Harvesting Production Test Data

Every year, semiconductor companies accumulate tens of terabytes of manufacturing test data whose inherent value and bottom line impact are lost. And it's only getting worse.

The explosion of Internet of Things devices will further challenge companies' capabilities: products are becoming more complex while quality expectations soar, which causes test programs and the data they generate to increase exponentially in size; data is collected from geographically dispersed sources and processes; and RMA prevention requires the retention of data for months and even years. However, all is not lost. Leading semiconductor companies are pioneering a multifaceted big data analytics strategy to improve product yields, prevent escapes, and streamline RMA management. This groundwork is creating a blueprint for how manufacturing test organizations in other industries can realize the benefits of data analytics.

Collection and Detection

Providing a solid foundation for big data analytics in manufacturing operations presents two primary challenges. The first is collecting data from the tester in a standardized format and quickly delivering it, regardless of where that tester is located. Most semiconductor vendors have supply chains composed of separate companies in different countries conducting manufacturing, assembly, and test. This often prevents product teams from gaining rapid access to clean, consistent test data. A standardized approach to collecting data across a global supply chain is necessary for companies to best leverage the knowledge contained within that data.

The second challenge is storing data for long periods of time and ensuring it is readily accessible for detailed analysis. For companies involved in market segments that demand high-quality electronic products, processes that can help limit test escapes, rapidly resolve field failures, and manage RMAs are critical. These processes have generated a greater need for engineering operations to work closely with IT to plan how global test data is managed. Will the data be stored on-site, in the cloud, or some combination of the two? Big data solutions need to store and provide rapid access to enormous quantities of information (tens to hundreds of terabytes) and help teams accomplish tasks in the most efficient way possible.

From Reactive to Proactive

Access to data in real time helps solve many problems but only if a user can quickly mine that data. Data by itself is meaningless until it is analyzed. And in the case of semiconductor manufacturing data, much of that value is time-sensitive. The faster a user can analyze data, the more valuable the analysis results.

In many industries, data mining is a "reactive" process. Something goes wrong (for example, too many field failures), so a product team starts to analyze data to determine the problem, correct it, and then put steps in place to keep it from happening again. But in many cases, the damage is done, either in terms of a product recall or a negative impact on product revenue or even the market valuation of a company. The challenge is catching these problems early enough to mitigate them.

One of the major benefits of big data analytics is being "proactive" in automatically analyzing, in minutes, any amount of data 24 hours a day. In semiconductor manufacturing, engineers can embed their knowledge into automated rules engines that mine data 24/7, search for manufacturing issues, and provide immediate alerts.

Acting on Data

Eliminating the "find a needle in a haystack" problem is a paradigm shift for product and yield engineers. It helps emphasize acting on issues instead of continually looking for problems and finding them too late to effect meaningful change.

A simple example is a probe card or load board that is starting to fail. The immediate effect is usually a drop in yield. But how long will it take for someone to notice a problem? In some instances, the problem could go unnoticed for hours or more. If yield drops 6 percent during that time, any material tested during that timeframe is irretrievably lost.

"Companies like Optimal+ are delivering on the promise of big data for semiconductor manufacturing by providing near real-time ability to analyze and act on the insights in the data, lowering the cost of test and improving the product quality. This trend will only continue as other industries start to embrace the benefits of big data."

—**Mike Santori**, Business and Technology Fellow, NI

This is where big data analytics comes into play. Yield engineers can set up a rule that checks for any statistically relevant drop in yield at any test site in the entire supply chain. As soon as the rule is triggered, the rule engine alerts the appropriate people to take action within minutes and, in this case, preserve yield entitlement.

This also helps improve quality. One issue that affects semiconductor device quality is the number of "touchdowns" during wafer sort. Depending on the retest policy, in the desire to "pass" a device, a die may endure too many touchdowns, which puts its long-term quality and reliability at risk. But if the device tests as "good," what can be done to prevent it from being shipped into the supply chain? Using analytics, every die from every lot can be evaluated between wafer sort and final test to see how many touchdowns it receives. If any given die records more touchdowns than is deemed acceptable, that die can be rebinned as "bad" before it goes to assembly or final test, which removes a highly suspect die from the supply chain.

From Pain Comes Progress

Whatever a company's pain points may be—yield, quality, or productivity—big data solutions can help improve operational metrics by automatically analyzing manufacturing data based on rules that embody the complete knowledge and expertise of its operations teams. Today, many of the world's largest semiconductor companies, both IDM and fabless, are leveraging the power of big data analytics to help them collect, detect, and act on global manufacturing data and drive yield and productivity while improving overall quality. This ultimately increases profit margins and market share.

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