Risks and Opportunities Surrounding the Inflection Point of the Decade

Akihisa Sekiguchi, Ph.D.
Corporate Marketing
TOKYO ELECTRON LIMITED
Outline

• Challenges for the Coming Decade

• What Happened During Past Transitions?

• Collaboration and New Opportunities

• Closing Remarks
Technology Needs: Challenging Physical Scaling

Source: TECHINSIGHTS
Technology Needs: Challenging Physical Scaling

Source: TECHINSIGHTS
Evolving material and device structure

450mm transition takes place amidst above changes

source: Intel ITPC
Scaling Benefit?

Economic benefits of scaling has been decreasing

Source: IBS

IBS

COST PER GATE REDUCTION TRENDS

REDUCTION RATE OF COST PER GATE HAS SLOWED
Challenges for Equipment Suppliers

Tool Technology
- Innovation required to achieve <10 nm scaling.
- Optimization between F/P, T/P, Cost for 450mm tools.

Financial Concern
- Concurrent R&D will seriously affect financials.
- It will take many years before 450mm ROI is achieved.

Risks & Opportunities
- Technology risk, Financial risk, Market risk etc…
- Collaboration work would lead to Opportunities.

Supply Chain participants must overcome above difficulties
Requirements for 450mm Tools

• **Minimum Requirements**
  – Match 300mm process performance on 450mm
  – Match basic system requirements
    • Availability, Footprint, T/P, Cost Scalar…

• **Important additional challenges**
  – Self diagnostics, intelligent tools
  – Business model innovation among suppliers
  – New design to handle changing material needs

Clear understanding of customer priorities is key
## 450mm Key Parameters Relative to 300mm

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Throughput</th>
<th>Footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>1.20</td>
<td>0.52</td>
<td>1.15</td>
</tr>
<tr>
<td>Coater/Developer</td>
<td>1.20</td>
<td>1.00</td>
<td>1.13</td>
</tr>
<tr>
<td>Dry Etch and Ash</td>
<td>1.18</td>
<td>1.00</td>
<td>1.23</td>
</tr>
<tr>
<td>Thermal</td>
<td>1.19</td>
<td>1.00</td>
<td>1.13-1.16</td>
</tr>
<tr>
<td>Implant</td>
<td>1.20</td>
<td>0.55-1.00</td>
<td>1.10-1.20</td>
</tr>
<tr>
<td>Wet Processing</td>
<td>1.73</td>
<td>1.00</td>
<td>1.20</td>
</tr>
<tr>
<td>Metrology</td>
<td>1.18</td>
<td>0.62</td>
<td>1.20</td>
</tr>
<tr>
<td>PVD and plating</td>
<td>1.4</td>
<td>1.00</td>
<td>1.32</td>
</tr>
<tr>
<td>CVD and ALD</td>
<td>1.23</td>
<td>1.00</td>
<td>1.30</td>
</tr>
<tr>
<td>CMP</td>
<td>1.18</td>
<td>1.00</td>
<td>1.38</td>
</tr>
</tbody>
</table>

450mm tool requirements are beyond ‘Simple Enlarge’

source: IC knowledge
Forecast of Wafer Fab Equipment Market

It takes time to realize return from 450mm investment

source: TEL Marketing

Akihisa Sekiguchi / Tokyo Electron/ December 6th, 2012
# Wafer Size Transition History

<table>
<thead>
<tr>
<th>Wafer Size</th>
<th>150mm</th>
<th>200mm</th>
<th>300mm</th>
<th>450mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>1983-</td>
<td>1990-</td>
<td>2001-</td>
<td>2018-</td>
</tr>
<tr>
<td>Motivation</td>
<td>Productivity</td>
<td>Productivity</td>
<td>Productivity</td>
<td>Productivity Competitiveness Shrink of Scaling benefit</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Intel</td>
<td>IBM</td>
<td>Tool Suppliers</td>
<td>Limited Device Makers Consortia Limited Tool Suppliers</td>
</tr>
<tr>
<td>Tool Development</td>
<td>Device Makers</td>
<td>Device Makers (Consortia)</td>
<td>Tool Suppliers leveraging consortia resources</td>
<td></td>
</tr>
<tr>
<td>Standards</td>
<td>SEMI, Selete</td>
<td>SEMI</td>
<td>SEMI</td>
<td></td>
</tr>
</tbody>
</table>

Changing business environment dictates collaboration
Collaboration Model

Cooperation is key to tool maturity at the HVM timing
Need for Collaborative Work

• with Consortia
  – Discuss Win & Win scenarios for the Supply Chain, e.g. through standardization
  – Leverage in a pre-competitive environment cost saving ideas such as facility connection

• with Device Makers
  – Learn from 300mm wafer transition and avoid repeating the same mistakes -> early information sharing and constant dialog
  – Specify timing nodes and goals for 450mm High Volume Manufacturing together with Tool Suppliers as early as possible
During early stages, consortia can provide leadership.
What else can We do?

• Suppliers` Issues are
  – R&D cost to meet customers` process requirements
  – Financial problem caused by prolonged 450mm startup and concurrent 300mm R&D
  – Smaller cap Suppliers can not afford 450mm R&D

• TEL’s Actions & Proposal
  – Unify Platforms
  – Open our Common Platform to all Tool Suppliers.
  – Support Equipment Suppliers transition into the 450mm market

TEL will contribute to the Supply Chain with Open Platform
TEL 450mm Common Platform

• **Concept**
  – Unify TEL platforms at 450mm Generation.

• **Target**
  – 1 month integration based on TEL standard interface.
Open Platform Alliance Concept

Open Platform Alliance

Device Makers

- Risk control by minimized parts & platform
- Procurement, Maintenance, etc…

Tool Suppliers

- Develop tool with universal controller
- Achieve asset light development

Parts Suppliers

- Minimize part number
- Increase productivity

Open Platform can benefit supply chain
TEL collaboratively develops tools with suppliers all over Japan
Concluding remarks

• Risks:
  – Prolonged 450mm market formation would impact financials of Tool Suppliers.
  – Clarity on investment timing is strongly desired to pace investment.
  – Even then, entry cost to 450 mm is high and innovation may be stifled.

• Opportunities:
  – Leverage 450 mm consortia such as G450C & continue the standardization efforts through SEMI
  – TEL’s contribution will be to provide a Common Platform