



सत्यमेव जयते

Nurturing Centers of Excellence



Experiential Learning

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Different Models of Seeking Excellence or surpassing

- One model is to surpass others at a particular time
 - India's best example is Sir C V Raman
- Another model is to surpass self with time
 - Global best example is Mahathma Gandhi



Nurturing Centers of Excellence: As a Process would need

- Identification and selection of centers of excellence
- Gathering people for whom excellence is a pursuit and shared goal
- Creation of an ambiance where spirit of excellence not only prevails but also self-propagates and unleashing of creative potentials
- Removal constraints which inhibit creativity
- Ensuring of just right levels of resource flow
- Define the value measures and establish a monitoring system

Nurturing Centers of Excellence in Research: Challenges and caution

- Research is a non-linear human activity with many imponderables
- While goals of Research could be defined a priori, outcome of research is hard to predict
- While value measures exist for evaluating science leading to intellectual products, such measures for societal impact of science are not easy to derive
- While promoting excellence, one tends to maximize what can be measured and immeasurable dimensions of research may remain outside the purview of excellence

India's Science, Technology and Innovation story

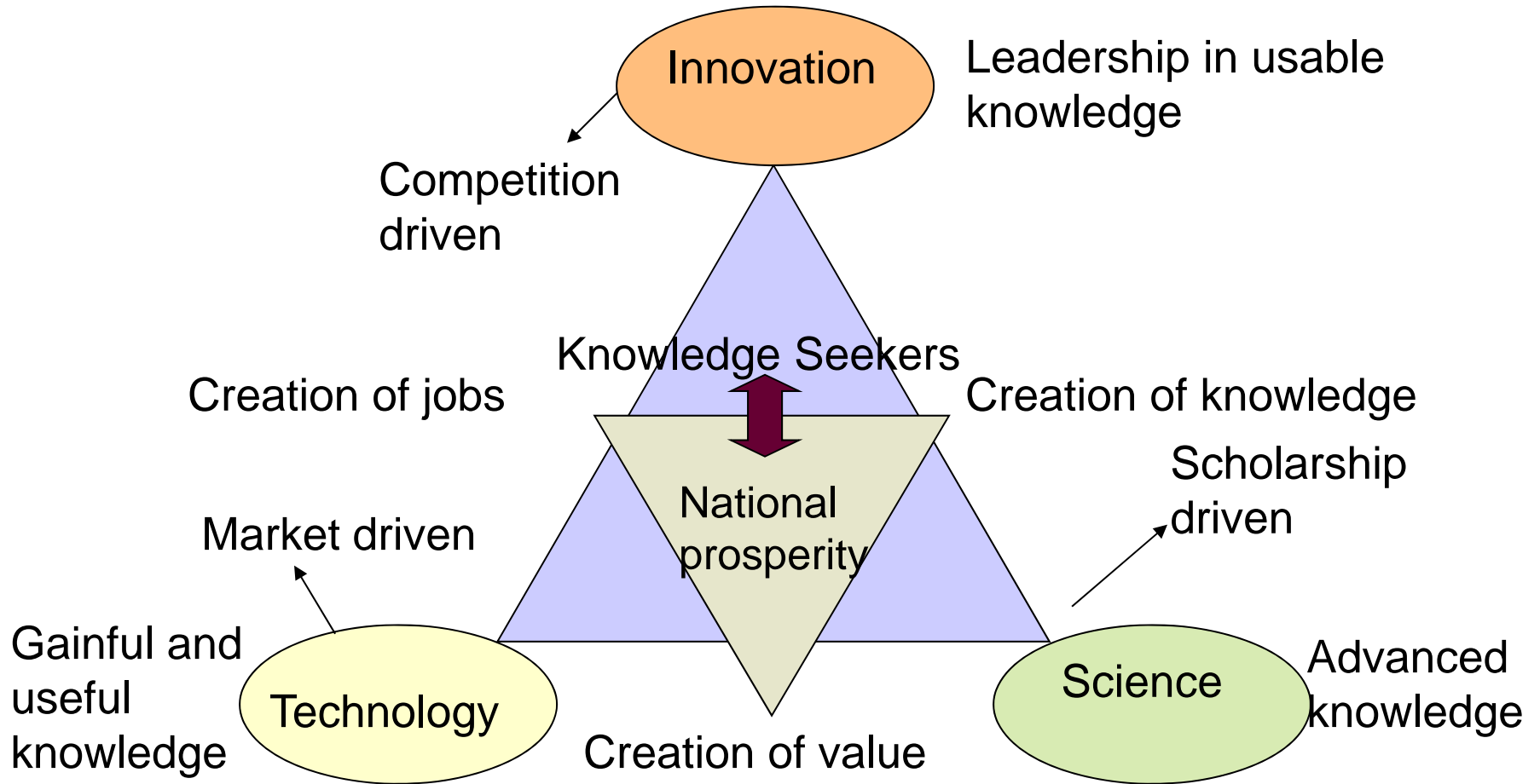
Some Unfolding lessons



Content for Indian STI sector and its changing context

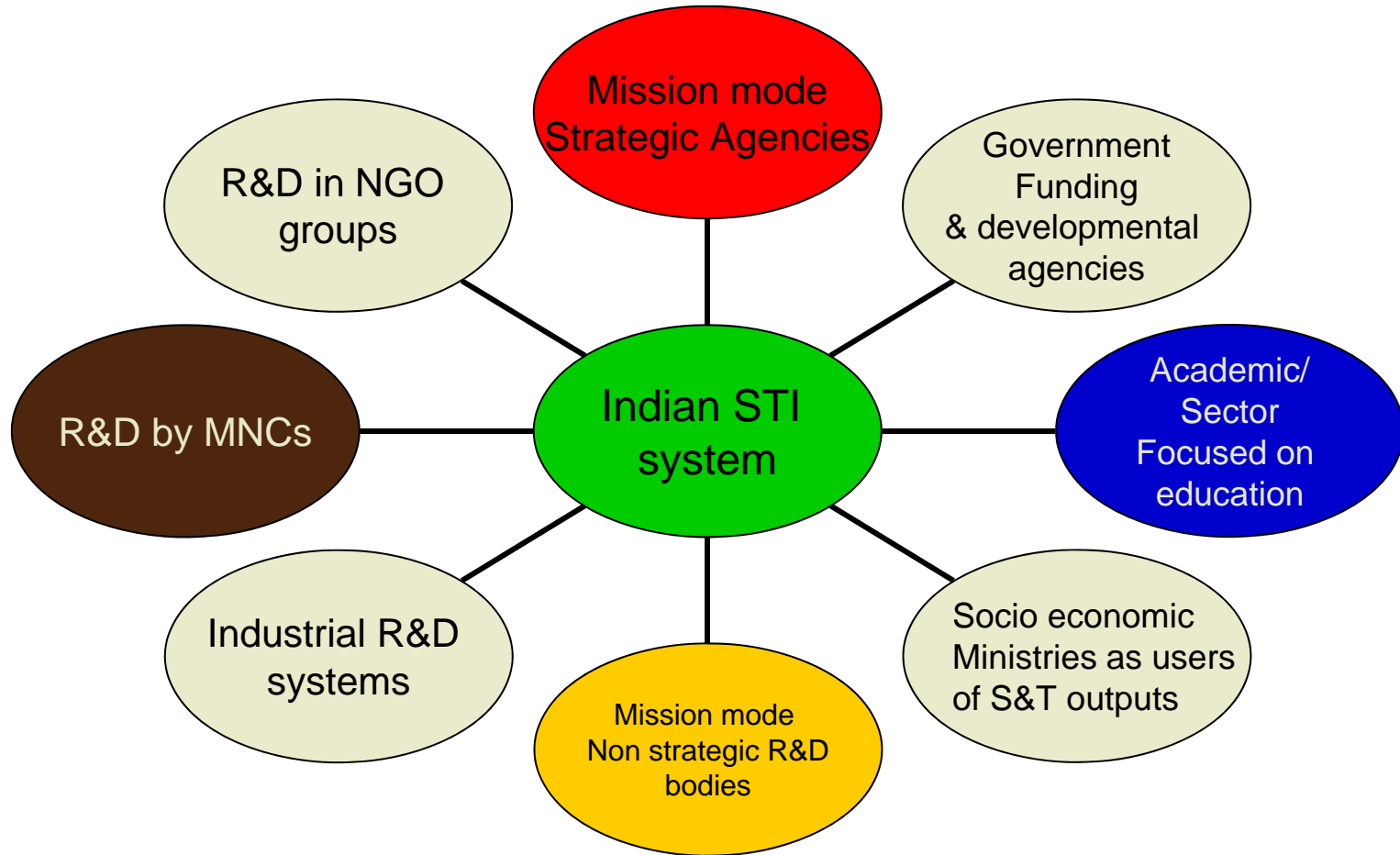
- **Indian science remained mal-nourished for long. Investments into R&D remained low**
- **Robust economic growth $\sim 8.5 \pm 0.5\%$ is providing some surplus for investment**
- **Developmental choices to people are on the increase**
 - ~ 400 million enjoy good purchasing power
