The world is changing
So is Higher Education

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C. Fong Shih’s 70th Birthday Celebration
American Academy of Arts & Sciences
May 12, 2016
C. Fong Shih @ 70!

A mentor, a friend, a leader
Some Inventions in 1946 (per Wikipedia)

- Annular blowout preventer
- Tepperware
- Filament tape
- Credit card
- Diaper (waterproof)
Some Observations

• Majority of the top 70 companies in the US in 1946 are no longer top companies today

• (Almost) ALL of the top 70 universities in the US in 1946 are still top universities today

Higher education institutions are conservative, with large inertia
Higher Education has changed in the past 70 years

The changes are accelerating recently

• Development of new technologies

• Globalization
Impact of new technologies (personal stories)

My wife Mei and Zhigang’s wife Denian are “classmates”

Mei is also learning French and German using Duolingo (developed by CMU faculty member Luis von Ahn)

Mei and kids sometimes learn new things through TED Talks

ALL FOR FREE!!
### Impact of Globalization (needs are global)

#### Top 25 Largest Companies Worldwide (ranked by revenue)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Name</th>
<th>Industry</th>
<th>Revenue (USD Billions)</th>
<th>As of:</th>
<th>Revenue Growth</th>
<th>Employees</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wal-Mart Stores, Inc.</td>
<td>Retail</td>
<td>$482</td>
<td>Jan-16</td>
<td>-0.70%</td>
<td>2,200,000</td>
<td>Bentonville, Arkansas</td>
</tr>
<tr>
<td>2</td>
<td>Samsung</td>
<td>Conglomerate</td>
<td>$305</td>
<td>2015</td>
<td>-7.20%</td>
<td>489,000</td>
<td>Suwon, Korea</td>
</tr>
<tr>
<td>3</td>
<td>Royal Dutch Shell</td>
<td>Oil &amp; Gas</td>
<td>$273</td>
<td>2015</td>
<td>-7.20%</td>
<td>94,000</td>
<td>The Hague, London</td>
</tr>
<tr>
<td>4</td>
<td>Vitol</td>
<td>Commodities</td>
<td>$270</td>
<td>2015</td>
<td>-13.70%</td>
<td>5,441</td>
<td>Rotterdam, Geneva</td>
</tr>
<tr>
<td>5</td>
<td>ExxonMobile</td>
<td>Oil &amp; Gas</td>
<td>$268</td>
<td>2015</td>
<td>-7.20%</td>
<td>75,300</td>
<td>Irving, Texas</td>
</tr>
<tr>
<td>6</td>
<td>Volkswagen</td>
<td>Automotive</td>
<td>$245</td>
<td>2015</td>
<td>2.80%</td>
<td>572,800</td>
<td>Wolfsburg, Germany</td>
</tr>
<tr>
<td>7</td>
<td>Apple</td>
<td>Consumer Electronics</td>
<td>$234</td>
<td>2015</td>
<td>28.00%</td>
<td>115,000</td>
<td>California</td>
</tr>
<tr>
<td>8</td>
<td>Toyota</td>
<td>Automotive</td>
<td>$227</td>
<td>Mar-15</td>
<td>6.00%</td>
<td>344,109</td>
<td>Aichi, Japan</td>
</tr>
<tr>
