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Concerns...

Let me lay aside my hat as a university president...Instead I am going to put on a hat both as a scientist and engineer who has been working very hard over the past decade to strengthen the economy of this state...and also a hat as a member of the National Science Board, the principal source of R&D policy in this country, which has voiced very serious concerns about the future of our nation.

I am absolutely convinced that our State faces a very unusual period of challenge in the decade ahead...a watershed, in a sense, from which we can either emerge at a national leader...or as an also run...a "have not" or perhaps even worse...as an Appalachia...

Quite frankly, the choice will be ours...whether we choose to continue our tendency of recent years to spend our resources only to meet the needs or desires of the moment... or whether we can develop the vision, courage, and discipline to invest in the future of this state...not just for this year or next...but for the next generation...our children...

Challenges: Some warning signs...

You all know the headlines

Familiar Ills which dominate the headlines

The budget deficit

The trade deficit

Displaced workers

Marginal Industries

The meltdown of the stock market

The bad news for Michigan is obvious...

Industries of great economic importance to our nation such as steel and automobiles have fallen victim to intense competition from abroad...

Plants have closed...our cities are filled with cronically unemployed...which may well exceed 10% along the I-75 corridor...

In Michigan we no longer worry about nuclear war and and the bomb because we believe that

"The odds are greater that America will be bought up by the Japanese than blown up by the Russians..."

The Rankings

Michigan's per capita income has now dropped below the national average...

Michigan has dropped to 20th in per capita income (and at \$15,393 is now slightly behind the national average of \$15,481)

Our unemployment rate consistently is at the top...

But the story becomes even more dismal when you look at our state's capacity...or perhaps I should say **willingness**...to invest in its future...

Our state has dropped from 5th in the nation in its support of public education to 35th...the bottom third!!!

Indeed, we have dropped to 32nd in tax revenue for higher ed--7.8% compared to 11.4% for California!

We are being outspent by 30 - 40% in state support per student... Not simply by prosperous states like California...but by our midwestern

neighbors!
In fact, the only area where we now lead
the nation is in our prison system...
We are now investing more in prisons than
in higher ed...that is, we spend more money
putting people into jail than we do in
keeping them out of jail!
We seem to have developed an
"Eat dessert first, life is uncertain" attitude that
is rapidly mortgaging the future of our children.
We see ourselves caring about the future, but we are
not preparing for it.
Paradox in attitude of public toward higher ed...
There is an increasing sense that in the
knowledge-intensive world that is our future,
research universities like Michigan will be
absolutely essential to the future prosperity
of this state
Note: Most of high tech developments center around
university complexes. The health and vitality of these
large university research complexes should be a focus
of concern.
And yet our efforts to achieve excellence
are generally met with charges of "elitism"
and "arrogance"...almost as if we are doing
something bad by trying to achieve quality.

Preparing for a future of change...

As you know, I am a scientist and engineer
by training and background...
I must also confess I tend to be one of those
people who lives more in the future than in
the present or the past...
And, now, entering the 1990s, I find myself
looking once again to the future, facing
the challenge of helping to build a University
able to serve our state and our nation in
the 21st Century.
the model of a University for the 21st Century...

Themes of the Future

Think about it for a moment...
A few themes of the future...
The students we are educating today will spend most of
their lives in the 21st century...
Yet most of us...and our faculties...are products
of the 20th Century...
Furthermore, the structure of the American university
as we know it today is a product of the 19th Century!
The way we are organized into departments and
colleges...our serial approach to education...
even the concept of courses and credit hours...
all were introduced over a century ago.
And yet the American society we serve has changed dramatically
during the past century and continues to change at an
ever accelerating pace.
It is therefore both appropriate and important to ask the question:
Is the University as we know it today really prepared to
educate the citizens and serve the society of the 21st Century?
While it is always dangerous to speculate about the future,
three themes seem very clear:
i) It will be future in which our nation becomes a truly
multicultural society, with a cultural,

racial, and ethnic diversity that will be truly extraordinary in the history of our civilization...

Those groups we refer to today as minorities will become the majority population of our nation in the century ahead...just as they are today throughout the world.

In this future, full participation of underrepresented minorities will not be just a matter of equity and social justice.

It will be the key to the future strength and prosperity of America, since our country cannot afford to waste the human talent represented by its minority populations.

- ii) It will be a future in which America will become "internationalized"... in which every one of our activities must be viewed from the broader context of participation in the global community... as America becomes a "world nation", with ethnic ties to every part of the globe...

The fact is, a truly domestic US economy has ceased to exist. In slightly more than 5 years, US trade deficit has taken us from the world's largest creditor to its largest debtor nation.

