Speaking to the Society of American Historians in 1966, Dean Acheson offered this advice:

"When Mr. Lincoln said that 'we cannot escape history -- we, even we here' -- he meant that we cannot escape historians, escape from being written about, gossiped about, and, perhaps, made the target of epithets. This is a tolerable fate. 'Sticks and stones will break my bones,' says the nursery rhyme, 'but names will never hurt me.' The aphorism may not be
wholly true, but it is good advice to work from and frees us to
go on to follow that of Mark Twain: 'Always do right. This
will gratify some people and astonish the rest.....' While
public men cannot escape historians, they would do well to
forget about them while they get on with their job.....seems to
suggest finding the test of action in imagining oneself
appearing well in a great pageant of human life, reaching back
into the mists and moving on into the clouds. In any event, it
is a form of concern with.....one's image..... But the
solution of every problem, every achievement is, as
Justice Holmes said, a bird on the wing; and he added, one must
have one's whole will focused on that bird. One cannot be
thinking of one's self or one's place in history -- only of
that bird. Regarding the much praised sense of history, I
would say to you historians, borrowing from a cartoon in The
New Yorker: 'Gentlemen of the jury, it's spinach and to hell
with it!'
Acheson's advice to those in public life is equally applicable
to those of us whose task is merely to provide the products and
services society needs. Meeting today's needs, solving today's
problems requires every ounce of will and energy we possess and
there is no room for concern over ego or image or our place in
history. Even spinach, however, has some virtue. So at the
risk of straining the metaphor, my purpose this evening is to
provide a serving of "historical perspective" in the hope of
putting this matter of computers and society into a frame of
reference that offers a more realistic appraisal of where we
are as well as where we may be within the coming decade.

Although people have always tended to ascribe human
characteristics to inanimate objects which are the tools of
their trade -- sailors being one of the better known
examples -- the computer industry has been particularly
prolific in that regard. One can only marvel at the
wistfull -- and at times even wishful -- thinking that
christened a device for recording the presence or absence of an
electromagnetic field as a "memory." "Protocol" may be a term
somewhat more appropriate -- for I defy anyone to understand
either the diplomatic or the data communications meaning of the
term. Of course, we have its lesser cousin, "the handshake,"
which is wonderfully appropriate since in either the political
or computer scenario we can never be quite sure if we are about
to be kissed or punched out. Today, of course, we are blessed
with "expert systems" which are "user friendly" -- a
contradiction in terms obvious to the most casual observer of
the human race.

Somehow, though, the epitome of all these technological
malapropisms is the use of the word "generation" to describe
this year's computer model. No, that's misstated -- the
industry, having not yet reached the cosmetic efficiency of the
automobile industry, has historically only been able to turn out a "new model" every five years or so -- thus we have been spared the generation hoopla except on a quintennial basis. As we gather here tonight, then, we are told that we enjoy the fruits of the fourth computer generation and that the fifth is close upon us. Nonsense (or worse). It is all once again a marvelous demonstration of the technologists capability for misappropriate use of language as well as their seeming overweening reluctance to try to understand the beings who speak it.

Tonight, I am going to talk to you about the real generation of computers. By so doing, I realize that perhaps I am perpetrating the unfortunate practice I have just deplored. But hopefully at least it will provide perspective rather than promotion.
The supposed generations of computers, by the way, are: the first or vacuum tube generation, the second or discrete solid state generation, the third -- the integrated circuit, the fourth -- the LSI and the fifth a somehow mixed affair of new circuits and new architecture -- embodying "artificial intelligence." Now all this is obviously a technologist's view of the world. It's like saying the generations of man are determined by the technology of the delivery room.

A societal view of the generations of computers would be a quite different one -- one in which a "generation" is determined more by their role in society rather than the technology of their innards. As we shall see, not surprisingly, the time span of a generation is about 20 – 25 years. For the next ten minutes or so, therefore, I'd like you to grant me some anthropomorphic license. I'd like to describe the arrival of computers in our society in the late
1940s as another wave of immigrants similar to those human waves that arrived from Europe in the 1870s, 1890s, and the first two decades 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. And, to make very sure I do not stumble unwittingly into the technologist's perspective, let me say right at the outset that it's the way computers are used -- that define the degree to which they are being assimilated. I'll have more to say about that when I've finished drawing my analogy but first....

