# CMPlicity<sup>™</sup>: Displacing Cost and Complexity with Efficiency and Simplicity in CMP

John Hughes, Product Manager, ATMI NCCAVS CMPUG Meeting, Semicon West 2008



### **Revenue & RDE Cost Trends**



# 2 x Cost To Revenue Growth Diminishing Margins



### Index Comparisons (2004 To Current)



Monthly Average  $\Delta$ '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



### **Applied Market Forces**

|   | Expenditure<br>Category | CI    | hange: | s from | n pred | cedinq | g mon | th   | Compound<br>annual<br>rate<br>3-mos. | Un-<br>adjusted<br>12-mos. |        |
|---|-------------------------|-------|--------|--------|--------|--------|-------|------|--------------------------------------|----------------------------|--------|
|   |                         | Nov.  | Dec.   | Jan.   | Feb.   | Mar.   | Apr.  | May  | ended                                | ended                      |        |
|   |                         | 2007  | 2007   | 2008   | 2008   | 2008   | 2008  | 2008 | May 2008                             | May 2008                   |        |
|   | All items               | .9    | .4     | .4     | .0     | .3     | .2    | .6   | 4.9                                  | 4.2                        |        |
| < | Food and beverages      | .4    | .1     | .7     | .4     | .2     | .9    | .3   | 5.9                                  | 5.0                        |        |
|   | Housing                 | .4    | .3     | .2     | .2     | .4     | .3    | .5   | 4.9                                  | 3.3                        |        |
|   | Apparel                 | .6    | .1     | .4     | 3      | -1.3   | .5    | 3    | -4.3                                 | 6                          |        |
|   | Transportation          | > 3.5 | 1.0    | .5     | 7      | .7     | 7     | 2. 🥑 | 8.7                                  | 8.1                        | >      |
|   | Medical care            | .4    | .3     | .5     | .1     | .1     | .2    | .2   | 1.8                                  | 4.1                        | -      |
|   | Recreation              | .2    | .0     | .2     | .1     | .3     | 1     | .1   | 1.0                                  | 1.2                        |        |
|   | Education and           |       |        |        |        |        |       |      |                                      |                            |        |
| < | communication           | .0    | .3     | .4     | .1     | .3     | .4    | .4   | 4.2                                  | 3.0                        |        |
|   | Other goods and         |       |        |        |        |        |       |      |                                      |                            |        |
|   | services                | .2    | .3     | .4     | .2     | .4     | .5    | .4   | 5.3                                  | 3.6                        |        |
|   | Special indexes:        | _     |        |        |        |        |       |      |                                      |                            | -      |
|   | Energy                  | > 6.9 | 1.7    | .7     | 5      | 1.9    | .0    | 4.4  | 28.2                                 | 17.4                       | $\sim$ |
|   | Food                    | .4    | .1     | .7     | .4     | .2     | .9    | .3   | 6.2                                  | 5.1                        |        |
|   | All items less          |       |        |        |        |        |       |      |                                      |                            |        |
|   | food and energy         | .2    | .2     | .3     | .0     | .2     | .1    | .2   | 1.8                                  | 2.3                        |        |

During the first five months of 2008, the CPI-U rose at a 4.0 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 16.5 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 13.9 percent annual rate and charges for energy services rose at a 20.3 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. Excluding 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.

United States Department of Labor Washington, D.C. 20212



### **Impact On Suppliers**

### **Transportation**



# Raw Materials Shipping





Manufacturing Warehousing



### **Implications To Customers**



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

Reuters, The Associated Press

Published: May 28, 2008

**NEW YORK:** Dow Chemical, the biggest U.S. chemicals company, said Wednesday it would raise its prices by up to 20 percent to offset oaring 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 \$8 billion on energy and hydrocarbon-based raw materials in 2002, and that level could climb fourfold to \$32 billion this year.

### More Coming?

### Demand Impact?



### **Added Complexity From Progress**



# **Value Chain Wild Fires**





# **Product Evolution – Buying Hierarchy**

### Functionality, Reliability, Convenience, Price



### 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**

**ISSUE TO RESOLVE** 

**RESOLUTION TOOLS** 

**IMPROVE QUALITY** 

**INCREASE SPEED** 

**REDUCE COST** 



MINIMIZE WASTE

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



### **Progress With Polishing Equipment Is Evident**



### **Slurry Blending System Evolution**

#### BATCH



MEGA Systems & Chemicals



### REDUCED VOLUME



# **Equipment Impact On Process Capabilities**



### **Efficiency And Simplicity In CMP**





# **Bye-Bye Limitations and Cost**

#### Limited Tune-Ability and Optimization Ability

- Individual Platen Tune-Ability
- Place to Platen Tailor-Ability and Balancing
- Metal Layer Optimization Ability
- Tool to Tool ptimization Ability
- Limited Process
  Solution
  - Down Force, Rotans, Pates, Oxidizer Concentration, Dilution
- High Slurry Usage & Cost Per N. fer
  - Max. Concentration Limitations of Commercial Jurry Blends
    - Shelf Life, Pot Life & Economics
  - Compromised Cost & Performance with Fixed Symulations
  - Significant Waste Due to Flushing urging & Meth.
- Throughput Limited on Flatform
  - Bottlenecked by the slowest Process Step
  - Constrained Primaterials
- Excessive space & Hardware Requirements Per Chemistry
  - end & Dist. Equipment Space / Cost  $\rightarrow$  Chemical Selection  $\rightarrow$  Polishing Process



## More Of What Is Needed

+ Unrivaled system and process <u>flexibility</u>

Rapid & thorough development enabledDirect manufacturing transferenceOptimally & 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 (N<sub>2</sub> 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**





# **Essence Of CMPlicity**



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 N<sub>2</sub> 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!** 







ATMI, the ATMI logo, AccuDose, AutoClean, Better Process. Delivered., Cerulean, CMPlicity, EPM, ErgoNOW, GasGauge, High Productivity Development, IDEAL Clean, LOK cap, NOWPak, NOWTrak, PDMPak, ProAct, the ProAct logo, ProE-Vap, RegenSi, SAGE, The Source of Process Efficiency, TiTaN Kleen, UniChem and VAC are trademarks or registered trademarks of Advanced Technology Materials, Inc. in the United States, other countries or both.

SDS is a trademark or registered trademark of Advanced Technology Materials, Inc. and Matheson Gas Products, Inc. in the United States, other countries or both.

Other company, product, or service names may be trademarks or service marks of others.