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## The End of Moore's Law?

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# Industry Observation

## E-Manufacturing Solutions Converge

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**E**-manufacturing promises to greatly increase the productivity of semiconductor manufacturing. One of the biggest challenges the industry faces implementing e-manufacturing is the ability to seamlessly integrate all the hardware and software components from various suppliers in the supply chain. Although this is not possible today, in the last few years several integrated technology solutions have emerged that greatly reduced the integration effort required to implement e-manufacturing. Standards and guidelines also are emerging that will improve the benefit-to-cost ratio of next-generation e-manufacturing systems.

In the fab, process, metrology and wafer handling equipment, as well as their subsystems, need to be integrated with manufacturing execution system (MES), equipment engineering system (EES) and yield management system (YMS) software.

One area of progress toward integration has been equipment suppliers' implementation of International SEMATECH's Level 0 and Level 1 e-diagnostic capabilities. Controllers use Web-based graphical user interfaces that permit remote collaboration — a fundamental Level 0 requirement — and/or on-board data collection (Level 1). Where secure access by the IC manufac-

turer is provided, these e-diagnostics solutions can exist today. IC manufacturers and equipment suppliers can collaborate remotely to quickly qualify new equipment and processes, and reduce equipment repair time.

A key aspect of e-manufacturing is connectivity to equipment subsystems and sensors for fault diagnosis. This connectivity allows subsystem manufacturers access to critical diagnostic information to guarantee uptime and further increase reliability of mission-critical parts. Process equipment controllers must be extremely reliable; this creates an obstacle to getting subsystem information through the real-time controller without compromising process equipment reliability. Large subsystem manufacturers offer connectivity and data management, allowing e-manufacturing systems to connect to subsystems and sensors concurrently with the process equipment. This integrated solution permits rapid diagnosis of the cause of process equipment faults.

Integrated metrology is enabling customers to begin using advanced process wafer-to-wafer control in their next-generation fabs.

Advanced process wafer-to-wafer feed-forward and feedback control software is helping companies meet wafer quality output guarantees and even exceed

ITRS roadmap expectations. These improvements in production are part of comprehensive process-module solutions.

At the same time, software suppliers are offering integrated factory system solutions that reduce the effort required to implement e-manufacturing. These include combined MES/EES solutions in some cases, and combined YMS/EES software in others.

An integrated global standards effort by SEMATECH, JEITA and SEMI is designed to ensure collaboration among the supply chain to specify the goals, requirements, and roles and responsibilities in future implementations. One key area being standardized by the customers is data quality, including the data types and rates required by the supply chain for next-generation systems.

The integrated technology solutions of today have greatly reduced the IC manufacturers' burden to implement e-manufacturing. As the industry drives toward a well-defined system that permits seamless integration of the various components and solutions, IC manufacturers will be freed to focus on their primary task — designing and producing chips to meet the ever-reduced time-to-market requirements of their customers. •



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