GC 2012-5658: AN OVERVIEW OF THE CONTEMPORARY ISSUES IN ENGINEERING EDUCATION IN INDIA

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AN OVERVIEW OF THE CONTEMPORARY ISSUES IN ENGINEERING EDUCATION IN INDIA -- CONTENTS OF PRESENTATION

- **Scope of Technical Education (India)**
- **Why India Will be Increasingly Important in the Coming Decades**
- **Quantitative Trends**
- **How India is Focusing on Priority Areas**
- **Some Current Issues in Engineering Education**
- **Rationale For Re-design of the Engineering Education System**
- **Some More Contemporary Issues**
- **A Summary of the Features of Indian Engineering Education**

SCOPE OF TECHNICAL EDUCATION

- **Technical Education in India, as a result of the definition provided by the AICTE Act, includes, in addition to Engineering, the following:**
  - **Management,**
  - **Architecture,**
  - **Pharmacy,**
  - **Computer Applications,**
  - **Hotel Management and Catering Technology, and**
  - **Applied Arts and Crafts**

WHY INDIA WILL BE INCREASINGLY IMPORTANT IN THE COMING DECADES

PROJECTED RELATIVE SIZE OF ECONOMIES

Country	GDP in US$ Terms		GDP in PPP Terms	
	2005	2050	2005	2050
USA	100	100	100	100
JAPAN	39	23	32	23
CHINA	18	94	76	143
UK	18	15	16	15
INDIA	6	58	30	100

Source : PricewaterhouseCoopers Report :

World In 2050
By 2050, in $ terms India's GDP will have overtaken that of UK and Japan and in PPP terms will have equalled USA.

Working Age Population (15-59 Yrs)

World : 100

	2000	2050
India	17	19
China	23	14
USA	5	5*
West Europe	3	2
Japan	2	1

*** USA adds significantly by its liberal immigration policy.**

Source: UN World Population Prospects Database 2004

The only country for which the number is rising is INDIA.

In 50 years, nearly ONE IN FIVE IN THE WORLD WILL BE INDIAN

ADVANTAGE INDIA – SOME EXAMPLES

- **Global Success of IT entrepreneurs (Silicon Valley, for example)**
- **Success of Indian MNCs (Tata Motors, "SWITCH" IT companies, NIIT, ….)**
- **Demographic Dividend (global workforce reservoir)**
- **Space, Nuclear Power – exclusive global groups**

QUANTITATIVE TRENDS

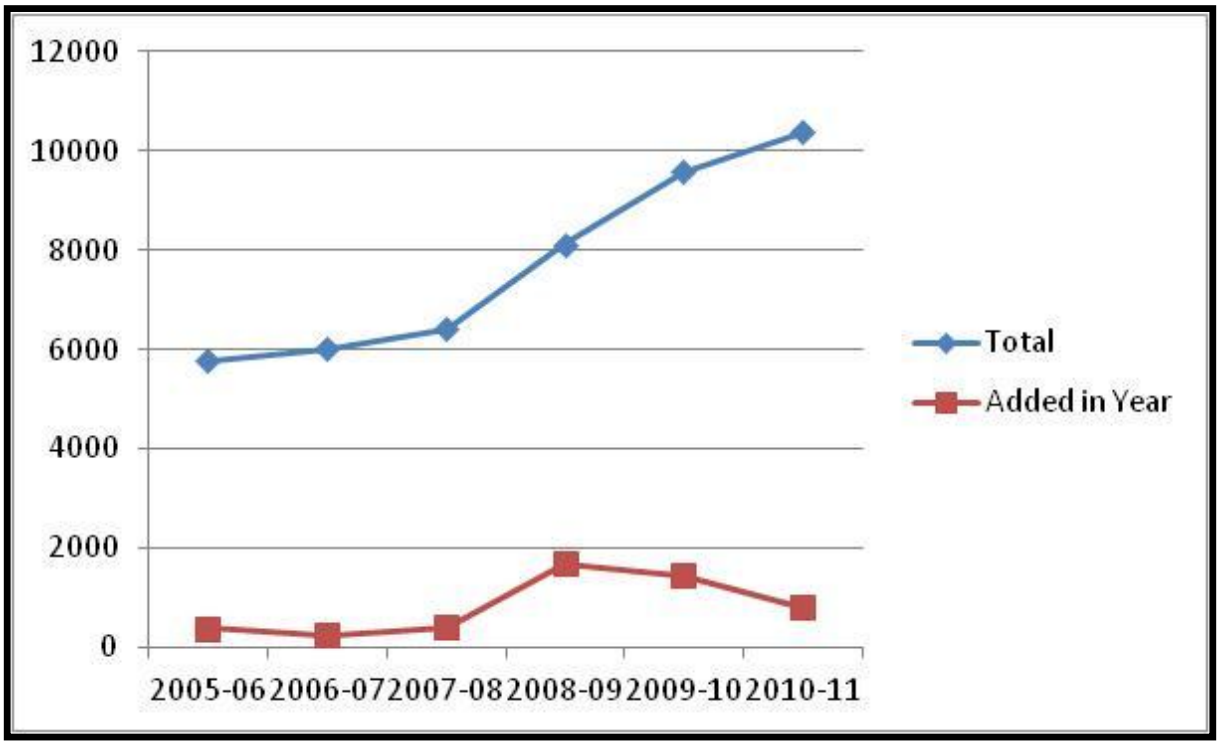
Growth of AICTE approved Technical Institutions in last six years

