

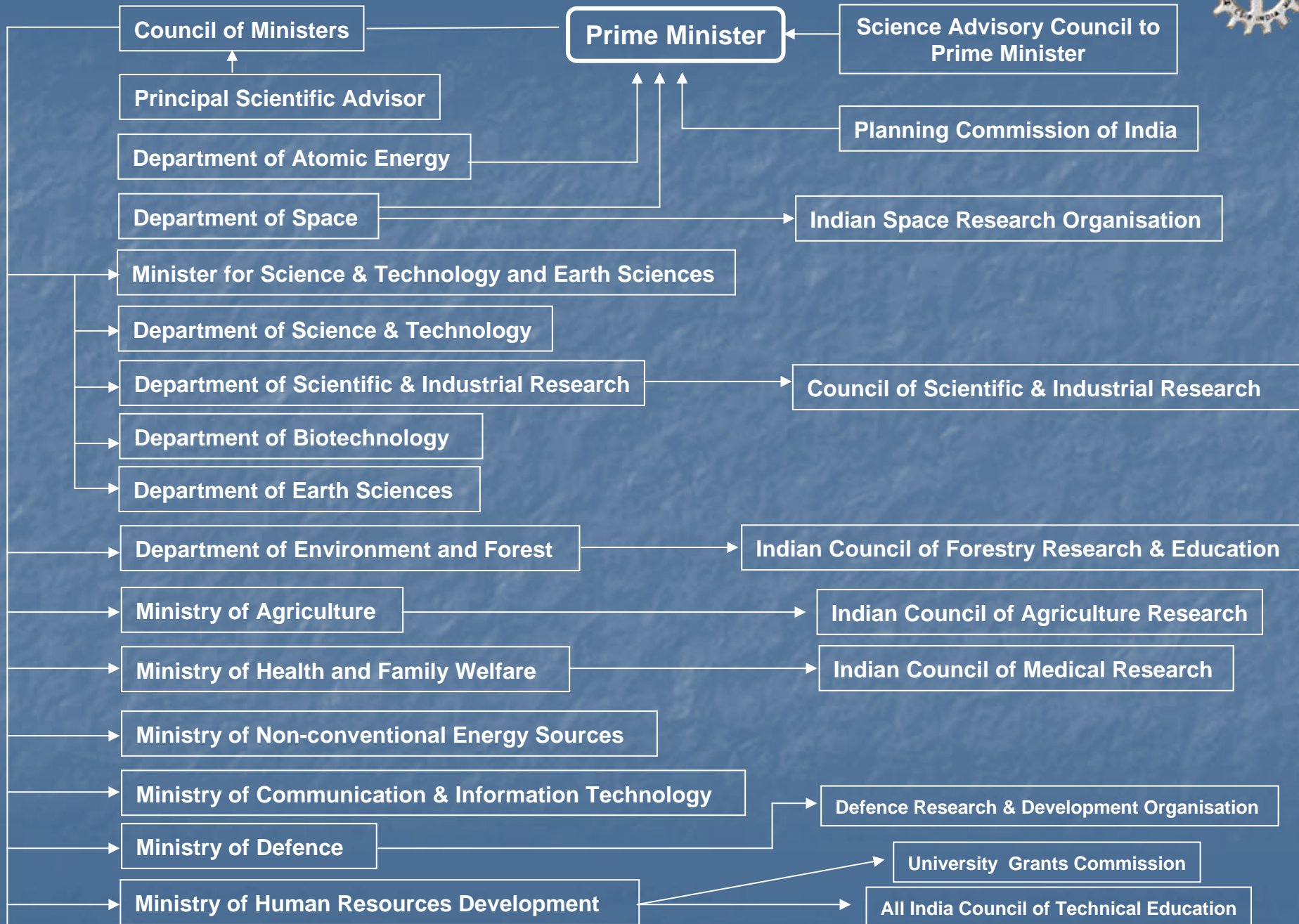


SUSTAINABLE DEVELOPMENT IN ASIA : THE NEED FOR PAN ASIAN S&T POLICY – INDIAN PERSPECTIVE

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Organization Chart of S&T Administration in India





