Youth unemployment is worrysomely high

Source: “Global employment trends for youth 2011” International Labor Organization
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Is unemployment becoming structural?

Jobless recoveries: The time lag between GDP recovery and employment recovery has been increasing

Lag from when real GDP returns to prerecession peak to when employment returns to prerecession peak

Months

Year in which the recession began


6 7 6 6 8 3 6 15 39 6

1 The National Bureau of Economic Research estimates that the recession began in December 2007. GDP returned to its prerecession peak in December 2010.

“Advancing technology does not inevitably produce an increase in the relative demand for skilled and educated workers” (Goldin/Katz in “The race between technology and education)
New jobs emerging

Figure 1: Sizing the App Economy (jobs, thousands)

Source: “The App Economy” Dr. Michael Mandel, February 27, 2012
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Informal economy is not understood


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Employment of Manufacturing

“Each 100 jobs in manufacturing supports 291 jobs elsewhere in the economy, compared to 154 jobs in business services and 88 jobs in retail trade”

Source: Bloomberg Business Week Commentary July 1, 2010: Andy Grove: How America Can Create Jobs

WHERE THE PARTS FOR A $500 IPHONE ARE MADE

$61
JAPAN
It doesn’t innovate as much as the U.S., but its tech prowess means a lot of high-end manufacturing value stays there.

$7
CHINA
Often more of an assembly line for other nation’s wares, work here accounts for only 3.6% of an iPhone’s production cost.

$11
U.S.
While America doesn’t make much of what goes into the iPhone, it’s always better to innovate than to fabricate; just see Apple’s profit.

$30
GERMANY

$23
SOUTH KOREA

$48
UNSPECIFIED

Figures are rounded. Source: Asian Development Bank Institute, 2009 stats.

Source: Time magazine May 16, 2011 from Asian Development Bank Institute 2009 stats
Apple: 5% of the revenue, 50% of the profit

Source: The Economist, February 12, 2011 “Blazing platforms”
Impact of Absolute Population Size

“When China awakens, the world will tremble”
Napoleon Bonaparte

Japan
25M skilled workers
US, Europe Challenge

1985

China & India
300M skilled workers
World challenge

2025

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Accelerating Change Demands Different Skills

Economy-Wide Measures of Routine and Nonroutine Task Input, 1960–2002

Mean Task Input in Percentiles of 1960 Task Distribution

- Nonroutine Analytic
- Nonroutine Interactive
- Nonroutine Manual
- Routine Cognitive
- Routine Manual
- e.g. consultants
- e.g. engineers
- e.g. assembly work
- e.g. paperwork
- e.g. plumbing

Personally-delivered vs Impersonally delivered

• “Impersonal services are the ones that can be delivered electronically from afar with little or no degradation of quality (e.g., keyboard data entry, manuscript editing).

They are potentially offshorable.

• Personal services are the ones that either cannot be delivered electronically (e.g., child care) that suffer severe degradation of quality when so delivered (e.g., surgery).

They are, for all practical purposes, non-[offshorable].”

Alan Blinder, Economist, Princeton U., 2006
Sources: Blinder/Krugman for X-axis, Levy/Murnane/Autor for Y-axis
Skill vs Delivery

- Offshorability (Communication) & Automation (Computing)

Nonroutine Skill
- Radiologist
- Legal discovery → Legal Opinion
- Security video monitoring

Routine Skill
- Typing clerk → Bookkeeping
- Taxi driver
- Policeman
- Court proceeding
- Surgeon

Impersonal delivery → Personal delivery
IN MORE DEVELOPED COUNTRIES

Source: “Tough Choices or Tough Times” 2007, National center on education and the economy

IN LESS DEVELOPED COUNTRIES

Race up the Value Chain

Creative Work

- Research
- Development
- Design
- Marketing and Sales
- Global Supply Chain Management

Routine Work

DONE BY PEOPLE

DONE BY MACHINES
The OECD’s View

- The great collaborators and orchestrators
- The great synthesizers
- The great explainers
- The great versatilists
- The great personalizers
- The great localizers

*To which I add:* The great innovators

Source: Andreas Schleicher
Ethics are indispensable for development

Economic Development Index (WEF 2010)

Corruption Index
(Transparency International 2010)
STEM job leverage

“While only 4% of the nation’s work force is composed of scientists and engineers, this group disproportionately creates jobs for the other 96%”

National Science Board, Science and Engineering Indicators 2009
More Proof

- Eight studies conducted in recent decades indicate that public investments in science and technology have produced annualized societal returns that range from 20% to 67%.

- Some economists estimate that about half the nation’s growth in GDP per capita during the last half-century can be attributed to scientific and engineering achievements.