Year	Engineering	Mgmt	MCA	Phar	Arch	HMCT	Total	Added in a year
2006-07	1511	1132	1003	665	116	64	4491	171
2007-08	1668	1149	1017	854	116	81	4885	394
2008-09	2388	1523	1095	1021	116	87	6230	1345
2009-10	2972	1940	1169	1081	106	93	7361	1131
2010-11	3222	2262	1198	1114	108	100	8004	643
2011-12	3393	2385	1228	1137	116	102	8361	357

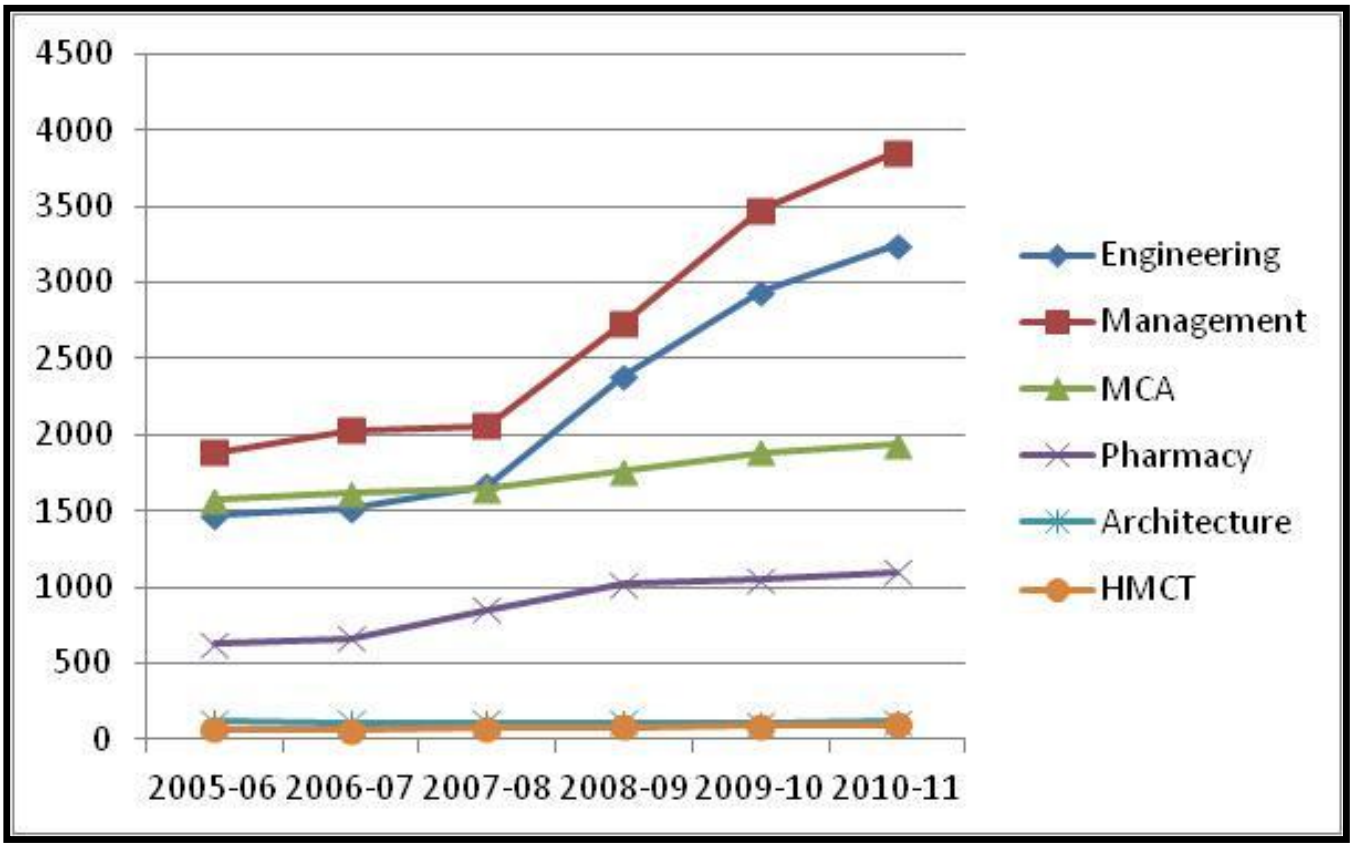
Growth of intake in AICTE approved Institutions in last six years

