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Science and Innovation: Driving factors

- Personal Passion
  - Discovering and crossing intellectual barriers
- National Purposes
  - Problem solving & serving national agenda
- Seeking Power
  - Providing one-up-man ship and leadership
- Serving People’s needs
  - Social causes of people centric actions

Science and Innovation in National Development

Yesterday, Today and Tomorrow and Beyond

India's Science Leaders: Post 1947 Accomplishments

- **The vision of political leaders like Shri C. Subramanian and scientific leaders like Dr M.S. Swaminathan has led to the First Green Revolution enabling India to produce over 200 million tons of food grains today through the use of high yield variety seeds.**
- **Dr. Varghese Kurien through milk co-operative movement, led India to become the largest producer of milk.**
- **Homi Bhabha established the TIFR, leading to nuclear science and research. Today India has 14 reactors producing nearly 4000 MW electrical power. Department of Atomic Energy targets 50,000 MW of power by 2003**

India’s Science Leaders

- **Prof Vikram Sarabhai’s space vision has enabled India to acquire the capability to design, develop, build and launch any type of satellite from Indian soil.**

- **Prof Shanti Swarup Bhatnagar created multiple CSIR laboratories in various disciplines for developing and transferring the technology to Indian industry including drugs for many tropical diseases.**

- **Dr Kothari was in the mission of creating a chain of DRDO laboratories for promoting self-reliance in critical technologies and strategic systems.**

