Industry Collaboration for Cost Effective Manufacturing

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Growth Requires Advancing Multiple Areas Simultaneously

**Technology**
- Continuing to Push Ahead
- **32 nm** 2009
- **22 nm** 2011
- **14 nm** 2013
- **10 nm** 2015+
- **Manufacturing**
- **Development**
- **Research**

**Manufacturing Efficiency**

**Sustainability**
- Intel's Approach to Eco-Technology
- Energy Efficient Performance
- Design for the Environment
- Policy + Industry
- Technology For Environment

**Wafer Size Transition**
- Image source: Extremetech, Google

Complexities are increasing but leadership is rewarded
Technology Complexity is Accelerating Costs

Leading Edge Fab Cost: +575%

Process Development Cost: +450%

Chip Design Cost: +733%

Source: Global Foundries, BofA Merrill Lynch Global Research Estimates
EUV and 450mm Reduce Technology Driven Wafer Cost Increase to Enable Continued Growth

Flawless and synchronized execution across the industry is required to realize benefits.
The Challenges of EUV

**Tool**
- **Source** – Availability, Power
- **Scanner/Track** – Availability, Defects
- **Metrology** – Fast detection of small reticle defects

**Reticle**
- **Defectivity** – Killer defect impact >> wafer process defect impact

**Resists**
- **Patterning requirements** – Resolution, LWR/Dose
- **Outgassing** – TPT, Scanner requirements

EUV HVM depends on manufacturability across all of these areas.
450mm Technical Challenges

**Die to die matching**
- Match material/feature characteristics
- Match die level e-test results
- Match all film variability

**450mm scalar targets**
- Optimized Throughput/m² ≥ 300mm
- Processing cost per wafer ≤ 300mm
- Environmental foot print ≤ 300mm

Intelligent scale-up requires close synchronization with 300mm HW innovation and technology roadmaps

**Innovative Design Improvements**
- Match material/feature characteristics
- Match die level e-test results
- Match all film variability

**Best In Class Equipment**
- Uniform plasma density
- Improve thermal control
- Better thickness control
- Optimized pumping
- Film stress management

- Optimize vertical space
- Optimized pumping
- Platform innovations
- Common modules/parts
- Green friendly materials
- Max. recycle/reuse
- Smart idling
Global Cooperation for Efficient 450mm Development

World's First 450mm Patterned Full Wafer
(ISS US, January 2013)
Industry growth depends on technology advancement implemented in efficient, sustainable and cost-effective manufacturing.

EUV and 450mm require close industry collaboration across many levels & in many forms.

EUV is progressing -- source power and reticle defectivity remain significant concerns.

450mm global collaboration is advancing industry readiness in a cost-effective manner.
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