Year	Engineering	Mgmt	MCA	Pharm	Arch	HMCT	Total	Added In a year
2006-07	550986	94704	56805	39517	4543	4242	750797	73566
2007-08	653290	121867	70513	52334	4543	5275	907822	157025
2008-09	841018	149555	73995	64211	4543	5794	1139116	231294
2009-10	1071896	179561	78293	68537	4133	6387	1408807	269691
2010-11	1314594	277811	87216	98746	4991	7393	1790751	381944
2011-12	1485894	352571	92216	102746	5491	7693	2046611	255860

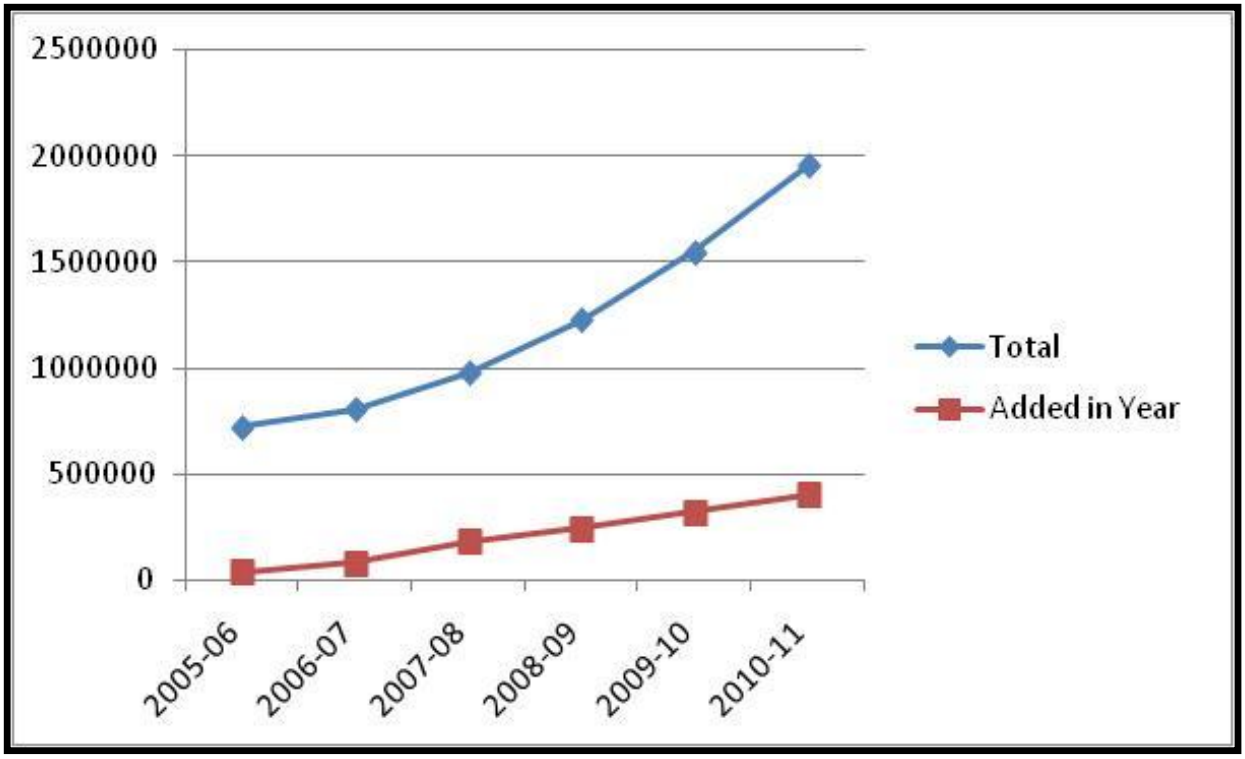
GROWTH OF TECHNICAL INSTITUTIONS IN INDIA – YEAR WISE ADDITIONS AND GROSS NUMBER



