CMPlicity™: Displacing Cost and Complexity with Efficiency and Simplicity in CMP

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Revenue & RDE Cost Trends

2 x Cost To Revenue Growth
Diminishing Margins
Index Comparisons (2004 To Current)

Monthly Average Δ’s
1 For 4.5 (+)
1.5 For 4.5 (Over QQQ)
Where’s The Upside?
Financial Performance Over Last 12 Months

Broad IC Suppliers
-20% to -70%
1 Exception

Memory Suppliers
-60% to -90%
1 Exception
During the first five months of 2007, the CPI-U rose at a 4.1 percent seasonally adjusted annual rate (SAAR). This compares with an increase of 4.1 percent for all of 2007. The index for energy advanced at a 15.5 percent SAAR in the first five months of 2008 after advancing 17.4 percent in all of 2007. Petroleum-based energy costs increased at a 19.9 percent annual rate and charges for energy services rose at a 25.3 percent annual rate. The food index has increased at a 6.3 percent SAAR thus far this year, following a 4.9 percent rise for all of 2007. Including food and energy, the CPI-U advanced at a 2.0 percent SAAR in the first five months, following a 2.4 percent rise for all of 2007.
Impact On Suppliers

Transportation

Raw Materials
Shipping

Energy

Manufacturing
Warehousing
Implications To Customers

Dow Chemical to raise prices 20% to combat high energy costs

NEW YORK: Dow Chemical, the biggest U.S. chemicals company, said Wednesday it would raise its prices by up to 20 percent to offset rising energy costs, as its chief executive lashed out at Washington for failing to develop a sound energy policy.

The increase is the latest signal that escalating energy prices are stoking inflation. Dow supplies a broad swath of industries, from agriculture to health care, and any sizable jump in chemical prices would very likely affect them all.

The price increases will take effect Sunday and will be based on a product's exposure to rising costs. Dow said it spent $5 billion on energy and hydrocarbon-based raw materials in 2002, and that level could climb fourfold to $32 billion this year.
Added Complexity From Progress

- Oxide, Tungsten, STI, Copper, Barrier

- Exotic Metals, Blends, Ceramics and Processes
Value Chain Wild Fires

Manufacturers

- Facility Needs
- Equipment Needs
- Chemical Blends
- Material Types

Suppliers

- Facility Needs
- Equipment Needs Or Suppliers
- Supply Capabilities
Product Evolution – Buying Hierarchy

Functionality, Reliability, Convenience, Price

Where The Suppliers Want To Be

Commoditize

Differentiate

Where The Customers Want The Suppliers To Be

Difficult For Both Supplier And Customers To Succeed
Both Must Innovate And Relentlessly Drive CIP
CMP Specific Customer Voice

PROCESS DEVELOPMENT TIMES ARE TOO LONG

DEVELOPMENT COSTS ARE TOO HIGH

THROUGHPUT IS TOO LOW

PROCESS RELIABILITY & FLEXIBILITY ARE TOO LOW

EQUIPMENT & CONSUMABLE COSTS ARE TOO HIGH

PROCESSES ARE TOO WASTEFUL
## Known Resolution Tools And Path

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*Must Be Properly Utilized In Development And Production*
World Class Manufacturing Evolution

- BATCH
- REDUCED VOLUME
- SINGLE PIECE FLOWS
- KANBAN

REDUCE / ELIMINATE STEPS
REDUCE VARIATION
CENTER PROCESSES

- IMPROVED QUALITY
- INCREASED THROUGHPUT
- REDUCED WASTE

- INCREASED PRODUCTIVITY
- INCREASED CAPACITY
- INCREASED EFFICIENCY
- INCREASED PROFITABILITY
Polisher Evolution

BATCH

SINGLE PIECE FLOW

KANBAN

Progress With Polishing Equipment Is Evident
Slurry Blending System Evolution

BATCH

MEGA Systems & Chemicals

REduced VOLUME

Majority Are Still Batching After All These Years
Equipment Impact On Process Capabilities

- **Polisher Selection**
- **Material Selection**
- **Delivery System Selection**
- **Equipment Definition**
  - **Blend & Delivery Equipment**
  - **Material Capabilities**
  - **Polisher Utilization**

*PROCESS CONSTRAINTS*
Efficiency And Simplicity In CMP
Bye-Bye Limitations and Cost