- **Inclusiveness of growth in a rapidly growing economy is a challenge**
 - Faster and Inclusive growth remains the stated policy paradigm. It is a challenge
- **India mainstreams STI sector into the developmental strategy**

Research and Development: In Nation Building





Anatomy of Indian Science, Technology and Innovation system



Some what thinly spread but rooted in all dimensions of STI system



Varying Excellence modes of Eight-part Indian STI System

- **Mission mode Agencies:** Focused on self reliance, under transition in the era of techno-globalism for seeking excellence
- **Government Agencies:** Focused on the balancing in the art of funding and excellence in scholarship focused science, market driven technology and competition linked innovation system
- **Academic sector:** Challenged by need to expand many fold without dilutions of excellence and loss of focus on research
- **Socio economic ministries seeking solutions from science:** Challenged by mis-matched rates of scientific development and societal absorption of global solutions for absorbing excellence in society



Varying Excellence modes of Eight-part Indian STI System

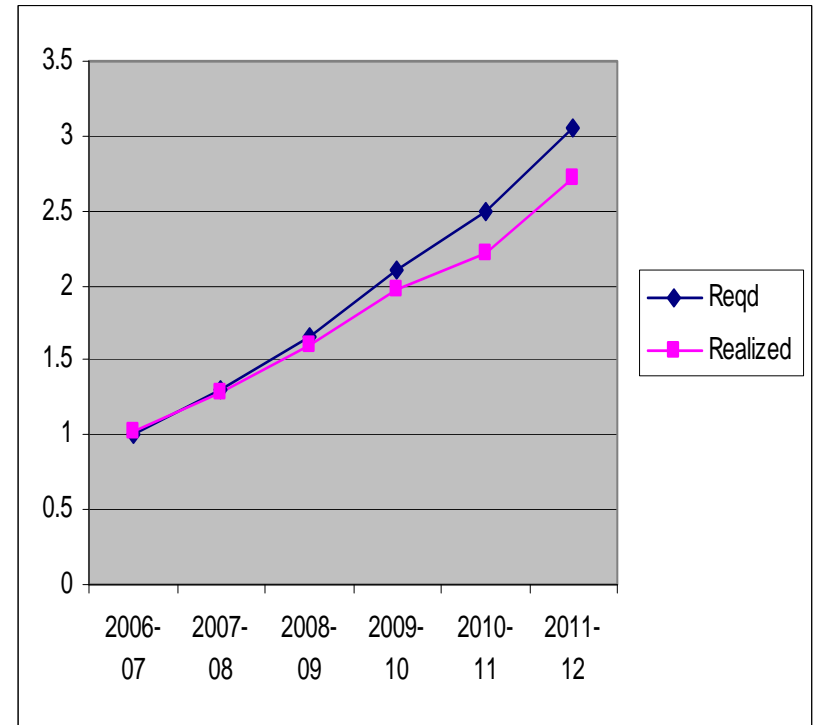
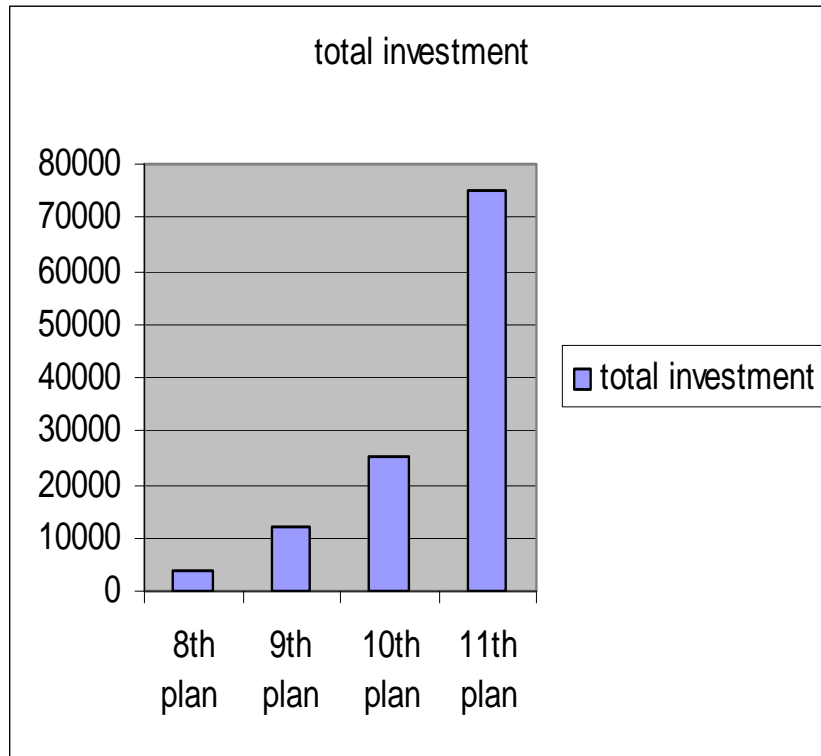
- **Mission mode R&D in non strategic sector:** Transition from command economy models to dynamic global competition in a weak technology demand status for rooting excellence in industry
- **Industrial R&D systems:** Lower levels of private sector investment into R&D and challenges of enhancing value addition to raw materials through innovation driven manufacturing
- **R&D by MNCs:** Taking advantage of low expertise costs for IP generation for global use and competitive excellence
- **R&D by NGOs:** Sustaining high manpower costs and R&D infrastructure in a largely public funded R&D landscape for collaborative excellence

