INSTITUTIONS OF HIGHER LEARNING AS CREATORS OF WEALTH FROM NEW KNOWLEDGE

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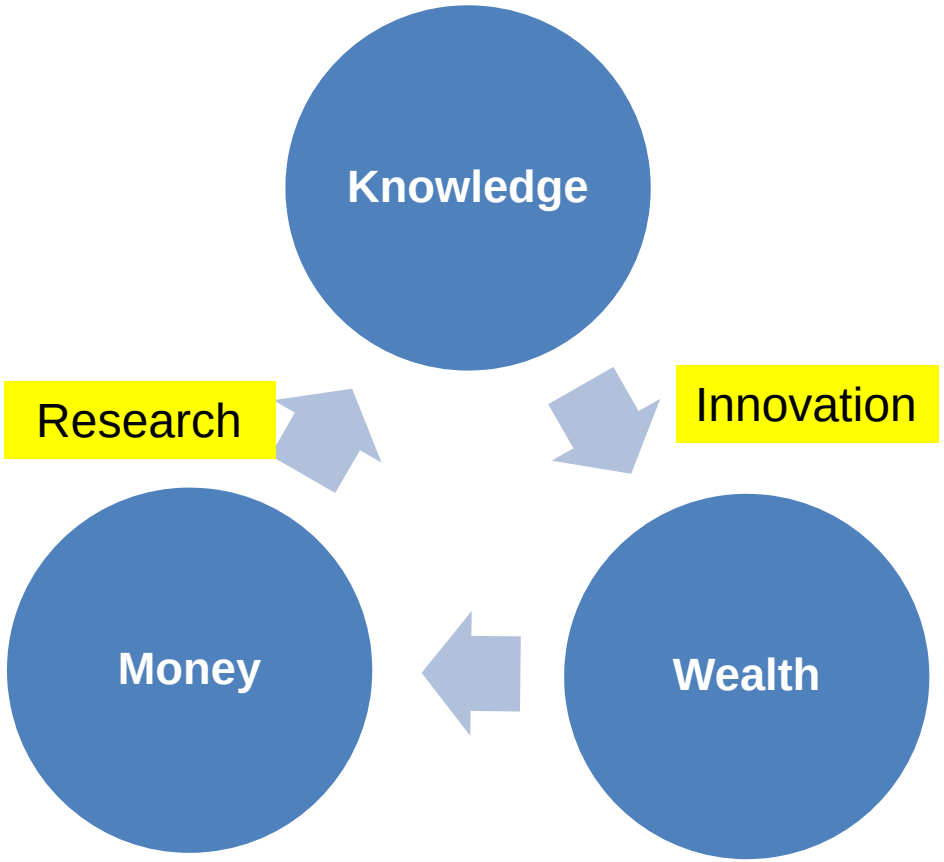
CREATING WEALTH OUT OF KNOWLEDGE

- ***Where*** : Universities, research laboratories, society, industry
- ***Who*** : Faculties, scientists, students, individuals as well as S&T professionals in industry
- ***How*** : Technology transfer and licensing, consulting, spin off ventures, in house conversion to products and services, out-licensing and co-development with partners
- ***Why*** : To create a virtuous cycle of wealth creation from knowledge



Only exploitation of knowledge can create wealth !

PURPOSE OF A UNIVERSITY

- Teach to educate
- Perform research to train
- Exploit Knowledge for public good or private good ?

Teaching, knowledge generation and dissemination were the core purpose of an university, not exploitation
Universities are good at discovery and creation of new knowledge; they have poor skills in exploitation

STRUCTURE OF SCIENTIFIC ENTERPRISE AT THE BEGINNING OF THE 20th CENTURY

Money

University **Government** Laws, Regulation

Industry

(Professor/Student/Problem/Thesis)

(Development, Manufacturing, Distribution/Sales)