POLICY FRAMEWORK FOR S&T GROWTH

- **Scientific Policy Resolution (1958)**
- **National Education Policy (1968)**
- **Technology Policy Statement (1983)**
- **National Policy on Education (1986)
(modified in 1992)**
- **Technology Vision 2020 (1997)**
- **Information Technology Policy (2000)**
- **Science & Technology Policy (2003)**
- **National Biotechnology Development Strategy (2007)**



SCIENTIFIC POLICY RESOLUTION : 1958

- To foster, promote, and sustain, by all appropriate means, the cultivation of science, and **scientific research in all its aspects - pure, applied, and educational;**
- **To ensure an adequate supply,** within the country, of **research scientists** of the highest quality, and to recognize their work as an important component of the strength of the nation;
- To encourage, and initiate, with all possible speed, programmes for the **training of scientific and technical personnel,** on a scale adequate to fulfil the country's needs in science and education, agriculture and industry, and defence;
- To encourage individual initiative for the acquisition and dissemination of knowledge, and for the discovery of new knowledge, in an **atmosphere of academic freedom;**
- And, in general, to secure for the people of the country all the **benefits that can accrue from the acquisition and application of scientific knowledge.**



TECHNOLOGY POLICY STATEMENT : 1983

- Attain **technological competence and self-reliance**;
- Use **traditional skills and capabilities**, making them commercially competitive;
- Ensure the correct mix between mass production technologies and production by the masses;
- Ensure maximum development with minimum capital outlay;
- Identify obsolescence of technology in use and **arrange for modernization**;
- Develop technologies which are **internationally competitive**;
- Improve production speedily through **greater efficiency** and fuller utilization of existing capabilities;
- **Reduce demands on energy, particularly energy from non-renewable sources**;
- Ensure harmony with the environment, **preserve the ecological balance**;
- **Recycle waste material** and make full utilization of by-products.



SCIENCE & TECHNOLOGY POLICY 2003

Sixteen point implementation plan; the important ones are

- S&T governance and investment
- Promotion of innovation
- Industry and scientific R&D
- Strengthening of infrastructure for S&T in academic institution
- New funding mechanisms for basic research
- Technology development, transfer and diffusion
- Indigenous resources and traditional knowledge
- Generation and management of intellectual property
- Human resource development



CREATION OF CORE SCIENTIFIC DEPARTMENTS

Central Sector

- * Deptt. of Atomic Energy
- * Deptt. of Ocean Development
- * Deptt. of Scientific & Industrial Research
- * Min. of Environment and Forest
- * Min. of Non-conventional Energy resources
- * National Research Development Corp.
- * Deptt. of Biotechnology
- * Deptt. of Space
- * Deptt. of Science & Tech.
- * Ministry of Information Tech.
- * Central Electronics Ltd.
- * Deptt. of Industrial Policy & Promotion

State Sector

State Councils of Science and Technology



TECHNOLOGY BASE

- More than 300 universities
- About 1200 in-house R&D units in industrial undertakings
- About 1200 R&D labs in Government and Public sector
- Growing acceptance of business incubators, technology/ biotechnology parks
- Small but formidable presence of R&D's centers owned and operated by MNC's
- More than 16 thousand science and engg. Colleges including IITs , IIITs and NITs
- About 157/million scientists and engineers



AIMING SUSTAINABLE GROWTH THRO' SUCCESSIVE FIVE YEAR PLANS

Five Year Plans	Period	Thrust
First	1951-1956	Agriculture
Second	1956-1961	Heavy Industry
Third	1961-1966	Agriculture
Fourth	1969-1974	Weaker sections of society
Fifth	1974-1979	Poverty alleviation and self reliance
Sixth	1980-1985	Allied agriculture and rural development
Seventh	1985-1990	Poverty alleviation, unemployment
Eighth	1992-1997	Human development
Ninth	1997-2002	Growth with social justice and equity
Tenth	2002-2007	Agricultural development for attaining equity and social justice
Eleventh	2007-2012	Technology led rapid inclusive growth



SHARE OF AGRICULTURE IN ECONOMY'S TOTAL OUTPUT AND EMPLOYMENT

Year	Share in GDP at current price %	Share in Employment %
1980-81	38.8	60.5
1990-91	33.2	59.0
2000-01	25.5	58.4
2001-02	24.2	56.7



The Government Mantra to sustainable growth

“TOWARDS FASTER AND MORE INCLUSIVE GROWTH”

Should we aim at development which is sustainable or both sustainable and equitable?



