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Technology

Trying to Maintain Moore's Law

By DON CLARK July 8, 2006; Page A2

Will Moore's law be repealed?

That question will be on the minds of some people gathering next week at the Semicon West trade show in San Francisco. It's a big event for little-heralded companies like Applied Materials Inc. and Tokyo Electron Ltd. that sell machines and materials used to make semiconductors. They play a big role in stoking the technology industry's growth engine, the relentless miniaturization that keeps improving the performance of electronic gadgets while reducing their cost.

Moore's law is named after Intel Corp. co-founder Gordon Moore, who predicted the number of transistors crowded onto a computer chip would double every year or two. So far, it has proved to be remarkably correct. Such improvements in chips explain why today's iPod nano stores so many songs, and why the next model will store many more.

But while the capacity of chips and the sales of chips have risen fairly steadily, competition has created supply gluts and shortages that whipsaw prices and profits. The cycles are particularly severe for the industry's tool makers. Market researcher Gartner Inc. Friday projected that semiconductor equipment revenue will rise nearly 25% in 2006 -- well above its projection of 14.3% growth in April - - after declining more than 10% in 2005.

Beneath those wild swings, long-term changes are under way. Using a 10-year average to smooth out the peaks and troughs, revenue

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PRICE	16.08
CHANGE	-0.30
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Tokyo Electron Ltd. (8035.TO)	
PRICE	7,990.00
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Intel Corp. (INTC)	
PRICE	18.56

growth for chip makers has gradually declined from an annual rate of about 13% in 1996 to less than 5% in 2005, says Sasson Somekh, president of [Novellus Systems Inc.](#), a maker of chip-manufacturing gear.

That creates a challenge for makers of chips and their suppliers, forced by competition to keep up research spending despite slower sales growth. "Technology is moving faster than ever," Mr. Somekh says.

Physics adds to the pressure. As transistors reach ever-tinier sizes, the expected gains in speed, price and power consumption are harder to achieve. Companies must adopt esoteric materials that push up the cost and complexity of making chips, and use tricky techniques to project circuit patterns more precisely.

In a study last year for the trade group Semiconductor Equipment and Materials International, consultant Ron Leckie concluded that makers of chip equipment and materials will need to spend a total of \$16 billion to \$20 billion annually on research by 2010 to keep up the pace of innovation. But together, they can only afford about \$10.4 billion based on expected revenue. Unless the funding gap is addressed, "it is likely that the pace of Moore's Law could slow down," Mr. Leckie says.

Responses to the pressures will be discussed at Semicon. One is more collective action; an industry-funded consortium called Semiconductor Research Corporation, for example, is announcing a university project to develop materials to speed the flow of electrons through chips, and another to develop chips that can recover from defects.

Write to Don Clark at don.clark@wsj.com

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