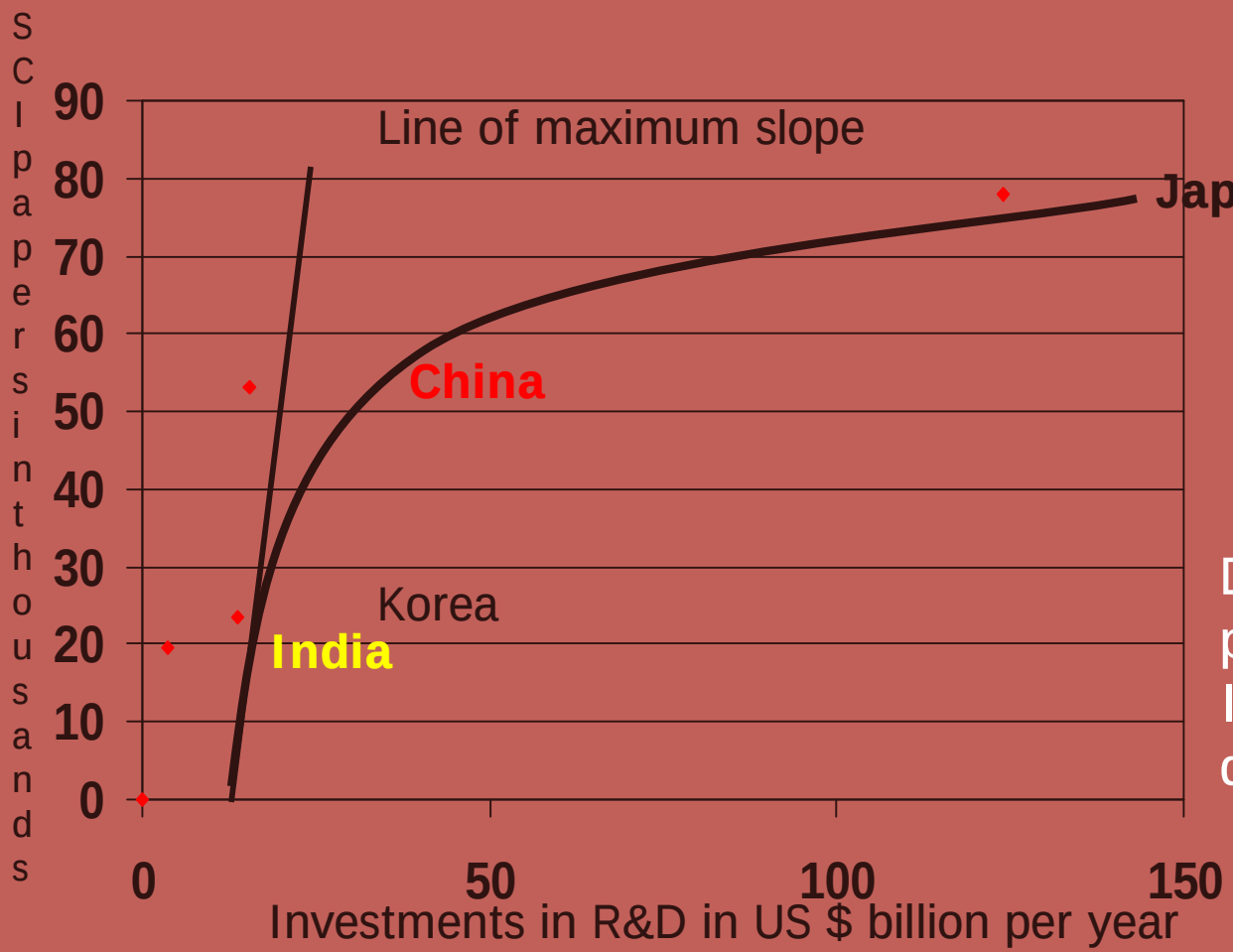
Three distinct Indian S&T phases

- **1947-66: Nation's Trust in Science and Investment**
  - power of science to solve real life problems
  - invested significantly beyond the means of a developing nation
- **1967-86: Nation's Demands on Science and Delivery**
  - Science and technology provided viable solutions
  - Technology denial propelled India to seek self reliance
- **1987-2006: Challenge and Introspection**
  - use of knowledge for generation of wealth and development of economy
  - India is undergoing a phase of impressive economic development and growth

Concern of the Indian Scientific Community today

- Indian science and technology yet to be in pace with developments of research in other countries. Growing, but slowly
- Competitiveness of India in science measured in terms of publications of papers does not match the inherent strength of the country.
  - Investment of India in science as a percentage of GDP is growing at a slower rate in tune with global trends
  - Talent of India is not attracted to study and careers with science in line with global trend .

GERD Vs SCI papers correlations in World of Science



Japan, China, Korea, India

◆ SCI paper

Dollar productivity in India is high; but quantum is low

Inter-comparison of India and China in World of Science

- China makes five to seven times larger investments into Science than India in terms of human and physical capitals
- Indian outputs are about 40% of the outputs of China in science and technology at her current input levels.
- China holds fifth slot while Indian position has moved down from the eighth to thirteenth slot in publication base during the last 20 years.
- India is seen as the emerging global R&D hub. If India does not invest, world will invest into Indians.

Parameter		China	India
Input	Researchers/Million (2004)	633	130
	Ph.Ds/year	40,000	6,300
	R&D investments US $ billion(2004)	25.5	5.3
Output	No. of SCI papers (2005)	68,226	28,477
	Citation frequency	3.9	4.07
	Relative rank	5th	13th

2006-2025: Phase ahead

Towards global eminence through

An approach of faster and more inclusive growth

Five Next Best Steps Planned

- Attraction of talent to study and career with science through efficient talent supply chain management for faster growth
- Larger investments into science
- Expanding and Strengthening of Institutional infrastructures for research for inclusive growth
- Efficient New mechanisms of support to science and technology through system improvement
- Developing measurements and assessment of scientific outputs for increased accountability

Plans for Talent Attraction: Championing for Science

- Fostering creativity among young through Innovation in Science Pursuit for Inspired Research (INSPIRE) through
  - Catching young and creating innovative experience with science
  - Rubbing Shoulders with icons
  - Assured opportunity for career with science
  - Retention of talents in public funded research through PPP

