CMP Outlook: Looking for a Better 2002

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You Can Have The Greatest CMP Tool.....

Bells and Whistles
The Brightest Engineers
....The Biggest R&D Budget

Ratio of R&D Spending to GDP

Unit: %
....The Best Sales Team
....But Without A Strong Economy
....Sales Are In The Toilet
...And Pink Slips Are Passed Out
IT HAPPENED IN 2001

CAN IT HAPPEN IN 2002?
The Economy Has a Strong Hold on Technology
Worldwide GDP is Tied to Semiconductor Orders

![Graph showing the correlation between World GDP YtY and World Semiconductor Revenue Growth from 1983 to 2003.](image)
WHY SUCH A HUGE DOWNTURN IN 2001?
Not Only A Sharp Drop In Semiconductor Orders

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But A Simultaneous Drop In Semis and Equipment
One Key Factor -- The Burst In The Internet Bubble

- Inverse wealth effect - Nearly $1 trillion
- Irrational exuberance of spending associated with the dot commers
- Stock analysts with their interpretation of the “new economy” and demise of the “old economy”
The Day The “New Economy” Died

BUY

BUY

BUY
Dateline October 9, 2000

**Worldwide Semiconductor Forecast (Millions of U.S. Dollars)**

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td>Total Market</td>
<td>169,136</td>
<td>231,601</td>
<td>295,180</td>
<td>336,150</td>
<td>320,930</td>
<td>339,545</td>
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<tr>
<td>Growth (%)</td>
<td>21.7</td>
<td>36.9</td>
<td>27.5</td>
<td>13.9</td>
<td>-4.5</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: XXXXX (October 2000)

"Near-term spot pricing is reacting to inventory building and should not be confused with the overall industry supply/demand picture. Stronger demand and some product allocation in late 2000 will result in higher prices for DRAM, flash and some SRAM densities has forced lead times out beyond 20 weeks."

Dateline August 24, 2000

XXX is predicting a shortage of DRAM production capacity will start in the third quarter of 2000 and last until the second quarter of 2002, eventually giving way to another memory glut in the third quarter of that year.

Semiconductor revenues are now expected to increase 44% in 2000 and 45% in 2001, according to XXX preliminary outlook.
Excessively Optimistic

Forecasts Part 2...
Giving Rise To Excessive Inventories of Chips

Dateline March 21, 2001

About $8 billion in excess inventory; 60% of the excess inventory held by contract systems manufacturers was in the networking and telecom sector.

Dateline November 27, 2001

'Effective' excess inventory could be as high as $7.4 billion at the moment
Then The Talk of a U.S. Recession

The R-word index
Stories in American newspapers* that mention “recession”

Source: Dow Jones  *New York Times and Washington Post  †September at quarterly rate

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Followed By One In Germany

The R-word index
Stories in newspapers* that mention “rec(z)ession”
Q1 1990-100


America

Germany

750
500
250
100

Germany: Handelsblatt  ↑To June 27th at quarterly rate
Sources: Dow Jones Interactive;
HypoVereinsbank Volkswirtschaft
Leading To Huge Layoffs

<table>
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<tr>
<th>Company</th>
<th>Layoffs</th>
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<td>Motorola</td>
<td>48,400</td>
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<tr>
<td>Nortel Networks</td>
<td>48,000</td>
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<tr>
<td>Lucent Technologies</td>
<td>46,000</td>
</tr>
<tr>
<td>Solectron</td>
<td>20,850</td>
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<tr>
<td>JDS Uniphase</td>
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<tr>
<td>Xerox+A47</td>
<td>13,600</td>
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<tr>
<td>WorldCom</td>
<td>11,550</td>
</tr>
<tr>
<td>Qwest Communications</td>
<td>11,000</td>
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<tr>
<td>ADC Telecom</td>
<td>9,600</td>
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<tr>
<td>Compaq Computer</td>
<td>9,000</td>
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<tr>
<td>Ericsson</td>
<td>9,000</td>
</tr>
<tr>
<td>Cisco Systems</td>
<td>8,500</td>
</tr>
<tr>
<td>Agilent Technologies</td>
<td>8,000</td>
</tr>
<tr>
<td>Unisys</td>
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<tr>
<td>Gateway</td>
<td>7,750</td>
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<tr>
<td>Hewlett-Packard</td>
<td>7,700</td>
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<td>Corning</td>
<td>7,575</td>
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<td>Verizon Communications</td>
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<tr>
<td>Philips Electronics</td>
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<td>Corning</td>
<td>6,575</td>
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<td>Sprint</td>
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<td>Agere Systems</td>
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<td>Dell Computer</td>
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<tr>
<td>Siemens</td>
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<td>Intel</td>
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<tr>
<td>Alcatel</td>
<td>4,800</td>
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<tr>
<td>Sun Microsystems</td>
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<td>Emerson Electric</td>
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<td>TRW</td>
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<td>Avaya Inc.</td>
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<td>Polaroid</td>
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<td>IBM</td>
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<td>EMC Corp.</td>
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<td>Lexmark International</td>
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<td>TDK Corp.</td>
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<td>Global Crossing</td>
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<td>Kemet</td>
<td>1,805</td>
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<td>Level 3 Communications</td>
<td>1,725</td>
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<td>Rockwell Automation</td>
<td>1,750</td>
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<tr>
<td>McLeodUSA</td>
<td>1,600</td>
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That Continue Today

