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FROM THE ARCHIVES: August 13, 2002

## Intel Unveils New Technology For Creating Tiny Transistors

By **DON CLARK**  
Staff Reporter of THE WALL STREET JOURNAL

**Intel Corp.** unveiled Tuesday new technology for making computer chips, part of a big bet that it can overpower its rivals amid a deep downturn in high-tech.

The new production process is the latest evidence of Intel's previously announced \$12.5 billion spending binge over two years on manufacturing technology. The Santa Clara, Calif., chip maker expects the latest process to yield the world's smallest transistors in large-scale production. Smaller circuitry on chips boosts their performance and reduces production costs.

Intel's big investments come at a time when business capital spending in general is way down, and the economy is widely viewed as needing a boost in big-ticket orders to stage an enduring comeback. Intel hopes that by investing now it will get a jump on rivals when the economy improves. The company's dominant position in supplying the brains for most personal computers has allowed it to remain more profitable than most competitors amid the current downturn.

By staying the course on capital spending, Intel could wind up with strong advantages in the capability of its chips and its ability to churn them out in big volumes. But if Intel has guessed wrong about the timing and strength of an economic recovery, or long-term demand for increased computing power, the company's impressive new production lines may wind up operating at a fraction of their capacity -- a miscalculation that could hang over Intel's income statement for years to come.



The gamble is likely to determine how history regards Craig Barrett, Intel's chief

**INTEL IN THE ARCHIVES**

- [Shares of Intel Retreat After Analyst Remarks<sup>1</sup>](#)  
08/12/02
- [Chip-Equipment Industry Is Still Hurting From Slump<sup>2</sup>](#)  
07/18/02

**COMPANIES**

Dow Jones, Reuters

**Intel Corp. (INTC)**

PRICE	15.78
CHANGE	-0.44
U.S. dollars	10:42 a.m.

**Advanced Micro Devices Inc. (AMD)**

PRICE	7.91
CHANGE	-0.13
U.S. dollars	10:37 a.m.

**United Microelectronics Corp. ADS (UMC)**

executive since 1998, who follows in the footsteps of the legendary troika of Robert Noyce, Gordon Moore and Andrew Grove. Mr. Barrett's tenure so far has been distinguished mainly by a spate of costly acquisitions and Internet-related diversions with little clear payoff.

The spending spree also is a survival test for a business model pioneered by Intel, which became a manufacturing powerhouse by the mid-1990s after nearly being driven out of business by foreign competitors in the prior decade. While most rivals contract to have their chips made by other companies, or have entered joint ventures to share large capital costs, Intel has steadfastly remained a primary manufacturer.

"Technology is being commoditized and there is a refusal on the part of Intel and other people to realize how quickly this is happening," says Hector Ruiz, chief executive of **Advanced Micro Devices Inc.**, an Intel rival. "I think Intel is trapped in a model that they can't see how to get out of."

Besides shrinking the circuitry on Intel's chips, Mr. Barrett plans to use the company's production skills to combine multiple features such as memory and wireless networking on the same chip with microprocessors, making Intel a more credible contender in communications and other markets beyond personal computers. The company also is moving, at two factories in Oregon and New Mexico, to 12-inch silicon wafers, up from the current industry standard of eight inches, which Intel expects to reduce production costs by at least 30% per chip. Silicon wafers are a fundamental element in the manufacturing process; hundreds of individual chips may be etched onto the surface of each wafer.

By contrast, Advanced Micro Devices doesn't plan to move to the new wafer generation until 2005, and then only by sharing costs with the Taiwanese chip maker **United Microelectronics Corp.**

"We really have two choices," Mr. Barrett says. Intel can build on its strengths in manufacturing, or be one of the crowd, standing in line to get services from factories that would make Intel's chips substantially similar to those of other companies, he says. "That doesn't fit my image of a technology leader," Mr. Barrett adds. "It doesn't fit my image of Intel and it doesn't fit my image of the technology marketplace."

Mr. Grove, who is now Intel's chairman, says Mr. Barrett is determined to use the company's financial muscle to emerge from the recession in a much stronger competitive position. He believes the strategy makes sense from a historical perspective: Just as boom-and-bust cycles took place in the building of railroads and canals, Intel is betting that the Internet downturn will be followed at some point by another swing toward technology investment.

