broadly based cooperation among all sectors of society -- industry, government, academia, and other private organizations.

Control Data's experience over the past quarter century has shown that the required cooperation among all sectors of society can be achieved. Unfortunately, it has made it equally clear that widespread cooperation among these sectors is not the normal state of affairs in our society. So change is needed -- and that comes hard.
Before going on, let me make a simplification with regard to terminology. The words "a high technology industrial base" become awfully cumbersome after a while and it's much easier just to say "jobs". So I'll just use "jobs" and we can all understand I mean the jobs assured by a high technology industrial base.

In any event, job creation requires cooperation in two separate but related areas. The first and most basic need is for greatly increased technological cooperation among large companies — in particular among high technology companies. The second is for cooperation among all sectors of society to achieve a healthier small business sector. I'll take the matter of small business first.

**Small Business Role in Job Creation**

You no doubt are aware that more than 80 percent of the new jobs created in the last ten years has been provided by companies with 100 or fewer employees. Yet the environment for small business has been steadily deteriorating because of increasing competition from large companies, increasing government regulation, and decreasing availability of technology and capital. At the same time, most of the technology, management expertise and capital resources are in big business -- and are underutilized.
Recognizing this need and opportunity, Control Data has developed a wide range of services for small enterprises including financial assistance, data processing services, education and training, management and professional consulting, and technology transfer. A particularly important service is our Business and Technology Centers (BTC's). BTC's provide various combinations of consulting services; shared laboratory, manufacturing and office facilities; and other services to facilitate the start-up and growth of small businesses. Economies of scale make it possible to provide BTC occupants with needed facilities and services of much higher quality and lower cost than they can obtain or provide for themselves.

We also assist small business by helping to launch and participating in the operation of community-based organizations with that objective. I will describe two: the Minnesota Cooperation Office for Small Business and the Minnesota Seed Capital Fund.

MCO: The Minnesota Cooperation Office, or MCO, is a non-profit corporation being financed during the early years by contributions and grants. Eventually it will become self-supporting from client fees and funds generated by investments in client companies.
The MCO's Board of Directors consists of leaders from all major sectors of society. The approach is simple: an entrepreneur has an idea for a new product or service and wants to start a company -- the MCO helps develop a business plan and obtain financing. The permanent staff is small. But the MCO draws on a volunteer advisory panel of engineers, scientists and executives for the specific expertise required to evaluate and help prepare business plans. Because these plans are expertly conceived, the chances of receiving adequate financing and achieving economic viability are substantially increased.

**Minnesota Seed Capital Fund:** Capital from more conventional sources such as venture capital companies and banks is often not available for new companies during their initial formation and early development stages. Because of this, the Minnesota Seed Capital Fund has been formed, with an initial capitalization of $10 million. It is receiving growing support. Recently, two pension funds became investors and several more are considering investment.

**Job Creation Network:** The Seed Fund, the MCO, and the BTC described a moment ago form the core of what is called the Minnesota Network for Innovation Job Creation. Accelerating the start-up rate of new enterprises and ensuring their profitable growth requires that each link in the small business
"chain of success" be given adequate attention. These links have been identified as technology, financing, management assistance, education and training, marketing, and efficient access to facilities and services. To address them effectively requires a comprehensive and systematic effort based on vigorous interaction among organizations from within both the public and private sectors.

The Minnesota Network provides this comprehensive and systematic cooperative effort. The Minnesota Network is also being replicated elsewhere -- particularly in connection with urban revitalization projects undertaken by City Venture Corporation. City Venture was formed in 1978 by twelve companies, including Control Data, and two church organizations. It is a for-profit consortium capitalized at $3 million.

City Venture plans and manages comprehensive programs for the revitalization of urban areas. Its approach mandates that plans for restoring a community must be based primarily on meeting the needs of residents for decent jobs. Small enterprises are a major source of those jobs, as well as an important means for building, rebuilding, and maintaining housing and commercial buildings. Small businesses also participate in providing health care, education, and other social services.
City Venture is four years old. During that time, government-funded contracts have been obtained for projects in many cities, including Minneapolis, Toledo, Philadelphia, Baltimore, St. Paul, Charleston, S.C., San Antonio, Benton Harbor, MI, Miami, and the South Bronx.

I could spend my entire time on the experiences we have gained directly and through City Venture in this matter of small business creation and assistance. But I will go on to the first important need I mentioned -- that of technological cooperation among large companies.

Large Company Cooperation

If anything, the needed cooperation in this regard is even more difficult to achieve than that in the small business area. The reasons are deeply rooted in the attitudes of large U.S. firms and the U.S. government -- attitudes which have been shaped by a hundred years of history. Those attitudes have become anachronistic as the world we live in -- and compete in -- has fundamentally changed over the past decade. It will change even more over the next twenty years, not only in terms of the rate of technological change, but also in terms of exploding capital intensity and of increasing international competition.
With the examples of our automobile, steel, and consumer electronics industries so vividly before us, we don't have to look very far for painful reminders of what happens when industries begin to lag technologically or in terms of capital investment compared to their international competition. But those examples may well be repeated even more painfully in my own industry -- the computer industry -- and it's closely associated semi-conductor industry.

