Welcome to Engineering

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Outline

- Why Engineering?
- Current Space-Time Coordinates
- Interesting projects in my career
- Parting Thoughts

Quote of the Day

"We can train ourselves to be
the masters of new technologies,
or slaves of new technologies.

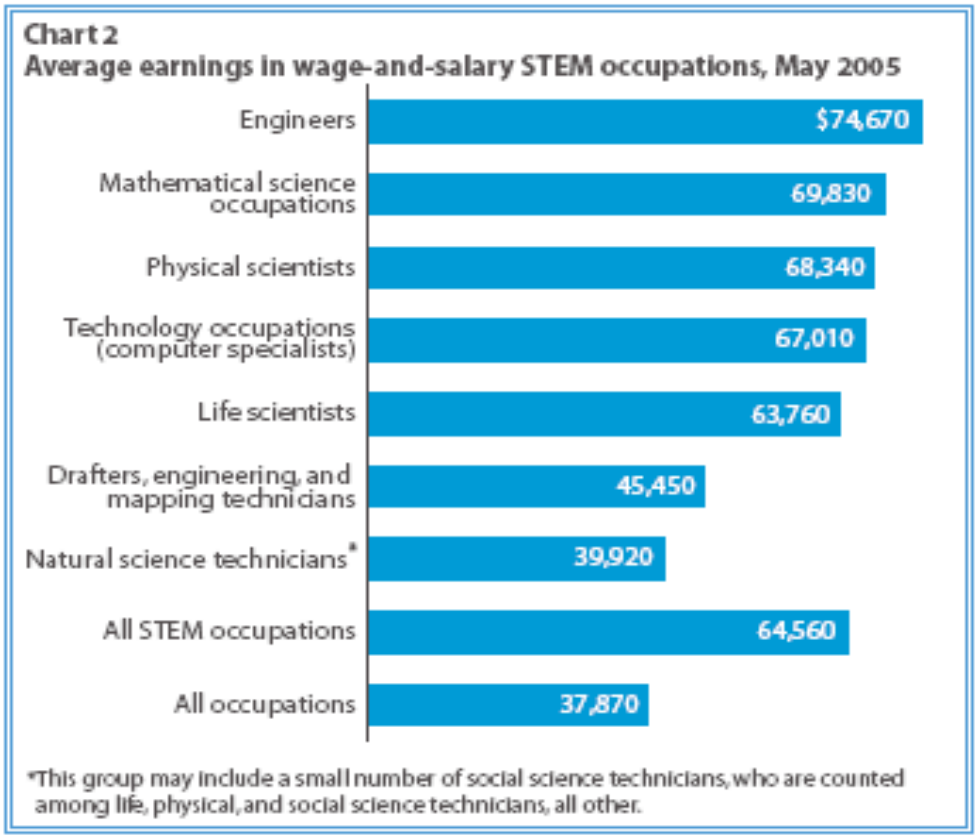
The choice is ours."

- Anonymous

Why Engineering?

Engineering Pays More

- **Average Engineer's salary about twice that of the average of all occupations**
- **Average of STEM occupations is about 70% higher than the average of all occupations**



Source:US Dept. of Labor, Bureau of Labor Statistics

Job Projections Increasing

Table 2
Employment growth and job openings in STEM occupations, projected 2004-14