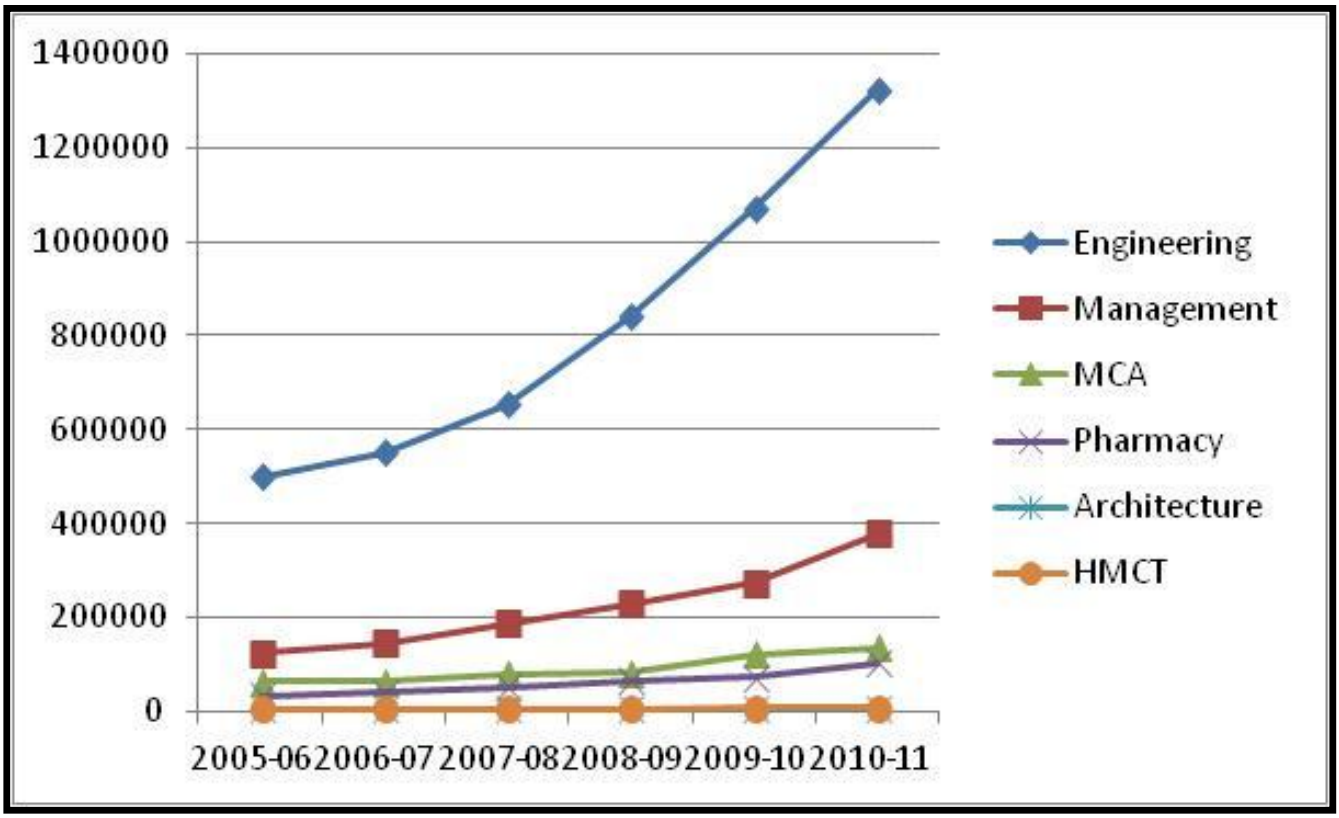
GROWTH OF TECHNICAL INSTITUTIONS IN INDIA – BRANCH WISE