Justus von Liebig 1803-1873

Students: Employment

Professor : Consultant

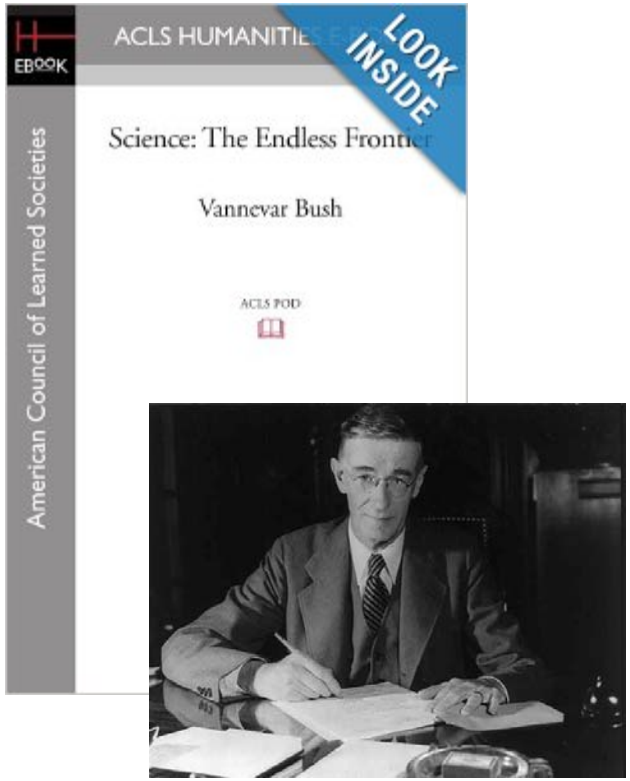
Knowledge, People

Products/Solutions for Problems

Many of Liebig's students became pioneers of the German chemical industry around 1900

IMPACT OF SCIENCE ON SOCIETY : THE LINEAR MODEL

- The tenet : investment in “basic research” by a nation ”performed without thought of practical ends” will lead to prosperity for its people.
- More money, more Institutions, more research, more papers and PhD’s will result in greater prosperity and wealth creation in society
- Basic leading to applied leading to development leading to production and markets : A linear model
- This tenet was implicitly accepted by Governments around the world as an established public policy
- Only a few years ago, the world began to question this assumption
- Rising above the gathering storm: Energizing America for a better future : National Academy of Sciences , 2007; Is the frontier really endless ? Bruce Alberts, Science 330, 1587 (2010); Gathering Storm revisited : Rapidly approaching Category 5 : National Academy Press, 2010; Roger Pielke, Nature, 466, 922, 19 August 2010



1945

The phenomenon of Increased public funding with reduced public accountability

THE SOCIAL FUNCTION OF SCIENCE

(J.D. Bernal, George Rutledge and Sons, 1939)

- Utility is the central objective of the scientific enterprise
- Central role of state in supporting / promoting science

The beginning of organized science or government funded or directed science

Roger Pielke, Nature, 27 March 2014, Vol. 507, 427

The Sage of Science, A. Brown, Oxford University Press, 2007

SMALL SCIENCE VS BIG SCIENCE

Individual scientists pursuing truth leads to the most efficient social outcomes

Michael Polanyi

The Republic of Science : Its Economic Theory,

Minerva, I , 54 (1962)

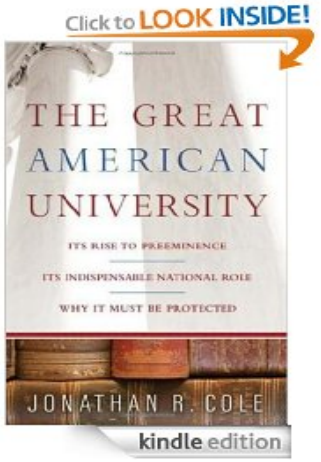
The intellectual debate between Bernal and Polanyi was one of the most engrossing debates of the second half of twentieth century; With the decline of communism and the rise of capitalism, Bernal lost this intellectual battle !

THE GROWTH OF RESEARCH UNIVERSITIES

- Academic values: Universalism, organized skepticism, creation of new knowledge, free and open communication of ideas, disinterestedness, free inquiry, academic freedom, international communities, peer review systems, loose governance and vitality to the community

- The primary purpose of an University became to be recognized as research with teaching as a secondary activity

- The Bayh - Dole act gave to University administration the same rights that Industrial R&D Centers had, i.e. the University could own the IP generated by faculties and create commercial values out of it. Bayh - Dole Act enabled , both, IP licensing and creation of spin offs



2010

A ROMANTIC VIEW OF SCIENTIFIC RESEARCH

" Scientific research has to do only with the respect with which we regard one another, the dignity of men, our love of culture. It has to do with : are we good painters, good sculptors, great poets? I mean all the things we really venerate in our country and are patriotic about. It has nothing to do directly with defending our country except to make our country worth defending"

Robert Wilson, arguing for support from the US Congress for building the Fermi National Accelerator, 1969

Source: Scientific Temperament: Three Lives in Contemporary Science, P. J.Hilts, Holiday House, 1984

GOVERNMENT FUNDED RESEARCH IS OF A RECENT ORIGIN

State funding of research is a post world War II phenomena

A large part of nineteenth and twentieth century research and explorations in science were not funded by the state.

