I. INTRODUCTION

Almost six years ago -- in January 1985 -- a blue-ribbon commission appointed by the President of the U.S. concluded that Americans "no longer can afford to ignore the competitive consequences of our actions -- or our inaction."

That warning set in motion a flurry of activity. "Competitiveness" became the obligatory catch word for whatever issue, initiative or idiosyncrasy was being put before national policy makers or corporate management. In 1986 alone, some 5,000 bills were introduced in the U.S. Congress to address the country's "competitiveness" problem.

Obviously there has been a great deal of irrelevant rhetoric and legislation. Still, for the first time, some fundamentals of the nation's productivity/competitiveness have been addressed.

There are basically three dimensions of the productivity/competitiveness issue facing U.S. industry: Quality, Education, and Technology. I have purposely left out the much cited factor of cost of capital in the U.S. Cost of capital is without question a factor. On the other hand, it is all too often merely a convenient whipping boy or red herring, and it is better to devote one's attention elsewhere.

In each of these dimensions, some significant actions have occurred:

**Quality:**  
- Malcolm Baldrige National Quality Award initiated in 1988;
- State level quality awards patterned along the same lines. Particularly note worthy are the programs in Minn., Calif., and Ohio.
- These give visibility and importance and the weight of the leading U.S. corporations.
Education:  
- Pres. Bush and State governors established a set of national goals in Nov., 1989. First time we have had such.
- BRT education task force set up to respond. 10 year commitment to work at the state level. Personally involved in Minnesota and New Mexico.
- Outcome based assessment; accountability.

Technology:  
- A growing awareness of the benefits of collaboration as evidenced by 1984 Cooperative R&D Act
- Realization that "balance of trade" in technology is equally, if not more, important to monetary flows in international trade. The 1988 Trade Act: "equitable access to technology."
- Recognition that technology is crucial to economic health as well as to military strength in assuring national security. This is reflected in changes to U.S. export control policy in 1985, 1988 and 1990.
- NSF initiatives. NSF budget doubled 1982-1989 ($0.9B-$1.9B). Services and Technology Centers, High Performance Computing, Engineering Research Centers, material sciences.

This is not an extensive list, but these things do demonstrate that in the U.S. there is a growing willingness to take meaningful and serious action at the national policy level.

We have by no means, however, come to grips with our productivity problems in a fashion that will produce continuous and lasting change. Let me comment briefly in that regard in terms of each of the dimensions of quality, education and technology.
II. QUALITY

As for the first dimension -- Quality -- I discussed at some length. But I do want to make the point that TQM as a management mindset may well be the most basic problem facing U.S. companies and Total Quality Management (TQM) is still by no means integrated into the mainstream management processes of strategy formulation and day-to-day operations in U.S. business. Quality is still too dependent on heroes and missionaries. Such people may move on to other goals or organizations. In short, the question is: is TQM in the U.S. the current business fad or have we crossed a watershed?

[possible breakpoint for 10 min. talk]

Certainly if the latter is to be true, there is a need for national leadership. The Malcolm Baldrige National Quality Award is a step in the right direction. In just three years of existence, the Baldrige Award has become a standard of excellence for quality improvement at U.S. firms. Winning it signifies that a company's products or services are among the world's best -- an honor that boosts employee morale, improves productivity and enhances a company's reputation among customers and shareholders.

However, because of the size and diversity of the U.S., a National recognition program is not enough. A consistent yet flexible hierarchy of Quality programs must be put in place. There are some encouraging signs in this regard although they represent in fact just that -- encouraging signs -- and do not yet by any means represent a homogeneous state of affairs. Some 13 states -- led by Minnesota, California and Ohio -- have created statewide quality prizes patterned after the Baldrige.

These state level programs are particularly important because more attention needs to be focused on smaller companies. To date a great deal of the quality focus in the U.S. has been in large companies. State-level quality organizations, such as the Minnesota Council for Quality through their programs and activities, can help small business implement the concepts of TQM.
Finally, by having company level quality award programs based on Baldrige principals, the hierarchy is completed. A number of U. S. companies including Control Data, have already done so.

However, Quality and TQM depend on far more than recognition programs. After all, TQM is not mere awards and heroes -- for that matter, it is much more than tools and techniques. TQM is a philosophy of management -- an approach to the process of managing resources, particularly human resources. As such, it must be integrated into the day-to-day processes of an enterprise, from the process of creating strategy to the processes of operations -- of designing, selling, building and delivering products and services. Only managers can cause that to occur. And managers used a comprehensive system of management.

Some of the lessons I've learned in unleashing the quality potential of an organization were the subject of my talk this morning.