GROWTH OF ADMISSION CAPACITY IN TECHNICAL EDUCATION IN INDIA – YEAR WISE ADDITIONS AND GROSS NUMBER



GROWTH OF ADMISSION CAPACITY IN TECHNICAL EDUCATION IN INDIA- BRANCH WISE



A QUALITATIVE ANALYSIS

ASYMMETRIES IN OUR TECHNICAL EDUCATION SYSTEM

- Asymmetry
- Divide
- Diversity
- Disparity
- Imbalances
- Inequities

CHARACTERISTIC	A	B
Geographical	Regions with high density of Institutions (SR, SWR, WR)	Regions with low density of Institutions (ER, NER)
Disciplines	IT related courses	Conventional courses
Level	Degree	Diploma
Location	Urban	Rural
Funding and Governance	Government	Self -- financing
Exam. System	Affiliated	Autonomous, Deemed University

ASYMMETRIES IN OUR TECHNICAL EDUCATION SYSTEM

CHARACTERISTIC	A	B
❖Prospective employers	Large scale, corporate sector	SMEs
❖Employment	Seeking	Generating
❖Level	UG	PG
❖Research	Experimental	Computer based
❖Nature of institution	Research University	Teaching institution
❖Subject Areas	Science and Technology	Arts and Commerce
❖Specialization	Generalist	Specialist
❖Prosperity of Stakeholders	Rich	Poor
❖Access to information	Information haves	Information have nots

EVOLUTION OF UNIVERSITY RESEARCH AND INDUSTRIAL CONSULTANCY IN INDIA

- **During the *Early Years* (70's)**

  "*Publish or Perish*"

- ***Later Years* (80's)**

  "*Publish and Consult; or Perish*".

- **Recent Years – post WTO**

  "*Patent, then Publish; and Prosper*".

- **The Open -Source Revolution**

  " *Publish, Share; and Feel-Good"*

OUR FOUR MAJOR CHALLENGES

- Increasing **Capacity**
- Improving **Quality**
- Enhancing **Research**
- **Internationalizing** Engineering Education and R &D

HOW INDIA IS FOCUSSING ON PRIORITY AREAS

1.Significant unmet demand of eligible school-leavers for entry into engg institutions.	**1.Major enhancement of admission capacity in both public and private institutions**
2.Paucity of qualified teachers	**2.NPTEL Project for developing curriculum-based learning resource materials.**
3.Paucity of Ph.D.s	**3.Significant enhancement in Ph.D. admission capacity in engineering institutions and research fellowships.**
4.Quality of engineering institutions	**4.Re-design of Accreditation processes aligned with Washington Accord (and ABET) outcomes – based criteria.**

INDIAN DECADE OF INNOVATION

- **President's Address to the Parliament on June 4, 2009**
- **"My Government will ensure that its policies for Education and S&T are infused with a spirit of innovation, so that the creativity of a billion people is unleashed.**
- **The next ten years would be dedicated as a Decade of Innovation"**
- **National Innovation Council established under the chairmanship of Sam Pitroda.**

SOME CURRENT ISSUES IN ENGINEERING EDUCATION

- **The (generation gap) between:**
  - **those who teach and those who learn**
  - **those who recruit and those who seek jobs**
  - **those who frame policies and those who function within the system**
  - **theory and practice of assessment of : learning, and of performance on the job**
- **How do we close these gaps?**

AUTONOMY

- **Whom to teach – Students**
- **What to teach – Curriculum**
- **Who will teach – Faculty**
- **How to assess – Exams**

- **Academic**
- **Administrative – Managerial**
- **Financial**
- **Functional**