CHALLENGES TO SUSTAINABLE AND EQUITABLE GROWTH

- Resource intensive industries
- Urbanization
- Agriculture (intensification thereof)
- Consumption patterns

Source : Development Alternative



BUILDING A SUSTAINABLE R&D/INNOVATION CULTURE



S&T POLICIES: WHAT VALUE THEY ADD?

- Focus?
- Defined Goals?
- Political support?
- Ownership from within the scientific community?



S&T POLICIES Vs. S&T IN FIVE YEAR PLANS

- Can comparisons be really made?
- Tenuous S&T policies
- S&T sector in Five year plans



SUSTAINING AGRICULTURE

In spite of sustained plan support to agriculture sector the productivity is declining:

- Its share in GDP is declining
- Its share in employment is declining
- From ~4% the growth rate in mid-90s it has come down to ~1.7%
- Manufacturing sector is growing >10% per year

Is it the new model of sustaining development?



SUSTAINABILITY THROUGH INNOVATION

- The route to sustainable and equitable development is through innovation – as innovation is the soul of any development strategy
- Development strategies require *inter-alia*
 - Systems to promote and nurture science and innovation
 - Sound scientific infrastructure in public institutions
 - Motivated and focused human resources
- India, Japan, China, South Korea, Taiwan, Singapore, Malaysia and other have - every system as above.
- For China and India it is only a few more years to catch and team up with Japan, South Korea and others to make Asia as the global hotspot of Innovation



SCHEMES FOR INNOVATION AND TECHNOLOGY PROMOTION

- New Millennium Indian Technology Leadership Initiative (NMITLI)
- National Innovation Foundation (NIF)
- Research and Development by Industry (RDI) programme
- Programme Aimed at Technological Self-Reliance (PATSER)
- Scheme to Enhance the Efficacy of Transfer of Technology (SEETOT)
- Technology Development Board (TDB) funding
- Home Grown Technology (HGT) scheme
- Integrated Technology Upgradation and Management Programme (UPTECH)
- Jai Vigyan Mission
- Schemes of Small Industries Development Bank of India (SIDBI) etc.



NATIONAL INNOVATION FOUNDATION

- Launched in March 2000 by Deptt of Science and Technology
- A national initiative to strengthen the Grass root Technological Innovation and Traditional Knowledge
- Has its basis in Honey Bee network
- To manage and support National Register of Innovation



EMERGING TRENDS

- Approx 30,000 professionals return to India
- IIT graduates migrating abroad
 - -70% (ten years ago)
 - -30% (today)
- Fellowship to attract talent from abroad (unlimited)
- Over 300 global players set up R&D centres
- Cost cum competence advantage
- Foreign R&D sector employing ~24000scientists
- MNCs relocating their inhouse R&D centres in India
- MNCs mostly in Computer/IT based R&D



NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT BY SECTOR

Sector	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Central Sector	9826.27	11050.20	11536.33	12072.98	13199.01	14443.36
State Sector	1289.88	1574.32	1494.33	1528.39	1682.24	1851.58
Private Sector	2657.83	2923.32	3292.69	3648.25	3955.14	4287.84
Higher Education Sector	623.64	650.94	714.80	750.54	890.60	1056.80

Sources: Data collected and compiled by DST. Rs. In Crores(10 Millions)



NATIONAL EXPENDITURE ON R&D IN RELATION TO GNP/GDP

Year	R&D Expenditure at current prices (Rs. Crores)	GNP at current prices (Rs. Crores)	GDP at of GNP (Rs. Crores)	R&D as % of GNP	R&D as % of GDP
1999-00	14397.60	1746407	1761838	0.82	0.82
2000-01	16198.80	1884890	1902999	0.86	0.85
2001-02	17038.15	2065908	2081474	0.82	0.82
2002-03	18000.16	2241722	2254888	0.80	0.80
2003-04	19726.99	2505707	2519785	0.79	0.78

Source: (i) Data on R&D expenditure collected and compiled by DST.
(ii) Data on GNP – Economic Survey, 2004-05.
One Crore= 10 Millions



FIVE YEAR PLAN ALLOCATIONS FOR S&T SECTOR

	6 th Plan	7 th Plan	8 th Plan	9 th Plan	10 th Plan
	1980-85	1985-90	1992-97	1997-02	2002-07
State Sector	295840	88679.0	158697.0	4034.7	12503.3
Central Sector	11301.0	25990.5	51889.3	120220.0	252430.0
Total	40885.0	114669.5	210586.3	124254.7	264933.3

