

# **LUMS**

## **The Making of a Research University**

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1634-35

**Lahore School Of  
Astrolabe Makers : Family  
of Qaim Mohammad 16/17<sup>th</sup>  
C (Lewis Evans Collection, USA)**

**For me, the symbol of Lahore is the series of astrolabes made by the family of Qaim Mohammad at Lahore in the early 17<sup>th</sup> century. It was the GPS and calculator of the time rolled into one. This particular example had the usual data of the geographical location of dozens of cities from central Asia to the Mediterranean, plus trigonometric tables. While traditional lunar calendar was expected, it is remarkable for its offering of the option of a solar calendar.**

***It was obviously meant for export. A true enterprise, exactly what LUMS wants to establish.***

- I welcome this initiative by LUMS for several reasons.
  - ***First***, this effort is being undertaken by a private University.
  - ***Second***, it attempts to reverse the unfortunate decisions of the sixties when engineering and medical faculties were separated from general universities and made independent universities on the premise that they will now be able to conduct research. Both the general and the engineering and medical universities suffered as a result of this decision.
- The **'General' Universities** have been deprived of :
  - Technology and workshops for fabrication, controls and instrumentation, engineering design + good clinical practices / data.
- **Engineering and Medical Universities** have been deprived of :
  - Basic sciences (mathematics, physics, chemistry and biology...)
  - Interaction with the humanistic and cultural aspects of education which come through rubbing shoulders with historians, linguists, economists, and anthropologists .. to name only a few

- **Higher Education is in distress everywhere; academically, financially, and due to “internationalisation”; It is difficult to sustain quality for rapidly expanding enrolments, and it is expensive**
  - **It requires time to stabilise ... there are no shortcuts**
  - **It needs to be built judiciously around the twin pillars of student aspirations and faculty interests**

## **Some Questions**

- **Is LUMS ready to accept the intellectual burden of a ‘proper’ university, with social sciences and humanities, physical sciences, and engineering on the same campus**
- **Why would students come to LUMS ?**
  - **Why do people go for higher education in S&E ?**
  - **Who will employ them ? is emigration the only option ?**
- **A research university?**
  - **What fields?**
  - **What mix of graduate research and teaching**
  - **What mix of graduate and undergrad teaching**
- **Sources of funding ?**

# What should LUMS Focus on: Which Areas ?

**The Student's Interests** : whether it is the First Degree or Graduate Studies..... B Sc / M Sc / or D Phil.. looks for

- Employability >> Job Satisfaction and / or Financial satisfaction, preferably both

- **Matching faculty interests** with those of the students ?

- **Matching faculty interests** with those of the Institution ?

- **Example:** Probably will not offer the Mongolian language except in exceptional cases, which might involve prestige for the institution because of the person hired

- **Allowing faculty interests** to prevail ... retention !

- **National Interests & Priorities** : Skill Gaps/Skills Shortages ? MITI Japan took great care to match such gaps /shortages by sponsoring new technologies, training, education, research

Will not talk about 'clustering' to cover a wider areas / more fields with fewer equipment ... have earlier submitted copies of these possibilities and the projected costs ( capital & operational) + cash flows to LUMS.

First, let me give you a peep into a current exercise at P Block

# Small Task Force: Vision / Forecast / Foresight Exercise

Many Futures are Possible ! Can we identify and manage and implement the Preferred Future ?

Problems of Forecasting

**Theme: Pakistan must become an affluent and developed nation *within one generation ... a core state of the 21<sup>st</sup> Century***

1. All strategies and actions will need to be subservient to the overarching objective of becoming a vibrant knowledge economy.

***The economics of knowledge must therefore underpin appropriate policies for growth in Pakistan.***

**But The 'K' word is everywhere! All countries wish to either become knowledge societies if they are not one already, or wish to enhance their knowledge advantage. So what must Pakistan do**

**With this in mind, a systematic analysis and foresight exercise would be carried out into the possible long-term global transformations, and its linkages with science, technology, economy, environment, and society, with a view to understanding the nature of the state of Pakistan and its people in 2030, and outlining the strategic directions to provide a concrete reality to Vision 2030 in both its physical and intangible forms.**

## A Flavour of the Vision Exercise: Societal Transformations

- **Scale of information / technology dispersion** is so massive, that it will change the scale and nature of human enterprise.
  - The way we live and work and educate ourselves, or compete and trade, and the manner in which we grow old and become sick, would have been completely transformed during the next 25 years
  - Enormous strains on Governments and society
    - *Traditional centres of power* – governments or industrial and business leaders– will no longer be able to digest information fast enough or to make every critical decision. *Individuals will have more information* at their fingertips and capacity than most countries have today.
- **Hard societal choices needed:**
  - Issues of culture and identity are likely to overwhelm society unless we achieve synthesis among the streams of religion, cultural roots, *and* scientific methodology.
  - The basic thread in the discourse of Vision 2030 will remain the creation of a just society, without which Pakistan will not flourish and prosper.

# Vision Exercise: Transforming Institutions of State and Governance

- **Institutions are created** when it is efficient to create them, i.e., when the social benefits of building institutions exceed the transaction costs of doing so.
- **Institutions are stabilized** within proper economic, political and cultural settings
- As the *scale* of economic activity expands in Pakistan, **better institutions will become unavoidable**.. Will also become affordable
- **The institutional transformation** must lead to trust between the state and the people and among different linguistic, ethnic and religious groups

It will be important to:

- **Critically re-examine** the future role and responsibilities of the state in providing the basic social services of education, health, energy needs, and security
- **Weave a thread** of administrative and social cohesive partnership with its citizens.

**Pakistan's Development Vision will demand enormous amounts of energy.**

- Pakistan is **running out of useable, affordable energy** .. so is the world
- **Current Total Primary Energy: of 55 MTOE expected to rise to 360 MTOE by 2030 ..... 7 fold increase... will still be less than Malaysia's current Per Capita consumption.**
- **Major Shift Planned:** >> coal, nuclear, and renewables <<
  - *More efficient use absolutely vital*
  - *Alternative sources / engine types*
  - *Alternative work habits*

***Producing Energy Specialists at LUMS??***

***Fuel Cell Developers at LUMS??***

**True Costs??:** Fuel cells, Nuclear de-commissioning, Coal based pollution, etc

# The Demographic Transition

Demographics ~ 240 million in 2030

.....~ 70% in urban areas.