DIFFERENT COMBINATIONS OF BUZZWORDS IN HIGHER EDUCATION

- ❖Inclusion
- ❖Excellence
- ❖Diversity
- ❖Employability
- ❖Global Engineer
- ❖Glocal
- ❖Expansion
- ❖Affordability
- ❖Sustainable Development
- ❖Relevance
- ❖Innovation
- ❖Quality

A CHANGING WORLD

Worldwide changes

- **Changes in technology**
- **Changes in education and training**
- **Changes to work and professions**
- **Changes in management and organisation of institutions**

GLOBALISATION--DIFFERENCES IN PERCEPTIONS OF DCs AND LDCs

Sector	Developed Countries	Developing Countries	
Economy	❖Favorable trading opportunities ❖expanded markets	❖deregulation ❖enhanced privatization ❖currency integration	
Education	❖Enhanced markets for educational products , processes and services ❖making up for reduced indigenous demand	❖study opportunities abroad for those who can afford it ❖Competition to local institutions	
Employment	❖leads to erosion of jobs ❖competition from low–wage work force from LDCs	❖leads to off-shore jobs ❖opportunities for short-term employment abroad	

SWOT ANALYSIS OF A TRADITIONAL ENGINEER

STRENGTHS	WEAKNESSES

☺ Analytical Capabilities
☺ Design Capabilities --
  - ability to handle open-ended problems
  - ability to handle poorly-defined problems
  - creativity and innovation
☺ Decision-making, including problem-solving
☺ Graphical communication skills
☺ Discipline,Work ethic.
	☺ Ability to work in a Team
	☺ Inter-disciplinary knowledge
	☺ Practical orientation (academics)
	☺ Commercial orientation
	☺ Introspective nature, modesty
	☺ Oral and written communication skills
	☺ Integrative skills
	☺ Ability to employ IT
	☺ Obsolescence (remedy : Continuing Education)
	☺ Inter-personal skills
	☺ Public perception and recognition

OPPORTUNITIES	**THREATS**
☺ Most real-life problems require contributions from Engineers ☺ National policies recognize role of S & T ☺ Business recognizes role of Technology ☺ Ambition of bright youth to become Engineers ☺ Globalisation offers opportunities for acquisition of state-of-the art technologies	☺ Competition from Scientists, Economists, Financial Experts, Administrators in high-level decision-making bodies. ☺ Quantitative expansion in Technical Education without simultaneous Quality assurance ☺ Industrial development entails depletion of natural resources and environment degradation -- Engineers held responsible for these.

A COMPARISON OF THE TRADITIONAL AND XXI CENTURY ATTRIBUTES OF ENGINEERS

TRADITIONAL ATTRIBUTES	XXI CENTURY ATTRIBUTES
❖ Problem-solving abilities ❖ Analytical skills ❖ Communication skills — ▪ Oral, written, graphic ❖ Ability to relate to practical aspects of engineering ❖ Inter-personal skills ❖ Management skills ❖ Decision-making skills ❖ Design capabilities ▪ ability to handle open-ended problems ▪ ability to handle poorly-defined problems ❖ Discipline, work ethic	❖ *Learnability:* learning to learn, on one's own ❖ Yen for life-long learning —continuous education ❖ Ability to muster knowledge from neighboring disciplines ❖ Ability to work in a team ❖ Exposure to commercial disciplines ❖ Creativity and Innovation ❖ Integrative skills ❖ International outlook ❖ Ability to employ IT ❖ Ability to work at interfaces between traditional disciplines ❖ Commitment to sustainable development

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

- **ENVIRONMENT, AMBIENCE**

❖ **Significant Impact of Technology on:**

Education, Industry, Commerce, Lifestyle, Entertainment, Society

❖ **Demand for Mass Education**

❖ **Widening of Disparities:**

- **Technology Divide**
- **Digital Divide**
- **Prosperity Divide**
- **Literacy/Education Divide**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

- **Increased Uncertainty, Lowered Predictability**
- **Importance of Institute-Industry Interaction**
- **Potential of ET and ICT for enhancing the effectiveness of Learning**
- **Distance Education / Virtual University Initiatives**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