Rs. In Millions

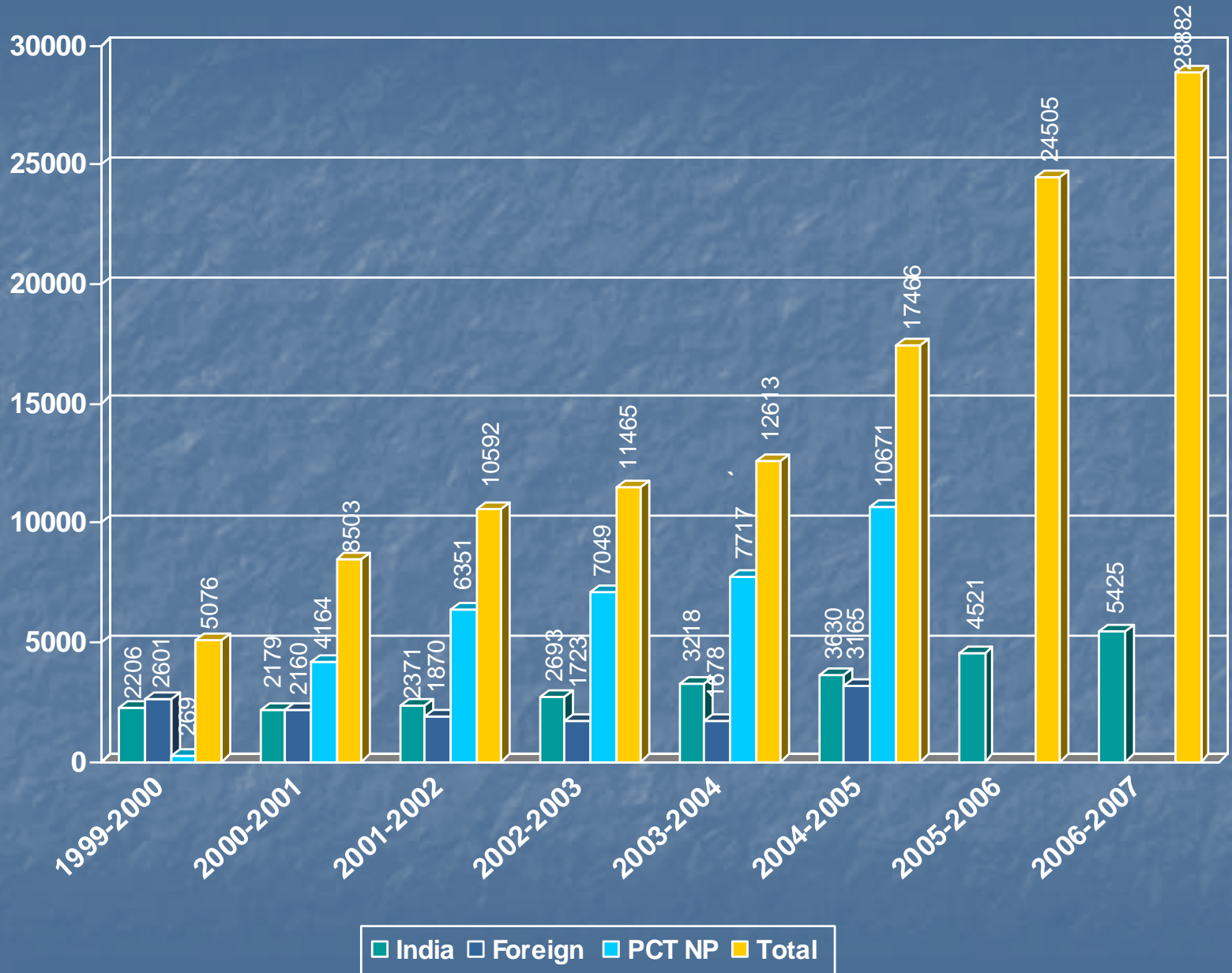


INDUSTRIAL R&D SPENDING

	Govt. Sector (%)	Pvt. Sector (%)
Japan	21.0	79.0
USA	30.5	69.5
France	42.0	58.0
Germany	37.0	63.0
UK	33.3	66.7
India	73.0	27.0