Actions for Nurturing Excellence and some value measures

**Science Advisory Council to PM
Made several recommendations**



Doubling Public Investments into R&D



Annual Growth of about 20-25% has been maintained over 11th plan period

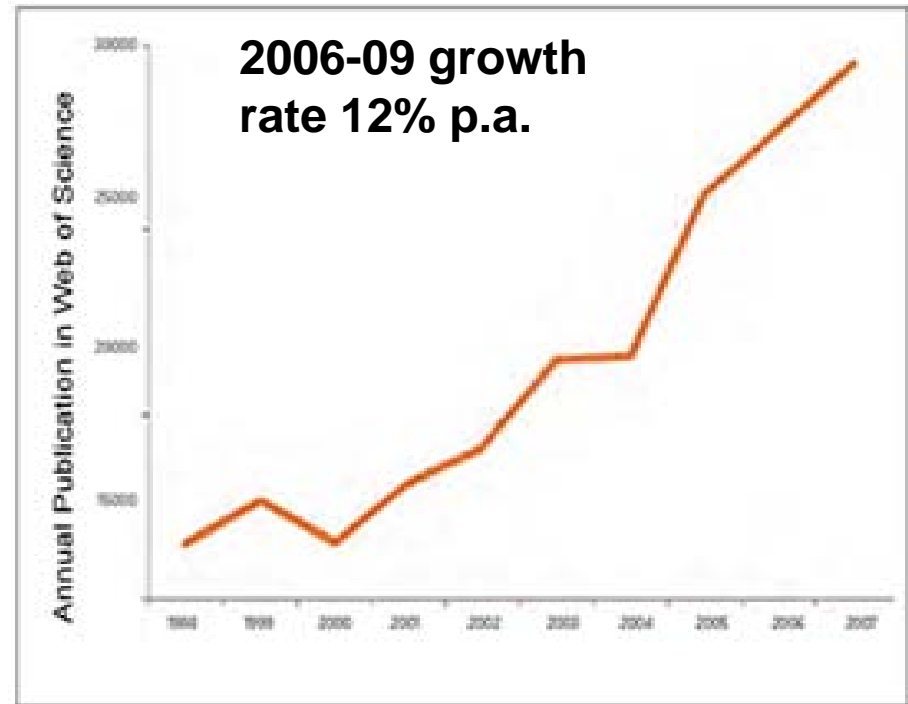
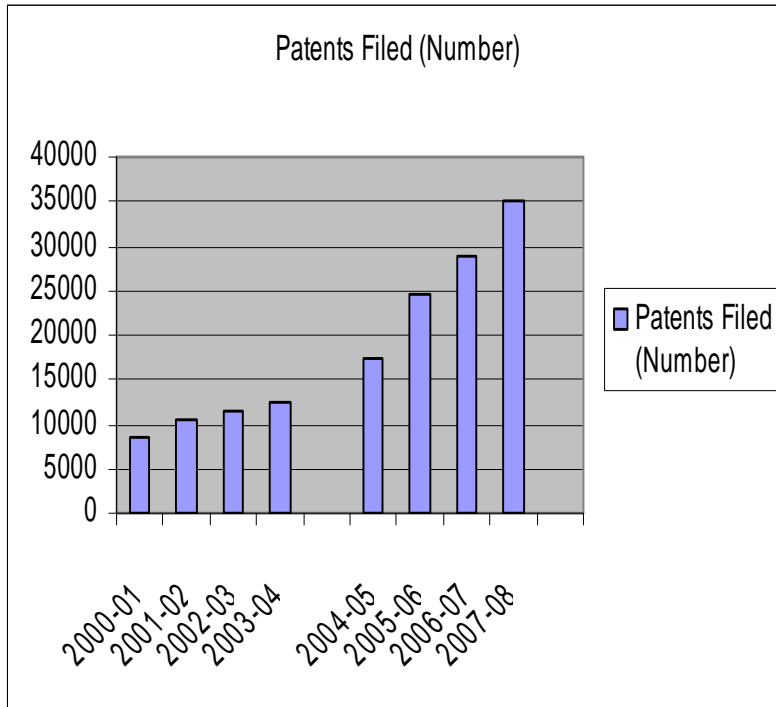


Some Tools of Change designed and implemented since 2006

- **Talent Supply Chain management**
 - Innovation in Science Pursuit for Inspired Research (INSPIRE); JC Bose (top-up provisions), Ramanujan, Ramalingaswamy, Ramanna, Wellcome-DBT Fellowships, revitalizing women component and young scientist's programmes, CSIR initiatives etc. PPP programmes are planned.
- **Rejuvenation of University Research**
 - Promotion of University Research and Scientific Excellence (PURSE), Consolidation of University Research, Innovation and Excellence (CURIE) for women-only universities, Special packages for some states, Revising of parameters for Fund for Infrastructure Strengthening (FIST)



Indian Growth Trends: Publications and Patents



Ranking of India in publications moves from 15th in 2003 to 9th in 2010

Growth Trends of SCI publications 1998-2007: Global Research Report Oct, 2009



Nurturing Individual Excellence

Some recent examples and value measures



Investment into Demographic Dividend

19.8% of Gross Budgetary Support to Education

20-25% CAGR in public expend into R&D since 2004



Several initiatives are being proposed

Indian enrolment into Higher education ramping up with high demand for faculty positions

Innovation in Science Pursuit for Inspired Research

Science and Innovation Scholarship to more than Million people



INSPIRE Program: At a Glance

INSPIRE Awards
200,000 per Year; Rs. 5,000 per award
Cover every high school in India
0.61 million awards released

←
Age 10-15

INSPIRE Internships
50,000 per year
Top 1% in class X criterion
75000 participated

←
Age 16-18

7500 based on Top 1% students in class X and XII Board Exams

10,000 Scholarships
Rs 80,000/yr for 5 years

2500 based on performance in national level examinations

15,000 students enrolled so far

←
Age 17-22, BSc/MSc levels

Top ranker in any science, engineering, medical, agriculture and veterinary related faculty in Indian universities