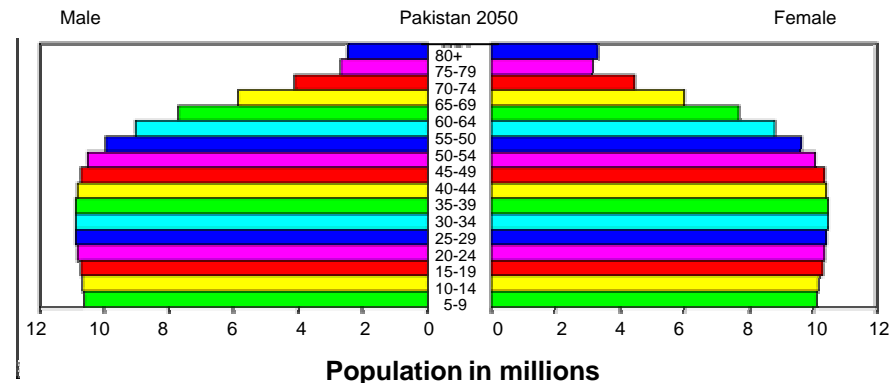
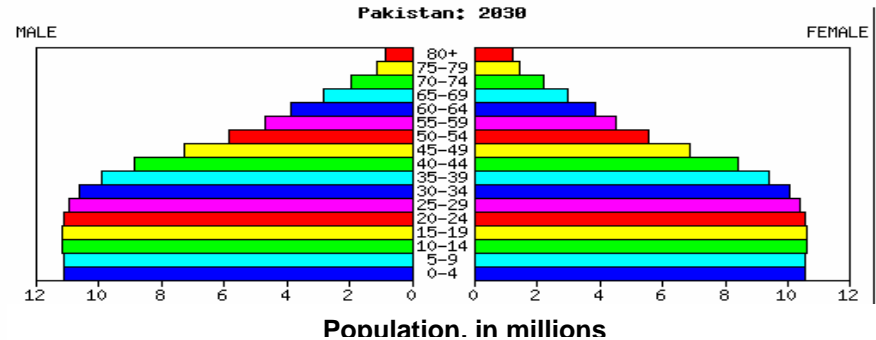
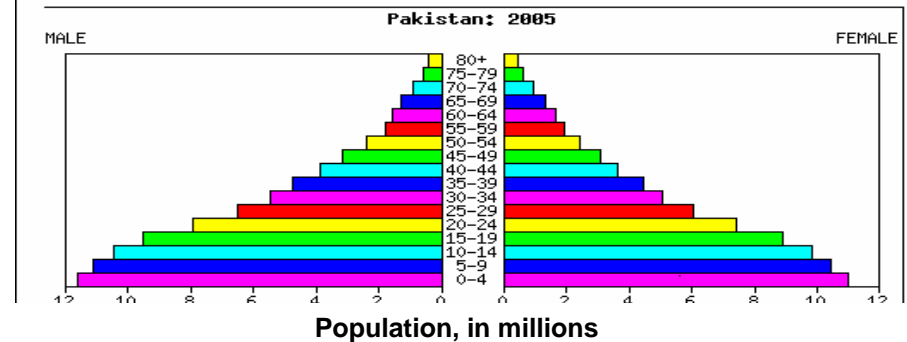
- Increased Life expectancy
- Population aging
- Epidemiological transition

Sub-replaceable Fertility in 50% of world population. Also: Algeria, Tunisia, Turkey, Lebanon, Iran are already there. So will Pakistan.

While the developed countries became rich before they grew old, We face the danger of becoming old while still remaining poor

Pakistan ...on a favourable portion of the demographic transition *until 2030*; with influx of some 60 million people in the economically productive age group. Is there a demographic dividend, or do we face **social chaos** if they lack skills & education?

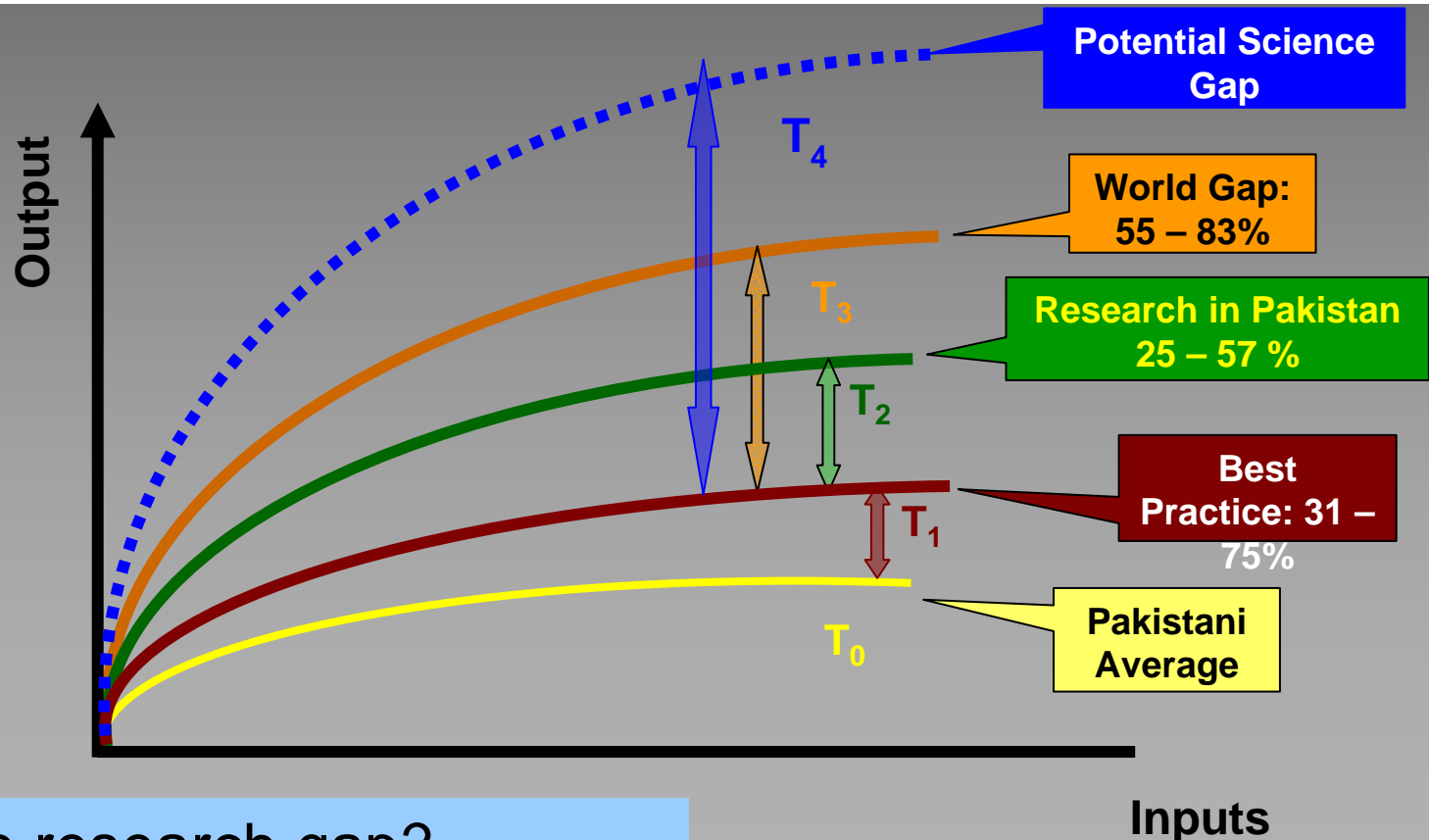
What kind of education and skills ?  
Role for LUMS in teaching the managing of aging societies??