II. THE FIRST GENERATION

As with 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, and so on. But the first true wave of immigration as so often happened with its human counterpart came in the wake of a great war -- namely World War II.

Out of that turmoil 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 did its human counterpart -- a thing of basic skills and little sophistication with a tremendous language barrier between it and the society in which it chose to reside.

Society, on the other hand, busy with its many other preoccupations, mostly ignored the newcomer. In certain
computer ghettos, however, such as California, there was growing concern as it proliferated. But in general, the new immigrant was tolerated -- the subject of ethnic type jokes

[computer joke]

but permitted to go about its cumbersome, sweatshop kind of work of stamping out payrolls and solving equations of fluid flow. 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 began to come into use. Although most were quite arcane and had strange names and sounds such as FORTRAN, COBOL, and ALGOL, some degree of communication with society began to be achieved. There was obviously still a lot of sign language required.

From shortly after World War II -- for 25 years this tide of immigration grew -- attracting new and more powerful fellow travelers.....all of them sensing opportunity.....seeking to make their mark. Many were quickly snuffed out in the accident-prone world of industrial America. Some survived and prospered. But all-in-all, these new immigrants were a rough hewn crew stumbling through society. Much as did the early human immigrants to the U.S., they increased the wealth of their masters, and of the whole economy -- they were a new and vital source of energy and productivity. But the computers were an alien lot, unintegrated and certainly incapable of
serving any broad spectrum of societal need. These computer immigrants were, in short, the cheap manual laborers of the new information age.

III. THE SECOND GENERATION

For the last 10-15 years, the second computer generation has begun to arrive on the scene. The scenario follows closely that of its human counterpart -- the sons and daughters of the first generation immigrants. The labors of the first generation have laid down a basic economic and intellectual foundation from which the second can go on to greater achievement. This second generation is better educated. That is, its capabilities are drawn from a broader and deeper base of technologies. As a consequence, horizons in society for the second generation have broadened and a greater variety of opportunity is available across which to apply their skills. No
longer are its members relegated to the sweat shops of numerical calculus and clerical processes. They've entered other occupations -- e.g. every police department includes them in its roster. Although hardly the equivalent of a good Irish cop on the beat, in their own way they make life safer for all of us. They perform routine chores for air travelers. And a few, following in the footsteps of pioneer Don Bitzer, have made it into the world of education. Slowly, then, the offspring of our immigrants are making their way into society.

But not surprisingly that is mostly for the more adventuresome. As a whole, the second generation is somewhat torn -- clinging to its attachment to the old ways of the first generation, yet wanting to explore the new horizons now open to it. Language continues to be a problem and although many can converse in the language of their adopted society, most are still far more comfortable with their native tongue. Some
computers and their friends (programmers) still hanker for the
ethnic cabals of old and decry the defection from the old
ways. And if you will grant me some poetic license, members of
the first generation just shake their disk heads in
bewilderment.

So that's where things stand. Slowly, painfully, we are
adjusting to the capabilities this new resource. Society at
large can no longer ignore its overwhelming presence. It
offers great promise and yet many are silently suspicious --
When our backs are turned, will it do us in?

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. I saw an
advertisement for a workstation the other day that speaks volumes as to where we really are. In full two-page glory stood a desk with a personal computer on top while down below the bold headline informed us that this was a "smart desk."

You can literally see there the doting, hard-working, first generation parent bragging about how smart the kid is.

And yet the pace of change is very great -- we are perhaps a bit more than half-way through the second generation and by the early '90s the third generation will be fully upon us.

IV. THE THIRD GENERATION

To pursue my analogy, this third generation will be educated and knowledgeable, i.e. based on a spectrum of technology, its "grandparents" couldn't imagine. It will be literate and articulate and fully 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 by society.

The point of all this is obvious. If the metaphor of generations is to be used at all, then it is more than misplaced to use it to describe the status of electrical circuits. The "generations" of computers, in fact, are defined by the ways in which people use them and, with that in mind, it should not be surprising that roughly 20 to 25 years -- not five years -- is the dividing line between the generations. Those are the generations of mankind, and the introduction of computers into society is faithfully following that generational pattern.

This view of the generations is also reinforced by some statistics. In 1950, the worldwide population of computers was about 50 and in 1970 was only about 125,000. Even as late as
the beginning of this decade, in 1980, the U.S. computer count was just over a million. Today, that figure is ____ million. This is beginning to measureably compare to the some 160 million cars, buses and trucks, about the same number of telephones and there are something over 110 million people in the workforce. So the second generation is a rapidly growing presence and paving the way for the yet to come third, full-integrated generation.

