

Economic Strategy Institute (3/11/92)
Academia and Technology

Introduction

Delighted to be here to talk with you about national technology policy.

As Roland Schmitt has said: "We have at last reached the point where technology policy can at least come out of the closet.

Subject of this conference as both timely and critical to our country's future

My remarks today are based on my perspective

as President of the University of Michigan which this year leads in the volume of federally funded non-defense research.

Also as someone who has spent most of my career in research and in technology transfer--

(Parenthetically, should note that I am not speaking as Chair of NSB.

I don't want to cause wholesale panic over there as

I speak with the candor of a midwestern engineer)

?Jim, I don't know if the foregoing is needed?

Since Michigan is located in the heart of the Rust Belt,

we have been experiencing first hand the transition from an industrial, domestic economy to a global one in what Erich Bloch has termed the "the age of knowledge."

Our University has been hard at work on strategies

to help diversify the economy of our state and rebuild competitiveness

to cushion against the continuing shocks

as the auto industry packs up to leave

with what little remains of their once unchallenged manufacturing empire.

Thanks to close cooperation among the three research universities of Southeastern

Michigan, state government and the private sector, we have begun to build

a new economy--attracting some \$XXXX million in new, mostly high tech business,

in the past decade or so.

Thus I can speak with personal feeling and experience of

the issues before us.

What we have learned in my state is that

America is entering an uncharted and and challenging era in which

educated people and the ideas they produce

have truly become the wealth of nations.

I suggest that it is our research universities

that are now the prime producers of that wealth.

Just one indication of this reality is that no other industrialized nation

relies so heavily on its universities

for research--now some 60% of all US research--(in early 60's US was 70%)

in contrast to Japan 20% publicly financed R&D and Germany 35%.

Clearly, any effort to implement a sound technology policy for America

rests on the foundation of a sound system of research universities

as a vital partner in collaboration with government and private sector.

The good news here is that America's system of higher education

is still widely acknowledged to be the strongest and most productive in the world.

A few weeks ago a New York Times editorial

called our nation's research universities

the "jewel in the crown" of our national economy.

It went on to assert that university research

"is the best investment taxpayers can ever make

in America's future".

This was an especially welcome and all too rare public acknowledgement

of the extraordinary contributions our research universities

make to our nation.

Unfortunately, the editorial was an outraged a response

to the most recent assault on the academy by misguided bureaucrats.
As you may have noticed, universities have been taking
a lot of hits lately, and not just in the media.

Universities at risk

If the good news is that our universities are the strongest in the world
the bad news is that the 1990's stand a good chance of being
the worst for higher education since the 1930's.

There is a frightening sense of crisis at many of our nation's most distinguished campuses.
"One Professor described the crisis in the New York Times as meaning
" the death of the 19th century university as we have known it".

Thus, to discuss national technology policy realistically

I believe it is imperative that we first understand that our universities---a vital partner
in any national strategy to improve competitiveness and productivity---
are at serious risk on a number of fronts.

Warning signs

There are plenty of warning signs that the American academic research enterprise
is in extreme distress. Let me note just some of them.

1. The most prominent warning signs are the deep and prolonged effects
of a deepening political-economic crisis

For one thing, of course, universities are feeling the effects of the current recession
both nationally and regionally.

But current fiscal woes are not just temporary set-backs
they go much deeper

Universities are suffering the consequences

of the structural flaws of national and state economies

--growing imbalance between revenues and expenditures --

that are undermining support for essential institutions

as government struggle to meet short term demands at the expense of long term needs
because the electorate has adopted a new credo: Eat dessert first. Life is uncertain.

.....and by the way, just sent the bill to the kids later--say in a decade or two.

Education at all levels is feeling the effects of two decades

of political failure to invest in our people and infrastructure--in our children's future.

NYTimes recently noted that last year for the first time

in over thirty years, state support for higher education

was less than for previous year--drop of about \$80 million.

Federal support for higher education is at a new low

XXX, including increasing unwillingness to pay its fair share
of the costs of research.

Cuts in federally supported financial aid has shattered.

the dream of equal educational access for many students

leaving higher education to scramble to try to make up the difference

while they also are forced to increase tuition to make up for massive losses in other
revenue.