<td>9</td>
<td>BP</td>
<td>Oil &amp; Gas</td>
<td>$223</td>
<td>2015</td>
<td>-37.90%</td>
<td>83,900</td>
<td>London</td>
</tr>
<tr>
<td>10</td>
<td>Glencore</td>
<td>Commodities</td>
<td>$221</td>
<td>2014</td>
<td>-5.30%</td>
<td>181,000</td>
<td>Baar, Switzerland</td>
</tr>
<tr>
<td>11</td>
<td>Total</td>
<td>Oil &amp; Gas</td>
<td>$212</td>
<td>2014</td>
<td>-11.50%</td>
<td>100,307</td>
<td>Courbevoie, France</td>
</tr>
<tr>
<td>12</td>
<td>Berkshire Hathaway</td>
<td>Conglomerate</td>
<td>$221</td>
<td>2014</td>
<td>8.30%</td>
<td>316,000</td>
<td>Omaha, Nebraska</td>
</tr>
<tr>
<td>13</td>
<td>McKesson</td>
<td>Pharmaceuticals</td>
<td>$179</td>
<td>Mar-15</td>
<td>30.10%</td>
<td>32,000</td>
<td>San Francisco, CA</td>
</tr>
<tr>
<td>14</td>
<td>Phillips 66</td>
<td>Oil &amp; Gas</td>
<td>$161</td>
<td>2014</td>
<td>-6.40%</td>
<td>13,500</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>15</td>
<td>Daimler</td>
<td>Automotive</td>
<td>$157</td>
<td>2014</td>
<td>10.10%</td>
<td>275,087</td>
<td>Stuttgart, Germany</td>
</tr>
<tr>
<td>16</td>
<td>General Motors</td>
<td>Automotive</td>
<td>$152</td>
<td>2015</td>
<td>-1.70%</td>
<td>284,000</td>
<td>Detroit, Michigan</td>
</tr>
<tr>
<td>17</td>
<td>Exor</td>
<td>Financial Services</td>
<td>$148</td>
<td>2014</td>
<td>7.80%</td>
<td>318,562</td>
<td>Turin, Italy</td>
</tr>
<tr>
<td>18</td>
<td>Allianz</td>
<td>Financial Services</td>
<td>$148</td>
<td>2014</td>
<td>10.40%</td>
<td>147,425</td>
<td>Munich, Germany</td>
</tr>
<tr>
<td>19</td>
<td>Ford Motor Company</td>
<td>Automotive</td>
<td>$144</td>
<td>2014</td>
<td>-2.00%</td>
<td>164k,000</td>
<td>Dearborn, Michigan</td>
</tr>
<tr>
<td>20</td>
<td>Lukoil</td>
<td>Oil &amp; Gas</td>
<td>$144</td>
<td>2014</td>
<td>1.90%</td>
<td>120,000</td>
<td>Moscow, Russia</td>
</tr>
<tr>
<td>21</td>
<td>Honda</td>
<td>Automotive</td>
<td>$142</td>
<td>2014</td>
<td>20.00%</td>
<td>198,561</td>
<td>Tokyo, Japan</td>
</tr>
<tr>
<td>22</td>
<td>CVS Health</td>
<td>Retail</td>
<td>$139</td>
<td>2014</td>
<td>9.90%</td>
<td>208,000</td>
<td>Woonsocket, Rhode Island</td>
</tr>
<tr>
<td>23</td>
<td>Chevron</td>
<td>Oil &amp; Gas</td>
<td>$138</td>
<td>2015</td>
<td>-34.90%</td>
<td>64,700</td>
<td>San Ramon, CA</td>
</tr>
<tr>
<td>24</td>
<td>E-ON</td>
<td>Electric utility</td>
<td>$135</td>
<td>2014</td>
<td>-9.80%</td>
<td>79,000</td>
<td>Dusseldorf, Germany</td>
</tr>
<tr>
<td>25</td>
<td>Foxconn</td>
<td>Electronics</td>
<td>$133</td>
<td>2014</td>
<td>6.60%</td>
<td>1,290,000</td>
<td>New Taipei City</td>
</tr>
</tbody>
</table>