"Craig has been very aggressive about turning a fairly good portion of that cash in to modern manufacturing capacity, because he realizes that other people are not in a position to do that," Mr. Grove says. Intel has nearly \$9 billion in cash on its balance sheet.

PRICE	4.27
CHANGE	-0.06
U.S. dollars	10:36 a.m.

**International Business Machines Corp. (IBM)**

PRICE	72.05
CHANGE	-1.15
U.S. dollars	10:37 a.m.

**Motorola Inc. (MOT)**

PRICE	12.28
CHANGE	0.01
U.S. dollars	10:37 a.m.

**Infineon Technologies AG ADS (IFX)**

PRICE	9.22
CHANGE	-0.52
U.S. dollars	10:37 a.m.

**Texas Instruments Inc. (TXN)**

PRICE	19.38
CHANGE	-0.66
U.S. dollars	10:37 a.m.

\* At Market Close

The next big shift will come from technology that can create lines of circuitry that are measured at 90 nanometers across (a nanometer is a billionth of a meter), compared with 130-nanometer dimensions that are the current state of the art. Intel believes it is ahead of rivals in shifting the bulk of production to 130-nanometer technology, and next year will begin shifting to 90-nanometers at a rapid rate.

In its announcement Tuesday, Intel described some key elements of its 90-nanometer production process, a proprietary recipe that includes the materials, equipment and sequence of manufacturing steps needed to create chips at the new microscopic dimensions. The company says its new process can actually create transistors whose key features are just 50 nanometers, or 1/2,000th of the width of a human hair.

Intel also announced plans to use a technology that effectively stretches the atoms apart in a silicon wafer to allow electrical current to flow faster, boosting computing performance. **International Business Machines Corp.** is credited with being the first company to adopt this "strained silicon" technique, but Intel expects to be the first to use it in massive production volumes.

The company is taking a similar stance with its move to 12-inch wafers, which are also denoted as 300 millimeters in diameter. Manufacturers and suppliers of production equipment have been working for more than a decade on the shift in technology, which requires an entirely new set of tools for each factory.

**Motorola Inc.**, for example, purchased land near Richmond, Va., and expected to have its own 12-inch factory operating there by 1998. It did manage to begin producing small quantities of chips that year using the technology, through a joint venture in Dresden, Germany, with **Infineon Technologies AG**.

Infineon went on to take the lead in moving to the new manufacturing technology. IBM and **Texas Instruments Inc.** have also opened 12-inch factories, as have foundry companies such as **Taiwan Semiconductor Manufacturing Co.** and United Manufacturing Corp.

But other manufacturers, such as memory-chip maker **Micron Technology Inc.**, say the shift is too costly for now, in part because of the high costs of 12-inch wafers. Motorola, in fact, never built its own 12-inch plant. Amid industry changes and financial pressures on the company, it now sees little reason to do so.

"I could just see that it would be difficult to utilize the volume that you would need to be a competitive facility," says Bill Walker, a Motorola senior vice president in charge of manufacturing. "It became very clear to me that not everybody in the industry needs their own 300-millimeter factory."

Intel has a big advantage that makes the 12-inch shift less of a gamble: It gets an average of more than \$100 per chip for its proprietary microprocessors. Micron, by contrast, sells its most popular memory chip, which is also sold by several other companies, for less than \$5.

Some rivals say they have been able to achieve innovations even while relying on third-party chip manufacturers. Henry Nicholas, chief

executive officer of communications chip maker **Broadcom** Corp., which obtains its chips from third-party manufacturers, insists his company has actually been able to introduce products with newer production capabilities more quickly than Intel. Those manufacturers, he asserts, have stayed competitive because equipment makers such as **Applied Materials** Inc. are transferring technology to them so quickly.

"Intel may say that they are leading the way in developing these technologies such as 90 nanometer," Mr. Nicholas says. "But you know who's really leading is Applied Materials."

Others say that Intel's manufacturing acceleration is having an impact. "Right now they are a full generation ahead if you include their 12-inch technology," says G. Dan Hutcheson, a market researcher at VLSI Research Inc. "It's a whole array of technologies that are all coming together here. It makes it very difficult for anyone to keep up with them."

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*Updated August 13, 2002 5:43 p.m. EDT*

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