Planned FDI R&D investment totals US\$4.65bn mostly US & Germany

INDIAN PATENT APPLICATIONS FILED





S&T COMPETITIVENESS RANKING

Year	India	USA	UK	China	Brazil
1998	38	1	13	21	35
1999	42	1	19	29	34
2000	39	1	16	30	31
2001	41	1	19	33	31
2002	42	1	16	31	35
2006	27	1	20	18	44
2007	27	1	20	15	49

Source: World Competitiveness Yearbook 2006



- Science is location neutral but technology may not be so
- Models of sustainable development, therefore, can not be overarching one – these are country, resource, technology and issues specific



SUSTAINING GROWTH THRO' PHARMA AND BIOTECH SECTORS



THE PHARMA SECTOR

The drug and pharma sector

- Epoch making 1970 Patent Act
- Exponential growth of pharma manufacturing sector (primarily small and medium sector firms)
- medicines of quality at affordable price, within every ones reach



GROWTH IN PRODUCTION OF PHARMACEUTICAL INDUSTRY

(Rs. in Crores)

Year	Bulk Drugs	Formulations
2000-01	4533.00	18354.00
2001-02	5439.00	21104.00
2002-03	6529.00	24185.00
2003-04*	7729.00	27692.00
2004-05*	9034.00	31946.00



EXPORT OF DRUGS, PHARMACEUTICAL AND FINE CHEMICALS

Year	Export (Rs. in Crores)
1998-1999	6256.06
1999-2000	7230.16
2000-2001	8757.47
2001-2002	9751.20
2002-2003	12826.10
2003-2004	15213.24
2004-2005	17857.80
2005-2006	21578.96

Source : Directorate General of Commercial Intelligence and Statistics (DGCIS, Kolkata)

Formulations contribute 55% while the rest 45% comes from bulk drug exports

DIAGNOSTICS : THE EMERGING LEADS



Diagnosics developed	Stages of trial
a.Human	
Hepatitis A ELISA diagnostic assay system	Industry level translation and manufacture have been taken up
PCR based rapid accurate diagnostic assay for typhoid fever	Laboratory validation and industry negotiation started.
PCR based rapid diagnostic assay for sexually transmitted diseases.	Laboratory validation is on.
<i>In vitro</i> screening system anti-inflammatory compounds	<i>In vitro</i> system is being used to screen anti-inflammatory compounds.
JEV	Commercialized
Alfa-feto protein	
Tuberculosis	
Tuberculosis -MDA	Under different stages of validation and up-scaling
Reproductive hormones	
b.Marine	
A polyclonal antibody-based immunodiagnostic kit for detection of different bacterial pathogens in finfish and shellfish	Commercialized
Combi kit for simultaneous detection of WSSV and MBV for specific detection of pathogens	
A polyconal antibody-based immunodiagnostic Assay for the detection of white spot syndrome virus	
c. Animal	
Peste des petis ruminants	Lab validation completed and technology transferred

VACCINES : THE EMERGING LEADS



Vaccines developed	Stages of trial/Commercialization
a. Human	
Combined DNA rabies vaccine for animals	Animal trials being conducted, likely to be commercially available after the regulatory approvals.
DNA/MVA based HIV-1 subtype C vaccine for HIV/AIDS	Poised for preclinical toxicology studies
Vi-conjugate typhoid vaccine	GMP grade preparation and preclinical toxicology studies planned.
Rotaviral Diarrhoea vaccine.	Rotaviral diarrhoea vaccine : completed phase-I clinical trial in adults and older children.
Malaria vaccine.	Entering into pre-clinical studies.
Edible vaccine for Cholera	Large scale antigens were produced in tomato plants and immunogenicity test carried out in mice.
Cholera (1 candidate)	Phase I & II trial
JEV (1 candidate)	Animal Toxicology studies
Tuberculosis (6 candidates)	Animal Immunology studies
b. Marine	
A heat killed whole cell vibrio immunostimulant for white spot shrimp virus	Commercialized marketed in India and middle-east countries
c. Animal	
Infectious Bovine Rhinotracheitis (IBR) vaccine for livestock animal	Commercialized
Recombinant Anthrax vaccine	Phase I/II human clinical trial



