

Michigan Legislators

Concerns...

Let me lay aside my hat as a university president...Instead I am going to put on a hat both as an 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...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 real 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 neighbors such as

Indiana and Ohio!
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.
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.
We see ourselves caring about the future, but we are
not preparing for it.

What is happening?

1) THE NEW MAJORITY...

America is changing rapidly...

By 2020, one of three Americans will be a person
of color.

By 2000, one-third of college-age students will be
from these groups

By 2000, 47% of our school children (K-12) will
be Black or Hispanic

There seems little doubt that America of the 21st
century will probably be the most pluralistic,
multicultural nation on earth...and perhaps in
history...

Our nation will face a challenge of diversity and pluralism
in the years ahead that will determine our strength
and vitality .

Less than 15% of new people entering the
labor force of the 1990s will be white males.

Put another way, unskilled minorities are a growing
fraction of the workforce and unless their abilities
are upgraded, the nation's overall skill level will not
be sufficient for tomorrow's economy.

Presently minorities fill 21% of 115 M jobs.

Of the 21 M jobs appearing before 2000,
57% will be filled by minorities.

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!

2) THE INTERNATIONALIZATION OF AMERICA

It will be a future in which America will become "internationalized"...
in which every aspect of American life 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...

Some signs...

Communications, travel, smaller world
Internationalization of commerce and industry...
Security and interdependence...
Nuclear weapons....

Some facts of life:

Market for nearly all significant manufacturing industries
has become world-wide
There is also the "3rd technological revolution"
The joining of computers and telecommunications into a
single yet differentiated system, that of the "wired nation"
and even the "world society".
1st TR was application of steam power to transportation and
to manufacturing
2nd was the spread of electricity and chemical processing.
The fact is, a truly domestic US economy has ceased to exist.
Today, imports and exports represent about 10% of GNP...
70% of goods we produce compete directly with foreign goods.
In slightly more than 5 years, US trade deficit has taken
us from the world's largest creditor to its largest
debtor nation.

Jack Welch, CEO of GE, noted last November:

"Within the next 2 to 3 years, at most, the most
important alliances will be forced in every
significant global industry--medical, autos, defense,
materials, and so on. Those who are slow to recognize
the emergence of these global alliances or to act in
forming them will find themselves locked out of the
game as we enter the 1990s."

American will no longer take its know-how and apply
it to low-cost natural resources from third-world
countries, turn it into products, and then sell it
back to them--as we do in a hierarchical economy.
Rather, we'll be only one member in a global
dynamic economy with tremendous network
interdependency between countries.

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
Indeed, now that native fertility rates have stood since
mid-1970s at 1.8 (below replacement level of 2.0),
immigration promises to become the main determinant
of future population variability

America is evolving into the first true "world nation",
shifting rapidly away from Eurocentricity into a society
with strong ethnic ties to all parts of the globe--
with a growing focus on the nations of the Pacific Rim.

US is no longer self-sufficient or self-sustaining. We are not
immune to the shocks of the world society. We have never
been more vulnerable.

3) DRAMATIC CHANGES IN THE STRUCTURE OF OUR ECONOMY

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:

In a car, 40% materials, 25% labor...

In a chip, 1% materials, 10% labor, 70% knowledge!!!

Increasing manufacturing production has come to mean

decreasing blue collar employment!

In the 1920s, 1 of 3 was a blue-collar worker
today 1 in 6 and dropping fast
probably to about 1 in 20 by 2000...

(We now estimate that GM will reach this point
probably before 2000...)

In a very real sense, the blue collared--that is,
low skilled--worker is disappearing rapidly!

Fundamental transformation underway in economy that is
"likely to reshape virtually every product, every service,
and every job in United States."

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knowledge-based economy, just as our industrial
economy evolved from an agrarian society at the
turn of the century.

A transition is occurring in which..

Intellectual capital has replaced
financial and physical capital as key to economic development

As Erich Bloch, Director of the National Science Foundation
puts it, we have entered a new age, an "Age of
Knowledge in a Global Economy"

The challenge today is to develop an agenda to achieve and
sustain prosperity in a new environment of intense
international competition and rapid technological change.

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 ledgerdremain
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 underinvesting 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 to 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

Since the birth of our state 150 years ago,
there has been a strong bond between the
people of Michigan and their university,
the University of Michigan.

Generation after generation of Michigan citizens
have reaffirmed their commitment to provide in
Ann Arbor an institution capable of:

providing to their sons and daughters an
education equal to the best

attracting to Michigan the most outstanding
scholars, scientists and engineers,
doctors, lawyers, and teachers, and
other professions so essential to our
prosperity and well-being

creating through its research and scholarship
the new knowledge so necessary to
economic growth and development

addressing through a myriad of public
service activities the many challenges
facing our state.