US is the destination of about half the world's immigrants Probably 10 million this decade alone...

One-third of annual population growth is immigration

- iii) It will be a future in which we rapidly evolve from a resource- and labor-intensive society to a knowledge-intensive society, in which intellectual capital...educated people and their ideas...become the keys to our prosperity, security, and well-being.

Our traditional industry economy is shifting to a new knowledge-based economy, just as our industrial economy evolved from an agrarian society at the turn of the century.

Industrial production is steadily switching away from material and labor intensive products and processes to knowledge intensive processes:

A transition in which..

Intellectual capital--brainpower-- is replacing financial and physical capital as key to our strength, prosperity, and well-being

It is my belief that these themes of pluralism, internationalization of America, and our evolution to a knowledge-intensive society will not only dominate the future, but will create a time of unusual challenge and responsibility, opportunity and excitement for this University.

Clouds on the Horizon

Maintaining Michigan's competitive edge requires attention to our traditional strength -- people and research -- and a strong offensive strategy based on these resources.

Central theme is that education, broadly defined, will play a pivotal role in the coming economic transition and its impact on individuals.

Previous economic transformations were closely associated with major public investment in infrastructure such as railroads, canals, electric networks, and highways. In the coming economic transition, an equivalent infrastructure will be an educated population.

WARNING SIGN 1: Michigan is slipping

No question that we have lost lead in many areas
Industrial productivity and heavy manufacturing
Steel, durable goods, ...

Moreover, key activities such as product design, engineering, and software development increasingly are likely to be done overseas.

Whether automobiles or refrigerators, computers or microchips, nuclear power or energy transmission systems, the likelihood is increasing that the systems are assembled from components designed, engineered, manufactured, and shipped from all parts of the world.

US trade deficit is only a symptom of America's lagging competitiveness. It means that the US economy has been living beyond its means.

The most serious long term problem is low productivity growth, however. With productivity growing at less than 1% per year, the American standard of living is falling relative to those in most industrialized nations. Our wages are already below those in Europe and Japan.

Over the long haul productivity growth is the main determinant of trends in living standards, and no amount of fiscal ledgerdemain can obscure a basic weakness.

The necessity for lower wage growth in US is result of lagging US productivity--that is, a lower rate of growth in physical output per worker and a declining advantage in technology and quality.

To do this, all the major inputs into our economy--quality of workforce, amount of capital investment, level of technology, and skills of managers--must be as good as the equivalent inputs going into the economics of our major competitors.

Key input, however, is quality of the workforce.

Our principal competitors are simply producing workers better capable of absorbing modern production skills. The lack of these skills is preventing us from achieving the productivity gains that we should be getting.

WARNING SIGN 2: We are seriously underinvesting in research and education...

Indeed, a recent SRI study has indicated quite clearly that we are undervesting in our "knowledge infrastructure" by at least 30% to 40%.

Interestingly enough, studies performed by both the Democratic administration and the Republican Senate agree with this prognosis...and yet nothing has happened...and we slip even further behind!

WARNING SIGN 3: A Serious Skilled Manpower Shortage

Traditional source of S&E college students is declining

25%-30% falloff in HS graduates by 1992

Assuming that same fraction (4.8%) choose to enter skilled, professions (a very conservative assumption), we could end up with a cumulative shortfall of over 100,000 positions by the year 2000.

Note: Composition of college age population is also changing...

By 2020 30% will be composed of Blacks and hispanics...

students who have not traditionally chosen S&E careers.

Indeed, by the turn of the century, over 50% of K-12 students will be Black or Hispanic.

The fastest growing pool of youths has the lowest participation rate in college and the highest dropout rate in high schools -- not the mention the least likelihood to study science and math.

NOTE: We must make special efforts to expand participation by these groups...not just because that is

good social policy, but because we cannot afford to waste their talents!

WARNING SIGN 4: Labor force of Michigan is becoming obsolete!

The education of the Michigan workforce is inadequate to the demands of the next century.

Each year, 700,000 drop out of HS and 700,000 graduate without functional literacy;

1,000,000 immigrants must be added to this.

Hence each year we have 2.5 million persons entering our complex economy annually with limited language and work skills

Yet our adult functional illiteracy rate is 13%--our high school graduate rate is down to 72%--and our high school graduates perform poorly relative to students in the rest of the world.

Michigan is undergoing dramatic change in industry...

Away from low-skill, blue-collar workers

The factory of the future will have NO low skill workers

Statistical quality control and just-in-time inventory systems require production workers with mathematical abilities that are far beyond the present level.