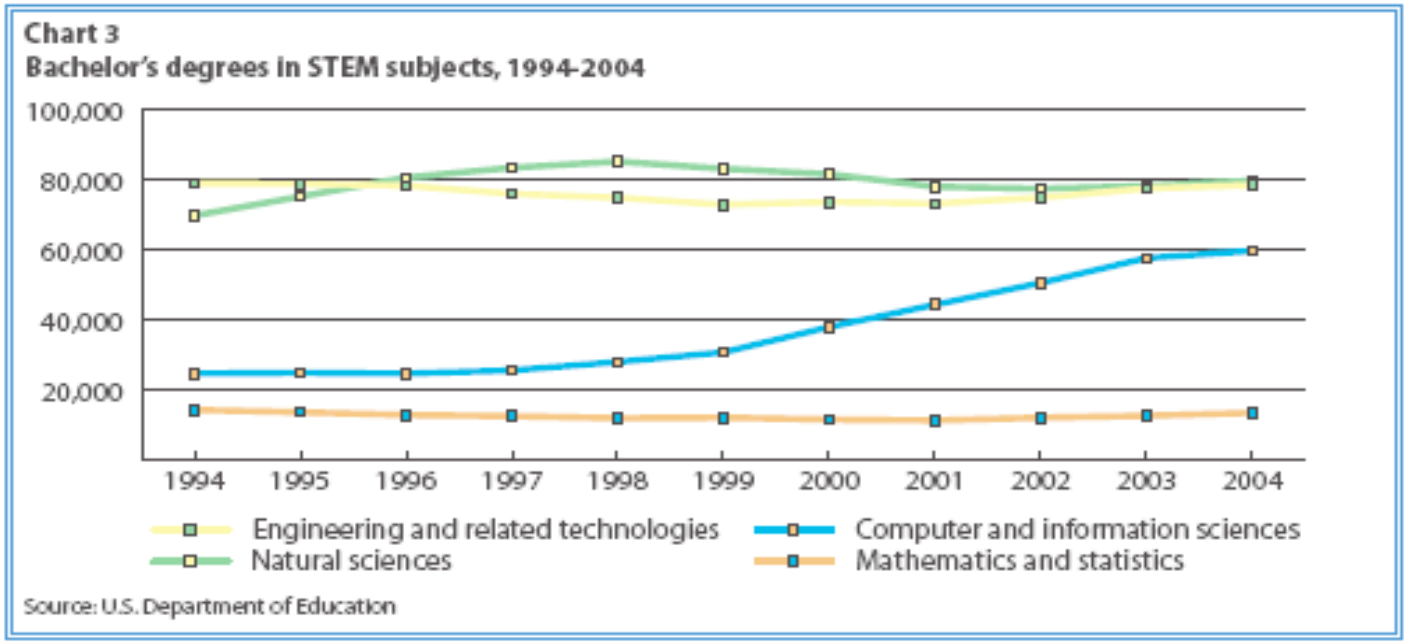
Occupational group	Employment		2004-14 change		Job openings due to growth and net replacement, 2004-14
	2004	2014	Numeric	Percent	
Science occupations, natural*	**806,330**	**931,027**	**124,697**	**15%**	**315,000**
Life scientists	231,723	279,890	48,166	21	103,000
Physical scientists	250,417	280,913	30,496	12	94,000
Natural science technicians	324,190	370,224	46,034	14	118,000
Technology occupations (computer specialists)	**3,045,836**	**4,002,547**	**956,711**	**31**	**1,350,000**
Engineering occupations	**2,299,778**	**2,576,906**	**277,128**	**12**	**798,000**
Engineers	1,448,871	1,643,500	194,629	13	507,000
Drafters, engineering, and mapping technicians	850,906	933,406	82,500	10	291,000
Mathematical science occupations	**106,965**	**117,297**	**10,332**	**10**	**39,000**
STEM occupations, total	**6,258,909**	**7,627,777**	**1,368,867**	**22**	**2,503,000**

* This group may include a small number of social science technicians, who are counted among life, physical, and social science technicians, all other.

By 2014, the net need for STEM skills is projected to be ~2.5 Million*

Source: US Dept of Labor, Bureau of Labor Statistics

Supply of Engineers Stagnating



Demand has been growing, but supply is flat

** *Source: US Dept. of Labor Website*

Current Space-Time Coordinates

Good News - The World Is Flatter*

- What you have and what we did not
  - Internet – Instant access to information
  - Pervasive use of technology
  - Exponential growth of available data
  - Easier access to remote corners of the world

Everything that could be done before can be done faster, better, and cheaper now

** Thomas Friedman, "The World Is Flat"*

Bad News – US Economy is ailing

- Total debt (government + private) is over $50 trillion
  - More than **$160,000** for every man, woman and child in US
- Home foreclosures reached record highs since the ’80s
- Unemployment stuck near 10%
- **US standing still in technical education, while others move on**
  - We are still stuck with 1970’s engineering capacity in universities (~75,000 graduates)
  - Former “Third World” gaining - India, China each approaching 1 million engineering graduates a year

Even top Engineering graduates will have to refresh their knowledge and skills periodically to compete