## Water, Food, and Arable Land

- **Low Water Storage, high wastage**
- **High Growth Rates in Agriculture**, will not be realised through current technology, practice and attitude –
- **Optimal Cropping Pattern** for maximum attainable yields keeping in view water availability and other inputs

Scope for  
Enhancing  
Productivity  
in  
Agriculture ?



Bridging the research gap?  
Biotechnology and LUMS ??

## Are we seeing a return to the City State?

**Global Urban Dwellers** exceeded those in rural areas for the first time in human history In 2005, ... [Shenzen, a small town, has now reached a higher population than London ... but in only 20 years ]

**Urban productivity** is generally 2 –5 time that of rural areas

**In Pakistan, too,** more and more settlements will grow into their **equilibrium size** – optimal and functional hierarchies of settlements.

Pakistan's urban population is projected to increase from the current 55 million to about 135 m by 2030

**Another 80 m people in only 25 years! Gigantic task**

- **Housing? Services? Slums? Unemployment? Social cohesion? Urban Poverty can be even more severe than rural poverty !**

**Can LUMS offer a programme in Urban Engineering ?**

## Where does LUMS fit in ?

Since Pakistan wants to become a 'Knowledge Society', let us examine the salient features of such a society:

- **Focused investment in education and training** (especially technical education), and lifelong learning and development
- **Excellent public institutions** : provide the legal and regulatory framework
- **An efficient and low cost**, national and international communications network
- **Products / services** with high- embedded knowledge / knowledge intensity.
- **A large number of Scientists, Engineers & Technicians** to *maintain and improve* the technological infrastructure.

Managing the knowledge society can be a major course at LUMS

# Education at LUMS: The National HE Context

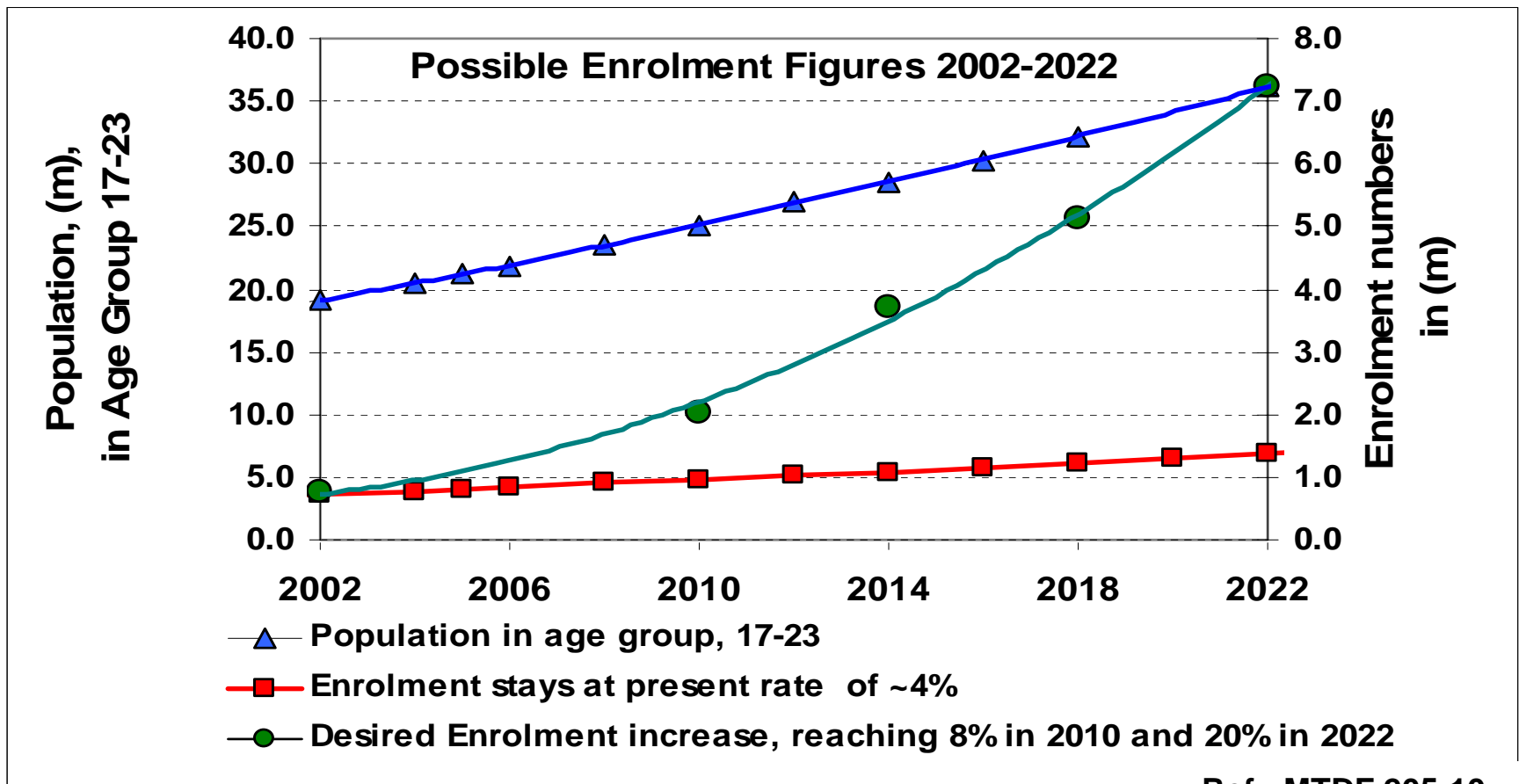
Pakistan's productivity levels are extremely low

What is expected of our Universities ?