CLINICAL RESEARCH/TRIAL SECTOR: PROVIDING NEW GROWTH OPPORTUNITIES

- Global market estimated at US\$60-65 billion (15% of global pharmaceutical turnover)
- Annual growth rate projected at 10-12%
- Indian market (2004-05) : US\$100 million
- Indian advantage is in cost of each trial, which is about 50-60% lower than USA
- Indian advantage is large patient base, diverse gene pool, growing number of specialty hospitals, TRIPs compliant IP rules, well articulated and globally at par regulatory environment
- As per Ernst & Young the total Indian market by 2010 to touch : \$1.5-2.00b
- Clinical trials conducted in India in 2004-05 : 175 (Projected growth rate 30% annual)
- National Register of Clinical Trials available with Central Drug Control Organisation

Based on : Indian Pharma Business & Tech, January, 2007



NATIONAL BIOTECHNOLOGY DEVELOPMENT STRATEGY

- This policy aims to chalk out the path of progress in sectors such as agriculture and food biotechnology, industrial biotechnology, therapeutic and medical biotechnology, regenerative and genomic medicine, diagnostic biotechnology, bio-engineering, nano-biotechnology, bio-informatics and IT enabled biotechnology, clinical biotechnology, manufacturing & bio-processing, research services, bio-resources, environment and intellectual property & patent law.
- National Biotech Development Strategy charts an integrated 10-year road map with clear directions and destinations.



SECTORAL ROAD MAPS

NBDS has well laid out sectoral road maps on

- Agriculture & Food Biotechnology
- Bioresources
- Industrial Biotechnology
- Microbial resources
- Marine resources
- Bioengineering and Nanobiotechnology



GROWTH THRO' INFORMATION TECHNOLOGY



IT - AN AREA DRIVING THE GROWTH : MAIN OBJECTIVES

- Create policy framework and develop associated infrastructure, facilities and capabilities for IT industry to be globally competitive.
- To conceptualise and implement programmes leading to creation of e-Society.