Monthly layoff announcements (in thousands)

Jan. 212,704 cuts

SOURCE: CHALLENGER, GRAY & CHRISTMAS
Every One A Consumer That Didn’t Buy A PC
Or A Handsfree Cell Phone
Or Other Electronic Gadgets Using Semiconductors
And DotBombs Creating A Glut Of Networking Equipment

- Market awash with state-of-the-art gear at dirt-cheap prices.
- Internet routers, which sort and direct data traffic, dumped for less than 10% of their original price on the used market.
- Continues today - Enron can expect to get between $1.5 million and $2.7 million for gear it originally bought for $30 million.
Making The Economy and IC Industry Worse Off
Recession? What Recession?

- Market psychology more than fundamentals drove technology share prices up so rapidly in 1998 and 1999.
- Psychology turned sharply negative in 2000 after the dot.com collapse.
- Can economic fears can become self-fulfilling prophesies?
- The National Bureau of Economic Research declared last November that the nation was in a recession that had begun the previous March.
- So the recession, it turns out, was over before we even knew it had begun: The economy apparently began growing again last quarter just as it was officially declared to be shrinking.
But The Warning Signs Were There

- Inverted Yield Curve - Short-term interest rates higher than bond rates. 8 of 9 past recessions.

- Sky Rocketing Oil - Price increase equivalent to $100 billion tax increase led industry and consumers to stop spending.

- Credit Crunch - In mid-2000, borrowing from banks at $4.6 trillion, Household debt to $7 trillion. Fear of loses led banks to stop borrowing and VC money to dry up.
Better Signs Ahead

Maybe he has a reason to be smiling!
Durable Goods Orders Are Up

DURABLE GOODS NEW ORDERS 2000 - 2002
Seasonally Adjusted, Month-To-Month Percentage Change

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Manufacturers’ New Orders Are Up

MANUFACTURERS’ NEW ORDERS 2000 - 2002
Seasonally Adjusted, Month-To-Month Percentage Change

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Housing Starts Are Up

New Housing Units Started in the United States
Seasonally Adjusted Annual Rate

Two or more units

Single family

Thousands of units

Inventories Are Down

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Leading Indicators Are Up
Other Leading Indicators are Up

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Recession warning (-3.5%)

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Business Conditions in Germany Are Up

Ifō Business Climate
Trade and Industry\(^1\)

Balances, seasonally adjusted data

- Western Germany
- Eastern Germany

1) Manufacturing industry, construction, wholesale and retail trade.

Source: Ifō Business Survey.

26/02/2002
There Are Positive Signs For The IC and CMP Businesses
The Semiconductor Industry Has Turned the Corner

Product Forecast
Total Semiconductor

Source: SIA November 2001 Forecast

11/9/2001

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The Troubled DRAM And Flash Markets Are Up

Product Forecast
DRAM & Flash Memory

Source: SIA November 2001 Forecast

Nov. 01 Forecast

Billions/$

1999 2000 2001 2002 2003 2004

Source Information Network
The IC Logic Market Is Up
Semiconductor Equipment Bookings are Up

Semiconductor Worldwide Shipments to December 2001 vs SEMI equipment bookings to January 2002
3 months ma in $B. Last 2 months subject to revision

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The Equipment Book-to-Bill Ratio Is Up

monthly SEMI equipment to January 2002
data from http://www.semi.org/

- Billings  - Bookings  - Book-to-Bill

3-month moving averages
last 2 months are preliminary

billings and bookings in $ billion

book-to-bill ratio
300mm Fabs A Key Driver

300MM FABS BY CAPACITY

K WAFERS/MONTH

NUMBER OF FABS

INITIAL CAPACITY  FINAL CAPACITY

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300mm Fabs A Key Driver

300MM FABS BY COUNTRY - 2003

NUMBER OF FABS

0 1 2 3 4 5 6 7 8 9 10

U.S. Taiwan Japan Singapore Germany Korea France Ireland
300mm Fabs A Key Driver

300MM FABS BY COST

COST ($ BILLIONS)