Shape of Things to Come

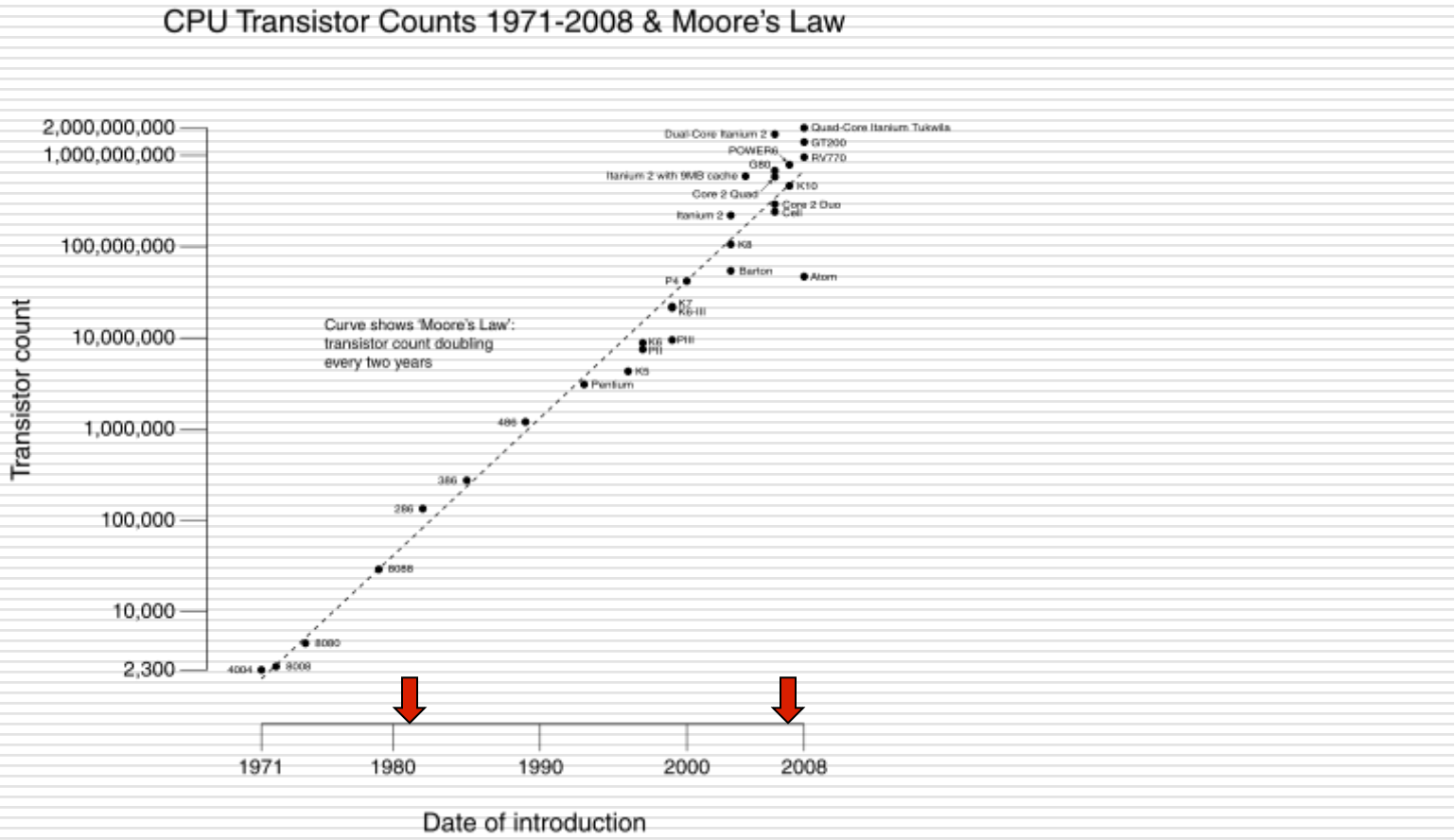
- An example of engineering excellence
  - $2500 car
  - 50 mpg
  - Seats 4
  - Super easy parking
  - Exceeds all emissions requirements

This is on sale in India. No plans to sell this in the US.

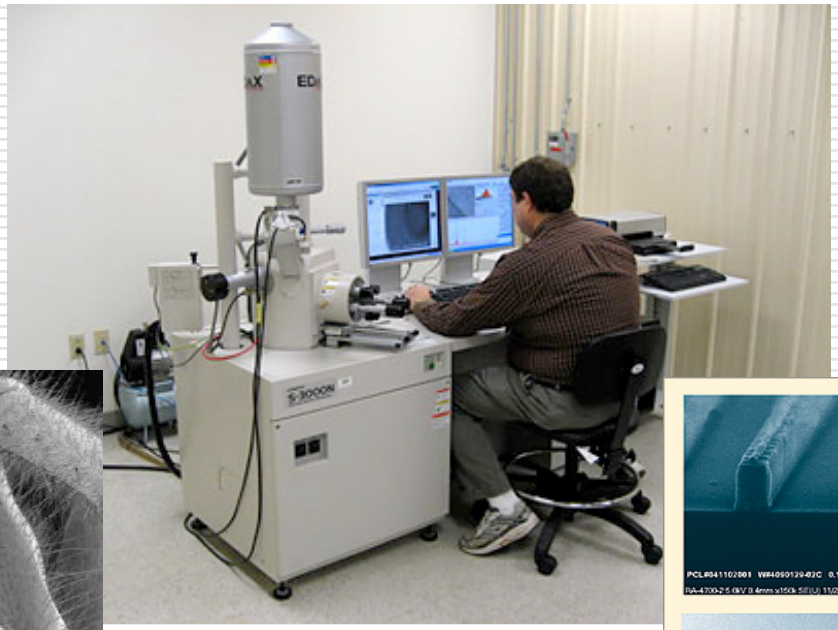
Source:Tata Motors website, Wikipedia (photo)