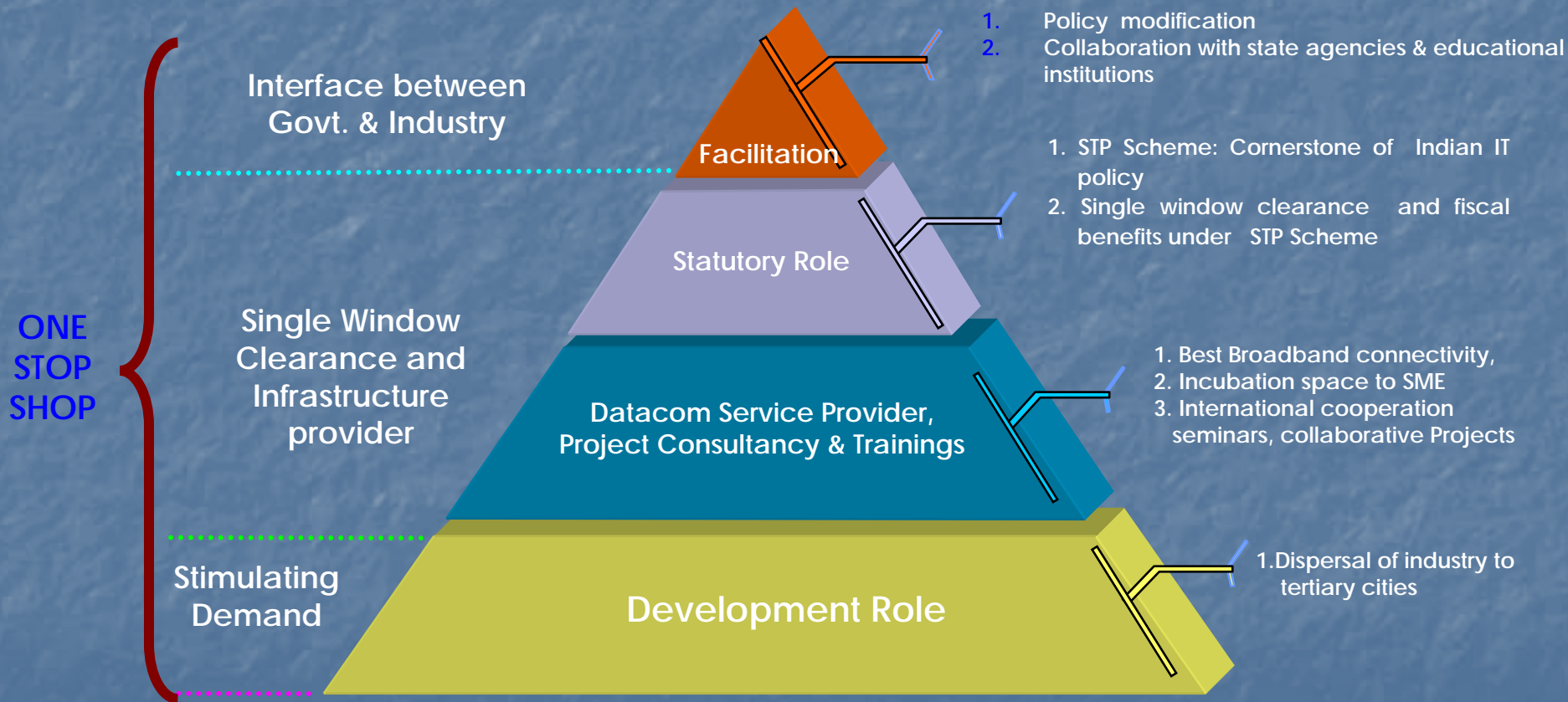


ENABLING INSTITUTIONS OF GROWTH

- Setting-up Software Technology Park of India
- Schemes on Standardisation, Testing & Quality Certification
- Availability of Human Resources
- Setting up high-tech clusters within STPIs
- IT/ BT corridors