• **Limited Tune-Ability and Optimization Ability**
  - Individual Platen Tune-Ability
  - Platen to Platen Tailor-Ability and Balancing
  - Metal Layer to Metal Layer Optimization Ability
  - Tool to Tool Optimization Ability
  - Limited Process knobs
    - Down Force, Rotation Rates, Oxidizer Concentration, Dilution

• **High Slurry Usage & Cost Per Wafer**
  - Max. Concentration Limitations of Commercial Slurry Blends
    - Shelf Life, Pot Life & Economics
  - Compromised Cost & Performance with Fixed Formulations
  - Significant Waste Due to Flushing, Purging & Methods

• **Throughput Limited on Platform**
  - Bottlenecked by the Slowest Process Step
  - Constrained By Materials

• **Excessive Space & Hardware Requirements Per Chemistry**
  - Blend & Dist. Equipment Space / Cost → Chemical Selection → Polishing Process
More Of What Is Needed

+ **Unrivaled system and process** *flexibility*
  
  Rapid & thorough development enabled
  
  Direct manufacturing transference
  
  Optimally & easily tailored to any application

+ **Improved process** *performance*
  
  Material degradation forces minimized or eliminated
  
  Process control capabilities substantially enhanced
Less Of What Is Undesirable

- **Substantially reduced** cost of ownership
  - Expensive, high maintenance components eliminated
  - Material handling and use reductions incorporated
  - Non value added utilities (N₂ and exhaust) minimized or eliminated

- **Minimized** waste
  - Equipment and material space needs significantly reduced
  - Material utilization considerably improved
  - Drums and totes eliminated
CMPlicity System Example

- Bulk Chemical Delivery System (BCDS)
- Copper & Barrier Slurry Component Supplies + Water & Peroxide Feed For One or More Polishers
- Chemical Dispense Module (CDM)
- Single Polisher Supply Shown Add As Needed
- Separated, Concentrated, Redundant, Chemical Supplies
Essence Of CMPlicity

**House Supplies**
- Peroxide (Typical)
- DI Water
- Raw Constituents
- Slurries
- Etc.

**CMPlicity™ Supplies**
- Slurries
- Concentrated Abrasives
- Concentrated Chemistries
- Dilute Chemistries (Fed)
- Dilute Chemistries (Blended)
- Etc.

N, X, ω: Arbitrary Numbers

Any Chemical...At Any Concentration...In Any Combination
To Any Platen...At Any Time
Heart Of CMPlicity

Package & Pressure Dispense Engine
Stainless Steel Overpack
   UN DOT and ASME Certified
   60 psi CDA Supply
   Reusable
High Purity PE Liner
   Contains Chemistry
   No Gas Contact w/ Fluid
   Certified Environment
   Recyclable
PFA Diptube
   Inexpensive
   Reusable
Driven By CDA
   No Humidified N₂ or Vacuum Needed
Coupled For Recirculation
   To NOWPak® or Standard PV’s

Illustration for Reference Only
Actual Products Differ in Size, Scale & Detail
Power Of CMPlicity

Single Platen Copper Process in Less Than 75 Seconds
Meeting or Beating Dishing, Erosion and Defectivity Requirements
82 Second Process Achieved in Initial Testing on 7 kA Cu (3 Component)
93 Second Process Achieved in Initial Testing on 11 kA Cu (3 Component)

Copper Removal Rate Range of 1,200 A/min to 28,000 A/min (@ 3 psi)
With 3 Component (A, B & Oxidizer) Chemical System (Plus Water)
7 kA/min Cu Rate @ 1 psi Down Force with 2 Component System
Wider Range With 4 Component System

POU Cu Slurry Cost to Customer Less Than $0.37 Per Pass
Initial Metal Thickness of 5 kA
42 ml of Slurry Constituent Chemicals Consumed Per Pass
$0.43 Per Pass @ 7 kA Metal Thickness

Base Equipment Footprint 8.1 ft2
3 Chemical, Redundant Distribution (Plus House Peroxide and Water) Center Flow Control Module and Canister Sets Not Included (Configuration Specific)
Path To Success

Manage Complexity From Progress
Extinguish The Value Chain Wild Fires
Satisfy All In Product Evolution - Buying Hierarchy
Resolve The Issues, Using Established Methods
Evolve The Systems

CMPlify Your Processes!