1,000 Fellowships

←
Age 22-27. PhD level

1,000 Faculty positions

National level selection based on merit and INSPIRE attachment without break

←
Age 27-32

27 Nov 11

ASIAHORC

Assured Career Opportunity in Research



JC Bose Fellowships: For promotion of individual excellence

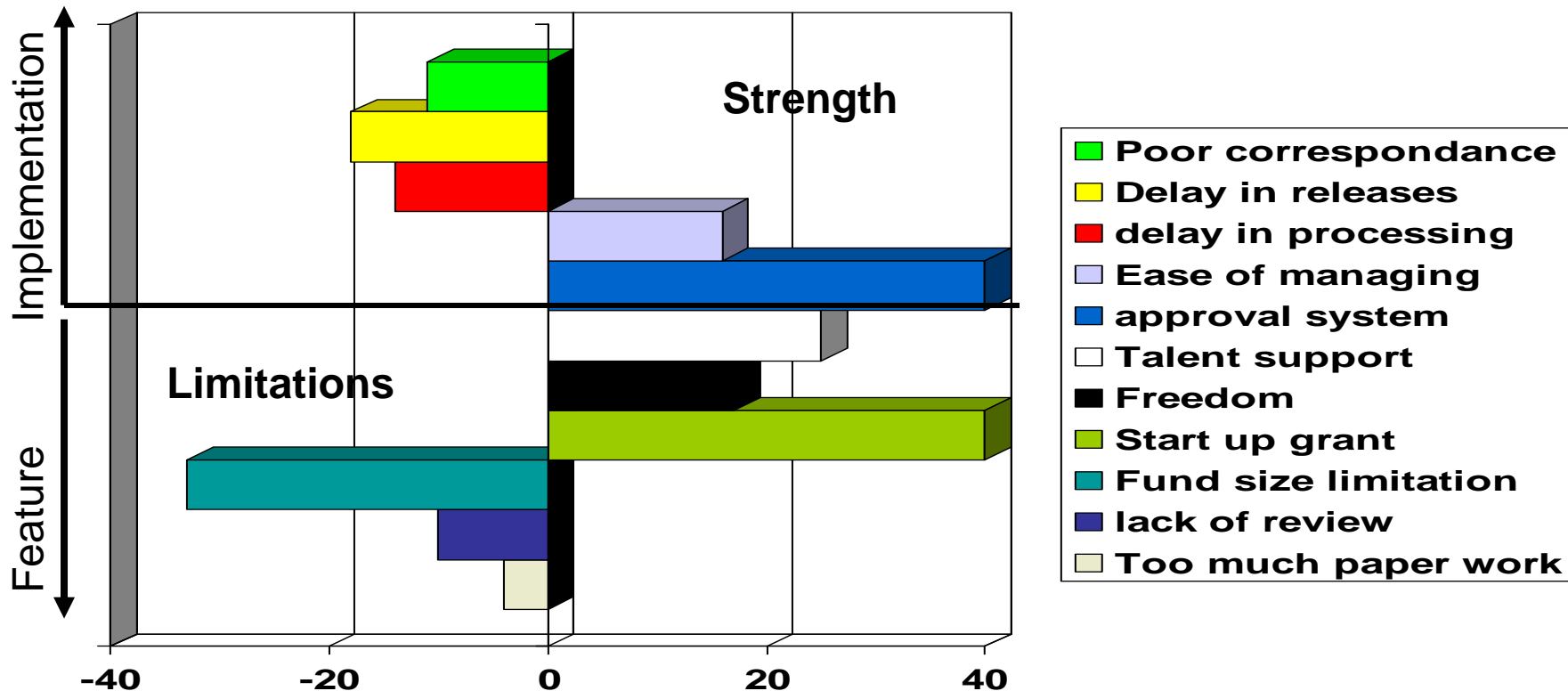
- For high performers in research selected on the basis of recognitions, a new fellowship scheme with topping salaries and research grant is implemented
- ~180 performing scientists receive the fellowship
- Performance of 67 scientists reviewed
- Outputs are
 - Average number of papers per scientist per year : 6.6
 - Average number of PhDs trained per year per person : 1
 - Average number of patents filed per person/ year : 0.33
 - Average citation per paper : ~5.5
 - Average impact factor aggregate per person/ year : ~18

Output indicators compare favorably with global bench marks



A sample study of Stakeholder value of DST: Fast Track Scheme

For improving funding actions



83 of the 125 stake holders approached responded with a perceived value of 8.3 out of 10.



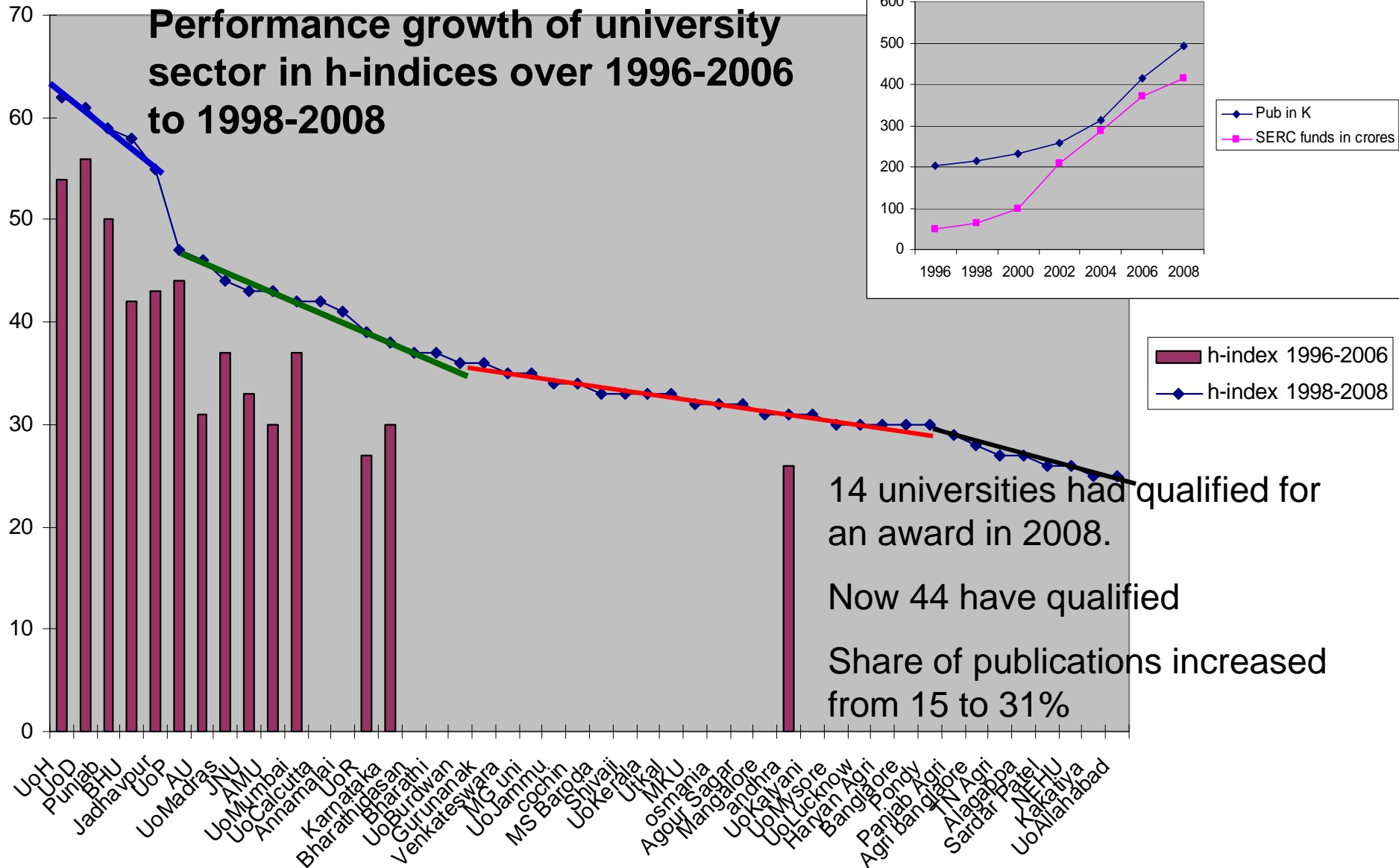
Rejuvenating Research in University Sector