With that, let me drop the generation metaphor and spend a few minutes exploring the promise and the pitfalls as we approach the end of the second and the beginning of the third generation of computing.

V. TOWARD THE YEAR 2000

It is important to bear in mind that being in the midst of the second generation of computing we are still dealing with an
oddity — a cultural oddity — at one and the same time more
and more visible and accepted and yet somehow still strange to
us. The transition from this state of affairs to the
commonplace has more profound implications than all of the
computer history to date.

Interdependent Independence

Perhaps most important it makes possible a non-pathological
solution to the profoundly difficult problem of organizing
which society finds itself,
society as we reach the end of the 20th century. The state of
affairs in which we find ourselves is one of "interdependent
independence."

Interdependence. For all the adult lives of everyone in this
room, that force has been growing, pressing, and shaping the
world around us. For nearly 50 years, from Wendell Wilkie's
One World to Toffler's Third Wave, we have been reminded by writers of every ilk of its growing presence. And inevitably, as it has grown, the counter-balancing force of individuality has also grown. Look around us. Take energy and food -- the very basics of existence: There is no nation on earth self-sufficient in both these necessities. Yet have we seen larger and larger conglomerations of peoples? Quite the contrary. Fifty years ago there were 79 nations in the world -- today there are 170.

As trend-watcher John Naisbitt has pointed out, "An extraordinary thing happened in the late 1960s -- the U.S. gave up the myth of the melting pot. For years we had taught our children in fourth grade civics (or thereabouts) that America was a great melting pot, as if we were all put in a giant blender and homogenized into Americans. Now we have given up that myth and recognize that it is our ethnic diversity that
has made us such a vital, creative country." We must structure ourselves to deal with this "interdependent independence" that will be necessary for 21st century existence. "Interdependent independence" -- is it achievable? Or is it just another oxymoron? What the world at large may or may not achieve is difficult to forecast. But in my own company -- Control Data -- I have experienced an example of what can be achieved. We have been busily planting the seeds of our future, putting in place the beginnings of that structure. We are already experienced in large company/small company cooperation, in network structures, in interdependent technology development and independent marketing. We have tested ourselves and gained experience. While the structure will continue to evolve, we are already well on our way to creating the environment in which it can grow and flourish.
The technologies of computers and communications provide us the opportunity to pursue individuality to a degree not possible today -- in education for example. And at the same time they provide the only resource capable of tracking and analyzing the incredible interdependencies of our world.

Jobs

No topic is of greater interest or importance in the world of the late 20th century than that of job creation. Computers, or more generally microelectronics -- have a seemingly paradoxical relationship to the issue of jobs. At one and the same time, microelectronics is the salvation of our base of manufacturing industries and the destroyer of the historic job creation role those industries have had.

Nor will the computer, microelectronic, and high technology industries generally in themselves create the necessary jobs
for those displaced from older manufacturing industries. The main issue for high technology companies is already the reduction of labor intensive processes. My own company has a standard objective of doubling its resources over the next five years with no increase in numbers of employees — although obviously the profile of those employees will change considerably during that period. In all, the computer industry has created ___ new jobs in the past 30 years — for the next 30 a realistic estimate is ____.

Yet appropriate application of new technologies, including computers, will allow us to attack basic unmet societal needs such as high quality, more available, more affordable education and training; better and more affordable healthcare; the morass of the agricultural sector; decaying urban areas; overcrowded prisons; and energy. And in so doing we can create the jobs we need. So again, the appropriate perspective — a third
generation perspective — is one that concentrates on the application of the tool -- rather than a fascination with the foibles of the tool itself.

For example, Control Data is using computer technology to deliver training, education, job skills, and other information to small business entrepreneurs and inner city and rural community residents. The results are dramatic.

We've started 15 Business and Technology Centers that provide office space and office services to help newly starting small businesses grow and prosper. These centers are the cornerstones of job creation networks in the cities where they are located. Through computers at these centers, entrepreneurs in these cities can take courses in management skills and gain access to important marketing information.
We also are a shareholder in a company called City Venture that has been involved in more than 20 urban revitalization projects around the country. In partnership with community organizations, City Venture assists with job creation, identifying and assisting entrepreneurs, community development and seed capital fund formation. Computers are used to train inner city residents in basic skills and job skills.