- An assessment conducted by the Bank of Boston concluded that research performed at MIT alone had resulted in the creation of 1.1 million jobs in 4,000 new companies.

- Alan Greenspan: “Had the innovations of recent decades, especially in information technologies, not come to fruition, productivity growth would have continued to languish at the rate of the preceding twenty years.”

Source: “Is America Falling Off the Flat Earth?” by the National Academies of Sciences 2007
STEM Professions Have a Positive Impact on Innovation Economies

“Our evidence shows that countries with a higher concentration of engineering college majors grow faster, whereas countries with a higher proportion of law concentrators grow slower.”

“If an extra 10% of enrollment was engineering, the growth rate would rise 0.5% per year; if an extra 10% enrollment were in law, growth would fall by 0.3% per year”.

Source: “Allocation of Talent, Implications for growth” 1990 National Bureau of Economic Research, Murphy et al
Top 10 Breakthroughs Transforming Life over the next 20-30 years

1. Alternative energy
2. Desalination of water
3. Precision farming
4. Biometrics
5. Quantum computers
6. Entertainment on demand
7. Global access
8. Virtual education
9. Nanotechnology
10. Smart Robots

Source: World Future Society
NAE Grand Challenges for the 21st Century

Sustainability, Health, Security, Joy of Living

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery
19 out of the top 20 Bachelor-level salaries are STEM-related

<table>
<thead>
<tr>
<th>Best Undergrad College Degrees By Salary</th>
<th>Starting Median Salary</th>
<th>Mid-Career Median Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace Engineering</td>
<td>$59,600</td>
<td>$109,000</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>$65,700</td>
<td>$107,000</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>$61,700</td>
<td>$105,000</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>$60,200</td>
<td>$102,000</td>
</tr>
<tr>
<td>Economics</td>
<td>$50,200</td>
<td>$101,000</td>
</tr>
<tr>
<td>Physics</td>
<td>$51,100</td>
<td>$98,800</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>$58,900</td>
<td>$98,300</td>
</tr>
<tr>
<td>Computer Science</td>
<td>$56,400</td>
<td>$97,400</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>$57,100</td>
<td>$95,000</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>$53,400</td>
<td>$94,500</td>
</tr>
<tr>
<td>Statistics</td>
<td>$48,600</td>
<td>$94,500</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>$41,700</td>
<td>$94,200</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$47,000</td>
<td>$93,600</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>$55,100</td>
<td>$93,000</td>
</tr>
<tr>
<td><strong>Construction Management</strong></td>
<td><strong>$53,400</strong></td>
<td><strong>$89,600</strong></td>
</tr>
<tr>
<td>Finance</td>
<td>$48,500</td>
<td>$89,400</td>
</tr>
<tr>
<td>Management Information Systems</td>
<td>$51,900</td>
<td>$87,200</td>
</tr>
<tr>
<td>Computing and Information Systems</td>
<td>$50,900</td>
<td>$86,700</td>
</tr>
<tr>
<td>Geology</td>
<td>$45,100</td>
<td>$84,200</td>
</tr>
<tr>
<td>Chemistry</td>
<td>$42,900</td>
<td>$82,300</td>
</tr>
</tbody>
</table>


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## Top-Paid Bachelor’s Degrees*

<table>
<thead>
<tr>
<th>Major</th>
<th>Average Salary Offer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum Engineering</td>
<td>$86,220</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>$65,142</td>
</tr>
<tr>
<td>Mining &amp; Mineral Engineering (incl. geological)</td>
<td>$64,552</td>
</tr>
<tr>
<td>Computer Science</td>
<td>$61,205</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>$60,879</td>
</tr>
<tr>
<td>Electrical/Electronics &amp; Communications Engineering</td>
<td>$59,074</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>$58,392</td>
</tr>
<tr>
<td>Industrial/Manufacturing Engineering</td>
<td>$57,734</td>
</tr>
<tr>
<td>Aerospace/Aeronautical/Astronautical Engineering</td>
<td>$57,231</td>
</tr>
<tr>
<td>Information Sciences &amp; Systems</td>
<td>$54,038</td>
</tr>
</tbody>
</table>

*Where 10 or more offers were reported.
Source: NACE Salary Survey WINTER 2010 Volume 49 Issue 1 www.naceweb.org
Top Bachelor’s Degrees in Demand

1. Finance
2. Accounting
3. Mechanical Engineering
4. Business Administration/Mgmt.
5. Electrical Engineering
6. Computer Science
7. Information Sciences & Systems
8. Marketing/Marketing Mgmt.
9. Computer Engineering
10. Chemical Engineering
11. Management Information Systems

Source: Job Outlook 2010, National Association of Colleges and Employers
Percentage of science graduates