Promotion of University Research and Scientific Excellence (PURSE)



Evidence based policy building for R&D funding

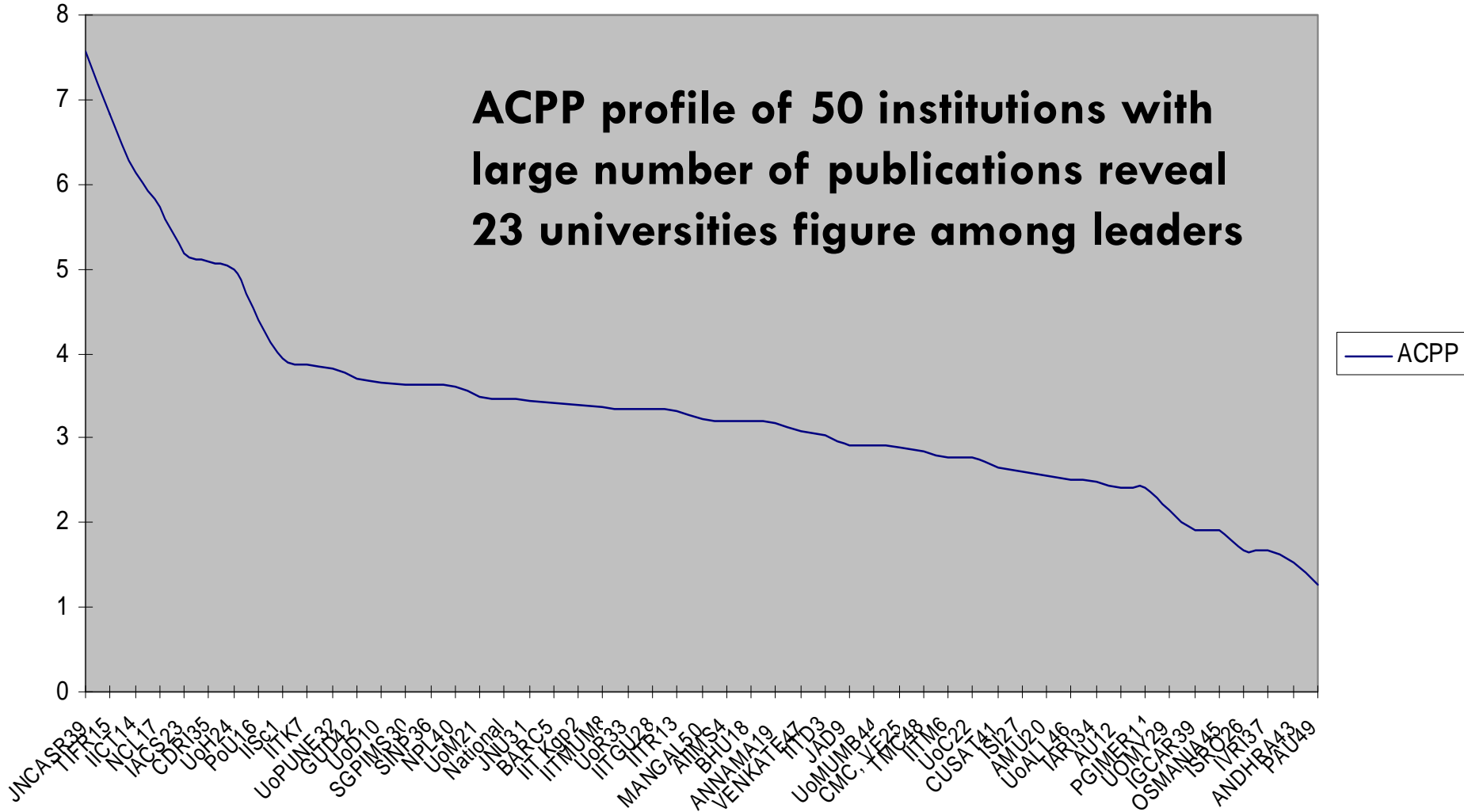
Performance growth of university sector in h-indices over 1996-2006 to 1998-2008