Control Data also is involved in delivering computer services to farmers through the establishment of independent, locally-owned, computer services businesses in rural communities. The computer services provide farmers with data to make better business decisions and help them better manager their operations. Because the services are offered through local dealers, new businesses are created in these small towns.

From all of these programs, more than 5,000 jobs have been created thus far.
The Third Generation at Work

Let me move on now to a more close-up view of this third generation computer (and its human companion) at work. A few brief scenes will serve to illustrate the powerful and integrated systems of endeavor which are possible as these more capable grandchildren come into the workforce.

Take for illustration the matter of health. Soaring costs of health care are a much discussed topic in recent years -- a drag on economic growth and productivity, a growing source of conflict between labor and management as business discovers it can't afford what was committed in more halycon days and a very hot potato in politics as government discovers the same.

Our second generation computers' role in society's frustrated attempts to address this problem is one of monitor and scorekeeper. Through their labors we are well informed as to
escalating insurance costs, checks are issued to pay those costs, and some computers are out in the trenches helping to monitor the critically ill. In business, the personnel department is awash with safety reports, absenteeism reports, health insurance cost reports. But all of this scorekeeping and does nothing to improve the basic health system. As the third generation comes into being, that will change. Partially because of improved capability technologically but much more because of a changed perspective -- a more complete and integrated understanding of the man-machine team and how it can function to improve the total healthcare system. In other words, it will change as the computer immigrant and its second generation offspring give way to a fully integrated third generation.

Time doesn't permit looking at every aspect of this but perhaps three snapshots will suffice: the computer assisting in improving the learning process of healthcare providers; the
computer assisting in providing more cost effective, better quality treatment of the ill; and perhaps most important the computer in the workplace -- helping people stay healthy and assisting management in its responsibility to help employees in that regard.

The learning process can take a quantum by the ability to include real world problems in simulated form. In a recent address, Professor Francis D. Fisher, Henry Luce Professor of Ethics and the Professions, Haverford College, described a program which is designed to teach gastrointestinal disease diagnosis. The following is his description:

"The scene opens (on videodisc) with the patient being wheeled into the hospital rom.....he describes the dizziness he experienced and other symptoms. Stop. The computer takes over, asking you, the 'student' doctor, what is wrong with the
patient? What additional information do you want? What tests would you like performed? The computer prints out a menu of a wide variety of tests. You select some and the test results are displayed. Do you want to ask the patient some questions? You can select those also -- and get answers. If a picture of the patient is necessary, as in answer to the question, 'Show me where it hurts,' the laser picks up a TV segment showing the patient pointing to the appropriate spot. There is also a segment showing views through a sigmoidoscope, if you ask for it. And you can stop the picture at any time for closer examination, of get 'instant replay.' You can also obtain expert opinion on certain matters.

When you make your ultimate diagnosis, the computer criticizes it, aware of the context of knowledge you had about the patient at each point you made a preliminary diagnosis or decided what question to ask. 'Yes,' the computer tells you, 'it was an
ulcer, just as you guessed after the first test, but at that
time it was a poor guess,' the computer points out, 'for there
were strong counter-indications that were not explained away
until later.' With a series of such cases, it is going to be
possible to give a physician ten years of gastrointestinal
experience in a few dozen hourly sessions."

Let's move on to the hospital and a system called HELP.

HELP does everything that computers traditionally do in
hospitals. It keeps track of billable charges for the patient
and inventory in the pharmacy. The patient's medical record is
kept in the computer. But HELP is a third generation computer
systems and does much, much more. HELP uses artificial
intelligence techniques to assist the doctor in reaching the
correct diagnosis. It remembers allergies and treatment
rules. With HELP the computer prompts the doctor to follow the
treatment protocols that the hospital medical staff adopts. This will improve the quality of medicine and help contain costs. The computer compares new patients to similar previous patients. By doing this, we can calculate the probability of success using several different treatments. The doctor makes the treatment decisions for the patient but the HELP system is a good and reliable assistant with a very large memory. At one and the same time, it makes possible more individualized treatment based on each patient's unique characteristics and also brings to bear the knowledge gained in treating those who suffer similar ills.