I know from those experiences that permanent change can occur -- and I also know full well the difficulty in doing that.

[end breakpoint]

III. EDUCATION

The second barrier to improving U.S. productivity is education.

America's education crisis has been widely discussed. There is no need for me, here, to add to the mountain of statistical rhetoric in that regard.

I should also note that there certainly is no lack of proposals to deal with the crisis. They cover the gamut of pedagogical, structural, financial and political solutions. Many of these proposals have merit, some of course are the sort of froth generated by any great turbulence.
The only point I want to emphasize today -- and I believe it is one that is not widely nor adequately understood either in the U.S. or outside -- is that the fundamental characteristic which must be dealt with in the U.S. system of education in diversity: cultural, economic, sociological, racial, geographical diversity is enormous in our country. The U.S. census, for example, is broken down into 250,000 distinct groups of people. We aren't viewed that way by others and we don't really view ourselves that way either -- at least in terms of the implications with regard to education.

The BRT initiative that I referenced at the outset is encouraging with regard to education reform for several reasons.

Not the least of these is that it first of all recognizes the diversity issue. The BRT efforts themselves are structured on a decentralized state level basis. Each BRT company and CEO has made a long-term, 10 year, commitment to work with state political and education leaders for reform.

With the encouragement of business, education leaders who take an outcome based approach to education reform now have a much stronger voice. Outcome based management is fundamental to dealing with the diversity issue.

The key to dealing with diversity, to assuring desired educational outcomes is technology. Computer and communication technology today for the first time provide teachers and administrators with the wherewithal to deal effectively and economically with the tremendous range of student diversity they face. The issue in technological terms however is not so much computer based instructional delivery -- altho that clearly has its place -- as it is the use of computers and communications to deliver personalized education management.

The next five years will tell how well we grasp the opportunity now offered.

IV. TECHNOLOGY

The issues with regard to the relationship of technology and productivity/competitiveness can be put in two categories of technology management -- the “macro-issues” and the “micro-issues”.
A great deal of attention has been focused on the failures of the U. S. government with regard to the macro-issues. This criticism is certainly valid with regard to the late 1970's and early 1980's, which was the crucial time during which far seeing and innovative government policies would have been highly leveraged with regard to today's productivity needs. Nothing can be done about that now. It's catch-up time.

On the other hand, it is simply not the case that government policy makers have ignored the problem. I have noted several items in that regard. Beyond that, when there has been leadership from the private sector, the U.S. government has shown a willingness to adopt legislation which deals with specific sectors of technology. For example, one crucial area of technology -- high performance computing -- was comprehensively addressed this year in Senate Bill 1976.

Clearly, there needs to be, and there can be more leadership at the national level in the area of technology policy. But a more fundamental failure is at the "micro" level -- that is in terms of technology management at the level of the individual enterprise.

The problems here are deeply ingrained in the corporate culture of U. S. enterprises. This culture has become increasingly preoccupied with "realizing wealth" as opposed to "creating wealth." The asset play, high leverage, hostile takeover approach to managing corporate equity in the U.S. has done extensive, and perhaps even irreparable, damage to the technology management dimension of improving U. S. productivity.

Technological cooperation - cutting across both the macro-issues and this micro - or individual enterprise issue is the need for greater technological cooperation. [Breakpoint]

Such understandings between companies -- large and small -- between government and private companies is not as some would believe, anathema to competitiveness or to a market economy. It is a matter of economies -- of the scale, complexity and risk associated with today's technological needs. It also demands a greater emphasis on and sophistication of what constitutes value added. What is missing in the minds of both corporate management and national policy makers is a paradigm of competition which is adequate to this complexity.
Einstein's theories and quantum mechanics gave scientists a new paradigm for studying and exploring physical phenomena more than three quarters of a century ago.

Today's management in grappling with the problems of technological innovation, however, must work within the limitations of its equivalent of 18th century Newtonian mechanics. [end Breakpoint]

The concepts and practice of pre-competitive technological collaboration is something that Control Data, and I personally, have long supported. From its earliest days as a small company Control Data engaged in technological cooperation. It was through a large business - small business academic - government collaboration that the first true successful super computers came about. Over the years a great variety of collaborations were developed involving technology standards, specific advanced product development, and even cooperative manufacturing. Finally in 1983, I headed a small group of people who brought into being the Microelectronic and Computer Technology (MCC) -- and ultimately the National Cooperative Research Act of 1984. Over the past six years, more than 150 other consortia have filed under the National Cooperative Research Act.

All companies, and especially U.S. companies, must learn how to manage large and complex technological cooperations. To do so will require imagination and daring. We have examples which show the way.