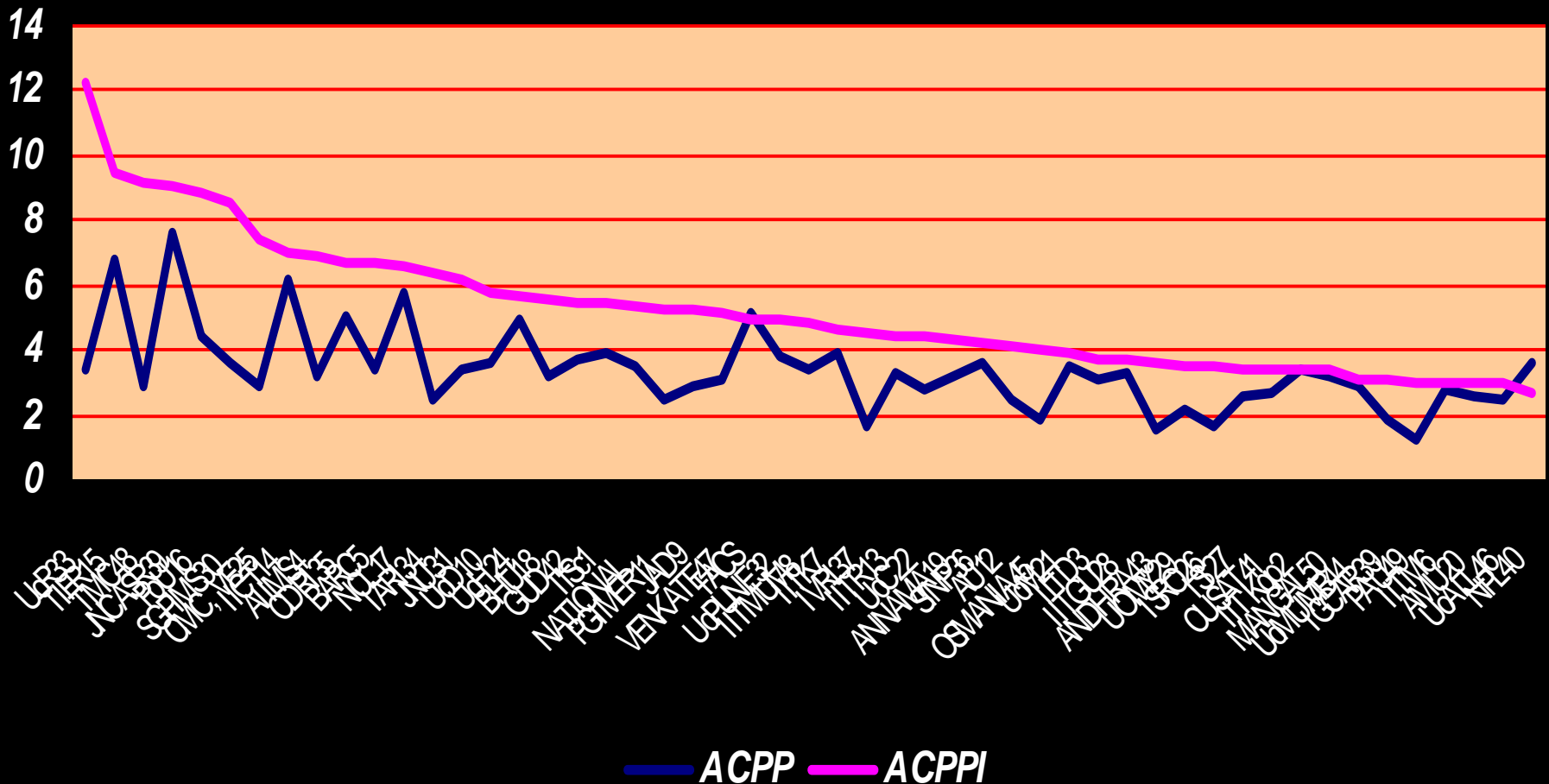
Average Citation per paper as value measure