In the brief span of two years, the U.S. position in micro-electronics has gone from one of an unquestioned and seemingly unassailable leadership to one of considerable questioning and doubt. The experience of being in second place in world-wide shipments of a particular advanced micro-electronic component -- the 64k random access memory chip -- occurred for the first time; a report by a government research lab has seriously raised the possibility of its being dependent on Japan for super computers by the end of this decade; Japan sponsored an international conference to announce its intention to become the world leader in computing by 1990; meanwhile it already dominates in the area of low cost printers and three inch magnetic disk drives, both of which are tied to the exploding personal computer market.
What it nets down to is that in two years or less we have gone from confidence bordering on arrogance to concern bordering on paranoia. How can that be? It can be because of the shock that has come from finally recognizing trends which have been developing for the past ten years. Changes have been taking place in every phase of microelectronics and computers including research, hardware, software, manufacturing, and applications.

1) The industry has become more capital intensive at the very time capital has become scarce and more expensive. You need look no further than the October 25th issue of Business Week. In an article entitled "The Pall That Lingers Over Silicon Valley," the editors say: "For the $9.3 billion industry, the recession started two years ago with crashing prices that devastated profits in such important categories as computer-memory chips."...."Still, chipmakers have kept up their capital investments -- in part because even the latest production equipment now becomes obsolete in three years or less, and because U.S. cutbacks in 1975 led to widespread shortages that opened the U.S. market to Japanese producers."...."This need to spend on capital equipment, coupled with the industry's current mired state, could force an industry restructuring."
2) Software technology is more pervasive and more critical to advances in microelectronics technology and certainly in applying it. For example, the November/December 1982 edition of High Technology Magazine in an article on artificial intelligence states, "These systems....will profoundly alter the way people work, live and think about themselves. Key....is a radically new style of computer programming....methods for efficiently representing facts and ideas on a computer."

3) Even more fundamental is the great shortage of technically trained personnel. This shortage is caused by several factors.

First of all, the present highly labor intensive education system simply can't produce the number and quality of engineers and other technical people we need. Trying to do the job with the current education system is like a business trying to compete with a factory full of obsolete and inadequate equipment. So just pouring more money at the problem isn't the answer -- and even if it were, the money isn't available because of a general shortfall in many other sectors of the economy.
Second, is the need for a larger number of students who choose engineering or other technical careers. Sixty-five percent of the students in Japan choose scientific and engineering fields. In the U.S. that number is 30 percent.

Third, is the matter of people already at work. The increasing rate at which technical subject matter becomes obsolete means most graduate engineers must be essentially retrained every five years.

Fourth and finally is the problem of inadequate laboratory facilities. This is more than a simple budget problem. The rapid change in technology that affects industry also means that teaching and research laboratories become obsolete at an equally rapid rate.

Control Data Experience

So our problems are deep rooted and complex -- and we are further confounded by the fact that the resources -- both human and financial -- necessary to their solution are scarced. Because of this, any meaningful solution must be based on widespread cooperation -- cooperation between industry, government and academia. Let me start with the problem of increasing the supply of engineers and computer scientists.
As I mentioned, there is no need to sit around and hope for budgetary magic or increased contributions that will somehow solve the problems. It won't happen. But through cooperation we can make better use of the resources that do exist. Control Data is engaged in some 40 cooperative projects with U.S. universities. I will describe two of them.

LDEC

One is aimed at increasing the capacity to graduate more engineers by applying a computer-aided instruction system to the complete lower division engineering curriculum. Here I want to distinguish between the general use of computers at a university to solve problems associated with various courses and a comprehensive CAI system which has all the features needed for university-level instruction -- namely: multi-media, stored information, transmission of information, interactivity which permits a complete interface with the students, tutorials, assignments, and record keeping.

Presently a consortium of seven universities are working with Control Data to develop this engineering curriculum using our PLATO CAI system. This school year, PLATO courses will be available in basic physics, chemistry, computer literacy, computer programming, as well as remedial training courses. By 1984, 12 courses representing 39 semester credits will be
available. Plans call for an eventual lower division curriculum of 64 or more semester units. The development of such a comprehensive program simply would not be practical under current budget restrictions for any one organization operating independently.

Another university cooperative program is the Microelectronics and Information Sciences Center at the University of Minnesota. As the result of an industry-university collaboration, the Center will not have to make a huge investment in laboratory and processing facilities. It will have access to facilities in industry which represents an equivalent investment of more than $100 million. Thus, the Center will not have to dilute research dollars with the cost of facilities or salaries for operating personnel. In fact, in the long run, because of the rapidly increasing complexity and cost of the facilities required for advancing the state-of-the-art in microelectronics, costs will be beyond any single university and most companies.

