Accelerating US Semiconductor Innovation

Opening remarks for PCAST meeting

Aart de Geus, Chairman and CEO
Synopsys, Inc.
May 12, 2022
Semiconductors at Center of Competitiveness in 21st Century

Progress of Mankind

Smart Everything
- IoT & smart cities
- Wearables
- Autonomous ...
- Enterprise AI

Science Revolution
- Planet
- Human & Bio...
- Life conditions
- Every vertical

Semiconductor Supply Chain
- Design
  - EDA
  - IP blocks
  - HW/SW
- Manufacturing, Assembly & Test
  - Equipment
  - Materials
  - EDA

Human Talent
Shortage... Bright, diverse, innovative, competitive... & global!
# US Can Build From a Position of Strength in Chip Design

## Market shares by country in semi supply chain

<table>
<thead>
<tr>
<th>Design</th>
<th>US</th>
<th>China</th>
<th>Taiwan</th>
<th>S. Korea</th>
<th>Japan</th>
<th>Europe</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDA</td>
<td>97%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>44%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic</td>
<td>67%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAOS²</td>
<td>37%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>29%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>US</th>
<th>China</th>
<th>Taiwan</th>
<th>S. Korea</th>
<th>Japan</th>
<th>Europe</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuf. equipment</td>
<td>41%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>11%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wafer fab.</td>
<td>12%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly &amp; test.</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Based on 2020 revenues grouped by firms’ country, except for wafer fabrication and assembly, packaging and testing – which are based on capacity location. Siemens EDA (former Mentor) classified as US firm. Sources: ESDA, IPnest, BCG/SIA, CapitalIQ

2. Discrete, Analog, Optoelectronics and Sensors

---

### Booming US investment in chip design

- >30% of annual revenue invested in R&D = the highest % in the economy
- ~18% of annual revenue invested in R&D
- +15% YoY increase in R&D $ in 2021

#### New entrants

- US hyperscalers and device makers:
  - ~30% of overall chip design activity

- US semiconductor start-ups:
  - >10x increase in VC funding since 2016
  - reaching $2.6B in 2021
Chip design innovation: the race is ON!

- **SysMoore**
- **1,000x Increase in design engineer productivity**
- **Moore’s Law**

- **Systemic Complexity**
  - Time
  - Energy Efficient Design
  - Multi-Die (Chiplets)
  - System Optimization
  - Safety
  - Security

- **Scale Complexity**
  - Area
  - Power
  - Perf.
  - Time-To-Results
  - Exponential Systemic Complexity

- **Results**
  - Energy Efficient Design
  - System Optimization
  - Security

- **Talent Shortage**
  - Exponential Systemic Complexity

© 2022 Synopsys, Inc.
EDA Innovation Turbocharges Semiconductors

- **Moore’s Law**
  - 1,000 x Increase in design engineer productivity

**EDA Innovation**

- **Al-Driven Design**
  - Superior design outcomes in much less time

- **Multi-Die (Chiplets)**
  - Many more transistors
  - Better yield and production costs
  - Test & re-use of “known good dies”: the new IP

- **System Virtualization**
  - Acceleration of SW development
  - Digital twins for Silicon lifecycle management

- **Manufacturing Virtualization**
  - Technology (Classic & Multi-Die)
  - Capacity (Classic & Multi-Die)

- **EDA SaaS**
  - Infinite elastic compute
  - Immediate access without upfront IT investment
  - Flexible, scalable “pay-as-you-use” licensing

**SysMoore**

- **Infinite elastic compute**
- **Immediate access without upfront IT investment**
- **Flexible, scalable “pay-as-you-use” licensing**
How can the US Government support the industry?

A) Protect US innovation model
- Private sector enterprise – with adequate incentives for R&D
- Access to global markets and global talent
- Intellectual Property (IP) rights

US policy in support of leadership in semiconductor design

B) Expand US chip design talent base
1. Fund 7,500 MS-graduates/year in semiconductors
   - US firms need +10% annual increase in design engineers
   - 20 universities, 2-year semiconductor funded Masters
   - $120K/engineer → $900M/year x 5 years → $4.5B
   - Public-private funding for top students
   - Foreign talent: Visa + work-permit after graduation

2. Boost design engineering skill development
   - Access to state-of-the-art EDA + IP through universities and incubation centers → $150-300M/year

3. Re-establish US as global talent magnet
   - Green card cap exemption for international advanced technical degree holders

C) Orchestrate ecosystem-level innovation
1. Next-generation multi-die (chiplet) architectures
   - Critical for HPC/AI roadmap
   - Exponential systemic complexity and connectivity
   - Requires standards/concerted effort across value chain
   - Linked to development of US adv. packaging capabilities

2. Other potential high-impact innovation areas
   - Ultra Low Power
   - High Performance Computing (HPC) power optimization
   - Silicon photonics
   - New materials: SiC (power), GaN (RF)
The new “great American enterprise”

May 25, 1961… “Put a man on the Moon”

“... a great new American enterprise, key to our future on Earth...”

“... no project will be more important in the long-range; and none will be so difficult or expensive...”

“... this nation should commit to achieving the goal before this decade is out...”

• ~$150B of funding over ~10 years
• Sparked development of many new technologies

Semiconductor Technology
• Apollo Guidance Computer first to use newly invented Integrated Circuits
• Apollo was the world’s largest customer for chips driving the growth of Silicon Valley

2022: “Zero CO₂ by 2050”

A mission that is meaningful to mankind

Avoid Climate Catastrophe

A new great American enterprise to avoid climate catastrophe...

... requiring massive breakthroughs in science, technology and engineering

⇒ enabled by semiconductors!
Thank You