Finally, there is the computer helping management in providing a total health system for employees. We have the beginnings of such a system at Control Data -- and, believe me, it is exciting. A crucial element is the data gathering -- the sensory element of the system. Sensing capability, sensing the
availability of a resource requires more than checking boxes on a standard form and processing that into a report -- it must be a dynamic, personalized process.

In a real-life health system, we encounter extreme states that must be sensed. We do this at Control Data with something called Employee Advisory Resource. Through EAR, we try to catch serious employee personal and work-related problems before they cause some tragedy. This involves an employee counseling service. It is available 24 hours a day by telephone to any employee or family member. Counselors are trained to stabilize crisis situations, make diagnostic assessments and offer referrals. That's at the extreme of pathological end of things -- in this instance, the total wellness system must sense the limits of stress just as computer-aided design does for the engineer, or a computer-aided flight system does for the pilot.
In the more normal range of activity, another program called "STAYWELL" is designed to keep employees fit and conscious of good health habits. There is a confidential health risk profile, followed by a detailed interpretation session with suggestions to the employee. Then the employee chooses from any number of activities designed for his or her individual needs. The STAYWELL process recognizes the particular needs, commitments, and characteristics of working people. Each element of STAYWELL can be tailored to address different demographic groups and to do this effectively. This is absolutely key and the thing that makes it possible is PLATO, the computer-based education system.

Management, meanwhile, through analytical reports coming out of the health claims processing system, is able to guide the developers of course material for STAYWELL. Note that management is not dealing with hypothetical data or some kind
of national average. The employee population, through the act
of filing claims, describes precisely, yet anonymously, the
health problems most needing attention. And it does this for
"this specific work force" in "this specific location." The
result will be a more vital -- a more productive --
organization.

Problems

Realizing the potential of the third generation is not
automatic. It depends mainly on the policies and attitudes --
the approach -- society at large takes to it. In this regard,
 too, we have a direct analogy to the waves of human immigrants
who reached America's shores.

And as with all potential for advancement, there is the latent
potential for human exploitation and suffering as well. This
is not the place for a digression into the perils of computer
fraud, privacy invasion, and human manipulation which are likewise possible as a result of a fully computer integrated society.

What We Must Do: Policy and Practice

Rather let me spend the time remaining in describing some of the actions we humans -- society -- must take to best utilize the capabilities of our third generation friends.

Cooperation

At the top of the list is a greatly increased level of cooperative effort -- the only way in which the necessary resources can be marshalled to solve pressing problems. In industry, cooperation must be at the level of basic and applied technology.
Over the last dozen years, there has been growing concern among thoughtful Americans about the decline of the U.S. position in a number of important and visible world markets. This concern has not been misplaced. The U.S. position of leadership in many fields and markets has increasingly been challenged, often successfully, by other nations. Japan is but the most obvious case in point and its challenges have covered a wide range of technological sophistication from automobiles to the most advanced electronic and computing devices.

To some degree, the decline of U.S. post World War II market dominance in many industrial areas was probably inevitable. First, the rapid rise of the international enterprise catalyzed the process. Second, the unprecedented open attitude of the U.S. government and the U.S. science establishment with regard to the international diffusion of scientific achievements provided additional fuel. Third, U.S. institutions of higher
learning welcomed, even sought, students from around the world. Finally, given the U.S.' openness with regard to its research programs and results, certain nations, most notably Japan, concentrated disproportionate resources on exploiting scientific outcomes by way of market-oriented innovation. This because they were significantly relieved of the necessity to "do" their own science.

All this was perhaps as it should have been -- up to a point. That is, on balance the U.S. benefited dramatically from its science and technology transfer activities for perhaps 20 or 25 years following the end of World War II. It could probably have continued to enjoy this situation but for two policy "failures" -- public and private. First, the U.S. was increasingly wasting the resources necessary for research and development through continued duplication of effort with regard particularly to basic and applied research. Both public and
private attitude and policy contributed to this waste -- as it still does. Second, U.S. firms failed to acquire the rights to the technologies and techniques developed overseas on the basis of U.S. science.

These failures have been compounded by the fact that overseas competitors profit from massive government, legal, and financial support, and from government-encouraged intercompany cooperation. The deep pockets of these firms and their governments can buy both new technology and market share. American firms are at best ill-equipped to counter such efforts individually.

