Technology Transfer

Introduction

The view from Michigan..."the Rust Belt"...

While people generally look at the midwest as a relic of America's industrial past, let me suggest that in many ways, it can also be viewed as America's future.

For it is in the industrial midwest...in Michigan... that we have had to learn how to adapt to a brave, new world of intense economic competition...

We have learned through the school of hard knocks, as we have fought and scratched and clawed our way back from the economic brink to achieve prosperity.

In a sense, Michigan's challenge is the challenge of dramatic economic change itself, being driven in large measure by technology ...

And we have had to learn how to develop a new agenda to cope with this future... to build a new team involving business, industry and labor, state government, and Michigan's colleges and universities.

Let me explain

The Bad News of the past several years...

Familar Ills which dominate the headlines

- The budget deficit
- The trade deficit
- The collapse of the Stock Market
- Displaced workers
- Marginal Industries

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...
- 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..."

What is happening?

- The world economy is now in control
- However, it is misleading to blame all our ills on international competitiveness alone!
- Something else is happening...

The Challenge of Change

The challenge of dramatic economic change...

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.

The days of low interest rates, limited foreign competition, slow-moving technology, stable markets, and mass production processes that once allowed our industries to thrive in a sheltered environment have long since passed.

A transition is occurring in which..

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

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.

In all developed countries, "knowledge" workers have already become the center of gravity of the labor force.

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 Age of Knowledge in a Global Economy

And in this age, the major force behind economic change is knowledge, itself.

But knowledge is highly mobile...it is not tied to geographic regions as coal or iron or oil.

By contrast, the knowledge revolution is happening worldwide and at a very rapid rate.

That new technology means economic development and trade is widely understood in all nations who have been sharply increasing their investments in science and technology.

The handwriting is on the wall...

A National Response

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

Maintaining America's competitive edge requires attention to our traditional strength -- people and ideas -- and a strong offensive strategy based on those resources.

People must be the major focus...

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.

They are our researchers and teachers, our leaders, managers,

and decisions makers in modern technological society.

Two-fold challenge

1. Achieve basic scientific literacy among all our citizens
2. Provide enough scientists and engineers for industry and academe

For this reason, the administration has chosen as its highest priority in the year ahead major new initiatives aimed at strengthening the source of intellectual capital in this nation.

The State of Michigan Response

What has been the response of Michigan to the challenge of change -- to the Age of Knowledge

The Michigan Strategy

Blessed with leaders that recognized the challenge...
had the vision to develop a forward-looking strategy to respond...
and the courage and skills to implement this strategy...

Economic prosperity lies not in tearing down our old industrial base for a different kind of economy, but in helping that base make the changes necessary to compete in a new economic environment.

The goal: Michigan must become America's factory of the future...
its source of emerging industrial technology...

Our ability to innovate will become our principal economic advantage...
innovation will be the energy that drives change

To position Michigan as the nation's source of emerging industrial technology, we recognized we must move along three fronts:

1. To enhance the growth of R&D in Michigan
2. To accelerate the transfer of technology into Michigan industry
3. To develop a strong coalition within Michigan among government,
   industry, labor, and universities to create a "venture culture"

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
Astin --> U. Texas

Why?:

- Produce talented engineers to implement new technology
- Through research produce creativity necessary for innovation
- Attract "risk capital" through massive federal R&D support
- Key to technology transfer
  - Traditional: graduates, publications
  - Entrepreneurs
  - Startups

- Development of Unique State-University Partnership
  - Universities committed 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 committed 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 activites

State Actions:

- Vision and courage of leaders in public and private sector
  - Recognized the importance of technology to Michigan's future...
  - Also were willing to make the investments today necessary for Michigan's prosperity tomorrow...