It was the two wars that gave impetus for the state to step in and direct research

No government funded research project on energy technology led to the discovery of steam engine or electricity, nor the discovery of automobiles and airplanes a programmed outcome of a structured approach to transportation technology !

DOES PUBLIC INVESTMENT IN S&T DRIVE ECONOMIC GROWTH?

- US became a rich nation around 1900 when there was no state funding of science; the industrial revolution occurred without state funding
- Much of twentieth century's economic growth was the consequence of two World Wars
- Economic activity is stimulated by privately funded research; Publicly funded research has no effect on economic growth *(The Source of Economic Growth, OECD Report, 2013)*
- Returns on publicly funded research is near zero
- Between 1998 and 2003, the budget of US NIH doubled. What were the economic or health outcomes of this increased investment ?
- GDP growth of a country has no correlation to its investment in S&T
- Investment in science and engineering research boosts economic growth *(CaSE, UK Report, Chemistry World, June 2014, p.9)*

The integration of Vannevar Bush's tenet with the economic theories of Joseph Schumpeter and Robert Solow in the early fifties led to the creation of the thought (or myth) that public investment in R&D is critical to a nation's growth

Terence Kealey, www.telegraph.co.uk/news/politics; Roger Pielke, http://thebreakthrough.org/index.php/voices/roger-pielke-jr/tall-tales-of-economic-growth/ ; C.Macilwain, Nature, vol.495, 143, 13 March 2013

THE PERILS OF ASKING GOVERNMENT TO SUPPORT SCIENCE

Improve the conduct of research that “can transform and improve our lives, advance our understanding of the world and create meaningful new jobs”

Tom Coburn

Senator from Oklahoma

NSF Appropriations, 2011

Politicians have overblown expectations from the scientific enterprise, from the exalted to the mundane !

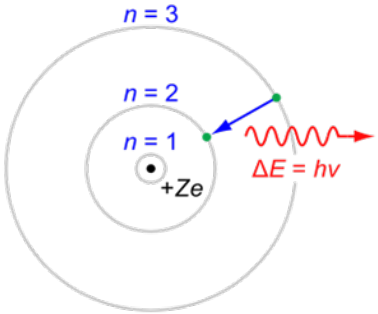
ISSUES IN EXPLOITATION OF ACADEMIC RESEARCH

- One extreme view is that academic research and commercial considerations of results do not mix
- Commercial considerations of research do create conflict in academia between the need to disseminate knowledge and limit access to knowledge
- Public pays twice for the same invention; taxes support university research that yields the invention and the high monopoly prices charged by the provider when the invention reaches the market

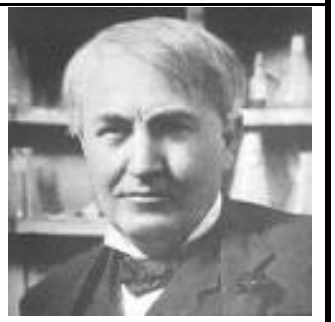
Should academic departments avoid redirecting research purely for commercial outcomes ? Should commercial opportunities be considered only as welcome by products ?