Let me cite just a few of many specific examples of the fiscal crisis

that is threatening our best of our universities both public and private:

...Columbia University \$15 deficit next year and another \$15 million in 1993

...Stanford cuts of 13% to trim deficits of 43 million over next two years

...Yale, cutting positions and merging departments by 11% 8 million deficit

...Harvard--\$41.9 million shortfall--first since 1973

...California

Penn threatened with as much as \$38 million in cuts from state next year

...And my own University of Michigan, where we have seen

2. Another critical warning sign is scarcity of research funding coupled with spiraling costs
Federal funding for science research one of the highest priority issues
facing US in this decade.

Although since 1983 federal funding has in fact increased

it did so only after a lengthy period of decline

What it comes down to is that we are supporting most scientists inadequately allocating scarcity not with a clear sense of priorities by in a scattered random actions by institutions with little understanding of long term implications.

In a way we are the victims of our remarkable postwar productivity..

The exponential growth of scientific knowledge in recent decades has meant that the number of specialized fields keeps multiplying as whole new areas open up for exploration.

The number of academic scientists and engineers has doubled since 1960 while federal research funding has increased by 20%.

Research today is far more sophisticated with rapidly escalating costs for facilities, equipment, supplies, graduate education

Also increasing number of institutions striving to strengthen research role.

The result is increasingly unhealthy and acrimonious competition which pits generations, fields, and colleagues and institutions against each other in scrambling for scarcer dollars.

Application success rate to research sponsors down to 10 -15% in some fields and averages less than 30% overall.

average proportion of approved grants actually funded NIH/NSF at all time low/ less than 30%

Because government r&d is now a zero sum game the squeeze is especially hard on individual investigators- so called "little science" as opposed to "big science"

Big science/mega projects such as the SSC, Space station, Magnetic Fusion, SSI, Global Change now accounts for now 20% of fy 92 R&D budget request eating up about 1/3 of civilian r&d and this proportion is growing.

Some of these projects are of great potential scientific value some are marginally valuable.

Real problem is that decisions about them are becoming politicized building momentum that will divert more and more of shrinking science budget away from small science research which is the most creative long term source of innovation.

What they don't realize is that fewer dollars are going to the kind of "small science" that yields the seeds of innovation in the future--.

e.g., lasers, biotechnology, fiber optic communications.

We desperately need to rebalance short and long term investments.

3. Third warning sign is science education gap at all levels
 - "A country with a scientific elite but an poorly educated workforce may be able to innovate, but it will find it hard to ensure that new ideas are effectively used at home"
 - "The ability of the workforce to make use of new technologies may be a country's best competitive advantage" (Economist)
 - How long can our universities expect to achieve the highest educational and research standards when our k-12 system is failing at every point to provide solid education to our children-- with the gap is especially great in science, math and technology subjects?
 - I won't repeat here all the sorry evidence of American educational failure. I think we all know how poorly our students perform on tests in comparison to the peers in other countries.
 - This has some very depressing implications for universities.
 - But by the time students get to our colleges and universities it is usually too late to make up for lack of preparation.
 - Far too few students are willing to take demanding science courses in college and, frankly, higher education must accept some of the blame for not setting far higher requirements for admission, graduation, grad study and teacher education as well as improved methods of teaching.
 - Result is that we face serious shortages at all points along the educational pipeline leading to academic careers in science and engineering.

A critical shortfall that is bound to affect our future competitiveness.
 We also are failing to prepare citizens, teachers, managers,
 and other professionals to make productive use of science and technology
 or to make informed decisions about public policy.
 Our graduate classrooms are filled with foreign students.
 because American students are studying law, business, and lots of other
 professions that pay well but don't do much for our trade balance.
 The biggest immediate worry for academia, is how and where we will find
 first rate new faculty in the sciences and engineering
 as we move to replace XX of the professoriate over the coming decade or so.
 The bottom line is that
 unless investment in education at all levels is our highest priority,
 our efforts to shore up the crumbling scientific and technological infrastructure
 will be built on the sand of educational inadequacy.

