AOI – Essential data management for 21st century logistics-centric manufacturing

Using inspection proactively

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The typical opinion about electronics manufacturing in Western Europe has tended towards a pessimistic view, as commentators focus upon movement to Asia and Eastern Europe. The fact is that electronics manufacturing in western countries is healthy, competitive and growing. Assemblers like Netherlands-based EMS provider A1 have achieved this by using technology to sustain a new and highly effective business model.

The powerful M22XDL460 AOI system from Marantz

The EMS provider opened for business in 2001, in the thick of the world electronics industry's rush eastward. That landslide is now beginning to stabilise, but the fact that the company was able to become established and to grow throughout that torrid period shows that its founders, Jos in het Veld and Rudy Oude Vrielink, knew exactly what they were doing. Theirs is a different business model than might at first be apparent. And that difference is significant in a world where so much commoditization continues to take place. "We are not an electronics company in the traditional sense. Rather, our strategy from the outset was to prioritise high logistical performance," says Rudy Oude Vrielink. "As a logistics business our systems are primarily designed to eliminate sources of errors, including those that occur in assembly."

"For example, preventing incorrect components from reaching the production line and onto our placement machines dramatically reduces the proportion of our work that involves solving technical challenges," he explains. This model has allowed the provider to succeed in delivering an intensely cost-competitive service on a fast turnaround basis, to compete with offshore manufacturers even at high production volumes.

Its approach takes advantage of the "right first time" philosophy that underpins total quality management, but in het Veld and Oude Vrielink have not adopted a common notion that inspection and testing become less necessary. Increasingly narrowed process tolerances are a requirement, and to achieve this, accurate measurement techniques are essential. "As we have perfected the logistics of the operation, we have progressively confined the variables to the assembly processes themselves," continues in het Veld. "But to deliver the performance our customers expect, in terms of product quality and turnaround time, we have to minimise those variables also. To achieve this requires robust techniques to ensure our processes are always in control."

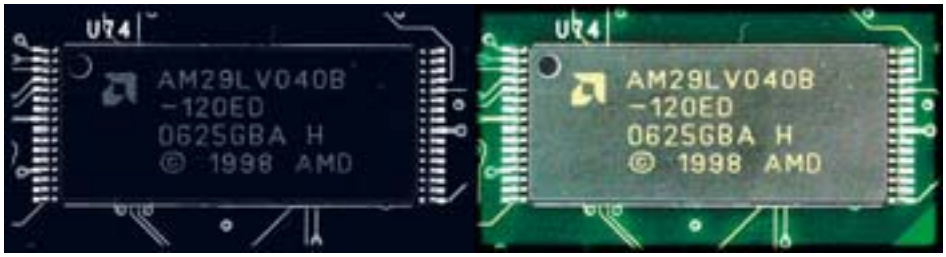
Sustaining a real-time process monitoring and improvement program is fundamentally reliant upon feedback of accurate quality data. "We needed a fast and reliable way to acquire usable quality data. And to allow the provider to deliver the same levels of service to all customers, it had to be compatible with short production runs," explains in het Veld. With its mix of customers including integrators of public transport management systems, industrial and medical electronics specialists, and high-volume manufacturers performing first-article build in Europe, A1's engineers may do as many as five product changeovers in a day. Often, there is not the time or the budget to develop custom test fixtures for in-circuit test. A more dynamic technique was required, to acquire suitable data on a per-board basis. Although flying probe testers, for example, have the speed and flexibility to cope with a high product mix and rapid changeovers, Oude Vrielink comments that important process-related information such as the quality of solder joints cannot be extracted.

A forward-looking implementation of AOI

To achieve the fast, flexible source of qualitative data required, the EMS provider invested in a Marantz M22XCL350 Automatic Optical Inspection (AOI) system in 2005, and upgraded to the more powerful M22XDL460 in May 2007 after enjoying significant initial success. The newly installed machine, with 24 bit colour defect detection, is able to quickly gather valuable quality data from inspected assemblies. The unit's software allows defects to be identified and recorded in a suitable format to allow process control deficiencies originating upstream to be rapidly identified. For example, the AOI system is able to judge offset or reversed components, as well as solder joint quality to detect actual or developing faults with upstream processes. This could be a blocked stencil aperture due to insufficient cleaning. On the other hand, a faulty placement nozzle may result in offset or missing components. Using AOI in this way is an example of how inspection can be used proactively, not only to detect faults but also to prevent defects from occurring. This is actually a forward-looking implementation of AOI technology; many other equipment vendors have only recently begun to introduce formalised systems to support this technique.