Higher enrolments ?

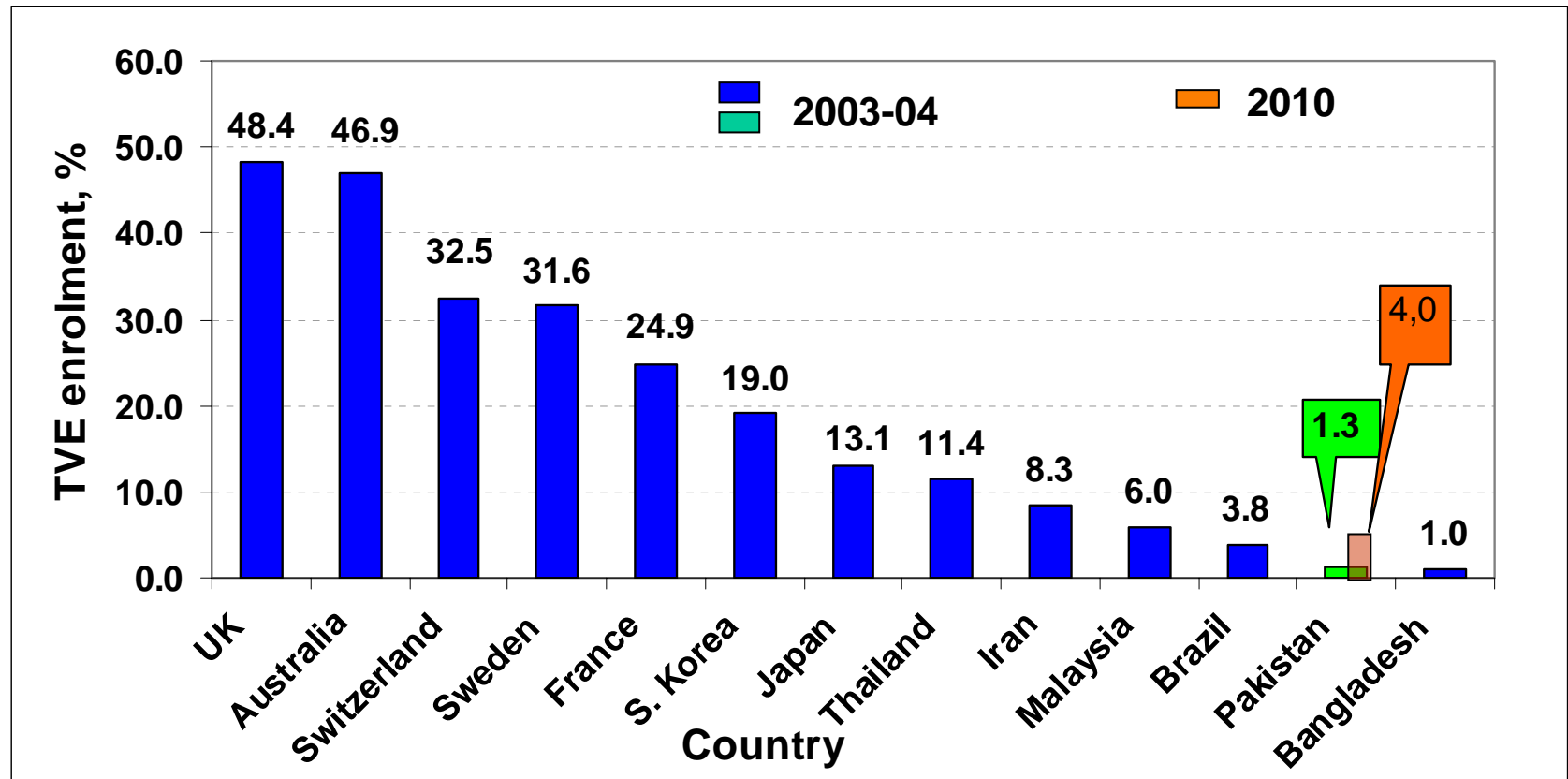
Much higher quality of education ?

Who pays for all this?



# Enrolment of School Leavers in Technical Vocational Education

Who will maintain the societal infrastructure, apart from producing more goods, services, food etc etc



[Ref: EFA Global Monitoring Report, 2003-04, except Pakistan (Min. of Ed)]