But past need not be prologue. At last the U.S. is coming alive to at least some of the problems it faces with regard to international competitiveness. One of the principal manifestations of this awareness is increased interest within both U.S. industry and government in cooperative research ventures. That's good but a deeper understanding is required.
The need for cooperative research, however, is not simply rooted in the existence of increasing international competition. It is crucially important to understand that the need for technological cooperation would have arisen whether the Japanese threat existed or not.

The long-term vitality of any industry -- and certainly of high-tech industries -- rests squarely on the existence of a large number of competitors -- individually innovating and creating new products and services. Yet, the history of most industries indicates a natural tendency toward consolidation into fewer and fewer firms as the need for efficiency and scale economies in production gains ascendency.

The trend of consolidation into ever bigger, less innovative organizations is a fundamental fact that can't be wished away. And it is reinforced and accelerated by the increasing capital
intensity of industrial growth. Each new wave of technology has required a greater commitment of capital as well as intellectual resources.

Most U.S. electronics firms suffer from scarce capital resources, high capital costs relative to international competitors, and a rapidly growing need for more capital to develop the new technologies needed for competitive survival. As to intellectual resources -- one example -- a 1981 study reported 54,000 job openings for graduates with degrees in computer science, but only 13,000 graduates with the necessary skills to fill those positions. This 75 percent shortfall will no doubt continue for the foreseeable future.

Paradoxically, at the same time we suffer from the scarcity of capital and intellectual resources, we also suffer from this continuing, enormous, needless duplication of technology
efforts. For every corporation to labor away at basics is a
terrible waste to society. A base technology can be exploited
in the form of many different applications to promote effective
competition across a broad spectrum of final products and
services and markets. That's productive. That's
pro-competitive.

What is required is a national policy which fosters
pro-competitive cooperation in technology development. Such a
policy is, as I have noted, necessary to match the competitive
forces from overseas, but more fundamentally, it is absolutely
necessary to assure a highly competitive and innovative
industry structure far into our country's future.

Beyond intra and inter-industry technological cooperation, we
must take a more integrative approach -- a more cooperative
approach to the whole public policy process. Only in this way
can we avoid the trap of special interest group fractionalization and stalement that is the inevitable result.

Progress in that regard in recent years has been particularly rewarding in my own home state of Minnesota. Take the crucially important task of job creation -- the bulk of which must come from small business.

Six factors are critical to the survival and growth of small firms: technology, or "know-how," financial, management assistance, education and training, marketing, and efficient access to facilities and services.

Together they form what can be called the small business "chain of success."

In Minnesota, each link in this chain is strengthened by the Minnesota Network for Innovation and Job Creation, a group of public/private partnerships and other entities that work together to assist small business.
A primary concern is small business's urgent need for technology -- the first link in the chain -- applicable to a wide range of industries such as agriculture, forest products, energy, electronics, computers, publishing, and tourism.

Major sources of existing technology -- specifically, large business sector and the academic sector -- might be encouraged to transfer their unused or underutilized technologies to small companies.

To meet small business's need for start-up financing -- the second link in the "chain of success" -- the Minnesota Seed Capital Fund was incorporated in 1980.

The Seed Fund is a for-profit venture capitalized at $10 million which is receiving growing financial support. It fills a critical financing gap by investing in new technology-based firms with job creating potential.
Most new firms cannot obtain financing from more traditional sources. Banks consider them too risky, and venture capital companies prefer to invest in proven technology or products and proven management. Small companies can come to the MSCF for up to $250,000 in start-up money.

To strengthen the management assistance link in the chain, the Minnesota Cooperation Office was founded in 1979.

Many entrepreneurs lack management skills and expertise. The MCO helps them to draw up comprehensive business plans and obtain financing. Then, through its Client Advisory Board of engineers, scientists, financial specialists, and business executives, the MCO provides management and consulting assistance during start-up.
The MCO is a community-based non-profit organization whose Board of Directors is comprised of leaders drawn from all major sectors of society. It is being financed during its early years by contributions and grants, but it will eventually become self-supporting through a combination of client fees and funds generated by equity investments in client companies.

The next link in the "chain of success," education and training, is strengthened by both the public and private sectors.

The University of Minnesota, area colleges, and vocational schools now offer courses tailored for small business owners, managers, and employees.

And a number of privately-owned learning centers have recently begun providing a range of affordable, high-quality, computer-based education and training services aimed at meeting the needs of small firms.
The sixth and final link in the "chain of success" is efficient access to facilities and services.