Unskilled labor will lose relevance in a world dominated by microelectronics, computers, and automation.

An example: Expert systems

The "expert system" craftsman...

About 45% of the job growth between 1980 and 1986 was in professional and managerial occupations, and almost 50% of the new jobs created between 1983 and 1986 went to people with at least 3 years of college.

Of the net increase of 25 M jobs to be created by 2000, 40% will be professional or technical positions; 58% will be marketing and sales, administrative or supervisory.

Serious concern:

1. The present generation of blue-collar workers does not have the formal education to be retrained!!!
2. Little sign that education system is adapting to this future.

Key input, however, is quality of the workforce.

Our principal competitors are simply producing workers better capable of absorbing modern production skills. The lack of these skills is preventing us from achieving the productivity gains that we should be getting.

In the past few decades we have neglected education's collective economic function. Whatever its individual payoff, it determines the human quality of the team on which every American plays.

It is bad enough to face the prospect of a significant fraction of our labor force becoming permanently unemployable because of an inadequate education. Do we want to condemn their children...OUR children...to a similar fate? Can we afford it?

The economic challenge, in simplest terms, requires upgrading the skills of 25 million American workers by 40% by the end of the century. A strong back and willing hands will no longer suffice.

The State of Michigan Response

What should be the response of Michigan to the challenge of change -- to the Age of Knowledge in a Global Economy...

The handwriting is on the wall...

Taxes, trade, and fiscal policies influence economic competitiveness. But in the long run, a strong base of science and engineering research and education is more important.

Maintaining Michigan's competitive edge requires attention to our traditional strength -- people and research -- and a strong offensive strategy based on these resources.

People -- not equipment or buildings -- are the source of creativity.

They generate the knowledge that makes the technological innovation possible. They are the workforce that makes society run.

As we look to the knowledge-intensive future of Michigan, we recognize as have so many other states that it will be our great research universities that will hold the key to our collective prosperity.

Importance of Research Universities

Importance of world-class research universities

Look around:

New England: --> MIT

Bay area-Silicon Valley --> Stanford & UCB

Southern California --> Caltech

Austin --> U. Texas

Why?:

Through research produce knowledge necessary for competitiveness

Produce talented professionals to implement new knowledge

Attract "risk capital" through massive federal R&D support

Key to knowledge transfer

Traditional: graduates, publications

Entrepreneurs

Startups

Development of Unique State-University Partnership

Universities must commit themselves to:

Strategically realigning activities into key thrust areas of major importance to State...

Attracting leading scientists, engineers, and professionals to staff these programs...

Developing new mechanisms for technology transfer...

State government must commit itself to:

Establishing higher education in general and the state's research universities as a high priority

Providing seed resources to sustain key thrust areas

Developing novel institutions to act as catalysts in these activities

University of Michigan Actions

The University must view itself as a partner with state government, business, industry, and labor in addressing the needs of the State of Michigan.

Key:

Began to think and act strategically...how to better position ourselves

Hence, we chose as our thrust areas...

Complex manufacturing systems

Machine Intelligence

Advanced electronics and optics technology

Information Technology

Health Sciences

Applied Social Sciences

Other steps

1. Recruiting key engineers and scientists

2. Modifying ways we interact with outside world...

Strengthened interactions with industry

3. Intellectual property policies

4. Michigan Information Technology Network...

Cultural Changes

Reaffirmation of the importance of individual achievement, of excellence...We have once again recognized the ability of talented people to do great things -- if we will only get out of their way and let them!

Importance of establishing an intense, entrepreneurial environment...a no-holds barred, go-for-it culture...in which individual initiative, achievement, and the quest for excellence are dominant elements

Already clear evidence of payoff...

1. Darling of the national press...
Hardly a week goes by without some reference to the phenomena occurring in "Automation Alley"...from Warren to Ann Arbor... an area now clearly identified as the hot spot of action in technology for the next two decades...
California dreamin'
Places like Silicon Valley and Route 128 are buzzing about Michigan...we are now raiding their best talent...
We've become a showplace: Bobby Inman, Governors,...
2. University's federal research increased by 25% each of the past two years to over \$200 million per year.
Industrially sponsored research has increased by 50%
Engineering research has more than doubled, to over \$40 million per year.
3. Research Excellence Fund has created nationally recognized centers in:
Complex manufacturing technology
NSF believes we now have best faculty in nation in these areas
Machine intelligence
Advanced electronics
Information technology
These programs already have attracted three major national research centers funded at \$27 M.
4. Beginning to win a few...
Howard Hughes Research Institute
DOD URIs (lion's share)
High Speed Electronics and Optics (Army)
Ship Propulsion and Hydrodynamics (Navy)
Expres
NASA Center of Excellence for Space Commercialization
National Center for Manufacturing Science
NSFnet
NASA ERC (Remote Sensing)
IBM/DEC/Apollo/Apple/Northern Telecom/....
Many other smaller activities
Several other major initiatives presently brewing...
too early to announce, however
5. National Image
U.S. News and World Report...
UM was ranked 8th in the nation in the quality of its UG education-- UM and Berkeley were only public universities in the top 10...along with schools like Stanford, Harvard, Yale, and Princeton
Professional Schools:
Law: 3rd
Engineering: 6th
Business: 7th
Medicine: 11th
6. Confidence in University, buoyed by the new priority given by higher education by the state, have enable use to attract to our faculty many