Pasteur's Quadrant

Bohr



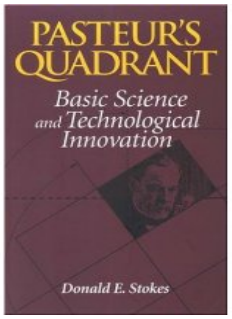
Pasteur



Edison

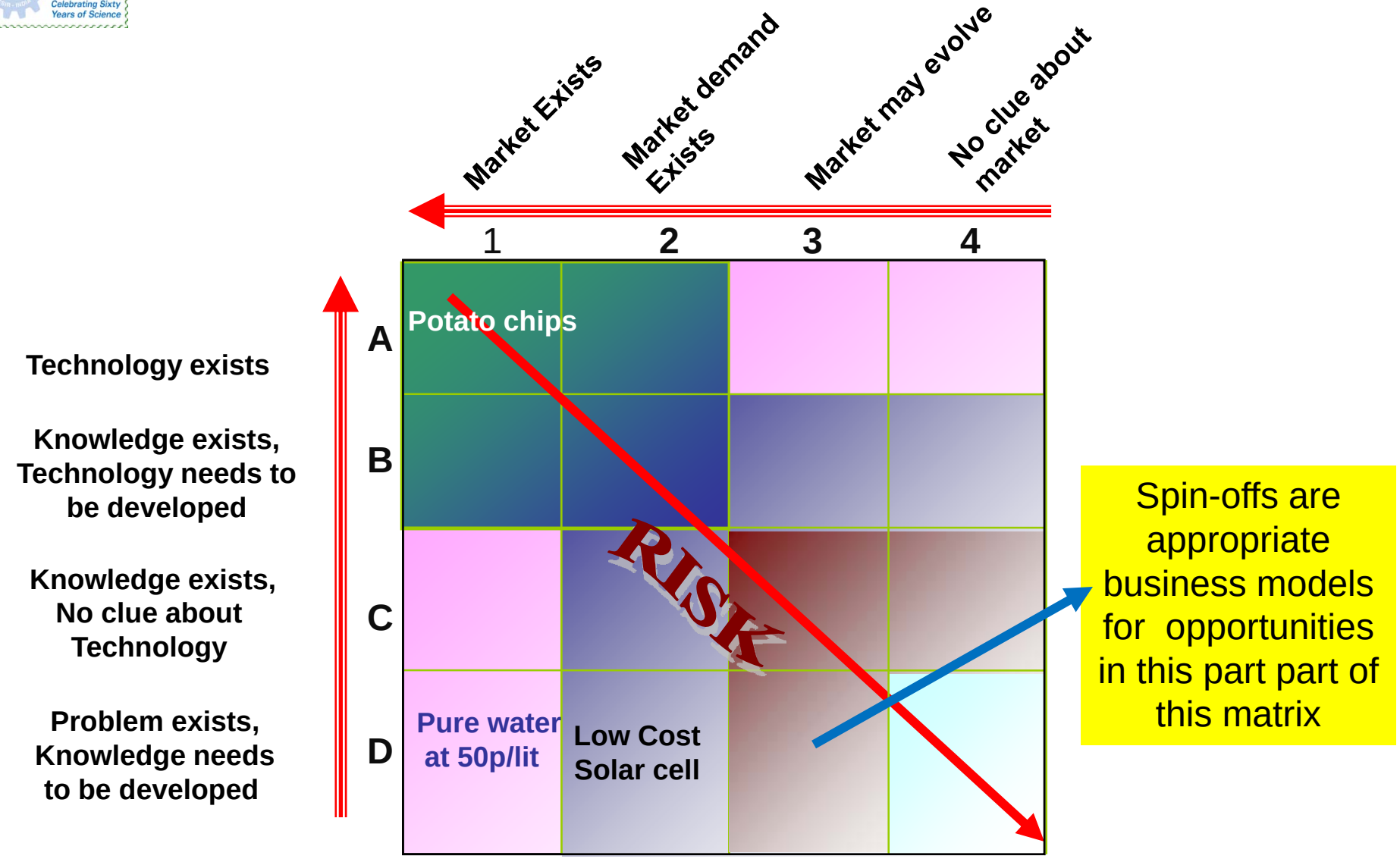
Fundamental Research

Use Inspired Research



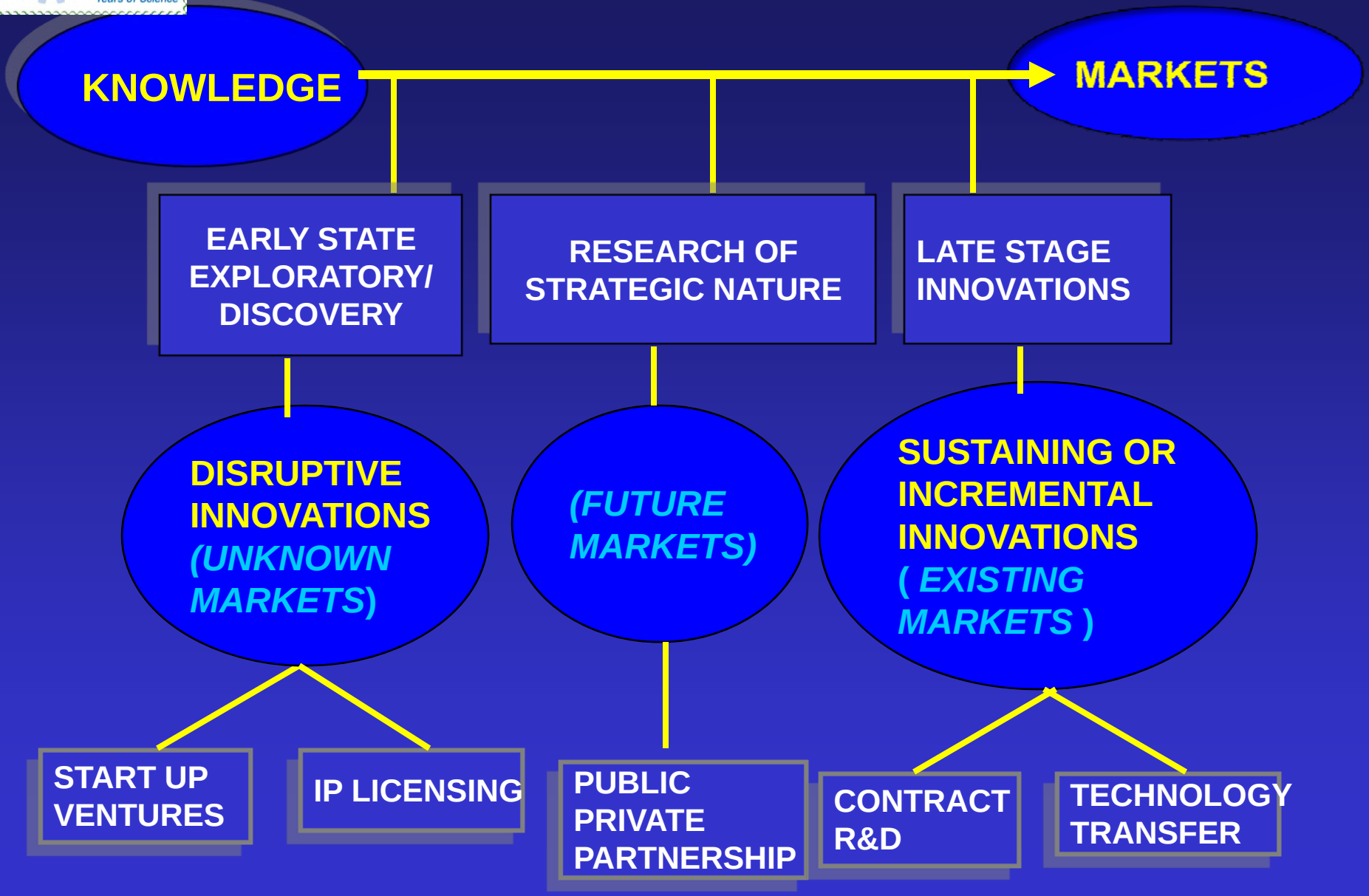
1997

COMPETITIVE POSITIONING OF KNOWLEDGE AND MARKETS



Academia needs to operate increasingly in the lower half of this knowledge – market matrix

LINKING KNOWLEDGE TO MARKETS



INNOVATION: INDIAN SCENE

- Weak and rare, both in academia and industry
- The western world moved from agrarian to industrial and then on to service based enterprises over two hundred years. The work force had the time to accept and manage the change through skill up-gradation and education
- In India we seem to have missed a full blown industrial revolution
- Consequently we also missed the beneficial aspects of the manufacturing revolution. India began to industrialize in the early fifties, but before this process reached maturity, we migrated to a service economy
- Our most successful businesses are focused on service models. Service industry does not require process or product innovations, but only innovations in delivery and cost management.
- The competitive advantage of companies in India do not depend on technological innovations but on process innovations
- Therefore, few large companies in India have deep traditions of research

INNOVATION : INDIAN SCENE

- In India, even R&D began to assume a service model, largely due to the cost arbitrage. A large proportion of R&D that is conducted in India by companies are for customers outside India, both by global MNC's and by Indian companies.
- The outsourced R&D model never gave Indian organizations an opportunity to take a concept to the market completing the full innovation chain. Instead they were only deployed to do those things where they had some competence
- The large corporations of the world knew better how to manage Indian talent. Indian talent today creates IP and value for the global corporations
- Few Indian organizations have learnt to effectively manage intellectual talent
- Universities and academia are driven by goals of peer recognition and the tyranny of factors and indices (H-index , Impact factor, funds); wealth creation not on top of its agenda
- The reasons are , both, socio – cultural as well as economic

Can India become an science and technology driven innovation powerhouse if the share of manufacturing in our GDP continues to be so dismally low ?