Championing for larger Investment for science

- **Investment in science has grown at 250% from plan to plan during 9th and 10th plan periods**
  - 400 % increase seems right for the 11th plan over 10th
- **Rate of growth GERD has not kept pace with GDP growth; the percentage investment for R&D has remained at 0.8% over GDP with 3:1 share of public and private investments in R&D;**
  - Increase from 0.8 to 1.3 % share of GDP by 2012 on current prices sought
- **Trebling the current investment into basic research;**
  - Total support is estimated at $500 Million per year. Trebling seems next feasible step

Expanding, Strengthening and Setting up of New S&T Institutions

- SERC (for Basic Research)
- Through revitalized fund for Infrastructure for S&T in Universities (FIST)
- New S&T and Educational Institutions
- Nano S&T Mission
- Science Innovation

Tasks ahead: To render Indian science globally competitive

- **Formation of New S&T Institutions**
  IISER(6), IITs(8), NIPER(6), IIIT(20), Central Univ(30).

- **Rejuvenation of research in university sector & widening research base and infrastructure is crucial to Indian Science**

- **Four-fold scale expansion of globally competitive R&D programs**

Launching of excellence-based inclusive growth model to establish and strengthen centres for research so that the Nation can become internationally competitive in the world of science.(Proposed Science and Engineering Research Board/Foundation)

Nano S&T Mission Launched

A. **Basic Research Promotion (NSTI)**
B. **HRD Programmes - Launching under-graduate / graduate educational programmes**
C. **Nano Technology Application Programmes (Public Private Partnerships, TBI etc.)**
D. **International Collaborations - Joint Centres in specific areas like manufacturing technology, metallurgy with US, Germany, France etc.**
E. **Mission Management**

What have we done so far??

- 105 Individual Projects
- 11 Centres of excellence on Nano Science with state of the art facilities
- 7 Nano Technology Centres & 1 Centre for Computational Materials Science
- Investment –$100 Million

Innovation stepping in:

Journey of mind to market needs many intermediate steps linking ideas to wealth generation.

Persisting dualism in India needs corrective steps

- **Viable Scientific and technological base**
- **Vast number of people awaiting developmental choices**

Priority of linking innovation to faster rate of wealth generation and inclusive growth.

Innovation infrastructure demands a risk-taking eco system based of mindset of investment for profits rather than control of expenditures .

Designing and Sizing Innovation Infrastructure

- Opportunity for both increasing private innovation effort and improve the impact of public funded R&D through fostered and incentivised collaboration
- Public support to private effort on innovation needs spill over of returns in social and public goods over private goods
- Establish Early Stage Technology Development fund for matching grants for enterprises, that encourage risk sharing
- Seed the emergence of investors for innovation
- Public support for private innovation effort for inclusive innovation