"Only that intangible, vital quality, the environment of active brains and productive skills in
 which companies operate is non-transferable. To change it, governments need to start at
 the school gates." (Economist in article on innovation)

4. A fourth and very dangerous warning sign
 is the rapid deterioration of aging academic research facilities and equipment.
 Increasingly complex and costly equipment and technologies
 are essential for cutting edge university research.
 Packard Bromely Report put the cost
 of renovating obsolescent university research equipment at \$10 billion.
 Yet government has not appropriated support for XX years.
 Result is desperation and inevitable politicization
 in which peer review is bypassed in direct appeals to government.
 "Earmarking" now by default the federal program
 supporting university research facilities and equipment.
 \$490 million last year.
 The pork barrel may be the wrong place to go for resources
 but what is the alternative?
 My colleague Frank Rhodes (not someone given to hyperbole)
 predicts that "if the government fails to come to terms
 with the need to modernize research facilities, there may be virtually no private
 universities
 left among the top twenty by 2030".
 Public institutions are not faring much better these days.
 In Michigan we have had no appropriations for new buildings since XXXX

5. Eroding Government-Academic partnership
 Surely the most ominous warning signs for academic research
 is the erosion, even breakdown, in the extraordinarily productive
 fifty-year partnership uniting government and universities.
 Scientists and universities are wondering if they can depend
 on the stable and solid relationship they had come to trust
 and that has paid such enormous dividends in initiative, innovation and creativity.
 Truly perverse that the relationship that has been in large measure responsible
 for our long undisputed technological superiority
 should be threatened at very moment
 when it has become most critical for our future.

*Partnership goes back a long ways---nearly 150 years
 to the Northwest Ordinance of 1846
 which gave rise to one of America's most wondrous social inventions--
 the great public land grant universities--
 Because they added a commitment to public service
 to the traditional academic mission of teaching and research,
 they created a continuing connection between theory and practice
 between public universities and the people they serve*

Result was a creative powerfully creative engine for progress uniting student and faculty member in a collective discovery and transmission of useful knowledge and technology.

Promoted first the agricultural development of America and then its transition to the industrial age.

WWII provided the incentive for even greater cooperation.

From work aimed at winning the war, university researchers achieved breakthroughs in nuclear fission, radar, microwaves, radar

Part of our university research became "mission oriented" and in this period we learned valuable lessons in how to develop and transfer technology strategically how to work as partners with government and industry.

Many of the technologies developed for use in the war were later adapted to commercial applications helping to fuel the postwar expansion and to create public demand for science and its products.

Jim: Note that preceding italicized section might easily be cut)

The emerging Cold War

provided the rationale for formalizing the postwar government-academic partnership The confidently optimistic terms of the social contract

were set forth in the Report by Vannevar Bush Science: The Endless Frontier:

"Moreover, since health, we'll being, and security are proper concerns of Government, scientific progress is, and must be, of vital interest to Government. Without scientific progress the national health would deteriorate; without scientific progress we could not hope for improvement in our standard of living or for an increased number of jobs for our citizens; and without scientific progress we could not have maintained our liberties against tyranny."

Bush report also stressed a corollary principle that the government should preserve

"freedom of inquiry" to recognize that scientific progress results from "the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for explanation of the unknown."

□

.....What enviably confidence and vision Bush showed

The Report generated vast federal support for basic science and set the stage for an incredibly productive "golden age" in national science and technology.

Until recently, the university relationship with government has been a positive one of one immense accomplishment motivated by a sense of serving high purposes

Now, in the 1990's there are many signs of strain--even rupture--in the relationship.

As President Bok of Harvard put it:

"Unless society appreciates the contributions of its universities, it will continue to reduce them to the status of another interest group by gradually stripping away the protections and supports they need to stay preeminent in the future."

Critical national decisions about science, technology and universities are being made in a rancorous atmosphere increasingly filled with mutual suspicion, anger, political opportunism and mutual disillusionment.

The recent controversy about overhead illustrates just how bad things have become.

A keystone of the government- university partnership was the agreement that government would pay the direct costs of research as well as for part of the overhead costs of sustaining overall institutional research strenght--

Overhead rates are negotiated by each university

with a governemtn sponsor covering a portion of the costs of such agreed upon items as utilities facilities, building depreciation, administrative costs, and other expenditures such as libraries, information technology infrastructure, etc.

By any standard it has been a bargain for the American people.

