

EDUCOM Panel

Personal Introduction

As many of you know, I am a scientist by
training and background...indeed, I
am perhaps the worst of all types
scientists...a burned-out theoretical physicist.

I must also confess to have always been
a bit of a computer hacker...
with an insatiable appetite for computational cycles...
...a “number cruncher”

Much of my early career was involved in the
simulation of nuclear systems...
...nuclear reactors
...nuclear rockets
...nuclear fusion (that’s HOT fusion)
requiring essentially “real-time” computing...
24 hours a day...on the fastest machines
then available...

But my interest in this technology took
a dramatic turn almost exactly a decade ago in 1979
when I was talked into teaching an introductory
freshman computing course using Apple II
computers.

You might say I got religion...
and began to sense the extraordinary impact
that this evolving technology could have on
education.

In a sense, I too have evolved as a computer
user over the years...
...batch processing...
...to time-sharing
...to personal computing...
...to interpersonal computing...

So what is next???

To answer this question, let me draw back
for moment to give you a broader perspective
as one who is attempting to lead a research
university into the 21st Century.

Themes of Pluralism, Globalization, and Knowledge

Our universities today are at a particularly important moment

in history, since they are being called upon to educate students who will be spending most of their lives in another century...citizens of the 21st Century, if you will.

And while it is always risky to try to speculate about the future our students will find, three themes of 21st Century America seem clear...

1. Demographic Change: The New Majority

America is changing rapidly...

When we hear references to the demographic changes occurring in our nation, our first thought probably focuses on the aging of our population.

It is indeed true that the baby boomers are now entering middle age,

and their generation has been followed by a baby bust... in which the number of young adults will be declining over the remainder of this century by roughly 20%.

Indeed, today there are more people over 65 than teenagers in this country, and this situation will continue for many decades.

Further, the growth rate in both our population and workforce is declining to the lowest level in our nation's history.

America will simply not be a nation of youth again in your lifetimes.

Yet, there is a far more profound change occurring in the population of our nation.

America is rapidly becoming the most pluralistic, multicultural nation on earth.

Women, minorities, and immigrants now account for about 90% of the growth in the labor force.

By the year 2000, they'll represent 60% of all of our nation's workers!!!

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.

And women have already become not only the predominant gender in our nation and our institutions, but they are rapidly assuming their rightful role as leaders of our society.

In this future, the full participation of currently underrepresented minorities and women will be of increasing concern as we strive to realize our commitment to equity and social justice.

But, in addition, this objective will be the key to the future strength and prosperity of America, since our nation cannot afford to waste the human talent represented by those currently underrepresented in our society, this human potential, cultural richness, and social leadership.

If we do not create a nation that mobilizes the talents of all our citizens, we are destined for a diminished role in the global community, increased social turbulence, and most tragically, we will have failed to fulfill the promise of democracy upon which this nation was founded.

But there are other important challenges associated with such demographic change.

In particular, it is important to realize here that 21st Century America will NOT be a melting pot in which all cultures are homogenized into a uniform blend -- at least not during our lifetimes.

Rather, it will be pluralistic...composed of peoples of vastly different backgrounds, cultures, and beliefs...peoples seeking to retain their cultural roots...to maintain their differences and identities.

Our challenge will be to find the common bonds and values that unit us, even as we learn to respect and value our differences.

The growing pluralism of our society is one of our greatest challenge as a nation...yet it is also among our most important opportunities, since it gives us an extraordinary vitality and energy as a people.

2. The Internationalization of America

The second theme is triggered by an event that happened from almost exactly two decades ago...when Apollo 11 set down on the Sea of Tranquility to put man on the moon.

The image I have in mind is that extraordinary photo of the earth taken by Lunar Orbiter as it circled the moon...
...an image that dramatically revealed how nations and peoples are passengers together on spaceship Earth.

It was a portent of today, a time in which all aspects of American life are becoming increasingly "internationalized", in which our nation has become a member of a truly global community.

Whether through travel and communication, the arts and culture, the internationalization of commerce, capital, and labor, we are becoming increasingly dependent on other nations and other peoples.

The world and our place in it have changed.

The fact is that a truly domestic US economy has ceased to exist. ...It is no longer relevant to speak of the Michigan economy or the American economy...

Our economy...our companies...are truly international, spanning the globe...and intensely interdependent on other nations and other peoples.

We are no longer self-sufficient or self-sustaining. We are not immune to the shocks of the world society.

As the recent events in China and the Soviet Union make all too clear.

But beyond commerce and national security, there is an even more important reason to pay attention to the trends of internationalization...