- **Changing Employer – Employee Loyalty Relationships :**
  Implications of:
  - **Lifetime employment**
  - **Outsourcing**
  - **Down / Right-sizing**
  - **Hire and Fire**

- **Quality Assurance and Accreditation**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

- **Significant Changes in the Practice of Engineering as a Profession in the new millennium** :
  - **Constraints imposed by environmental considerations**
  - **Customization demanded by diverse customers**
  - **Opportunities offered by technology developments in several sectors**
  - **Availability of sophisticated diagnostic and computational tools**
  - **Wide choice of materials**
  - **Implications of Globalization, such as , for example, Innovation as the basis of Competitiveness**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

❖ ***Changing and Emerging Roles of:***

- **Leadership, Governance**
- **Faculty : Teaching, Mentoring, Assessment**
- **Support Services**

❖ ***Redefined Goals of Technical Education*:**

- **Quality, Excellence, World-Class**
- **International Competitiveness**
- **National Relevance**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

❖ ***Redefined Goals of Technical Education (cont'd)*:**

- **Appropriate Technical Education**
- **Identification of Stakeholders, and Fulfillment of their Requirements**
- **Emerging Demands of the Profession**
- **Professional Ethics and Human Values**
- **Social and Societal Responsibility**
- **Sustainable Development**
- **Environmental and Ecological Responsibility**
- **Resource Conservation**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

❖ ***Perspective Planning*:**

- **Manpower Development**
- **Discipline-wise distribution**
- **Regional distribution**
- **Level-wise distribution : Degree / Diploma**
- **Ph.D and P.G. programs**
- **Emerging Thrust Areas**

RATIONALE FOR RE-DESIGN OF THE ENGINEERING EDUCATION SYSTEM

❖ ***Emerging Models*:**

- **Technological Universities**
- **Deemed Universities**
- **Virtual Universities / Distance Education**
- **Autonomous vs Affiliated Institutions**
- **Twinning arrangements with foreign institutions**
- **"Brick" , "Click" & "Hybrid" Models.**

SOME MORE CONTEMPORARY ISSUES

❖ **I .*Which Stakeholder should dictate our System*?**

- **Student**
- **Employer / Recruiter**
- **Institution**
- **Faculty**

SOME MORE CONTEMPORARY ISSUES

II *Conflicts* :

- **Short-range perspective of Employers vs. Long-range perspectives of Academics**
- **Soft skills demands of Employers vs. Hard skills focus of Academics.**
  - ❑ **A person with hard skills, but no soft skills:**
    - ▪ **'Nerd', not a Leader**
  - ❑ **A person with soft skills, but no hard skills:**
    - ▪ **Bluff-master, gas-bag**
- **Institution's perception of a Faculty member as a Commodity, a 9-5 worker; a commodity which can be purchased in the market.**

SOME MORE CONTEMPORARY ISSUES

III *Internal Brain Drain* (criticized)

- **Students given professional education (Engineering , e.g) taking up careers un-related to their education and training**
- **Particularly, Marketing, Advertising, Finance attract criticism.**
- **We have learned to accept *External* Brain Drain :**
  - **Brain Gain, Brain Circulation**
  - **The Success of the Silicon Valley Entrepreneurs**
  - **Offshore jobs from India**
  - **Alumni support to their Alma Maters**

THE SYMBIOTIC AND SYNERGISTIC RELATIONSHIP BETWEEN UNIVERSITY AND INDUSTRY

- **University is the intermediary between two important Stakeholders:**
  - **Students**
  - **Employers**
- **We need bridges between Engineers in University and Industry through committed Educators, Researchers and Professionals.**
- **The two Partners need and depend on each other, and derive mutual benefit from the partnership – *Symbiosis*.**
- **The overall impact can be much greater when the two partners function in phase and in resonance – *Synergy*.**
- **It is necessary to create a win-win partnership for both partners.**

A SUMMARY OF THE FEATURES OF INDIAN ENGINEERING EDUCATION

- **Our Technical Education System is characterized by**
  - **Huge size**
  - **Many Asymmetries and Divides**
  - **Diversity (of many types)**
  - **Variable Quality**
  - **Frequent changes of Policy**
  - **Many International Collaborations**
  - **Many Strengths and Weaknesses**
  - **Many Opportunities and Challenges**