1. Research Excellence Fund
   - $25 into building key research areas within research universities
2. Centers of Excellence
   - Industrial Technology Institute
   - Michigan Biotechnology Institute
   - Michigan Materials Processing Institute
3. Michigan Strategic Fund
4. New coalitions and partnerships
   - Fraser-Iacocca Commission on Jobs and Economic Development

University of Michigan Actions:

- Key:
  - Began to think and act strategically...how to better position ourselves
- Recognition:
  - 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!!!
  - A fascinating and unique convergence of technology...
    - The chip, computers, AI, new materials, mech systems

Driven by money (investment) and need (competitiveness)

Michigan-->nation's source of emerging industrial technology

A transition is occurring in which..

Intellectual capital ("brainpower") is replacing financial or physical capital as key to economic development

Hence, we chose as our thrust areas...

Complex manufacturing systems

CRIM - ITI -- The Center for Research on Integrated Manufacturing, responsible for the basic research and instruction necessary to sustain the Industrial Technology Institute...and to maintain the momentum of Automation Alley now developing in Michigan.

Machine Intelligence

CMI - EDS -- The Center for Machine Intelligence, an exciting new venture formed with the participation of industry and federal government to explore the whole new technology of thinking machines -- machines taht can perceive their environment, think, and act. First applications will be in manufacturing. However next generation of thinking machines will be designed and built by intelligent machine!!! (Note address is 2001 Commonwealth)

Advanced electronics and optics technology

CAEOT -- The Center for Advanced Electronics and Optics Technology, aimed at research into the marriage of electronics and optics -- laser on a chip. It is now the largest university laboratory in the nation specializing in ultra high speed, high frequency electronic devices and advanced electronic materials such as galium arsenide.

Information Technology

CITI -- The Center for Information Technology Integration, essentially a skunkworks operation exploring the forefront of modern computer telecommuncations with several fo the leading companies in the nation. The U of M itself has become the laboratory, the "test bed", for this exciting venture.

Other steps

1. Recruiting key engineers and scientists
2. Modifying ways we interact with outside world...

Strengthened interactions with industy

3. Intellectual property policies
4. Michigan Information Technology Network...

University-Industry Interactions

- Synbiotic Relationship
  - An association between two unlike organisms for the benefit of each.
  - Both industry and university have a "service to society" component
  - Fundamental goals are different:
    - Industry:
      - To make a profit
    - University:
      - To create and maintain knowledge and impart it to its students.
  - In a university-industry partnership, it is important that each partner focus on what it does best.
- Traditional forms of interaction
  - i) education of students who then take positions in industry
  - ii) open publication of research results in scholarly journals that are then read in industry.
- New challenges:
  - i) Time required for technology transfer from university to industry must be reduced dramatically to meet the needs of existing companies and to spawn new industries.
  - ii) Academic institutions are ill-equipped to respond to the highly focused, immediate needs of industry without considerable disruption of oncampus responsibilities.
  - iii) Inadequate mechanisms for achieving more direct industrial support of academe through financial assistance, equipment donations, and visiting staff.
- Premise:
  - Both industry and academic desire stronger, more sophisticated, and more sustained relationships between each other,
  - Relationships that are better able to respond to the needs and capabilities of each group.
- Mechanisms of Interaction
  1. Traditional Modes:
     Most important mechanism is placement of graduates.

2. Cooperative education programs
3. Continuing education
4. Oncampus sponsored research
5. Consulting
6. Entrepreneurial activity
7. Industrial Affiliates programs
   Companies subscribe to support a particular technical focus
8. Industrial research partnerships
   Work closely with a single company on common research problems. Involve teams of PhD students led by senior faculty, working side-by-side with industrial engineers and scientists, both on campus and on site.
9. Bridging Institutions
   - National
     - MCC
     - Microelectronics Research Corporation
     - SEMATECH
   - State
     - Industrial Technology Institute
     - Michigan Biotechnology Institute
     - Michigan Materials Processing Research Institute
   - Local
     - Center for Machine Intelligence
10. Technology Transfer

Technology Transfer

UM Approach:

1. Surveyed policies of other peer institutions
2. EOs took a trip out to Stanford
3. Send staff to survey other institutions

Basic Premises

1. Research universities--particularly public research universities--have major responsibilities to make every effort to transfer intellectual properties resulting from its academic activities into the private sector where they will benefit society--in a manner consistent, of course, with their academic missions.
2. Such technology transfer will occur most rapidly when those who create the intellectual properties have maximum incentive and

opportunity to transfer them to the outside.