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

With falling fertility rates, immigration will soon become the main determinant of the variability in our population.

As we have been throughout our history, we continue to be nourished and revitalized by wave after wave of immigrants, coming to our shores with unbounded energy, hope, and faith in the American dream.

Yet today, in a very real sense,

America is evolving into the first true "world nation", with not simply economic and political but also ethnic ties to all parts of the globe...

From this perspective, it becomes clear that understanding cultures other than our own has become necessary not only for personal enrichment and good citizenship, but indeed, necessary for our very survival as a nation.

3. The Age of Knowledge

Looking back over history, one can identify certain abrupt changes, discontinuities, in the nature, the very fabric of our civilization...

The Renaissance, the Age of Discovery, the Industrial Revolution

There are many who contend that our society is once again undergoing such a dramatic shift in fundamental perspective and structure.

Today we are evolving rapidly to a new post-industrial, knowledge-based society, just as a century ago our agrarian society evolved through the Industrial Revolution.

In a sense, we are entering a new age, an age of knowledge, in which the key strategic resource necessary for our prosperity, security, and social well-being has become knowledge--educated people and their ideas.

Knowledge will play the same role for us now

that in the past were played by natural resources, geography, or unskilled labor.

In the knowledge-intensive future that is our destiny

it seems clear that education in general...

...higher education in particular...

...and the research university most specifically are rapidly becoming the key ingredients determining the strength, prosperity, and social-well being of our communities, states, and nations.

Just think of the challenges

which cry out for our attention

- the plight of our cities,
the development of an underclass
the polarization of American society
- greenhouse effect and global change
- international competition
Pacific Rim or Europe 1992
- health care: cancer, heart disease, AIDS
- new frontiers: outer space
or spaceship Earth

The Need for a New Paradigm

In a nutshell, as I look to the future, I sense

an ever-accelerating pace of change in our society, in our state, in our nation, in our world.

The themes of change,

- i) the growing pluralism of our society
 - ii) our evolution into a world nation, ever more tightly coupled to the global community
 - iii) and our rapid transition to a knowledge-based economy
- are not themes of the future...
...they are themes of today...
...and they are already dominating every aspect of American life.

Furthermore, the winds of change that are blowing today...

will also drive great changes in higher education.

The triad mission of the university as we know it today,

teaching, research, and service...

was shaped by the needs of an America of almost a century ago...
as American expanded to the frontier...
as it evolved through the industrial revolution...
as it absorbed wave after wave of immigrants

Yet our nation today is changing once again,

at just as rapid a pace...

Hence, is it not appropriate to question whether our

present concept of the research university, developed largely to serve a homogeneous, domestic, industrial society...must also evolve rapidly if we are to serve the richly heterogeneous, knowledge-intensive, world nation that will be America of the 21st Century.

I believe that the 1990s will be

a time in which we are called upon to re-invent the nature of the university once again...
to develop a university capable of educating the citizens and serving the society of not the 20th Century, but rather the 21st Century.

This is our challenge...

This is our responsibility...

This is our opportunity.

And this is also where you come in...

The Role of Information Technology

Because it is also clear that the knowledge

infrastructure of our world provided by
information technology will be of increasing importance
in the years ahead...
...a technology that not only provides a lever for the mind...
...multiplying our talents and extending our
intellectual span...
...but provides the tools of interaction that
allow us to overcome the barriers of space and time
and unite as students, teachers, and scholars...
...indeed, as a people...in ways we never
dreamed possible...

At Michigan we have been convinced

for some time that the computer has evolved
far beyond simply a tool for scientific computation
or information processing.

It is now a robust technology absolutely

essential for the support of all knowledge-based
activities...and knowledge-based organizations
such as universities, corporations, government.

Hence it was natural that several years ago,

we would accept the challenge of embarking on a
great adventure, to turn this University into a
gigantic laboratory--an experiment in the development
and application of this technology--in our efforts to
build a University for the 21st Century.

Some parameters of the University

Of many ways, Michigan represented the

ultimate challenge, since it is long been viewed
as both the prototype--and indeed the flagship--
of the comprehensive, public research
universities which have served America so well
over the last century.

**This is a very large, a very complex,
and a very decentralized place...**

University of Michigan = "multi-versity"

- i) Spans all intellectual disciplines and
professional areas
- ii) Provides instruction, research, service
- iii) Attempts to conduct programs that rank
among the nation's best in all areas

(and succeeds...)