In practice, the team at A1 has also streamlined its end of line test procedures, thanks to the tighter process control now achieved through continuously feeding back AOI data. A great many process-related faults simply do not happen. "Assemblies can now be more than adequately analysed using functional test routines, which saves considerable time compared to implementing full in-circuit test," explains Oude Vrielink. But there is no implied reduction in the rigour with which quality-control measures are applied. "Frequently, the demands in terms of turnaround time and price, combined with short product lifetimes, preclude generation of a custom test fixture. So our use of AOI is a large factor in allowing us to exceed our customers' quality and testablity demands within the typical practical constraints."

Historically, AOI machines have demanded time consuming programming for each new board, in order to teach the system to properly identify defects and avoid false calls. But in western manufacturing businesses today, the emphasis on high mix, low volume production has significantly altered the requirements of automatic optical inspection, demanding an entirely new engineering model for useful implementation. Complex, high-value as-

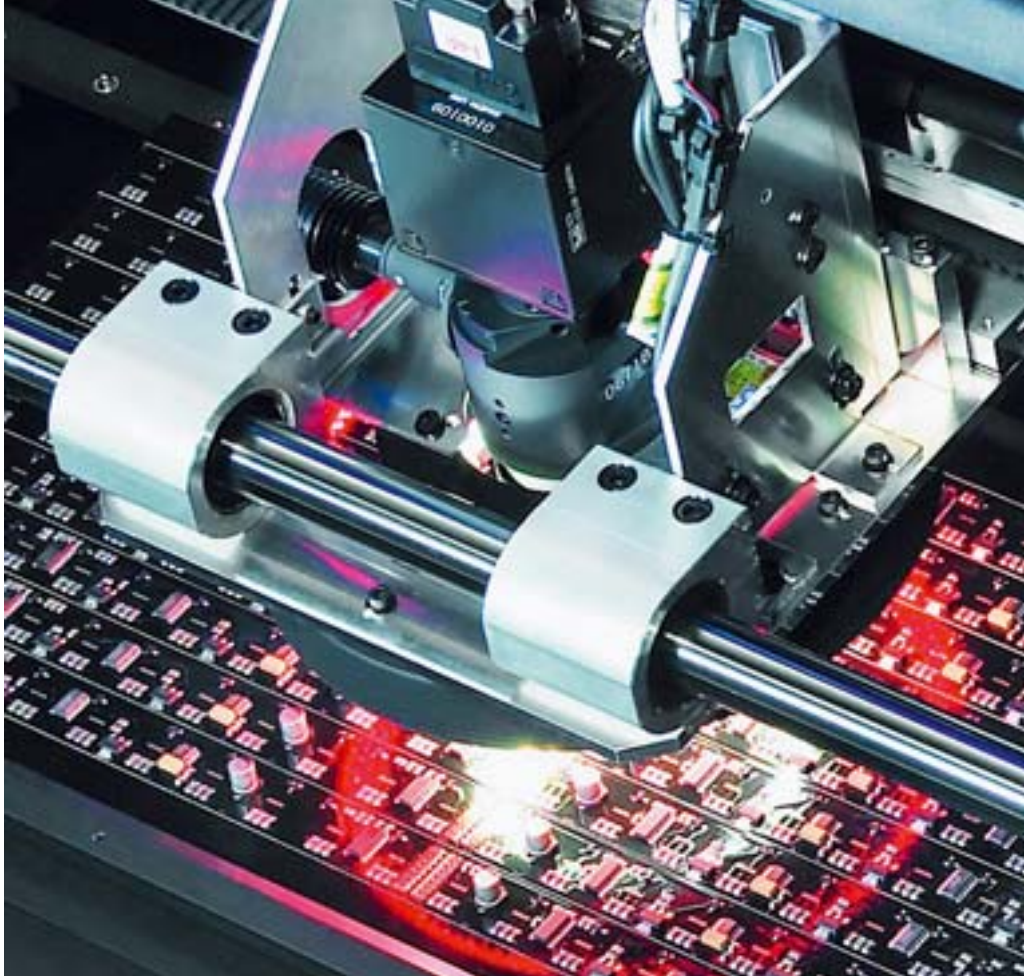


24 bit colour improves image clarity

semblies and multiple changeovers per day means assemblers have little time to enter into lengthy programming activities. Fortunately AOI platforms have made significant advances to reduce programming time for precisely this reason. "A short programming time was the top of our shopping list; AOI can do nothing to help our model if the programming times are excessive," comments in het Veld. "We chose the M22XDL460 because of its high performance in this respect, as well as several features that improve the flexibility and productivity compared to other machines in its class." The system allows the user to optimise the machine for inspection of parts, solder print and solder fillets, and also provides special controls including zoom-in and optimisation of camera settings. By providing tools to collect and record inspection data, and then to combine this with previous and new inspection results, the new AOI machine is able to become even faster and more accurate over time. "We now have a large database of cases, which we use to help programming, with a high confidence of low false-call-rates. We can typically programme the machine for a new assembly within less than 20 minutes," adds Oude Vrielink.

Building up new libraries

It is true that the change to lead-free assembly has demanded a fresh start, in terms of building up new libraries. The entire AOI community, worldwide, has had to reset its expectations for solder joint appearance. Not only is the surface finish different, but there is a much wider variation in the appearance of acceptable lead-free solder joints. "We typically now compare an individual joint against several models to ensure that acceptable joints are not failed," says Oude Vrielink. We see this as an advantage, as it imposes a more rigorous inspection of each joint." To maintain its assembly and inspection capabilities for products that are exempted from lead-free legislation, such as aerospace equipment and some types of medical instruments, A1 is committed to building its libraries for both technologies.



M22XDL460 close up