3. A university's ability to recruit and retain outstanding faculty and staff will be increasingly influenced by the environment it provides to allow, encourage, and facilitate such activities. Technology transfer is an outlet for creativity for some areas. There is strong evidence that the best "academics" and "entrepreneurs" may be one and the same!
4. Technology transfer activities can have a dramatic positive impact on the quality of basic research since they create pressures to work in exciting, high risk, interdisciplinary areas to achieve the quantum leaps in knowledge not normally available in the industrial setting. It is wrong to equate "commercial value" with "applied research". Frequently the real barriers to application are due to a shortage of basic knowledge.
5. It is unlikely that most universities will reap substantial income through direct control of intellectual property (e.g., patent licenses, equity interest in spinoff companies). However institutions could gain substantial indirect benefits from aggressive technology transfer transfer efforts through increased public support and private gifts.
   and private
6. Universities must take care to avoid a parental attitude toward their faculty and staff. In their perhaps well-intentioned efforts to protect them from the harsh, cruel world of private enterprise, the university will, in reality, constraint and frustrate those already experienced in such activities and prevent the development of a learning process (albeit sometimes by the school of hard knocks) among others, while removing the incentive for wide-spread faculty involvement in technology transfer activities.
7. Faculty and staff in universities should be assumed to be mature, responsible individuals who will behave properly in balancing the univerity's interests and their own responsibilities for teaching

and research against their interests in intellectual property devlopment and technology transfer.

8. Technology transfer from the campus to the market will only succeed if we recognize that it is highly people-dependent. It is essential that we stimulate and encourage the individual researcher/inventor to participate in these activities, and then remove the constraints to provide maximum incentive and opportunity for this process to occur.

Michigan Policy

This summer the Regents of the University adopted a new set of Intellectual Property Policies.

Basic Objectives (in order of importance):

1. To provide services to the faculty and staff to facilitate their efforts to carry our the University's mission.
2. To facilitate the rapid and efficient transfer of knowledge and technology from the campus to the private sector in service of the public interest.
3. To attract resources for support of the academic programs of the University.

Note:

1. Emphasis is placed first on service to the faculty and staff...(in a sense, our translation of the old Stanford saying that "The University is run by the faculty for the faculty..."
2. We recognize that research universities have an obligation to transfer knowledge from the campus to the public.
3. We do not believe that technology transfer will be a "cash cow" for the University. Hence, we have intentionally de-emphasized protection of the University's financial interests in intellectual properties.

UM Disclosure Policy

University employees have an obligation to disclose promptly and complete any intellectual property they have developed.

UM Options for Commercialization

Prior to expenditure of UM resources for protecting and marketing intellectual properties, the inventor is asked to select one of the following options for commercialization:

1. Licensing Third Parties
   UM may license properties to external entities for further development and commercializationin exchange for a return on resulting revenues.
2. UM may enter into licensing agreements with employee/inventor-owened companeis due to recent changes in State Law. ("Contracts of Public Servants with Public Entities", 1983)
   Terms may include royalty payments or equity interest (unlike Stanford). Emphasis here will be on helping the company become viable.
3. Empolyee may petition UM to reassign ownership to inventory if they elect to market, protect, and license it on their own with minimal UM involvement. (Note: We could always always reassign, but in the past we would do so only if we did not see a benefit to UM. Now the inventor can petition directly if he believes he can do a better job.)
   In this case, UM would ask for recovery of any patent and licensing expenses plus 15% of royalties, equity, or other value received (although this can be waived). in the past

Comment on Ownership:

Note this policy is kind of a hybrid of Stanford and MIT:

1. Automatic reassignment when research not externally sponsored.
2. If federally sponsored, then UM will work with inventor to seek reassigment permission from government.
3. Privately-sponsored research subject to contractual terms.