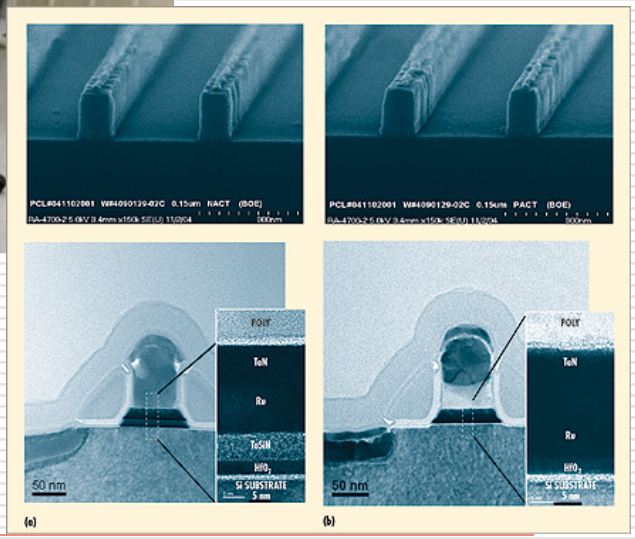
Interesting Projects in My Career

Moore’s Law


CPU Transistor Counts 1971-2008 & Moore's Law
2,000,000,000
1,000,000,000
100,000,000
10,000,000
1,000,000
100,000
10,000
2,300
Transistor count
Curve shows 'Moore's Law': transistor count doubling every two years
Dual-Core Itanium 2
Quad-Core Itanium Tukwila
GT200
POWER6
RV770
G80
Itanium 2 with 9MB cache
K10
Core 2 Quad
Core 2 Duo
Cell
Itanium 2
K8
Barton
Atom
P4
K7
K6-III
K6
PIII
PII
K5
Pentium
486
386
286
8088
8080
4004
8008
1971
1980
1990
2000
2008
Date of introduction

Electron Microscopes





CMOS Image from Sematech Publication

Lithography and FIB Machines

Courtesy JEOL Corporation

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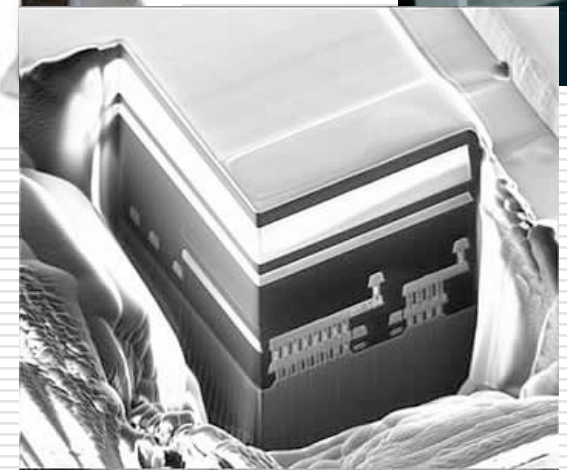
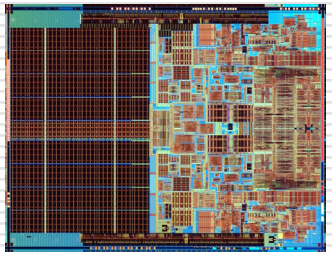


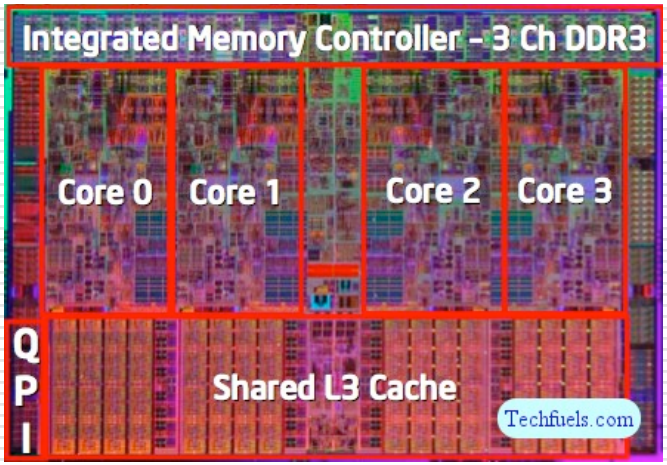
Cross Section- Winn Tech Nanotechnologies

Core Series of Processors

~250 million Transistors



~730 million Transistors



Parting Thoughts

What to do going forward

- It is a more interesting AND challenging world out there
- Take as much math as possible
  - Work on all skills – concepts, computation, analysis
- Physics is the basis for engineering
- Try for interdisciplinary approach past 2nd year
  - More valuable than one discipline
- Don't forget humanities and social sciences
  - They put your career in context
- Be creative with your knowledge and skills
  - Next generation iPod is counting on you!

Good Luck, and Best Wishes!!