Component libraries have been an integral element of Marantz AOI since 2003, and the latest release includes over 500 different pre-programmed component packages. Dedicated custom libraries can be generated while teaching from the master library, enabling the creation of new masters as well as board specific inspection libraries. Libraries can also be merged with one another, further expanding the set up flexibility and reducing the time to production. Use of a component library can improve the efficiency of program creation time by as much as 75 %.

The EMS provider directly links its AOI system with the data produced from upstream component placement. This data follows an internally-defined format, as the company converts each customer's bill of materials into its own set of article numbers; another example of how data is manipulated to prevent errors. "Our people always get to work with a consistent set of part numbers and identifiers, which eliminates mistakes due to learning-curve issues and the informal interpretation of customers' instructions," offers Oude Vrielink.

To maximise productivity and line utilisation, the provider is also using the offline programming capabilities of the AOI solution, which also supports remote-desktop working to programme the machine, even from off-site when necessary. In addition, there are powerful modes to minimise the inspection time per board, such as the ability to begin inspecting the next PCB while still completing the classification of defects from the preceding assembly. In such a competitively priced machine, the availability of these features results in a true low cost of ownership.

Paperless repair

The EMS provider uses AOI data to drive its paperless repair activities. Paperless repair combines end of line test results and defect analyses with source CAD data for the assembly to direct repair workers quickly to the site of any defects that have been identified. The company has four fully integrated repair stations, using barcode identification and connecting automatically to the defects database containing AOI results, to take full advantage of the speed and accuracy advantages of paperless repair. "The capabilities of our AOI machine now enable a cost-effective and accurate paperless repair facility," explains Oude Vrielink. "Our operators can access the defect data for a given board conveniently, from across the enterprise network, to acquire a graphical representation of all defects detected. The paperless system allows us to update the documentation for any given product instantaneously, which is not only convenient but also provides the assurance that our operators are always working from the latest data for any given assembly."

Focusing on logistics

It is clear that the ways in which the EMS provider uses data throughout the organisation are critical to the success of its logistics-centric business model. Focusing on logistics has proved to be the key to growing its business in the face of strong global competition, particularly in countries where labour costs remain much lower than in Western Europe. Their challenge is to manage complex engineering tasks while maintaining extreme logistical efficiency. In answering that challenge, Rudy Oude Vrielink and Jos in het Veld of A1 Electronics have identified the importance of the correct tools to both acquire accurate data and productively utilize it throughout their organisation. After two years' of using high-speed, flexible AOI to achieve this, they say they would never be without it.

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RÉSUMÉ

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