Royalties

Probably most liberal policy in country...
50% of first $100,000
40% of second $100,000
33% of amount above $200,000
(with rest split between inventor's unit and University)

Development and Marketing Support

Building a very strong service operation...

i) evaluation

ii) patenting and licensing

iii) marketing...

600 corporate contacts... with a list that is growing rapidly

iii) facilities and resources for development activities (particularly for SBIRs)

iv) assistance with spin-offs

Key Themes:

1. **"Service to faculty"** orientation
2. **"Free market"** strategy...we let faculty and staff select how best to handle commercialization--including letting them own the invention, if they are convinced that this is the best way to do.
3. Maximum **"flexibility"**...
   ...in negotiating research contracts
   ...in development
   ...in marketing and licensing

Results:

1. Disclosures are doubling each year...up to over 300 last year.
2. About one-fourth of these are showing active progress toward the marketplace
3. Spinoff company activity is building rapidly.
4. Royalty income $750,000 last year...project $2 M in 1990

Cautions

1. Primary mission of the University:
   Teaching and scholarship...
   Concern: Do such commercial activities contaminate the

academic purity of the University...
do they distort academic values?
Are faculty members drawn away
from teaching and basic research?

2. Academic freedom and openness
   Concern: Do they constrain
   publication and encourage
   secrecy?
3. Balance between basic and applied
   research
   Concern: Does technology transfer
   shift university research toward
   more applied--and therefore,
   presumably, more commercially
   valuable--endeavors?
4. Symbiotic nature of relationship...
   Private sector must not attempt
   to mold higher education into its
   own image...
5. Unwarranted intrusion of private
   sector into government regulation
   of universities -- use GE example...
   which attempts to pass a state law
   (Neil Flynn, Charles Willsey, GE
   Medical Systems, Illinois)
   i) wherever state funds are involved,
   industry-funded university research
   should be conducted under a royalty-
   free nonexclusive agreement.
   ii) The state would required that
   patentable ideas arising from university
   research be filed for patents prior to
   publication in a technical journal. (GE
   does not believe this is an infringement
   of academic freedom...)

Michigan is on the move!

State has taken strong first steps to rebuild capacity of its research universities to provide the knowledge-based resources so necessary to our long term well-being and prosperity.

The people and ideas...
the outstanding graduates, scientists, and engineers;
doctors, lawyers, teachers, and other professionals;
and leading edge research and service activities.

Indeed, Michigan is rapidly becoming a model for the nation of the advent of an exciting new competitive age.

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, entreprenureal environment...a no-holds barred, go-for-it culture...in which individual initiative, achievement, and the quest for excellence are dominant elements

Appendix

- Ownership Policies
  - Illinois:
    - Any invention developed with University or facilities belongs to UI. However, new policy in 1986 which admits there are some circumstances in which UI will relinquish ownership of inventions.
  - Cornell
    - Retains ownership, except software, but title to inventions reverts to inventor if "positive determination regarding pursuit of a patent" is not made within 3 months of disclosure.
  - Purdue
    - "We invent, we own"... The institution has a separate not-for-profit foundation that actually holds title. No policy on reassignment of ownership.
  - MIT
    - New policy which encourages MIT to "step aside" and not exercise its contractual rights to technology, thereby clearing the way for the MIT inventor to seek ownership when it will enhance the transfer of technology to the public.
  - Wisconsin
    - Presumed faculty is owner unless there is a contractual obligation. WARF handles most intellectual properties, although there is no obligation for faculty member to use them.
  - Stanford
    - "Except in cases where other arrangements are required by contract, it is the policy of the University to permit faculty, staff, and students to retain all rights to inventions made by them".

Steps:

1. Universities should carefully monitor their relationships with the private sector.
2. Universities should negotiate relatioionships that avoid objectionable restrictions on faculty behavior
3. Government can assist by continuing its support of basic research.
4. Government can make certain that the patent system continues to provide adequate protection of the commercial valueof intellectual property. Best deterrent to secrecy may be perfection of methods that allow parties to disclose their research results while also protecting their proprietary interest. Much depends on jow the judicial system interprets current law as companies and universities bring suit to protect patents against infringements.