Government saved all the costs of building and supporting separate research facilities

research products such as computer chips, XX and gained many other intellectual multiplier effects in the bargain.

But now government increasingly is shifting the full costs of doing research to the universities.

Now when research institutions are already brought to their knees by drastically reduced revenues

there is a nightmarish effort to rescind these contractual arrangements unilaterally.

and not through good faith negotiation among friendly and longstanding partners

but in screaming headlines, leaked stories, misleading claims, and hostile maneuverings for political advantage.

Some government auditors now are actually claiming that perfectly legal contracts

establishing overhead are unenforceable because they are "inequitable"

They are suggesting that they intend to collect

a punitive \$XXX million dollar bill to top research universities.

This may just another political game for some

But for some of America's strongest universities

and for America's future technological competitiveness

this could be a deadly blow.

Of course, there have been some abuses--

They should be and are being addressed.

Few if any the result of misconduct and the amounts paltry in comparison . to the real scandals of S&L bailout.

In fact, most of the allegations of misconduct

are no more than the normal disagreements among accountatnst on both sides

trying to apply a far too vague set of regulations.

(Jim: Note that the foregoing section might be cut if too controversial)

The recent conflict about overhead charges

really just another step in the government

effort to shift more of the costs of research to our universities.

It is a perfect example of seeking short term savings

at the expense of the future.

If government is looking to the universities to fund its research,

and pay for facilities and equipment

this country really is in trouble .

It just isn't there, folks.

Bureaucratization, politicization, and regulation

also are a symptom of the deteriorating relationship.

Amount of review and length of review between submission of proposal

to federal sponsors and beginning of research is now close to a year.

Increasing regulation of science adding to costs and bureaucracy

e.g., new standards for animal care, collection,

handling and storage of radioactive, biohazards or toxic wastes,

environmental air quality, handicap access,

however important or desirable, contributes to rising costs

and administrative creep.

Another very serious problem in the government-academic science relationship

is government regulated intellectual "protectionism"

threatens to the vitality of science and its fundamental values.

The free flow of ideas and persons is essential for good science.
The government may want to protect new technologies
from foreign competitors.
There may be room to negotiate
but unilateral efforts to interfere with scientific exchange of ideas
in the long run accomplish little and they
endanger overall scientific progress.

Shrill search for fraud in science
another example of the adversarial relations.
Certainly universities and scientists must set
and keep to the highest standards of integrity
but there are real dangers in the witch hunt mentality that prevails
among those who are more interested in headlines than science.

All these and other problems suggest that
the time has come to renegotiate the social contract
between government-academic science from the ground up.
Ultimately today, we lack that earlier sense of shared vision and high purpose
and this more than anything is the reason for breakdown in the relationship.
Need to redefine and clarify our mutual expectations and obligations
but more importantly to set forth a new, generous, and compelling vision
for the national interest in promoting science and technology.

6. Sixth warning sign is the depressing deterioration of public understanding
and support for higher education, science and technology
As I said at the outset, higher education has been the subject of a lot
of critical attention of late.

I have literally filled a bookshelf and file drawer
Given their increasingly vital role in the emerging economy,
I often ask myself why this is happening.
But perhaps it is not so paradoxical.
When you get right down to it,
the key issue is that, at least in part,
we are victims of our own success.
Today more people have a stake in higher education.
More people want to harness it to their own ends,
We are more visible, more vulnerable,
We attract more constituents and support
...and more opponents,
We have become in the minds of many
just another arena for the exercise of political power
...an arena for the conflict of special interests
We have become a prime target for
media attention and exploitation
We are more a focus of concern of the powerful
and for the powerless.
Given the divisions in society at large,
is it any wonder that we find ourselves the battleground
for many competing values and interests, both old and new.
(Jim: Foregoing is probably expendable)

The very ethos of higher education and science is being undermined
as the all too familiar current of anti-intellectualism in American life
runs at high tide.

Prevailing populist sentiments often are at odds with maintaining
highest academic standards --giving rise to charges of "elitism"
that play well in the popular press---certainly must admit this is exacerbated
by the arrogance of some of our scholarly spokesmen.