Parameters:

Enrollment: 36,000 (Ann Arbor) (48,000 total)

Faculty: 2,600 (16,000 employees)

Budget: \$1.6 billion

Academic Units

17 Schools and Colleges

Hundreds of research centers, institutes,
and other types of interdisciplinary
programs

We also run the largest health care system in
the Midwest, treating over 750,000 patients each year...

We conduct events in the performing arts which rival
New York and London...

whether it be Leonard Bernstein performing his 70th
birthday concert with the Vienna Philharmonic
or, God-forbid, the Grateful Dead....

And, speaking of entertainment, we also have the
Bo and Steve show...the Michigan Wolverines...
playing in the fall to 105,000 every Saturday afternoon

Hence, we viewed the University of Michigan

as a great challenge for information technology.

If we could undergird this complex, knowledge-intensive
institution on the infrastructure of information
technology, then surely we would be well on
our way toward re-inventing the University for
the 21st Century.

But of course, we also had one very important

advantage...the "fault-tolerant" nature
of the University community...since students,
faculty, and staff are far more willing to
put up with occasional glitches and outright bomb-outs
than most elements of our society.

A Case Study: The "Electronic" University

Our goal was rather simple:

To build the most sophisticated
information technology environment of any
university in the nation...an environment
that would continually push the limits of what could
be delivered in terms of power, ease of use, and

reliability to our students, faculty, and staff.

We sought a distributed intelligence, hierarchical

computing system linking personal computer workstations, superminicomputers (and, more recently, minisupercomputers) mainframe computers, function specific machines, library access, a host of various servers, and gateways to international networks and facilities such as the NSF SCC, national data centers, etc.

Managed to recruit people with the vision

and energy to make this a reality...

Doug Van Houweling

Lynn Conway

Carolyn Autry-Hunley

Doug Hofstadter

Randy Frank

Burt Herzog

To create the organizational structures...

ITD

Information Technology Division

CITI

Center for Information Technology Integration

CMI

Center for Machine Intelligence

Cognitive Science and Machine Intelligence Lab

NSFnet (IBM, MCI)

NSF Supercomputer centers

NASA, Internet, National Research and Education Network

MITN

And to build the partnerships with

the leading information technology companies throughout the nation and the world.

Underlying Philosophy

i) Determined to stay always at the cutting edge...

...but with a very strong service focus

ii) Determined to remove all constraints...

...no limits whatsoever on student and faculty use

iii) Multivendor environment

...choosing whatever technology was the most powerful

- iv) Relied heavily on "fault-tolerant" nature of University community to develop an entrepreneurial culture...a "go-for-it" philosophy!

Today...

- i) roughly 3,000 public student workstations (funded through \$220-\$400/y fee... gives us \$10 M/year of venture capital to play with)
- ii) roughly 30,000 workstations
- iii) student purchase plan... MacTruck -- truckload sales...
- iv) robust networking... digital wire plant... LANs...
- iv) one of the largest installations of mainframes in the world... all networked together into an institution-wide file system
- v) 80,000 users on system
- vi) UM has become the focal point in efforts to build the "interstate highway system" of information exchange...with EXPRES, NSFnet, internet, MITN,...coordinate access to NSF SCCs... National Research and Education Network

Concluding Remarks

Yet, we have only begun to scratch the surface

in the development and application of this incredible technology.

Here in Ann Arbor, we view information technology

as providing both the infrastructure and the linkages among these themes of change...

...our growing pluralism

...our growing interdependence with the global community

...and our growing dependence on knowledge as key to our futures.

We believe we are even now riding the "fourth wave" in the use of

information technology...where the computer becomes not simply just an information processing tool, but rather a medium of communication, cooperation, and collaboration...facilitating entirely

new intellectual endeavors...

Personal computing to "interpersonal computing"

As the result of the rapid spread of personal computers and computer networks, and the development of new insights into human cognition and group behavior, we are at the threshold of a major shift in the underlying paradigms and uses of information technology.

This is important, since many in our society continue to

view the computer as a symbol of the de-personalizing nature of modern science and technology.

Yet, if ever there was a tool for empowering

the individual, it is information technology.

This is truly a liberating force in our society,

not only freeing us from the mental drudgery of routine tasks but linking us together in ways we never dreamed possible ...overcoming the constraints of space and time.

In part, it is our challenge, collectively, as

as educators, scholars, leaders of business and government ...to build greater public understanding and support for this extraordinary tool...
...so key to our nation and the world as we prepare to enter the "Age of Knowledge" that is our future...

Just as it is to higher education as together we face the

challenge and adventure of building the University of the 21st Century!