But if we are to truly develop and maintain a high technology industrial base in the future, the major change which must occur in U.S. industry is that of practicing technological cooperation. Control Data's experience in technological cooperation over the past 10 to 15 years has demonstrated that
such an approach not only will work -- but that it is essential to the maintenance of a vigorous competitive environment. Our experience in this regard has led to a current effort which involves a dozen U.S. semi-conductor and computer companies. We are forming the Microelectronics and Computer Technology Corporation (MCC), a for-profit research and development company. MCC will undertake a number of advanced technology projects, the cost and risk of which make them impractical for a single company to undertake -- even if it had all the necessary skilled people -- which no one does. The individual companies will be able to use the technologies coming out of MCC in their own unique value-added products an services.

The Lessons of Experience

LDEC, MEIS, and MCC are only three more recent cooperative efforts, but our experience in technological cooperation goes back many years and covers all aspects of our business. For example, Control Data's billion dollar OEM peripherals business is the outgrowth of such a cooperation begun in 1972.

Let me conclude, then, by summarizing what we have learned from these years of experience -- what must be done to bring about widespread technological cooperation.
First, it must be fostered not only by top operating management, but also by the board of directors. In that regard, the board of every large company should adopt what I refer to as a Policy for Innovation. One part of the policy requires semi-annual reviews of the company's need for innovation and the actions being taken to achieve it. There is a great difference between run-of-the-mill innovation aimed at improving existing products and services and innovation which addresses new ones. It is the latter that is the subject of the proposed policy. Because such innovations entail greater risk and greater cost, completion dates are much more difficult to estimate. Therefore, the policy must provide for a periodic review and adjustment of the budget....and, subject to board approval, annual bonus plans as well.

Special emphasis should also be given to policies which foster innovation in the area of access to knowledge by individuals and small companies. Every large corporation has extensive latent resources which, if used creatively, could help individuals and small companies, and also enlarge profits. At the same time, the big businesses involved would be creating a favorable environment for innovation within their own organizations. Many employees would be stimulated to think about change and would become not only more amenable to it but also would help to engender it.
Directors should also institute policies to foster cooperation with other companies and the government. Participation in at least one consortium should be required....for example, one such as MCC. Another example would be participation in a consortium engaged in providing industry-wide training needs. The investment would be modest and the risk relatively small for a large firm, but the benefits would be substantial. Training and re-training costs plague every industry and are a root problem to be solved in increasing innovation and improving productivity. So cooperation rather than duplication has obvious benefit to all.

In addition to the required change in the U.S. corporate attitude toward cooperation, or perhaps as a necessary prelude to such change, the relationship between government and private enterprise must likewise change.

In the context of cooperative R & D, there are specifically the strong disincentives to such activity provided by the present U.S. antitrust laws. As it happens, this does not affect MCC -- the cooperative effort I described earlier. We are keeping the Justice Department informed with regard to MCC, we are not asking for a business review letter. We can legally form and operate it in spite of the fact that current laws are archaic and discourage cooperation.
Also I should add that while I have alluded only to technological cooperation in the microelectronics and computer industries, broad-based R & D cooperation is urgently needed in every industry. In fact, in the long run it is a better basis on which to develop a response to unfair foreign competition than are reciprocal trade barriers.

What is needed to help bring this about is a change in the tenor of current laws -- from laws which sometimes permit technological cooperation -- to legislation which encourages it. Anti-trust and Justice Department guidelines on compliance currently require lengthy and complex analyses -- and even then, in virtually every situation, legal opinions have various degrees of ambiguity. Hence, many corporations are scared of anti-trust suits.

It is also true that Justice Department lawyers take narrow, legalistic views that reflect the status quo. They never attempt to look ahead to think about accommodations to change brought about by R & D -- technological advance. Their usual approach is to sit back in a "now explain it to me" posture as opposed to one of "let's work this out together."
The legislation that is pending in Congress to encourage R & D cooperation by providing immunity to third party suits, i.e. HR 6262 Edwards/Hyde, et. al., S.2717 Genn/Kennedy, and S.2714 Tsangas, represent a step in the right direction. However, the certification process specified in them is burdensome and uncertain as to outcome.

Therefore, in an environment with timid corporations and status quo Justice Department lawyers, none of the present proposed bills will accomplish the needed results.

Legislation is needed which defines certain objective criteria which, if met, would immunize a venture from antitrust attack. We call this a "self-certification" approach. Participants would thus be in a position to structure effective R & D ventures as the unique circumstances may require, in an atmosphere of certainty rather than ambiguity. Ventures that did not meet the criteria could still seek Justice Department approval, whether by way of a business review letter or a new certification process implemented to handle such cases.

In reality, this proposal is not a very wide departure from existing antitrust law -- the big difference is that it would substitute certainty for ambiguity in the important area of cooperative R & D.
There is much more that could be said on this multifaceted subject. But this much is clear: Cooperation is necessary to not only sustain the international competitiveness of existing high technology companies, but also to foster the growth of new companies. How we treat this issue -- more than any other single factor -- will determine the economic future of this country. And since our political future is inextricably tied to our economic future, there is a whole lot more at stake here than mere prosperity.

Thank you.