New small businesses can seldom afford all of the facilities and services they need. But if all or most of these essentials are available in a single location at a reasonable cost, the chances that beginning firms will survive are greatly enhanced.

This is the premise behind Business and Technology Centers that have been established in Minnesota.

Each BTC contains shared office, laboratory, and manufacturing space. Tenants may use on site information centers, computer-based education, training, and technology-locating and transfer services; drafting, accounting shipping, and clerical services; and more.
The BTC's are helping small businesses to succeed. Although the national failure rate for small businesses is 80 percent after five years, at the St. Paul BTC, this failure rate has been cut to 14 percent after three years. Although this is not a direct comparison, the trend toward a vastly reduced failure rate is unmistakable.

By addressing all six links in the "chain of success," the Minnesota Network takes a comprehensive approach to helping small businesses get started and grow. It serves as an excellent example of how the public and private sectors can work together.

Minnesota Wellspring, a non-partisan public/private partnership initiated in 1981, also has job creation as a primary goal.

Wellspring combines the efforts and resources of labor, business, agriculture, education, and government into a single
forward-thinking, action-oriented organization. It aims to mobilize state-wide support for new and better jobs through scientific discovery, technological innovation, and enlightened public policy.

Wellspring strengthens the Minnesota Network by addressing the organizational and other resource linkages needed to create jobs and encourage the growth of local companies.

In addition, Wellspring supports the Minnesota Network by identifying sources of funding for the Minnesota Cooperation Office and the Minnesota Seed Capital Fund.

Through Wellspring and the Network, significant progress has been made in assisting small business and stimulating job creation. Clearly the public/private partnership concept is sound and deserves additional support from government,
business, and individuals. That support should come in the form of active participation, direct contributions, investments, and tax incentives.

To encourage big business to assist with small business start-ups, a "Help-Start-A-Company" program has been established.

Most of the resources needed to create new companies -- including technology, capital, and management and professional expertise -- reside in big business.....where technology and management expertise in particular tend to be underutilized. Helping small business start-ups only makes more efficient use of these assets, but also returns attractive profits to a large corporation.

"Help-Start-A-Company" assistance takes the form of technology spinoffs, management and professional consulting, or equity investments. Various components within the Minnesota Network
are available to help identify entrepreneurs, locate technologies and sources of seed capital, provide access to facilities and services, and assist with other vital functions.

Public/private cooperation is a proven and vital ingredient to a societal structure in which we can realize the potential offered by not only third generation computers but also other high technology products. It is the only viable approach to maintaining the motivating and energizing independence we need in the face of the ever increasing interdependence of the world in which we live.

This is not theory. For Control Data, the list of cooperative undertakings grows daily. MCC and SRC, the Minnesota Supercomputer Institute, and STARCO, are but recent additions to a long list including the Minnesota Wellspring; Minnesota Network for Job Creation; City Venture; Rural Ventures, Inc.;
and dozens of others. What is required is human leadership, not some technical solution to a societal future of cooperative endeavor. The third generation of computers will be there -- ready to take its place at our side.

Industrial Policy

At the national policy level, however, rather than a more integrative, synergistic approach the squeeze on the more somber side of things is the evidence of growing societal dismay, special interest groups proliferate, and rising rates of economic instability has produced economists simultaneously land low rates of inflation and by a misplaced debate with regard to forecast the return of higher rates -- or cite economic growth above expectation while forecasting probable economic downturn in less than a year. Is such gross instability inevitable? Is this the world into which the third generation of computers will be introduced? If it is, we are in for unnecessary woes.

A more fundamental and less symptom-treating public policy process is required. This, to repeat, requires a more cooperative approach, but it also requires shedding much of the semantic baggage currently in vogue with regard to economic growth and a so-called industrial policy.
The first point that must be grasped is that the problems we face cannot be fixed by manipulating taxes and interest -- i.e. fiscal and monetary policy. It is almost terrifying to now read that the best minds tell us to believe that the competitive challenge from Japan can be reduced to the problem of an over-valued dollar. Before that, it was the "savings rate," (as Drucker has pointed out, though high, the savings rate in Japan is in fact inadequate in the context of their provision of social services). Before that it was labor rates.