CREATING WEALTH OUT OF NEW KNOWLEDGE : THE INDIAN CHALLENGE

- Mindset not oriented towards problem solving
- Tendency of academic community to assume a high pedestal
- The concept of academics as consultants to industry non existent
- Institutions function in departmental silos
- Institutions are predominantly resource driven
- Faculties do not see a compelling need to create IP.
- Peer recognition systems heavily biased in terms of abstract academic research; not enough incentives for individuals who wish to translate science into products and services
- Distance from markets and users
- Weak institutional mechanisms for technology transfer, IP licensing and creation of start ups ; poor supporting innovation ecosystems
- Poor communication of research results to user community
- Inadequate risk takers , both, in industry and academia
- Talent mobility
- Lack of role models for scientist - entrepreneurs

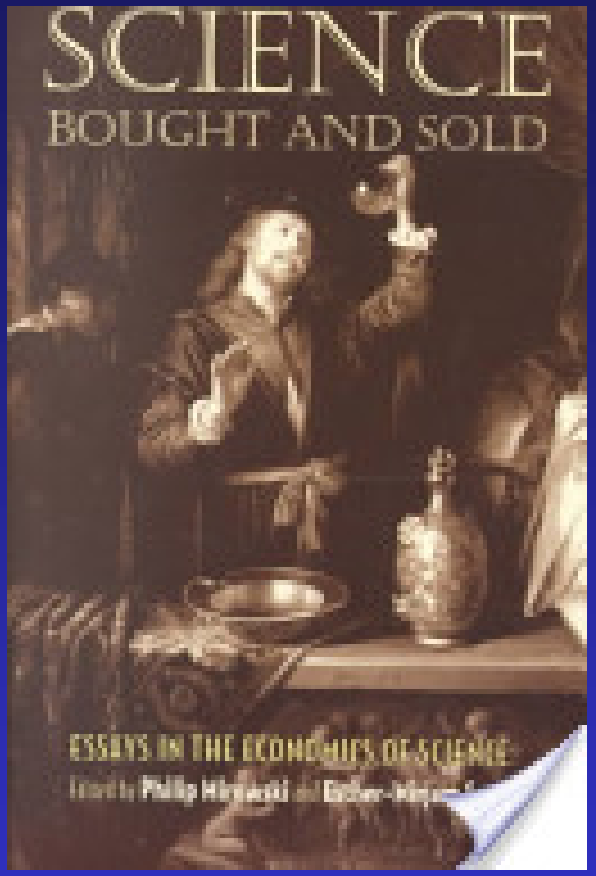
R&D INSTITUTIONS AND NATIONAL INVESTMENT ON R&D (DSIR, 2007)

R&D Institutions	Number of institutions	Percentage of national investment on R&D (2003-04)
Central government R&D institutions	707	62.6
Public sector institutions	115	4.5
State government institutions	834	8.5
Universities and institutions of national importance	284	4.1
Private sector institutions	2020	20.3
Total	3960	100

SOME PRESCRIPTIONS FOR CHANGE

- Improving the innovation ecosystems in universities is necessary, but not sufficient
- Larger change needed in mind set and culture. We need new evangelism to make our universities a breeding ground for new thoughts and big ideas that will impact society
- Too long, we have created specialized academic institutions, exclusively for science, technology, medicine and research institutions focused on narrow disciplines. Within these institutions there are departmental silos
- To foster a climate of innovation we need to bring disciplines together under one roof
- Research must return within the folds of a university. Skewed funding of research to autonomous scientific institutions has done a great harm
- Whereas access may necessitate taking education close to where it is needed, promoting disruptive thinking will require nurturing universities closer to established innovation hotspots.

Goethe once said about science: "To one man it is the highest thing, a goddess; to another it is a productive cow who supplies them with butter. We must honor the goddess and feed the cow.



Science Bought and Sold: Essays in the Economics of Science, University of Chicago Press, 2002


1950 - 2010
Celebrating Sixty
Years of Science
THANK YOU