ACPP



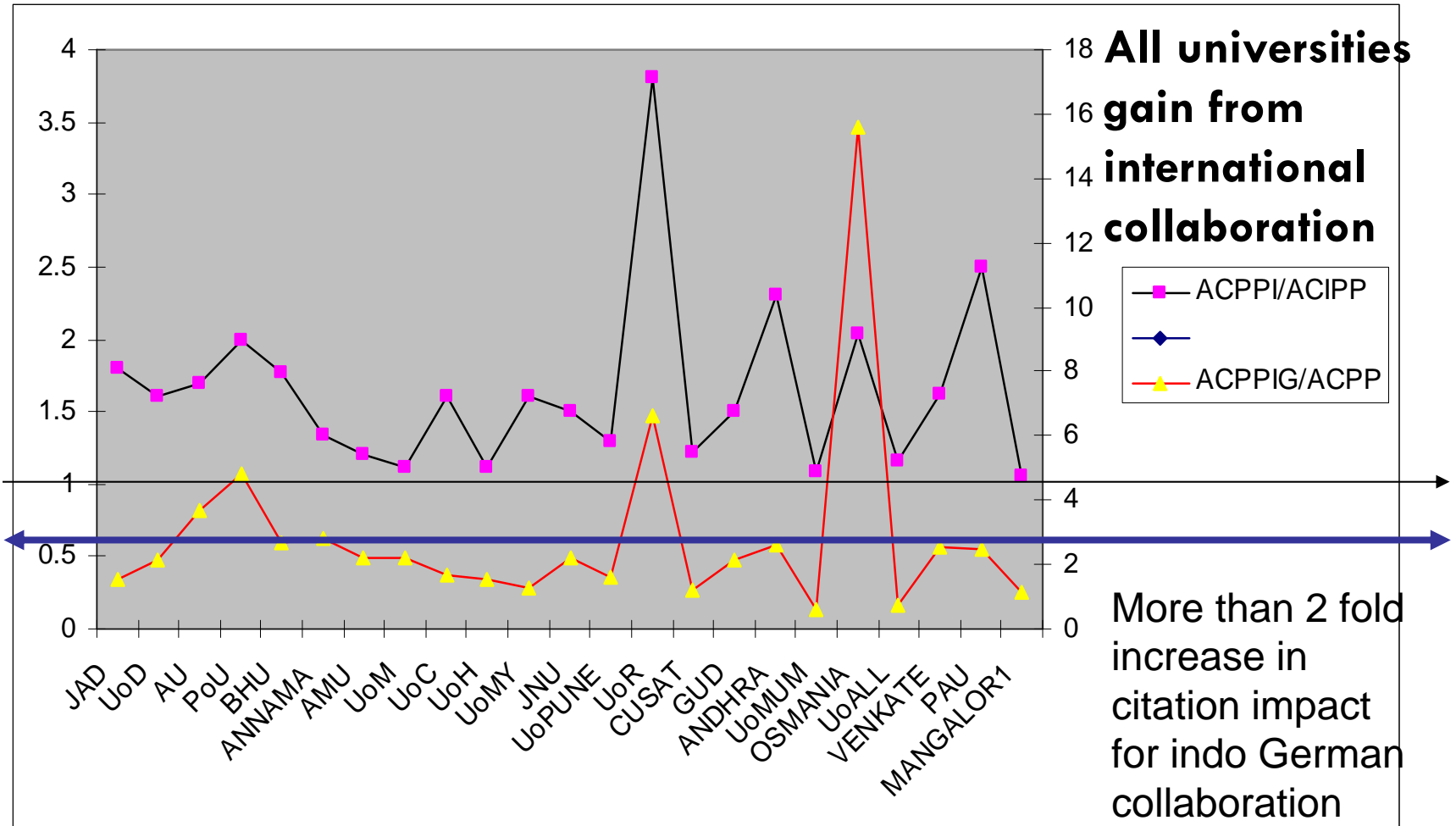


Citation impact gain from international collaborations



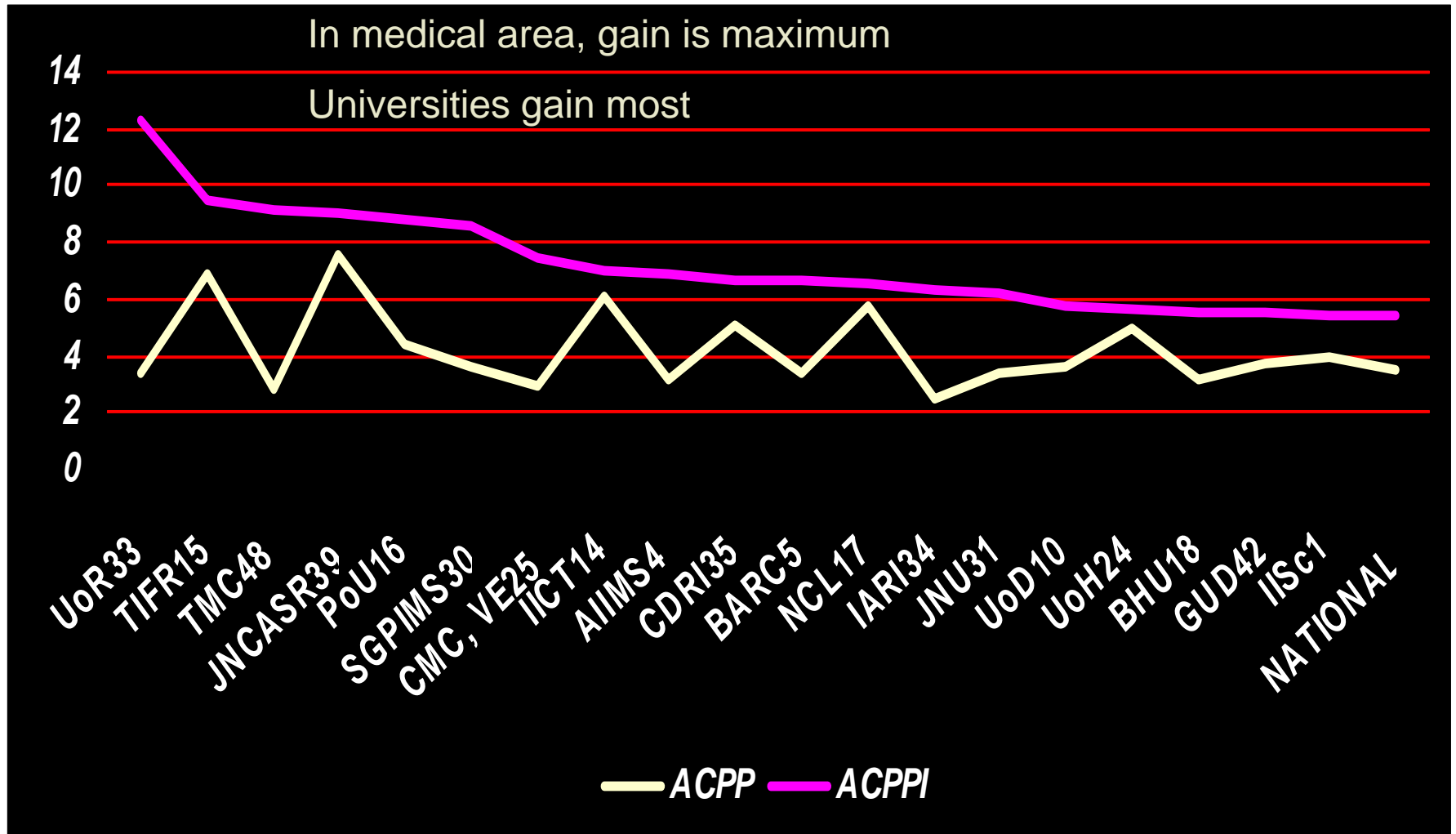


Gain of citation of impact of university research on account of collaboration





Gainers from International collaboration





DST nurtures some autonomous R&D institutions

Some Excellence indicators



Outputs indicators of some institutions nurtured by DST

- **Aggregated Average number of**
 - Papers in SCl journals per scientist per year ranges : 2.2
 - Average impact factor per paper : 2.9
 - Number of PhDs per faculty per year : 0.4
 - Number of patents per year per faculty : 0.33
- **Eminence indicators**
 - Bhatnagar prize winners : >40
 - Fellows of the academies :67
 - Scientists with H index > 25 per 100 scientists` :16
- **S&T indicators of two high performing institutions**
 - JBCASR: Paper/scientist per year: ~ 7.5; Average citation per paper over five year cycle; ~ 7.5, Impact factor per paper: 4.5
 - IACS: Paper/scientist per year: ~ 6; Average citation per paper over five year cycle; ~ 5.7, Impact factor per paper: 2.9



Decade of Innovations 2010-20: Stated Plan

- The Government has committed through a presidential address declared that 2010-20 period as a “Decade of Innovations”.
- Designing and developing a National Innovation Ecosystem accorded highest priority
- Policy instruments to stimulate the engagement of the private sector into R& D in public and social good areas including clean energy
- International S&T cooperation is a part of the National strategy of the plan for Decade of Innovations



Addressing the call for Decade of Innovations: Work in Progress

World is pursuing the Innovation Agenda. Is there a unique opportunity for an Indian model for Designing an innovation landscape?



Comparisons and Contrasts of Innovation systems

- Most developed countries invest about 2% of GDP into R&D with a share of 0.7:1.3 from public and private sector, respectively. In such economies, competition among the private sector drives the innovation for gaining leadership in the market space. Therefore the process of innovation is the focus of the design in their innovation system for “Quality Innovations” for global competitiveness
- In India, investments into R&D are at about 0.95% of GDP with shares of 0.7: 0.25% from public and private sector, respectively. Under such conditions, public and social goods priorities could drive the purpose of innovations and focus on “Affordable Innovations” for inclusive growth agenda of the country.



Designing Science, Technology and Innovation ecosystem

- ***To meet the challenges of faster and more inclusive growth by balancing between Open Source and Competitive innovations***



Four part Approach to Innovations

- **New Millennium Indian Technology Leadership Initiative:** PPP model for global referencing
- **Venture fund support system:** Technology Development Board equity participation model
- **Grass Root Innovation:** National Innovation Foundation involving 2,50,000 grass root innovators
- **National Innovation Council:** For global bench marking and alliances
- **Power of Ideas support**



Cotton Stripper from grass root innovation



Health care products from formal innovation system



Some recent and good examples from Indian innovation system



**Nano Car: 2500 US \$ c
from Tatas for providing
an opportunity for middle
income families**



**Jaipur foot:
Affordable
prosthetics @ US
\$ 28**



**Hepatitis Vaccines: 40 cents a dose
product giving health care access
to large number of people with low
purchasing power**

Jaipur Foot: A case of disruptive affordable innovation from India



Available, Affordable, Accessible Innovation



Seeking Solutions from Science: A New Indian Trend

- Supreme Court of India orders that Secretary Science and Technology will solve the water problem of India through R&D solutions and the Government will make available all resources needed.
 - This is in some sense an expression of trust in R&D-led solutions for water problems
 - A Technology Mission on Winning, Augmentation and Renovation (WAR) for water is mounted and ongoing for demonstrating convergent technology solutions for 26 different types of water challenges in different locations in the country