On the one hand the so-called "new age" thinking

has a grip on leading elements of our culture
rejecting the "rationalism" that is the very foundations
of scientific learning and technological development.
Meanwhile, mostly from inside the academy neo-marxists assert
that "objectivity" sought by science is impossible
a fraud because it is tainted by class interest.
Obviously we must do a better job of public education about science and technology
issues,
we are not likely to be able to count on the political viability of
any technology policy, however sound.

7. As a result of the problems I've described
The morale of academic researchers probably has never been lower.
And I think this is the most ominous warning sign of all
since it is bound to affect future recruitment and current productivity
not just of universities
but of our society.
It is telling that a recent special report in *Science* was entitled:
Science: the End of the Frontier.
Leon Lederman, President of the AAAS notes the results of an informal survey
of scientists
as reflecting a "depth of despair and discouragement
that I have not experienced in my forty years in science"
He reports that senior colleagues have said they are "ready to throw in the towel"
Obtaining and managing funding taking more and more time away from research
Amount of review and length of review between submission
and beginning of research has now close to a year.
Funding competition that undermines collegiality, bureaucratization,
teaching, monitoring, and professional pride and satisfaction.

Listen to leading scientists responding to the *Science* survey:

"(There were) three incidents where we had to stand by while competition from abroad
moved forward on research based on our ideas....The history of the past decade is one
of continual harassment over money, lost opportunities due to inadequate support, and
a stifling of imagination due to money worries." from MIT

"The effect is devastating....Our senior faculty are demoralized and our junior faculty
are jumping ship. Undergraduate and graduate students are turning away from
science at a time when we need them most." (Illinois)

"Funding situation is the worst I've seen in 25 years as a successful researcher" Yale

"I suspect if I were 25 years younger, I would not choose an academic research
career. "

"I spend about 30% of my time writing proposals and progress reports.....morale,
momentum, critical mass are all in grave danger." MIT

"I expect that you will find that irreparable damage is being done to new young
investigators starting up their first labs." Berkeley

Lederman from *Science* "...academic research community beset by flagging morale,
diminishing expectations, and constricting horizons. "

My colleagues and I in academia are sounding the alarm!

We have been living on the intellectual capital
generated during that Golden Age" of American science of the late sixties.
Will our generation be the one to use up the last of this wealth
doing nothing to replace and extend it for our children?

Our universities today are endangered by formidable forces
at the same time
that they are called on to take on new and critical roles

Our Chair today, Erich Bloch, pointed to the array of tasks before us: "The solution of virtually all of the problems with which government is concerned: health, education, environment, energy, urban development, international relationships, space, economic competitiveness, and defense and national security, all depend on creating new knowledge--and hence upon the health of America's research universities." □

Universities are putting their own house in order

I have already noted the troubling issues threatening academia.
But I would not want to suggest for a moment that we don't also have serious
internal challenges to address if we are to serve America well in the future.

Unlike many other institutions in our society, universities are trying to
reshape our institutions to reflect the rapidly growing ethnic diversity of our population.
At the same time, we must come to terms with internationalization
that requires us to prepare our students to function effectively in a global society
revolutionizing our teaching, research, and service missions.
Finally, we are creating information technology infrastructures and networks
that are the equivalent today of the interstate highway system of the fifties.
The difference is that now we are moving the information that is the lifeblood
of the new economy.

Most of our universities recognize that continuing incremental growth
not possible and not what we need, anyway.
From here on out, we will have to plan and manage better.
eliminate those activities that, however useful, do not relate to our strategic purposes.
We are borrowing from business some of the lessons of restructuring
introducing strategic planning, reducing bureaucracy, implementing total quality
management
cutting costs while improving quality and efficiency.
Trying to change our academic culture
to encourage boldness, daring, quick decisions, and risk taking
Intellectually and structurally, we are trying to shift the balance
of disciplinary and interdisciplinary teaching and research,
reform and improve undergraduate and graduate education,
individual and collaborative research,
coming to grips with the need to provide lifelong education.
Of course, we are giving a high priority to trying to find
better ways of transferring the products of research
so that they can be put to productive use.
Expanding the concept of extension services to assist small manufacturing
information networks for sharing technical information and providing advisory services
Reaching out to establish partnerships with many constituencies,
especially the schools to help improve standards.