- of the world's leading scholars and teachers, scientists and engineers.
7. And, at the same time, the University has continued to leverage the state's investment, attracting \$2 from outside the state for every \$1 in state appropriation. Moreover, activities of our graduates and applications of our research have an impact on state's economy that totals in the billions of dollars.
 8. The growth of a \$4 B industry in industrial automation in the Detroit-Ann Arbor corridor has been traced directly to UM!
 9. In 8 states bordering the Great Lakes, there are 16,000 companies producing high tech equipment, including robotics, optics, biomedicine, computer software, and electronics.

BUT, Michigan's efforts have just begun...

Perhaps the most ominous dark cloud on the horizon of all is the increasing evidence that our state has not yet awakened to the nature of the investments it must make.

While we all give the "age of knowledge" lip service, the evidence suggests that in reality, we long for a return to the agricultural and manufacturing economies that once made us reach...

We continue to invest as if these were the future...and we lose...

Over the past 10 years, high tech states such as California, New Jersey, Massachusetts, and New York have seen real dollar increases in higher education appropriations of roughly 20 to 30%. In sharp contrast, over this period Michigan has declined by 4.5%...

We still have far to go to counteract the crippling deterioration of public support experienced in the 1970s and 1980s.

1. While Michigan ranks 5th in tax revenue, we rank only 32th in appropriations per student and only 37th in percentage of total appropriations allocated to higher education.
2. SRI Study suggests that we presently are underinvesting by as much as 30% in the knowledge infrastructure necessary to secure our state's future leadership and prosperity.

If we fail to increase the rate of investment, Michigan will not only risk falling behind other midwestern states, but regions such as California and New England will pull even farther ahead...and pull our industry with them!

Certainly these states are prosperous...but they are also investing substantially more of their resources in higher education...in preparation for a knowledge-based future...than are we.

Indeed, one measure of the importance of higher education in the state budget is the ratio of tax dollars per enrollment ratio... a measure by which Michigan ranks 47th in the nation!

It seems clear that higher education faces a serious challenge in Michigan. Our present level of public support is clearly inadequate to maintain a system that is competitive on a national basis.

We are attempting to compete in this knowledge-intensive future with an underfunded public system of higher education... and no private capacity (such as a Stanford, MIT, or Caltech).

Only the autonomy granted to our public universities have allowed them to "overachieve" their public support through higher tuition and other sources of financial support.

This has given public higher education in Michigan some capacity to face the devastating impact of the past decade...but it is rapidly losing this capacity...and there seems little doubt that the quality of our system will probably be gone in the next 10 to 20 years if the present trends of inadequate state support coupled with tuition constraints continue.

And what will then happen to Michigan. We will become a "have not" state, competing in low wage industries in dying industries. We will have rejected the age of knowledge!

Indeed,
Intense international competition, turbulent markets, rapid technological change present new challenges to our future.
To stand still...to fail to make the investments in our research universities so necessary for tomorrow...is to lose the race for future prosperity and well-being of our citizens.
We really have no choice but to forge ahead, to pick up the pace, and to increase these investments in order to secure once again the position of leadership to which our state has long been accustomed.

The Dangers...