- Korea
- Japan
- EU
- United States
Comparison with India and China

Source: Duke University, Framing the Engineering Outsourcing Debate, Dec. 2005
Adjusted to population size

Country

<table>
<thead>
<tr>
<th></th>
<th>Bachelors</th>
<th>Subbaccalaureate</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>289.3</td>
<td>468.3</td>
</tr>
<tr>
<td>India</td>
<td>103.7</td>
<td>95.4</td>
</tr>
<tr>
<td>China</td>
<td>271.1</td>
<td>225.7</td>
</tr>
</tbody>
</table>

Source: Duke University, Framing the Engineering Outsourcing Debate, Dec. 2005
Leaky pipeline

Source: Carnevale & Smith: http://cew.georgetown.edu/stem/ 2011
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Quality matters, not just quantity

IN LOW-WAGE COUNTRIES, ON AVERAGE ONLY 13% OF UNIVERSITY GRADUATES ARE SUITABLE TO WORK IN A MULTINATIONAL COMPANY

"Of 100 graduates with the correct degree, how many could you employ if you had demand for all?"

%  

Max. 50 50 50 50 30 19  
Min. 10 13 10 10 3 10  

Engineer Finance/ accounting Life science researcher Analyst Generalist Average for university-educated young professionals

Weighted average of all low-wage countries studied* 17 19 14 15 10 13

* Argentina, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech Republic, Estonia, Hungary, India, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Philippines, Poland, Russia, Romania, Slovakia, Slovenia, South Africa, Thailand, Turkey, Ukraine, Venezuela, Vietnam.

Source: Interviews with HR managers, HR agencies and heads of global resourcing centers; McKinsey Global Institute analysis


McKinsey report concluded that only 10% of Chinese engineers and 25% of Indian engineers can compete in the global outsourcing arena.
4 Tiers of STEM Competency

- Direct Careers
- Adjacent Careers
- Influential Professions
- Everyone

Neglected - Needs more highlighting
STEM for the other 95%

Adjacent Careers:
• Marketing, Sales, etc
• Trade professions (Certifications, HVAC, car mechanics, nursing, etc)

Influential Professions:
• Journalists
• Financiers
• Lawyers
• Politicians
• Doctors

Everyone: and enrolling Liberal Arts colleges
• Understanding risk: personal finance; health
• Understanding Life: concepts behind curves
Math or Numerology? Cosmology or Mythology? Evolution or Creationism? etc.
Microeconomic view
Engineering PhD median salary

US (CA): $125,200
Germany: $99,400
China: $53,700
India: $39,200

How do you justify 2-3x differential?
## Workforce Requirements Survey

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Language (spoken)</td>
<td>Critical Thinking/Problem Solving</td>
</tr>
<tr>
<td>Reading comprehension (English)</td>
<td>Communications (oral &amp; written)</td>
</tr>
<tr>
<td>Writing (English)</td>
<td>Collaboration/Teamwork</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Diversity</td>
</tr>
<tr>
<td>Science</td>
<td>Information Technology Applications</td>
</tr>
<tr>
<td>Government/Economics</td>
<td>Leadership</td>
</tr>
<tr>
<td>Humanities/Arts</td>
<td>Lifelong Learning/Self-Direction</td>
</tr>
<tr>
<td>Foreign Languages</td>
<td>Professionalism/Work Ethic</td>
</tr>
<tr>
<td>History/Geography</td>
<td>Ethics/Social Responsibility</td>
</tr>
</tbody>
</table>

Source: “Are they really ready to work?” report by the Conference Board, P21 et al
"Has your organization identified these skills as priorities for employee development, talent management, and succession planning?"

<table>
<thead>
<tr>
<th>Skill</th>
<th>Agree/Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical thinking</td>
<td>73.3%</td>
</tr>
<tr>
<td>Communication</td>
<td>79.2%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>72.3%</td>
</tr>
<tr>
<td>Creativity/innovation</td>
<td>66.6%</td>
</tr>
</tbody>
</table>

Source: AMA/P21 2010 Critical Skills Survey, released April 2010
What else do we need?

1. Research from multiple, validating sources
2. Understand the *forward* impact of Technology, and structural limiting factors (legal, financial, social, etc)
3. Governmental data collection in leading-edge industries, informal industries, and shadow economies
4. Leading indicators embedding a feedback mechanism to continuously fine-tune projections
5. Synthetic *systems-level* focus to understand causality and connectedness in a global economy
6. Creative models to rethink economic progress (GHP vs GDP)
7. STEM:
   - Are some professions/fields more conducive to overall employment growth than others?
   - Are the mismatches temporary or endemic?
   - Can we quantify “Public good” benefits?
Thank You