An Alternate Definition of CMP – Cost Managed Processes
Overview

• Background and Market Trends

• Managing the Major Categories of CMP Cost
  – Development
  – Capital
  – Operating

• Bottom Line
Consumer Drivers

• Since 2005, consumer products have become primary industry driver.

• Short product life cycles.

• Consumers demand More for Less.

• Consumers demand More in Less Space.

• Historically enabled by Moore’s Law – device shrinks & larger wafers.

• Result = Fierce Competition
  + Control Unit Costs
  + Develop Technology Fast
  + Ramp Volume Quickly


Source: 2007 Industry Strategy Symposium – Steve Newberry, CEO, Lam Research Corporation
• Two process modules have enabled CMOS advances over the past 15 years:
  Photolithography → Shrinks
  CMP → Stacks & New Mtrls (esp. interconnect layers)

• Not surprisingly, the two most expensive unit operations in the fab are typically photo and CMP
Device market is evolving:

i. Leading (“bleeding”) edge $\rightarrow$ More Moore; 300mm (possibly 450mm), $\leq$90nm (65nm, 45nm, 32nm)

ii. All others $\rightarrow$ Legacy Devices; More than Moore; $\leq$200mm, $\geq$130nm (some cross over for 90nm)

Source: International Technology Roadmap for Semiconductors (ITRS)

As reported by Pete Singer, Editor-in-Chief, Semiconductor International

Ludo Deferm, VP Business Development, IMEC, “…older technology nodes get a second life and show the promise of a whole new industry driver. This is because they are sufficiently scaled to develop smart devices and sensors such as CMOS MEMS, integrated sensors, power devices, biochips, and so on.”
Fab Adjustments

- Two Examples: TI and National
- Unit volumes flat to increasing
- ASPs flat to declining
- Gross margins improving substantially

- HOW ??
  - Cost Managed Manufacturing

- Contributing Factors
  - Moved away from Moore’s Law push
  - Product innovation focus
  - Lower capital burden
    - Fab Lite, used equipment, etc.
  - Multi-level cost reduction efforts
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• More and more difficult to stay on Moore’s law track
• “Easy” integrations have already been done
• New materials being integrated to meet specs
• Timelines for each new material are getting shorter
• Complex processes require multiple iterations to debug
Development Costs

- Classic engineering tradeoff: Speed, Low Cost, or Quality (choose 2)
- Shorter product life means shorter timeline for next gen
- Development $$ have to be amortized over product life

Actions being taken by fabs to control development costs:
- Extreme prioritization and focus (no “science projects”)
- Push early screening and optimization down to suppliers
- Outsource non-critical functions or bring in outside resources
- Alliances and consortia to share next gen development costs
• CMP equipment includes
  – Polishers (& cleaners)
  – Metrology

• Increasing # CMP layers requires more tools

• Cost per tool has risen by up to 10x in 15 years

• Result: CMP % of WFE continues to rise

CMP/ECMP Equipment Revenue Forecast ($ Millions)

Source: Laredo Technologies
Capital Costs

- Leading edge fabs still spend huge $$$ on WFE
- Older fabs being extended well beyond original design life
- Pricing pressures not as strong as consumables due to small number of viable OEM’s

Actions being taken by fabs to control capital costs:
- Increasingly popular “fab lite” model (or outsource altogether)
- Extend installed base whenever possible (incl. upgrades)
- Repurpose or sell certain fabs
- Some choosing to buy refurbished rather than new tools
Operating costs include:
- Consumables
- Labor
- Cleanroom overhead
- Other variable costs
  - Test wafers, maintenance, parts, etc.

Cross-fab comparisons difficult due to differences in cost models

Engineering teams being mobilized to reduce process cost per wafer
Operating Costs

• Consumables are an obvious target for cost savings
• Competition among providers enhances price erosion in some markets (e.g. Cu stock slurries)
• Supplier margins being squeezed

Actions being taken by fabs to control operating costs:
➢ Maximize throughput & minimize CMP polish times (integration)
➢ Increase slurry dilution and run lowest flow possible
➢ Extend pad life, especially with optimized conditioning
➢ Apply price pressure on suppliers (cost alone can justify switch)
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• CMP is enabling for many devices and/or materials

• Fabs are increasingly focused on reducing CMP costs

• Three distinct cost factors: development, capital, and operating (per wafer polish)

• Can be viewed in terms of CMP life cycle
One Set of Solutions

• Reduce Cost and Risk
• Accelerate Time to Revenue
Bottom Line

- Competitive pressures are increasing in most device markets over time

- Long-term viability for device manufacturers depends on controlling costs at all levels

$$\text{CMP} = \text{Cost Managed Processes}$$
THANK YOU!

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