Capital in whatever form -- savings, subsidies, whatever -- money -- is but one factor in the matter of job creation. Both the proponents and opponents of "industrial policy" fall prey to the trap that money is the answer. They only argue about whether it is "directed" or "undirected," cheap or expensive, it is in the form of subsidies or taxes, and so on and so on.
Two other basic elements of economic growth, technology and education (skilled workers), are for the most part ignored. There is considerable agitation from time to time with regard to education; there is almost none with regard to technology except in the view of protecting military technology from theft or "leakage."

More crucial is that the level of complexity generated by global interdependence and population density demands a higher degree of coordination of these three factors of money, technology, and adequately skilled people than just the ad hoc processes of the past.

This does not mean "picking winners" or "protecting losers" but it does mean that the government must provide a comprehensive infrastructure which will facilitate development and interaction of the three factors of economic growth. Over the
past 100 years there has been intensive study and development of policy concerning money: banking, finance, savings, taxation, standards, regulation and safeguards (SEC, FRB, FDIC, FSLIC, etc., etc.), governmental financial instruments — the list goes on and on — all to facilitate capital formation and flow.

So, with regard to education and the set of worker skills most likely to be needed five, ten, 20 years down the road, there is ample precedent for an approach of analysis, planning, policy and legislative initiative. To cite another example, just as an interlinking local, state, and federal highway system is planned in terms of standards, objectives, and financing alternatives, so too can an interlinking local, state, and federal "worker skills" system be built.

Even more (because our thinking is still further behind in this regard — consisting of little more than a patent system) is
the need for government initiative with regard to technology.

The need to create a policy infrastructure which promotes technological cooperation and technology diffusion; which set standards for technology valuation (for trade purposes); which identifies technology research areas beyond the scope of private organizations (again analogous to the interstate highway system) and provide for their pursuit by means of government support and direction.

To say that these things will take care of themselves is as foolish as saying without a policy infrastructure that capital formation will take care of itself. And it is not at all to say that the result will be a federal bureaucracy "picking winners and losers." Most important is that the needed approach must include an important role for state and local government. The cornerstone of any true U.S. industrial policy must be that the role of federal government is to set standards
and safeguards, sets policy which encourages cooperation within industry and between industry, state and local government, and academia, and defines the framework in which local initiative can occur.

The concentration on technology, worker skills, and money takes matters out of the arena of "industries." Certainly it eliminates the pernicious discussion between choosing "services" versus "manufacturing" industries — the "death of smokestack America" discussion.

The industrialization of the U.S. economy did not mean the elimination of U.S. agriculture but rather its transformation to take advantage of new technology. And new educational infrastructures (e.g. the agricultural extension system) were essential to that process. Just so, the move into a service-dominated economy should not mean the elimination of
traditional manufacturing industry but rather its transformation to take advantage of new technology. Not every farmer or each and every segment of agriculture has survived. But manufactured products must be a vital part of our economy and a major factor on U.S. exports.

An industrial policy aimed at the basics of technology and education as well as monetary and fiscal policy can provide the basis for renewed growth. It may be distressing that it is harder and more complex to achieve such a policy than merely relying on the simple mechanisms of the past, but that just happens to be the nature of things as the 21st century approaches.

VI. CONCLUSION

Let me conclude briefly by quoting from Irving Shapiro's new book, *America's Third Revolution*, which will appear next month. In it he says:
"America has launched three revolutions. The first was for political freedom. The second, the Industrial Revolution, was technological and material in focus. It took a nation rich in potential and made it rich in fact. Though we think of that revolution as history, it is still going on. The third revolution, unnamed, lies even more in the column of unfinished business. It is a revolution to make real the notions of social justice and equality, a revolution driven by a vision of a nation as rich in quality as in quantity.....one of its premises is that a wealthy society has few, if any, excuses for not being just and humane....."

And Shapiro goes on to echo much of what I've been talking about during the last few minutes. "My main concern," he says, "is with the present and future relationships between the private and public sectors, and with the question of what it will take of them both to deliver on the promises of the
nation's revolutions....What is needed from this time forward is not just a cease-fire between the private and public sectors, but a new economic and social attitude, one that recognizes the imperative for successful enterprise in world competitive conditions, and one that realizes as well that economic units have responsibilities in the realm of social change....

In short, those responsibilities, I would only add, include that of shaping a societal fabric of cooperative endeavor in which not only will competitive opportunity be enhanced, but in particular a societal fabric in which the third generation of computers will find full flower.

Thank you.