Department of Science and Technology

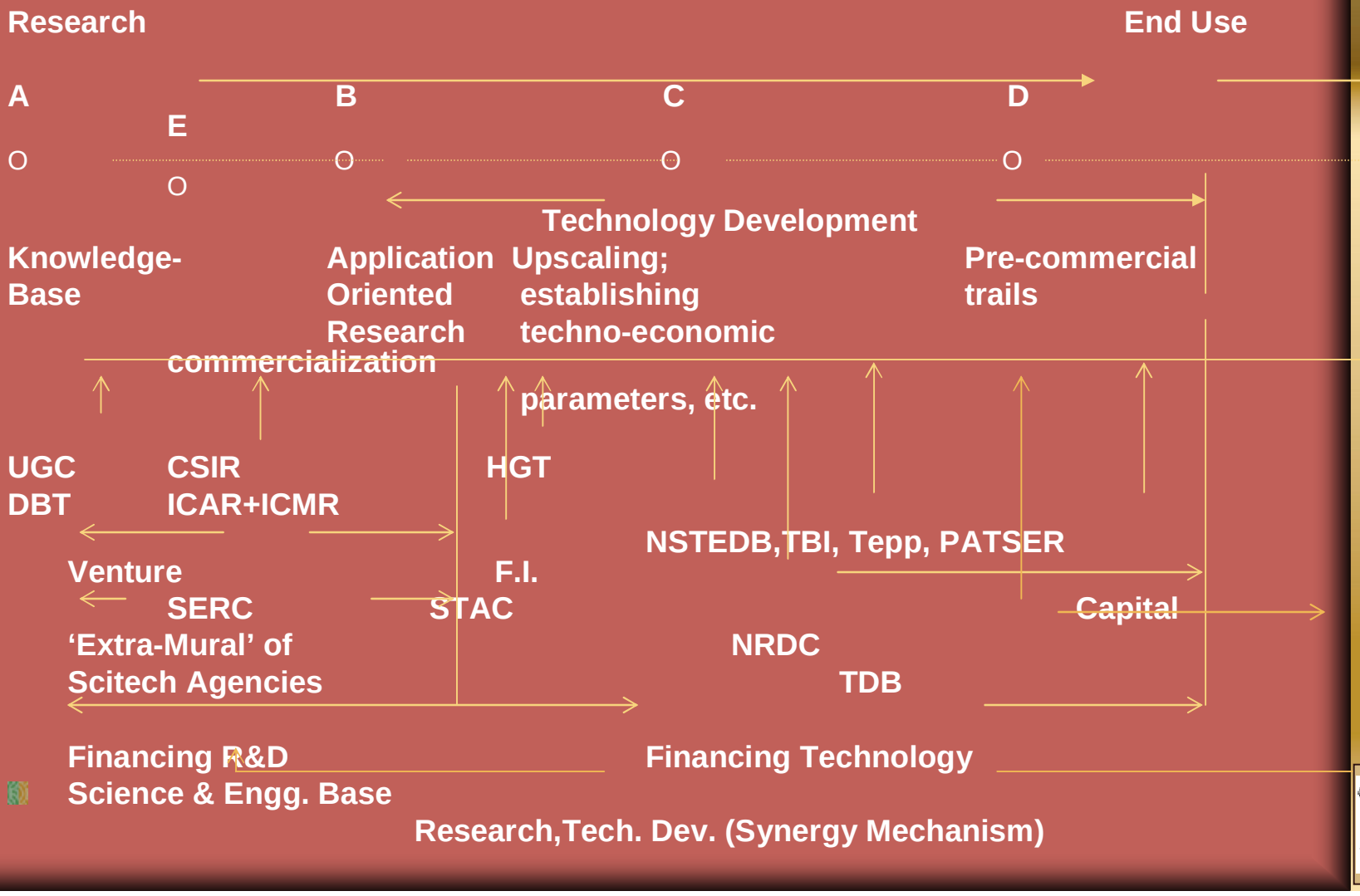
Steps Already Taken

- **Focus on Innovation through political will and public policy**
- **Public Private Partnerships: In Innovation clusters**
- **New Millennium Indian Technology Leadership Initiative**
- **Strengthening of Schemes: STEP/TBI, TePP, HGT, PATSER, SBIRI and Technology Development Board-mechanisms**

Small Business Innovation Research Initiative (SBIRI)

- Boost PPP in biotechnology (medical, agriculture, food, industry and environment)
- Supports high-risk pre-proof-of-concept research
- Generating ideas by bringing users and producers of technology together
- Increase private sector commercialization derived from Govt. funded R&D
- Model being replicated in Nano Technology and other Sectors

Research,Technology Development & Commercialization Chain



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India Vision 2025

- Demand technology led growth of GDP. Emergence of India and China as economic powers of the world by 2025 is a predicted theme. India is at the doorsteps of opportunity in the changing knowledge-based global economy. Could India’s Science and Technology landscape enable this forecast? The answer is a big YES

THANK YOU!