Is our state willing to make the investments necessary today... to build the prosperity we desire for tomorrow?
Even though surveys indicate public supports education, this has yet to be translated into priorities.
Education always falls at the bottom of the list of social needs.
Is this because of an aging electorate?
Is it the "Me Generation" of the 1960s now growing up into mature Yuppiedom?
No. Rather it is the fact that for many years now we simply have not been willing to invest in our future...and the future of our children...
We have chosen instead to mortgage this future to pay for mistakes made in our past.
Six-month planning horizon...desire for immediate results...inability to identify the investments which have to be made today to yield the objectives for tomorrow.
The old T-shirt expression: "Eat dessert first, life is uncertain" reflects our present tax policy.
The attitude we have taken toward our most precious resource, our youth, is both callous and alarming.
I simply cannot accept the excuse that "we can no longer afford this investment in the educational opportunities we offer our youth".
To be sure, the immense social needs for welfare assistance, medical care, prisons, and all of the other programs that drain our tax dollars are compelling.
However, by choosing to meet these needs with resources taken away from our system of public education rather than through reforms in our tax structure or political system, we have in reality mortgaged our future by withdrawing the educational opportunities from our youth.
Michigan has had a long tradition of wealth and a caring attitude for its populace. But it seems clear that if priorities are not changed, Michigan will become poorer and poorer and finally it will not be able to meet the "caring needs" of its people. It will then have become a "have not" state.
We seem to have forgotten the commitments and sacrifices that past generations of citizens have made to build educational institutions of exceptional quality -- institutions that have provided many of us for years with unsurpassed educational opportunities.
All human societies endeavor to endow their children with an enlarged and enriched culture, for transmission to their successors.
If it is not to be our young people and their work that will gain us a secure place among nations and our better life for our citizens, then what will it be instead? And if we fail to invest adequately in the successor generation, then what kind of caretakers of our heritage and theirs will they turn out to be?
We are a nation that has always believed deeply in generational

improvement--in the prospect that things will be better for our children.

Americans must put aside their suspicions and answer that call, because the result of failure will be that 40 years from now a generation will stand where we are today and know that things are, for the very first time in history, worse than they were for their fathers and mothers.

We simply must re-establish the importance of both our personal and public investments in education, in the future of our children, in our own future, at the local level if Michigan -- indeed, if our nation -- is to face the challenge of the age of knowledge.

A different way to look at it:

The Investment in Human Capital...

The real issue here is not the investment in education...

it is the priority that we as a nation place on investing in our children.

We should feel both embarrassed and ashamed for robbing our youth to pay for our own excesses...

But let's take the cynical view that responsibility and stewardship will simply not be a compelling enough argument to reprioritize the importance of investing in human capital...in our youth.

There is another viewpoint, however...

If we do not invest in the youth of today, they will not become a sufficiently productive workforce to keep the checks coming to those of us who retire in future years!!!

By 2000, there will be only three workers to support each retiree...and one of these will be minority!

Look at it another way...which is the better investment...

\$3000/y to keep a preschool kid on track

\$5000/y to achieve a strong K-12 education

\$10,000/y to sustain strong college education

or \$30,000/y to put someone in jail...

The Need for a New Coalition

Somehow we must reprioritize the agenda of this state...

To shift away from our present myopic policies of addressing only the needs and desires of the moment
And, instead, to begin to make some of the key investments necessary for the long term...

The key investments in people in general...and in our children in particular...

This is not just the worry of local communities or state government or public institutions

It is everybody's concern!

Leaders in the private and public sector are going to have to step forward and unit behind this initiative.

We must learn to build new coalitions involving the public and private sectors...state government, education, business, industry, and labor...to develop an agenda appropriate to secure the future of our children, our state, and our country.

Michigan still has the opportunity to regain economic leadership.

We still are blessed with abundant natural resources, a people of great strength, and a system of higher education of a quality envied by the rest of the nation...albeit sustained by "overachievement" in the face of inadequate state support.

But, the writing is on the wall...

The future of our state is being lost rapidly through serious underinvestment in our

most valuable resource, our youth...

Conclusion

Let me conclude with a word about the role of the press in all of this.

I don't think there has been a time in our history when a free and vigorous press has been more essential.

The people of this state...and indeed, of our nation...must have the facts, however unpalatable they may be.

Only when we face reality can we understand the options... the costs of going on heedless as we have been... of exercising responsible choice.

You are the key to developing this public understanding.

A free press is also indispensable to us in education for another reason.

We need to be held accountable to the public that supports us.

There is no higher trust that the education of the young, and therefore, I believe that our accountability must be correspondingly great.

Oh, don't get me wrong. There are plenty of times I wish your reporters and headlines would just go away!

But there are also plenty of times that I have been grateful for the understanding and the support of the media.

In the long run, the truth is our best ally.

Certainly there is a natural tension in the relationship between the press and public institutions such as this university...but this can be a healthy tension.

Whatever our temporary disagreements, I know that for the long run we have one thing in common. We both want to serve the public to the best of our ability and to help this state successfully meet the challenges before us.

Thanks for coming today. I hope that you will find it possible to return to our campus from time to time in the coming years. You will always be welcome.

Now, Tim White tells me that some of you might like to ask a few questions or offer some comments.