This sustained public investment and confidence
in the University over the years has enabled it
to serve the state in all of these ways and more.

Through this unique partnership, the University and
its activities in education, research, and public
service have served our state and its citizens well.

Today our state faces new challenges that will call
once again on the vast resources of its University.

1. Michigan faces a period of dramatic economic
change, during which it must evolve from a
resource-intensive to a knowledge-intensive
economy, in which intellectual capital will replace
financial and physical capital as the key to
economic development and prosperity.

Our state will become ever more dependent on
key knowledge resources such as the UM
as it faces the challenge of intense competition
and rapid technological change, as it enters
the age of knowledge in a global economy that

will be its future.

2. Michigan also faces the challenge of providing to all peoples, regardless of race, creed, or national origin, the opportunity to participate in a future of prosperity and fulfillment.

Here, too, the UM must play a critical role, in reaching out to underrepresented minorities and other groups facing inequities in our society and providing them with the opportunity for full participation.

This demands a renewed commitment to increase the participation of those racial, ethnic, and cultural groups not adequately represented among our students, faculty, and staff.

The University must serve as a model in its effort to build a multicultural, pluralistic community on its campus which achieves new levels of understanding, tolerance, and mutual fulfillment for peoples of diverse backgrounds.

3. The University will also be a key in address the particular needs and concerns of impoverished areas throughout our state.

It intends to focus its considerable resources in the social sciences and professions on the problems faced by Michigan's cities.

It intends to use its vast resources in basic and applied science to develop and transfer the new technologies capable of economic development and growth to all regions of the state, from the metropolitan Detroit area to the Upper Peninsula.

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 reserach 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 text equipment, including robotics, optics,
biomedicine, computer software, and electronics.

Opportunities:

Our state has many unusual opportunities...if only we can take advantage of them...

1. Intellectual

Michigan is where our nation makes things...

Cars, refrigerators...machines that make cars ...

Surrounded by excitement of industry in transition

"factory of the future"

robotics, machine intelligence, animate systems

EDS, Hughes, Saturn

But these are just tip of the iceberg!!!

Let me explain...

The Michigan Economy

Michigan's economic engine:

--and will remain for the foreseeable future --

durable goods manufacturing.

State becomes prosperous in only way:

By increasing value of goods and services that industries

in its economic base sell outside the state. Industries

such as retail trade and medical services do not contribute

to economic base, but simply shift resources internally

from one economic sector to another.

Challenge:

Must shift Michigan's economic base toward those products

and processes that are less vulnerable to low-wage

competition and more dependent on human skills.

Key: Michigan must become America's factory of the future

The nation's center of complex manufacturing processes...

The world's source of emerging industrial technology...

Note: New technology ("high-tech") in Michigan

will not be a separate industrial sector...

rather it will be at the heart of every industrial sector

2. Leadership

Leaders in our state must recognize the importance of technology

Michigan leaders must not only recognized importance of technology

The have also demonstrated vision & courage to make key investments

Attempting to establish clear priorities critical to future

Then to develop mechanisms to focus resources on priorities

3. Attitude

Conviction

Importance of individual achievement, of excellence

4. Some unique resources

Infrastructure of this State

The world center for complex manufacturing activity

Unique R&D resources

General Motors Research Laboratory and Tech Center

Ford Scientific Laboratory

Dow and Michigan Molecular Institute

Michigan's academic institutions

A broad and deep system

Ex: Produces over 6,000 engineers each year!

Ex: My own University ranks 1st in the nation

in the production of engineering graduates...

Drawn from the 98th percentile of high school graduates

Ranked 5th or 6th nationally

Suggestion: These institutions will play a key role in making

Michigan the focus of the economic renaissance of the industrial

nation!!!

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

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

willing to invest in our future...and the future of our children...

We have chosen instead to mortgage this future to pay for mistakes
make 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.

**head 2 + 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 **Error!**

head 3 - the educational opportunities from our youth.

We seem to have forgotten that the combination of

head 3 - now a generation will stand where we are today and

know head 3 - that things are, for the very first time in history,

worse than

they were for their fathers and mothers.

At the center of the problem is inability to formulate and pursue
a strategy of investment.

The most highly leveraged expenditures we can make are
those on the young.

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.

The Real Challenge -- and a Possible Solution

The citizens of this state expect...and deserve...state services
which exceed the present revenues...

Indeed, there are strong signs that we simply are underinvesting in
the future of this state...

Hence, the real question that we will eventually have to come to
grips with is not the expenditure side of the equation...but
rather the revenue side...

The future of our state depends on this...

It will be time of unusual challenge, responsibility, and opportunity
UM and State must work together in a partnership to secure

the future prosperity and quality of life desired by Michigan citizens.