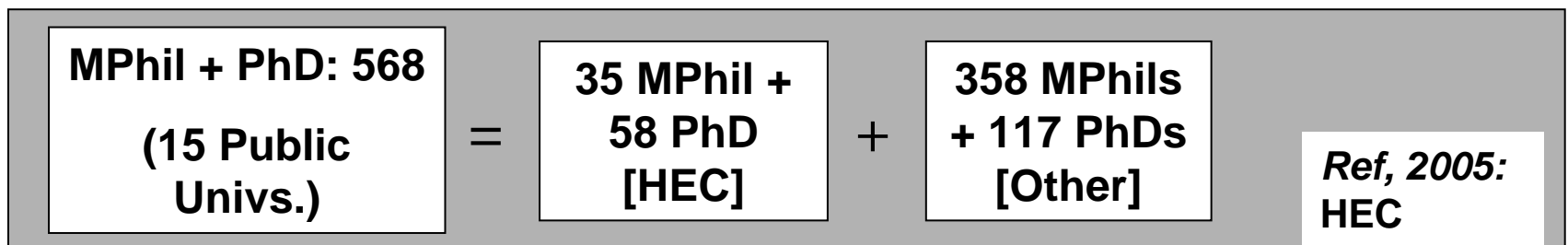
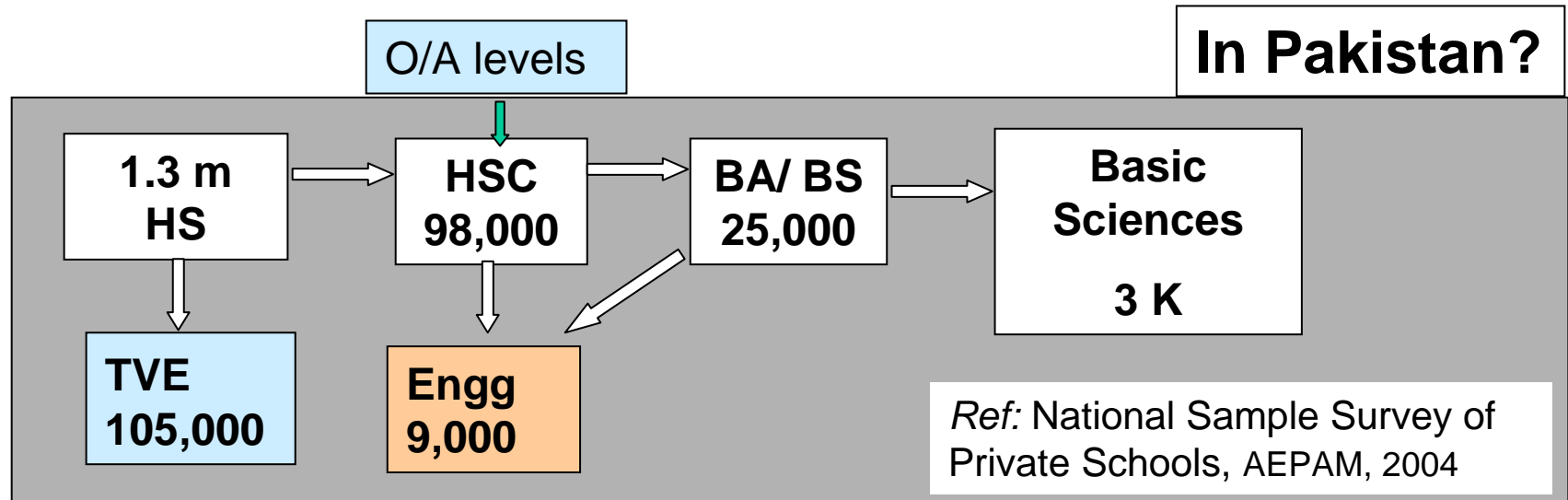
Can the LUMS SSE also help create skills in emerging areas?

# LUMS wants to be a Research University.

## What kind of person will enroll at LUMS ? *Example: Physics in Pakistan*

Falling enrolments worldwide

- Indifferent Standards at high school / college / university level
- Few Jobs outside the conventional government jobs
- Continuous hemorrhage and exodus



Since 1997 : **18 physics + 28 chemistry** departments closed  
Now: 3000 Physics graduates vs 15,000 psychologists per annum

*Ref:* 'Dyson': BBC Dimbleby Lecture, Dec 2004

1991 to 2003: Overall A-level enrolments went up by 7.4 %.  
BUT A - Level enrolment in science declined :

**Chemistry: 19 %**,    **Physics: 30 %**,    **Maths: 25 %**,  
[Only **Bio** went up by 11 %]

Between 1996 and 2002:        1st-year undergrad. enrolment fell

Engineering & Technology: **8 %**

Phys. sciences: **20 %**

*Ref:* Lord May of Oxford; President of the Royal Society, 17 May 2004

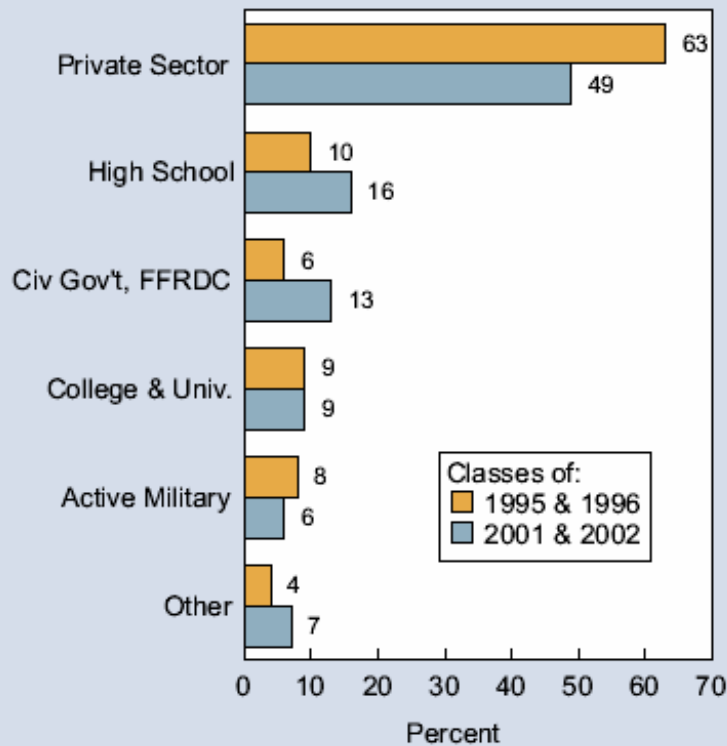
# Where do Physicists Work in the USA

**In 2003:** 1.22 million graduates in all subjects

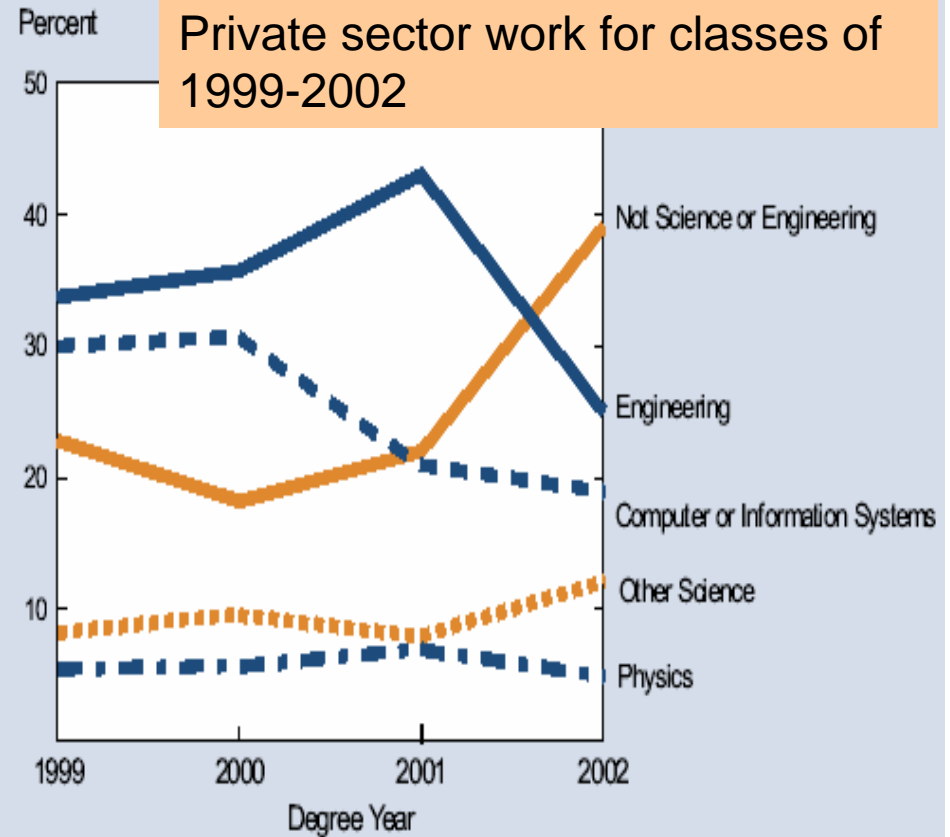
**Physics Bachelors** : 4553 ( 0.37 % of total)