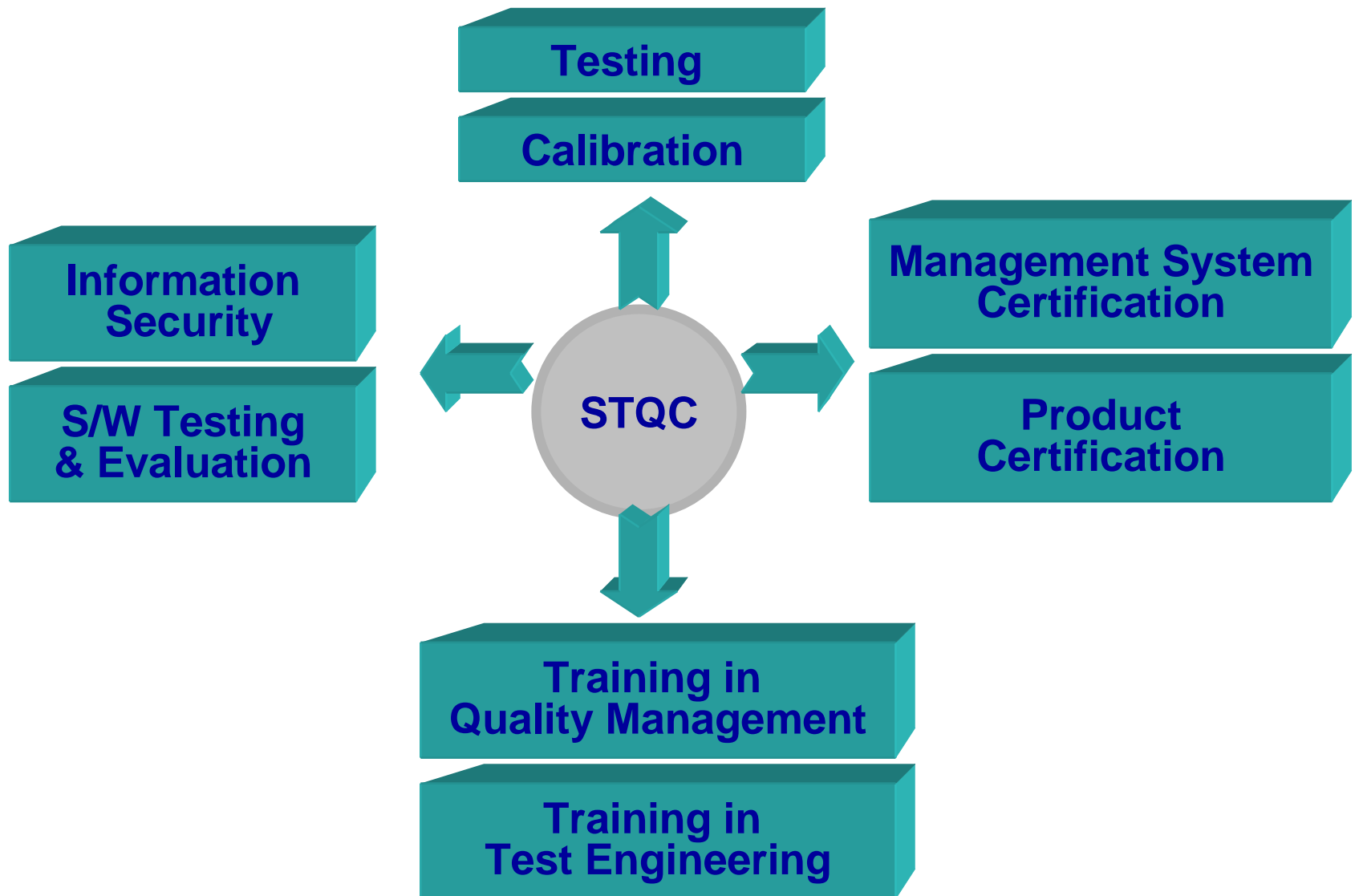


ROLE OF STPI



Source : Dr. A.K. Chakravarti

STQC ACTIVITIES & SERVICES





R&D IN IT : ENABLING STRUCTURES

- Introduction of IT as a subject at school level-preparing IT researchers of tomorrow
- Setting up Centre for Development of Advanced Computing
- Setting up Centre for Development of Telematics
- IIITs, IISc, IITs, select CSIR Labs, Academia
- About 20% of IT export is of R&D services with a value of app.US\$2.3bn
- MNCs locating their R&D centres in India



CREATING AN INDIA E-SOCIETY

- National e-Governance Plan
- Facilitating Good Governance : National Information Centre (NIC)
- Bridging the Digital Divide
 - Common Service Centres (CSCs)
 - Media Lab Asia (MLA)
- Technology Development of Indian Languages (TDIL)
- Information Technology Act, 2000
 - e-Commerce
 - e-Governance
 - Cyber Crimes
 - Cyber Security

Source: Dr. A K Chakravarti



National e-Governance Plan (NEGP) : The Vision

All Government services **accessible** to the common man

In his **locality**,

through Common Service delivery outlets and

ensure **efficiency, transparency & reliability** of such

services

at **affordable** costs to realise the **basic needs** of the

common man

(<http://egov.mit.gov.in>)



NEGP –Mission Mode Projects (MMPs)

MMPs identified on the basis of high citizen / business interface – project cover range of key services offered by department

• Central (9)

- Income Tax
- Central Excise
- Passports/Visa & Immigration
- MCA 21
- National ID
- Pensions
- E-Office

Industry Initiative

- Banking
- Insurance

State (11)

- Agriculture
- Land Records
- Transport
- Treasuries
- Commercial Taxes
- Gram Panchayats
- Municipalities
- Registration
- Police
- Employment Exchange
- E-District

Integrated (7)

- e-BIZ
- EDI
- **India Portal**
- **Common Service Centers**
- **EG Gateway**
- E-Courts
- E-Procurement

States can add up to 5 state specific Projects



RECOMMENDATIONS



PAN – ASIAN S&T POLICY

FRAMEWORK – THE STRATEGY (I)

- Developing economies of Asia know it well that sustainable development should ideally be equitable, impacting the life of every individual. It has to reach every strata of civil society.
- Asia having about 40 countries has only a few developed economies, for the rest we need to identify, work on and deliver research based developmental solutions which are sustainable and equitable and in the first instance focus specially on:
 - rejuvenating agriculture,
 - providing health & sanitation,
 - safe drinking water,
 - sustainable use of bioresources
 - preparedness for disaster mitigation



PAN – ASIAN S&T POLICY

FRAMEWORK – THE STRATEGY (II)

- Asia needs to play a special role in developing global strategies for R&D/S&T based solutions for local problems.
- In order to do so we need a PAN-Asian S&T Policy Framework, conceived and framed by us only



The PAN Asian S&T Policy should help to bridge the technological, digital, gender and genetic divide, the lack of which is now leading to the emergence of a shining urban Asia and a deprived, suffering rural Asia

Adapted from CSIR
Foundation Day 2007 lecture by
Prof. M.S. Swaminathan





THANKS