In a much larger sense, Universities are asking themselves if it is time to break the mold
to reinvent ourselves, open our minds to new possibilities and challenges.
This time of great change, shifting paradigms, provides the context
in which we must consider the changing nature of the academic research enterprise itself.
Can no longer simply extrapolate the past.
Instead, we should not shrink from exploring
the full range of possibilities for the future.

But here we face a dilemma: both the pace and the nature of the changes occurring in our
world today have become so rapid and so profound that our present social structures
government, education, the private sector--are having increasing difficulty in even sensing

the changes, although they certainly feel their consequences, much less understanding them sufficiently to allow institutions to respond and adapt.

Let me go further. I worry that our present institutions, such as universities and government agencies, which have been the traditional structures for intellectual pursuits such as research, may turn out to be as obsolete and irrelevant to our future as the American corporation in the 1950s. We need to explore new social structures capable of rapidly sensing and evaluating change and capable as well of engaging in the strategic processes necessary to adapt and control change.

To take just one example, since the business of the academic research enterprise is knowledge, let me suggest that the impact that extraordinary advances in information could have--likely will have--profound implications for what universities do, where, when, and how they do it. Technology such as computers, networks, H.D. t.v., ubiquitous computing, knowbots, and other advances may well invalidate most of the current assumptions and thinking about the future nature of the research enterprise.

Will the "university of the twenty-first century" be localized in space and time, or will it be a metastructure involving people throughout their lives wherever they may be on this planet, or beyond? Is the concept of the specialist really necessary--or even relevant--in a future in which the most interesting and significant problems will require "big think" rather than "small think," where intelligent software agents can roam far and wide through robust computer networks containing the knowledge of the world and instantly and effortlessly extract what a person wishes to know.

Will lifestyles in the academy (and elsewhere) become increasingly nomadic, with people living and traveling where they wish taking their work and access to their social and professional networks with them as recently speculated by Attali?

In the spirit of these questions, perhaps we should pay far more attention to evolving new structures such as "co-laboratories" in which scholars collaborate worldwide through robust networks, rather than old fashioned structures, such as research universities, federal research laboratories, research projects, centers, and institutes. There is a possible implication here. If information technology will indeed allow, perhaps even require new paradigms for research organizations, should we not place a far higher priority on linking together our scientists and engineers, not to mention linking them with the rest of the world, including private business and industry? This would seem to be a modest investment compared to other megaprojects such as the superconducting supercollider and the space station. Further, without investigating the impact of this technology-based infrastructure first, we may find ourselves making massive investments in research structures of the past.

The challenges of coming age are immense

We have just lived through one of the most incredible periods
in human history? -

-collapse of communism, biotechnology, moon walk, information technology.

We no longer have to sustain a disproportionate share of the costs of Western security
freeing up for the first time in half a century, new resources for investment.

Isn't it ironic that the national mood should be so morose

our sense of possibilities is so constrained and our mood so fearful?

We should literally be full of confidence and optimism

eager to meet the challenges ahead.

at this conference

For the first time we have within our reach knowledge and technology

to take on the truly big and significant research tasks

address problems, improve the quality of life

--global warming, human genome,

and the whole host of problems that cry out for accelerated

pace of research --health, environment economy--

We seem to be in a state of national paralysis, mired in pessimism,

forever caught up with old issues and ideologies, cynically pursuing special interests

at the expense of the society as a whole, gobbling up our children's future with greedy consumption, unwilling to save or invest, unwilling to face realities. Rather than rejoicing we are sour, suspicious, eagerly stalking scapegoats instead of taking honest stock of ourselves and our future.

Robert Reich (pronounced as sh): "Most fundamentally, the American political process at the highest national level failed to identify the critical nature of the transition through which the nation was passing and to focus the great energies of the continent on a satisfactory passage to a new phase in American and global history. (Reich)

Earlier speakers at this conference have pointed to the evidence that bears him out. e.g., American gains in productivity since mid-70's is the poorest of the Big Seven of the industrialized world.

Who would have thought we would see America in sixth place in per capita gnp-- My colleague Paul McCracken points out about the same position that Argentina occupied at the turn of the century ...something to think about!

Japanese share of global high tech market increased from 18 to 27 percent in 1980's while US and Europe share dropped by 4%.