**Physics PhDs** : 1100 ( half were foreigners)

**Figure 10. Initial employment sectors of physics bachelors.**



*AIP Statistical Research Center, Initial Employment Report.*

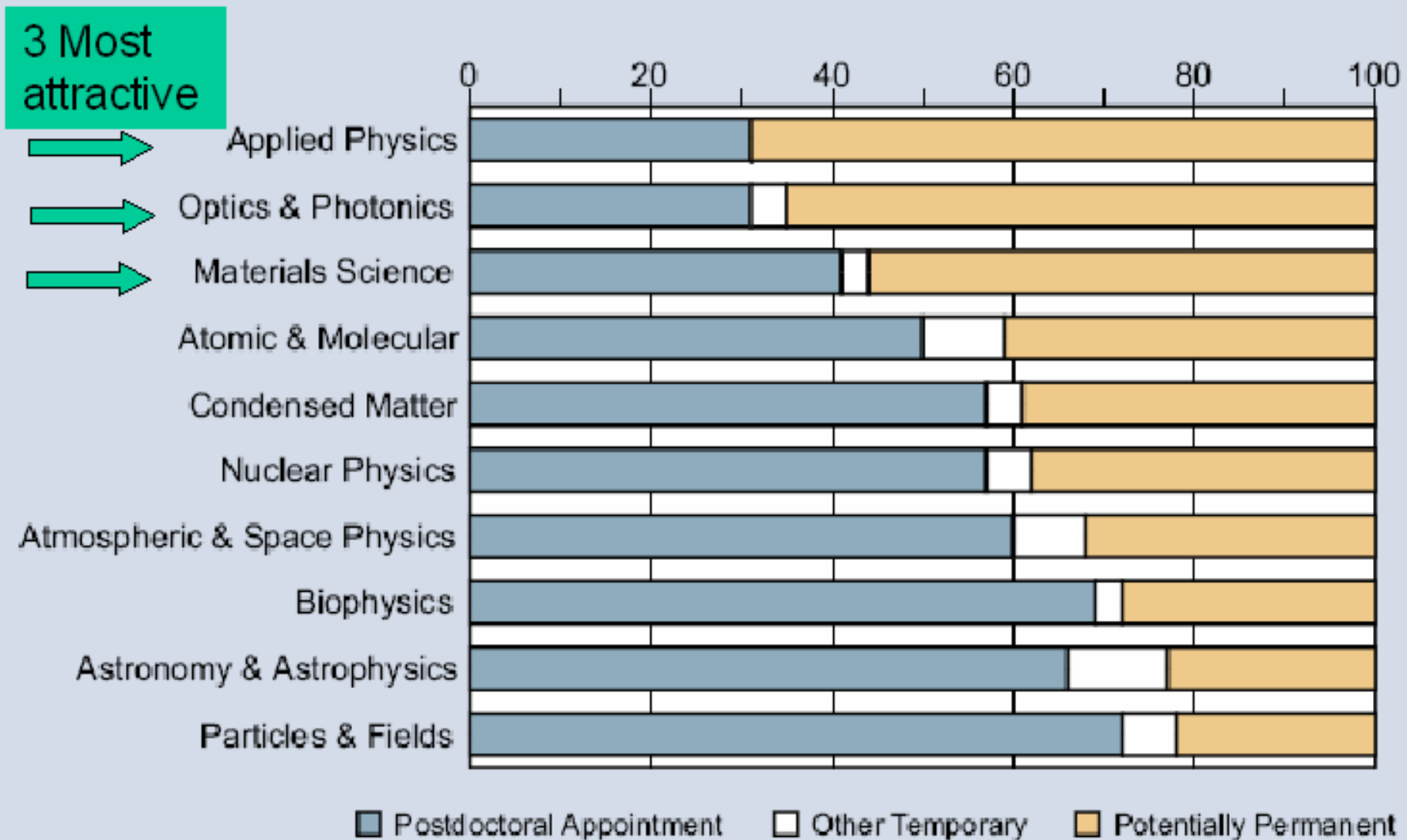


*AIP Statistical Research Center, Initial Employment Report.*

# The Work Physics Bachelors do in the USA

Primary Employment for Physics Bachelors, Class of 2001 and 2002			
	Priv. Sector Wt: 49%	Civil Govt\ Wt: 13%	Colleges/ Univ. Wt: 16 %
	28	34	17
	23	17	6
	19	3	4
	13	6	3
<b>Research</b>			
	5	3	10
<b>Education</b>			
<b>Others</b>	3	2	4

# USA: Initial employment of physics and astronomy PhDs by subfield, classes of 2001 & 2002.



Ref: AIP, Initial Employment Report, March 2005

**Numbers:**

2001: 1157

2002: 1095

- **The Alliance:** Physics-Biology-Nanotechnology-Maths-Electronics
- **Microelectronics** - materials-conducting polymers

Science graduates are not prepared for role of :

Teacher,

Industry, (QC , enterprise)

Service sector ... internships

Yet they can make effective contributions here.

Producing PhDs? PhDs have to be teachers also. No attention given to this aspect.