Impact of Globalization (customers are international)

Carnegie Mellon University International Students Statistics
Undergraduate Regions of Citizenship Fall 2005 to 2014

# of Int’l Undergraduate Enrollments

<table>
<thead>
<tr>
<th>Country</th>
<th>2005</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>UK</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Mexico, C &amp; S America</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Australia and New Zealand</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Other Europe</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Canada</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>India</td>
<td>5%</td>
<td>16%</td>
</tr>
<tr>
<td>Other Asia</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Korea</td>
<td>29%</td>
<td>21%</td>
</tr>
<tr>
<td>China</td>
<td>28%</td>
<td>36%</td>
</tr>
</tbody>
</table>

Carnegie Mellon University
Graduate Regions of Citizenship Fall 2005 to 2014
Another data point:

Population of school age people in India
Impact of Globalization (operation is global for some institutions)

Carnegie Mellon University International Educational Programs
Educatina Global Citizens: 2015 Degree Programs Outside of Pittsburgh

- BS Biological Sciences – Doha
- BS Business Administration – Doha
- BS Computational Biology – Doha
- BS Computer Science – Doha
- BS Information Systems – Doha
- Master of Information Systems Management – Doha
- Master of Entertainment Industry Management – Los Angeles
- Master of Human-Computer Interaction – Madeira
- Master of Science and Robotics Technology – Nanjing, Plymouth
- MS Computational Finance – New York
- MS in Biotechnology Innovation and Computation – Harbin
- MS in Civil and Environmental Engineering – Nanjing
- MS in Computer Science - Beijing
- MS in Electrical and Computer Engineering – Guangzhou, Kigali, Silicon Valley
- MS in Engineering and Technology Innovation Management –
- MS in Information Technology – various locations
- MS in Information Technology – eBusiness Technology - Singapore
- MS in Information Technology – Information Security – Kobe, Silicon Valley
- MS in Information Technology – Mobility – Silicon Valley
- MS in Information Technology – Software Management – Silicon Valley
- MS in Mechanical Engineering - Shanghai
- MS in Public Policy and Management – Adelaide, Washington D.C
- MS in Software Engineering – Paris, Silicon Valley
- MS in Software Management – Silicon Valley
- PhD in Applied Mathematics – Lisbon
- PhD in Civil and Environmental Engineering – Ankara, Colombia
- PhD in Computer Science – various locations
- PhD in Computer Science – Robotics – various locations
- PhD in Electrical and Computer Engineering – various locations
- PhD in Engineering and Public Policy – Lisbon, Porto
- PhD in Human-Computer Interaction – Lisbon, Madeira
- PhD in Language Technologies – Lisbon
- PhD in Mechanical Engineering – Daejeon, Singapore
- PhD in Software Engineering – various locations
- PhD in Technological Change and Entrepreneurship – Lisbon
- PPD – Professional Practice Doctorate in Architecture - Salford

Silicon Valley, Singapore
MS in Information Security Policy and Management - Singapore
MS in Information Technology – various locations
MS in Information Technology – eBusiness Technology - Singapore
MS in Information Technology – Information Security – Kobe, Silicon Valley
MS in Information Technology – Mobility – Silicon Valley
MS in Information Technology – Software Management – Silicon Valley
MS in Mechanical Engineering - Shanghai
MS in Public Policy and Management – Adelaide, Washington D.C
MS in Software Engineering – Paris, Silicon Valley
MS in Software Management – Silicon Valley
PhD in Applied Mathematics – Lisbon
PhD in Civil and Environmental Engineering – Ankara, Colombia
PhD in Computer Science – various locations
PhD in Computer Science – Robotics – various locations
PhD in Electrical and Computer Engineering – various locations
PhD in Engineering and Public Policy – Lisbon, Porto
PhD in Human-Computer Interaction – Lisbon, Madeira
PhD in Language Technologies – Lisbon
PhD in Mechanical Engineering – Daejeon, Singapore
PhD in Software Engineering – various locations
PhD in Technological Change and Entrepreneurship – Lisbon
PPD – Professional Practice Doctorate in Architecture - Salford
Carnegie Mellon University’s Global Presence
Challenges and Opportunities for Higher Education

- Technological challenges
- Global challenges
- Financial challenges

Key to success: to attract the best talents of the world
Still passionate about international collaboration

Happy Birthday, Fong!!
EXTREME MECHANICS LETTERS

The launch of this new journal is driven primarily by rapid advances at the forefront of applied sciences, such as: micro and nanotechnologies, biotechnologies, soft materials, smart sensing/actuation, manufacturing, device fabrication, many of them depend heavily on mechanics tools.

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- Interdisciplinary and multi-disciplinary

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DR. K JIMMY HSIA, is W. C. C.раф and Lilian B. Williams Professor of Mechanical Science and Engineering, and of Bioengineering at the University of Illinois at Urbana-Champaign, USA

DR. JOHN A. ROGERS is Swanlund Chair Professor of Materials Science and Engineering, with affiliate appointments in Chemistry, Bioengineering, Mechanical Science and Engineering and Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign, USA

DR. ZHIGANG SUO is Allen E. and Marilyn M. Puskel Professor of Mechanics and Materials in the School of Engineering and Applied Sciences at Harvard University, USA.

AMONG THE TOPICAL AREAS OF INTEREST ARE:
- Materials of extreme properties, such as exceptional hardness or softness
- Materials under extreme conditions, such as high temperature and high loading rate
- Stretchable, wearable, or implantable electronics for entertainment or healthcare
- Soft robots in manufacturing, surgery and assisted living
- Robots that crawl, run, swim, or fly
- Biomimetics that perceive, act, learn and remember
- Active materials in response to mechanical, chemical, electrical, thermal stimuli
- Instability and large deformation in nature and engineering systems
- Force-induced configurational changes of proteins leading to cascades in cellular responses
- Deformation, transport and fracture in high-efficiency batteries
- Interfacial phenomena in interactions between fluids and solids, deformation and failure of materials, and processes of living cells
- Self-assembly of materials and devices
- Thin-membrane origami and kirigami
- Mechanics of 3D printing
- Materials and structures of hierarchical architectures
- Hybrid systems of air, liquids, and solids
- Earthquake and hydraulic fracture
- Foldable, lightweight structures for space exploration

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