Cause is failure to invest in basics

US non-defense research still higher than any other country as percentage of GNP=1.9% in 1989

But Japan spends 3% of GFNP on non defense research and Germany 2.8% (according to Science) and there is recent evidence that Japan actually outspends us in real dollars.

Also great cause for concern is leveling off of private investment in R&D

Rising share of commercial benefits of American research innovation is going to foreign countries

Growing gap between rich and poor, "symbolic analysts" and non skilled workers.

Will a technology policy help?

The short answer is yes,.... but

A good case can be made for a strategic approach to investment in critical generic technologies.
advanced materials
biotechnology
information technologies
manufacturing and process

It makes sense to start with limited objectives and an experimental approach rather than taking on an agenda that is too large and diffuse.

Better to demonstrate results with specific strategic goals to help launch initiatives and then get out of the way

....A modest technology policy would fill a void in public policy making and resource allocations especially if it is designed to strengthen our academic research base as well as our civilian technology .

Jim: Note that Erich Bloch says that Vannevar Bush's Report was written "at a time when our science base was weak and technological base was strong. Now situation is reversed/basic research and higher ed system are strong while our civilian technology is weak. I am assuming you want to challenge his assertion about academia a bit

The new OSTP US Technology Policy is a big step forward
a credit to the efforts of Dr. Bromley and others.

Technology policy would help stimulate market and public incentives and vehicles to promote new and more productive relations between academia and private sector

Perhaps would help improve the "fit" of mutual expectations and obligations because I think both sides often have had trouble in working well together .

Technology policy could direct support to higher risk ventures

Explore ways to shorten time lag between discovery and commercial adaptation.

One thing to be grateful for is that the old dichotomy

between theoretical and applied research, never been very useful has finally been put to rest.

Bloch: science and technology a continuum--interacctive and interdependent--with stimulation and feedback flowing back and forth through system. Flow is neither linear nor unidirectional. Science asks "what is" while technology asks "what can be?"

..A new policy initiative might help us make sense of the technology policy we have already.

To be sure, it is uncoordinated, scattered and and has gradually lost strategic focus.

But it does also have the virtue of flexibility,

security of multiples of funding sources, experimentation with structures and vehicles. provides multiplicity of incentives that call forth investments by private sector as well as coordination and collaboration with universities. e.g.,

...Government industry consortia such as SEMATECH in semiconductor manufacturing

....Engineering Research Centers and Science and Technology Centers founded to foster closer cooperation between in multidisciplinary research and education relevant to industry. Science notes that a report soon to be released says the 45.6 million is being leveraged to produce highly significant results.

...Multi company industry efforts such as MCC and SRC

...Three Regional Manufacturing technology Centers sponsored by NIST to help small business improve productivity through technology transfer

There are also the National Laboratories

Over 700 such laboratories, accounting for over one-third of federal R&D expenditures, \$21 billion a year.

Seem to represent "the marching army" syndrome. Federal laboratories originally designed for highly specific roles, such as atomic energy development, defense research, or manned space flight, have acquired a momentum and a constituency quite independent of these original roles. Many of these laboratories are now thrashing about, seeking to find other missions to justify their massive public investment. But in the process, they are trampling other sectors such as education and industry.

Perhaps a national technology policy framework would help us assess the relative economic productivity of these labs in comparison to investments in universities and industries.

Above all, technology policy could help bring national attention to issues, stimulate policy debate, and help focus and prioritize decision making.

Caveats

I do think there are some caveats

For example, a policy should not take on or promise too much, start small and demonstrate effectiveness. risk of boomerang effect if can't deliver.

I worry that if we justify a national technology policy

purely in terms of national competitiveness

we try to motivate by appeals to protectionist sentiments, scapegoating, and self interest that not only are antithetical to the values and methods of science and academia.

but also create backlash since they are not worthy of our best values and will not inspire us to achieve common purpose and goals.

Instead, let us set our sights higher

when we consider a new basis for partnership between universities and public.

Set us on the path to the great frontiers of the twenty-first century.

Reaching for the stars, colonizing space,

and perhaps even the existence of other life forms.

using powerful new tools such as molecular biology

and information technology to create a new future

enabling mankind to break the bounds of our planet

and begin the colonization of our solar system and

perhaps even the stars beyond

creation of new materials, atom by atom, of

artificial intelligence, of new life forms.