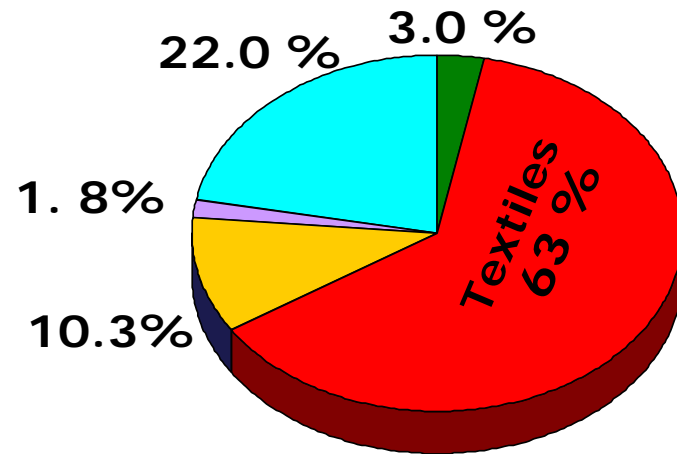
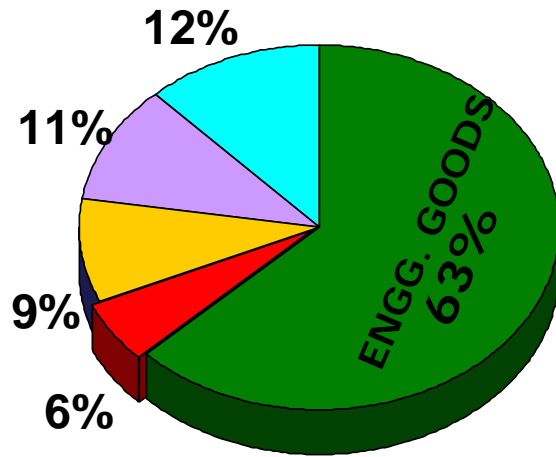
Pakistan wants to move towards diversification in manufacturing, services, trade.  
 Can we Relate Graduate Employability to World Trade ?

**WORLD Trade**

1990 : 3,337 billion  
 2001 : 5,984 billion  
 2003 : 7,503 billion

**PAKISTAN's Trade**

1990 : 6.9 billion  
 2001 : 9.3 billion  
 2003 : 11.9 billion



■ Textile & Clothing

■ Agric. Products

■ Chemicals

■ Engg. Goods

■ Others

# Jobs for Scientists and Engineers in Pakistan?

Pakistan wants to move towards diversification in manufacturing, services, trade.  
Can we Relate Graduate Employability to World Trade ?

<b>Composition of World Trade in Engineering Goods</b>	
<b>Engineering Goods</b>	<b>World Markets, 2004 US\$ (b)</b>
Electronics / Electrical / Components	1,500
Pharmaceutical Chemicals	630
Automotive Industry	600
Contract Manufacturing / Outsourcing	186
Ceramics	83
Surgical /Electro Medical Instruments	30
Fan Industry	2.6

**Message:** go for electronics in all its manifestations  
Major Re-location of Manufacturing and Design Taking Place

## Shift in Markets / Production by Region & Sector

### World Markets: Shift in 3 years only

- **2004:** US\$ 1500 b; ~90% in N.Amer, EU, Japan,
- **2006-07:** US\$ 1900 b: share will fall to ~70%
  
- Major Share: Consumer Eln., Computers, Telecoms.
  
- CHINA >> ~22% of the world production in 2004

# Worldwide Re-structure of the Electronics Industry: *Shift of Manufacturing and Markets to Asia*

**CEM** (contract electronic manufacturing)

**EMS** (electronic manufacturing services) and

**ODM** (original design manufacturers).

Major new global players have emerged in developing countries

This activity was worth US\$ 103 b in 2000, US\$ 186 b in 2004 and is expected to ~ US\$ 500 billions by 2010.

Global growth ~ 23% per year

- o Automotive Software Engineering,
- o Math Based Applications And Product Development ( SW )
- o Engineering Analysis
- o CAD

## Why focus on electronics will suit Pakistan?

- **Creating One Man-job In Electronics Requires ~10 %** of the capital required for classical industries
- Ideally suited to the **agile, flexible nature** of the 21<sup>st</sup> century economy
- Demands **far less electric power, or water, or space**
- A **cleaner** work environment ... environmentally friendly
- Provides **returns** which are among the **fastest** in the economy
- Suits **cultural temperaments** which prefer white-collar jobs
- Very **gender affirmative** .. large fraction of female employees

**Growing at CAGR of 36% in Pakistan  
Lahore & Karachi becoming major centres**

# Thrust Areas within Existing and Emerging Disciplines in which Pakistan intends to invest

Based on a detailed national audit of current activities and potentials in natural sciences and engineering, special attention will be focussed on:

- **Land, Water and Food**
- The **Automated** Workplace; **Sensors** and the **New Machines**
- New Sources and Technologies for **Energy** and Transport
- **Biology** and Health Sciences
- New **Materials** and Material Processing
- **Design, Simulation and Modelling**
- Technologies for **Information and Communications**
- **Space and Marine Sciences**

Good topics for LUMS. These are all multi-sector, multi – disciplinary. ‘Electronics’ in all of them

## Fixed-functions Products: Will Gradually Die Away

Movement From *Fixed* >> *Programmable* Functionality.

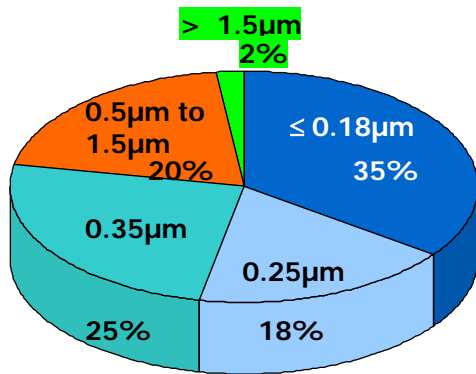
- First happened in memories, DSPs and logic. Now ASICs / FPGAs.
- ASIC design starts are drastically falling
  - **ASIC design starts** : **10,000 in 1993**, and ~ **2000 in 2003**
  - **FPGA Design starts**: ~ 100,000 in 2003
- ASICS good markets for hi- volume applications & integrations
- Outside this area, FPGAs will take over