NUMBER OF FABS

0 1 2 3 4 5 6 7 8 9 10

.5-1.49 1.5-1.99 2.0-2.49 2.5-2.99 3.0-3.49 3.5-4.0
New Materials Present Opportunities

![Graph showing new material opportunities for CMP](image)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Transistor</td>
<td>1 Mb</td>
<td>4 Mb</td>
<td>16 Mb</td>
<td>64 Mb</td>
<td>256 M</td>
<td>512 M</td>
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<tr>
<td>Insulation</td>
<td>Glass (oxide)</td>
<td>Low-k</td>
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<tr>
<td>Wiring</td>
<td>Tungsten</td>
<td>Copper</td>
<td>Aluminum</td>
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<tr>
<td>Memory Size</td>
<td>1 Mb</td>
<td>4 Mb</td>
<td>16 Mb</td>
<td>64 Mb</td>
<td>256 M</td>
<td>512 M</td>
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<tr>
<td>Processor Speed</td>
<td>20</td>
<td>33</td>
<td>66</td>
<td>100</td>
<td>266</td>
<td>500</td>
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China Will Boost Market - Not For Production

IC Production

Year

Billions of ICs

But For Consumption of ICs

ICs Imported

<table>
<thead>
<tr>
<th>Year</th>
<th>Billions of ICs</th>
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<tbody>
<tr>
<td>1995</td>
<td>10</td>
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<tr>
<td>1996</td>
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<td>36</td>
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<td>2004</td>
<td>40</td>
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<tr>
<td>2005</td>
<td>50</td>
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</table>
So It Must Import ICs To Meet 7-8% GDP Growth
Wassenaar Arrangement

- Export licenses be issued for sub-0.30-micron technology to China
- Current limit is 0.25 microns with prospects for 0.18 microns in late 2002
- Would limit China to IC production on 200mm wafers
- Would minimize the need for CMP
CMP Was Growing Faster Than Overall Equipment Market

[Graph showing the growth of CMP compared to the overall equipment market from 1994 to 2001.]

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And Its Share of The Overall Equipment Was Growing
But It Has Become A Mainstream Tool

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And Its Share of The Market Will Stay The Same

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue ($B)</th>
<th>CMP ($B)</th>
<th>% CMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>3.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>3.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>3.5%</td>
<td></td>
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<tr>
<td>2003</td>
<td>3.6%</td>
<td></td>
<td></td>
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<tr>
<td>2004</td>
<td>3.7%</td>
<td></td>
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</tr>
<tr>
<td>2005</td>
<td>3.8%</td>
<td></td>
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</tr>
</tbody>
</table>

Total Equipment ($B)CMP ($B) % CMP
But Market Share Among Vendors Has Been Erratic
And What Will Be The Impact Of Alternative Methods?

- Spin Etch Planarization (SEP) is being pursued by SEZ
- ACM Research's current-controlled electroplating and electropolishing technologies
And More Problems For Slurry Suppliers

- 3M’s slurry-free process
- Non-Slurry reactive liquid
  - Every vendor is working on it
  - Every user is working on it
Copper Has Planarized The Slurry Market

2001 COPPER SLURRY SHARES - $22 MILLION

- Cabot: 95%
- Hitachi: 1%
- Fujimi: 1%
- EKC: 1%
- Others: 1%

2002 COPPER SLURRY SHARES - $66 MILLION

- Cabot: 64%
- Hitachi: 9%
- Fujimi: 3%
- EKC: 3%
- Others: 18%
- Rodel: 3%
Final Slide That Reinforces Growth Of CMP Market

ECD and LOW-K EQUIPMENT MARKET

Revenues ($Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Low-K CVD</th>
<th>ECD</th>
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<tr>
<td>1998</td>
<td>$40</td>
<td>$60</td>
</tr>
<tr>
<td>1999</td>
<td>$20</td>
<td>$80</td>
</tr>
<tr>
<td>2000</td>
<td>$60</td>
<td>$100</td>
</tr>
<tr>
<td>2001</td>
<td>$140</td>
<td>$160</td>
</tr>
</tbody>
</table>

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Technology Can Conversely Impact the Economy

Advanced Technology

Lower Cost Chips

Higher Performance Chips

300mm

0.13μm

Copper

Low-K

Lower Cost End Products

Higher Performance Products