Mission Implementation Strategy





Favorable Contexts for STI Collaboration between among nations in Asia

Science, Technology and Innovation sector has gained entry into the main stream national developmental agendas in some what similar time space for most nations in Asia



History of Excellence and New Perspectives in Asian S&T

- Pursuit of Excellence has been a social practice in Asian countries for several centuries prior to industrial revolution
 - Gun powder from China, Number “0” from India are some examples
- Post industrial revolution and post war era, Japan remained the sole representative of Asia in global S&T space until 1990s
 - Japan innovated and gained large share of global trade
- Since 1990s Asian thrust into S&T sector has been significant
 - Asia’s share of S&T outputs indicators, is growing and is reaching values similar to those of Europe and North Americas. In areas like materials sciences Asia leads
- By 2020, Asia may emerge as a major source of S&T by virtue of demography and engagement
 - For the new Perspective, collaboration may seem an unexplored area



Affordable Innovations for Public and Social good under PPP

- **Agriculture for food and nutrition security**
 - Water and land saving agriculture; Avoiding food wastes
- **Affordable human health care**
 - Extremely low cost solutions to human health care challenges; Diseases suffered by people with low purchasing power
- **Technologies for clean energy**
 - Renewable energy systems; Enhancing energy efficiency in use; high focus on solar energy
- **Innovations for sustainable environment**
 - Zero emission in industrial production; Atom and Energy efficient manufacture
- **Innovative deployment of technologies for water security**
 - Technology agnostic approaches for sustainable solutions



Advantage of collaborative excellence in STI sector

1. World faces threat of climate change and focus on adaptation and mitigation call for new technologies and life style adjustments
 - Global bad can not be fought by countries through competitive excellence models alone. Collaboration for global good is without choice.
2. With weather extremes and natural disasters challenging the world, new tools and forewarning systems with global collaboration seem necessary
 - Earth and atmosphere being common, science for global health monitoring and natural disaster mitigation call for collaborative excellence
3. Affordable human health care is a global priority
 - “Not-Reaching the un-reached” is not an option for human health care. STI has to deliver values for affordable health care



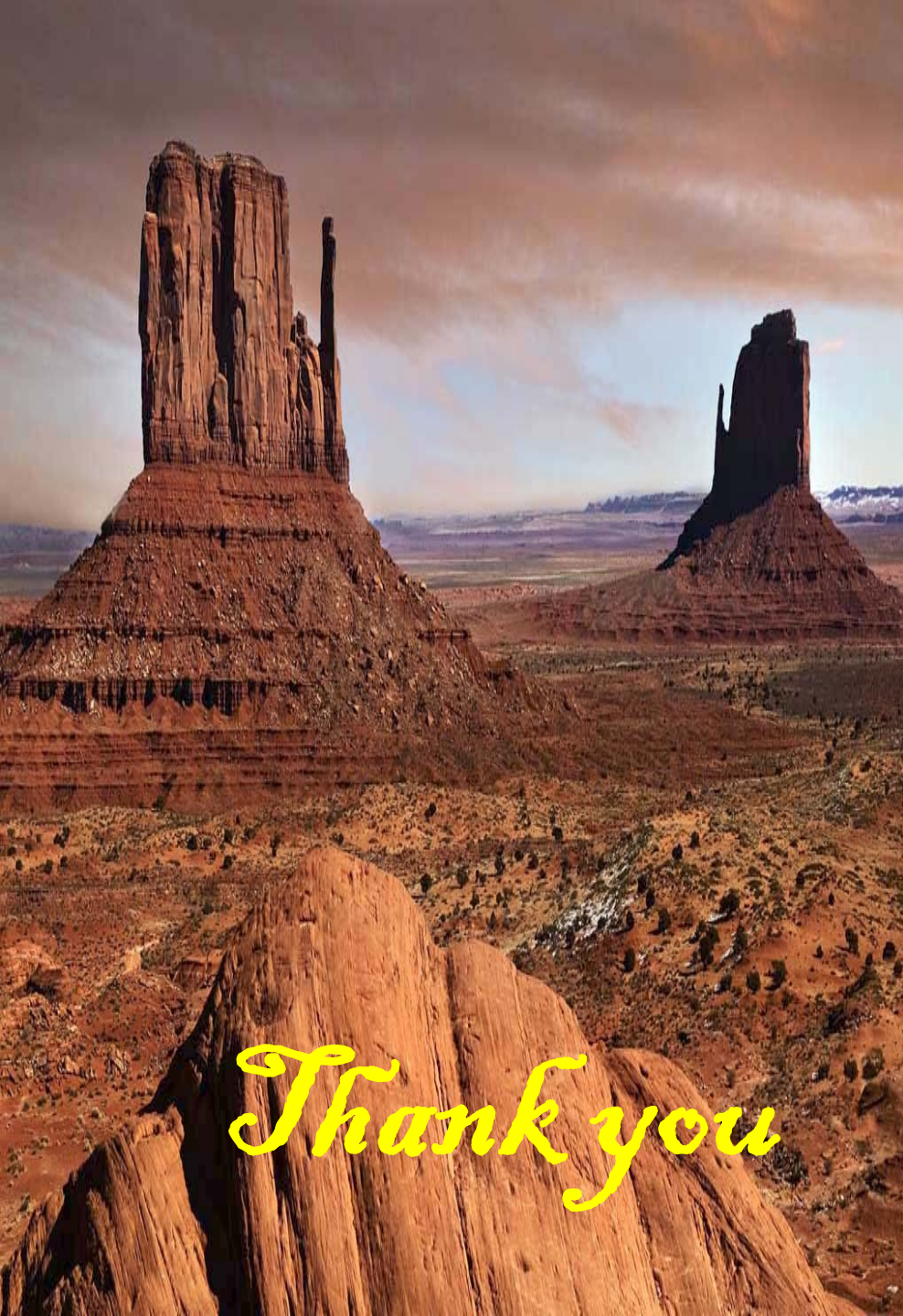
Strategic Alliances and Partnerships: In Innovation Agenda

- Global Technology and Innovation Alliance (GITA) is the planned step forward for building strategic alliances and partnerships where India's strength in cost optimization while partners strength in quality of innovations could provide a win-win formula
- PAN India initiative based on Public-Private-People-Partnership (PPPP) model involving carefully developed strategic alliances for affordable quality innovations under S&T partnerships



Summary and some lessons

- Nurturing excellence in Asian centers demands culture specific approaches
 - For surpassing other and surpassing one self with time
- Excellence in Research demands varying modes depending on the nature of enterprises and programme goals
 - Strategic and non-strategic sectors demand different tools
- Excellence in passion driven science demands autonomy, right-sized funding and right value measures
 - Individual and institution models may vary
- Asian countries are in the right context of gaining global competitiveness
 - Collaborative excellence in some areas might be valuable



Thank you

Challenge Ahead

*motivating scientists to
discover solutions*