**FPGA market >> to \$5 billion in 2007. The profit margin is over 60 %.**

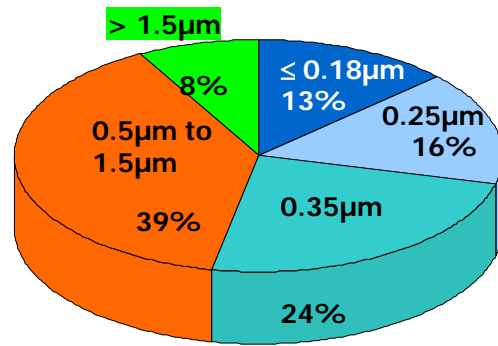
**USA has ~ 400,000 IC designers, China has only ~4000;**

- **By 2010 China will require 300,000 IC design engineers & specialists**  
.....[Pakistani Universities?](#)

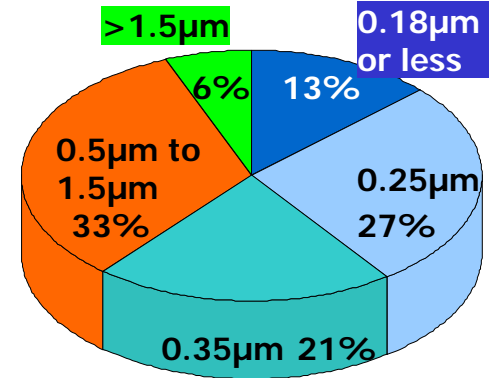
# Design Market for Process Technology is for $\leq 0.35 \mu\text{m}$



Digital Design, 78 %



Analog design ...64 %



Mixed-signal Design, 65%

Ref: Surveys of IC Design Houses, 2004

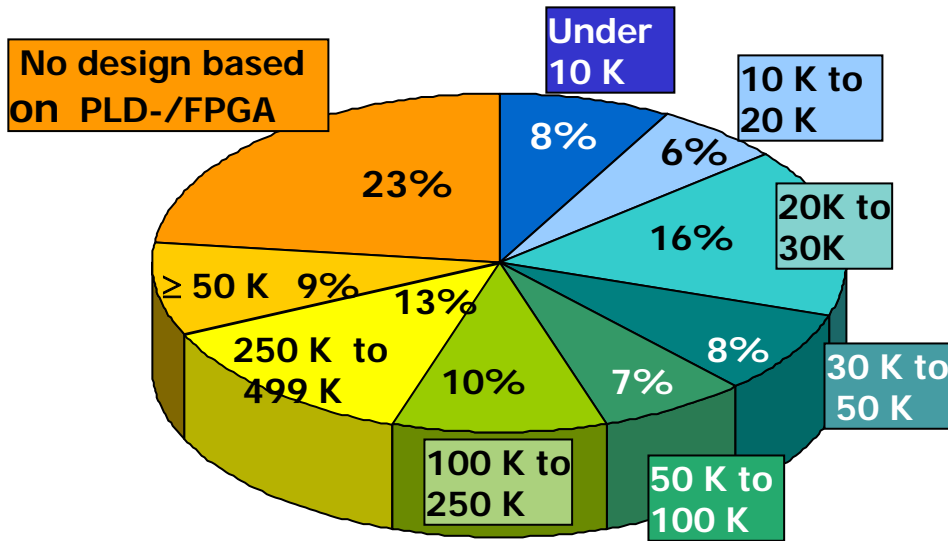
Major shortage of design engineers for sub 0.25 micron technology

While timing integrity is relatively easier to simulate, it is the signal integrity which becomes an extremely critical factor here.

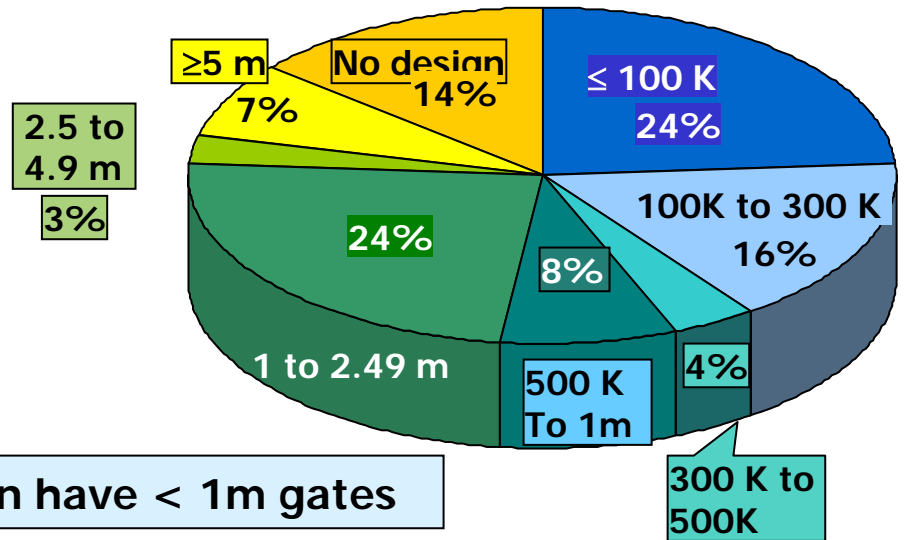
Future: 'high end' of 0.18 micron, 0.13 microns and even lower at 90 nm

# Design Market by Gate Count

**ASIC designs: 55% design have < 250 K gates**



**A very useful segment exists in sub 300 K gate count for FPGAs and under 50K for ASICS**



**PLD / FPGA Based: 52% design have < 1m gates**

# PSDP Allocation for the Knowledge Economy: 2005-10

#		
	Higher Education	
	College Upgrade	
	<b>Sub Total A</b>	
	<b>ICT Infrastructure</b>	
	<b>Sub Total (B:E)</b>	
	<b>Total (Rs billion)</b>	

# 'Cost Recovery' in Higher Education; Who Pays

## How Much Recovery Through Fees is Reasonable: *Harvard*

- **Differentiated fee structures** ... favour physical and social sciences as against Business or Engg.
- **Governments must be ready to pay more for students** enrolling in high-priority fields
- **Return to our traditional method** of funding education ... Waqf of Land ...
  - Shara-e- Madaris in Damascus
  - Diyal Singh Trust in Lahore
  - Oxford and Cambridge are the biggest landlords in the UK
  - Land Grant Universities in the USA ... and if one finds oil on that land ... Univ. of Texas, Austen.
  - Masjid Wazir Khan in Lahore

**Government ?** Some proposals in the final stage of approvals. Will allow private universities to compete for R&D funds, and faculty support.

**Thank You**