Production Test for Modern Electronics Production

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1.Summary

Electronics production and production test are topics seldom found in technical college and university studies. As long as these functions were kept within the company that developed the product, the companies trained their people themselves. Due to outsourcing of the production facilities, the interface between development and production has been formalised, and the requirement for trained and skilled people is emphasised. But where do the production companies find skilled personnel?

To make the problem even more pronounced the evolution of the machinery and technology requires even more experienced operators. Therefore, the Norwegian Government funded this project to increase the knowledge level of the project participants.

2.Project description

The evolution of printed circuit board technologies makes it costly for an individual company to keep updated. Six independent production companies therefore decided to co-operate on the evaluation of new production and test machines and tools for electronics production. In 1999 government funding was awarded for a two-year project. Some subsidiaries of the original companies also joined, and now nine companies are participating. The University of Trondheim (NTNU) and the Technical College of Kongsberg (HiBu) also participate in order to learn and spread the results among their students. SINTEF Electronics and Cybernetics handles the project management.

The project is an evaluation project with limited research. The participants get no direct funding, only refunds for expenses like travel and training. The project has a focus on test and verification during production, and is divided in four subprojects:

1. Computer Integrated Manufacturing (CIM). The conversion of CAD data is time consuming and error prone. The goal is to find automatic systems that read CAD data from different systems and convert to both production and test machines.

2. Inspection systems. The purpose is to catch faults before the circuit board is powered up. These tools also give information on the quality of the production line.

3. Boundary Scan and Mixed-Signal Test Bus. Design for testability is an extra cost for the development company, but can save both time and money in production. The life cycle of the product must be considered.

4. Diagnosis and repair. This work is related to circuit boards that have failed in the production test. Methods are sought that reduce the time spent on fault location and repair. The results will also be useful for field repair.

3.Status

The project has run for one year, and the production lines have been described, where the errors most probably occur, and the type of tool that will best improve the situation. Vendors that serve Europe, particularly the Nordic countries, have been selected. Most vendors have been accommodating, and tools for a trial period have been supplied free of charge. The tools however, have required training, which has been paid through the government funding.

The evaluations have been organised so that representatives from two companies have co-operated. Their increase in knowledge about tools and methods has been tremendous.

3.1Computer Integrated Manufacturing (CIM)

Tools are being sought that convert CAD data to a common description language, and

from that common language to different production and test machines. Two different production lines have been defined. The vendors want to restrict the conversion to only a few machines for the evaluation, because it is time consuming.

The CIM tools use a proprietary intermediate language to which the CAD data is translated, and from there the control information for each production and test machine is generated. The dream is to skip this intermediate language and translate directly from CAD to machines. Where are such tools to be found when there is no such research activity at the universities?

3.2Inspection systems

Information has been collected on most types of equipment, both automatic, manual, optical, and x-ray. The equipment is sorted in two groups, Inline and Offline. Optical systems were evaluated last year, and during spring 2000, X-ray systems will be evaluated. It has been discovered that there is a remarkable difference in programming time for the systems. Would it be an interesting research topic to automatically generate the test programs from CAD data and a first visual inspection of the board?

3.3Boundary Scan and Mixed-Signal Test Bus

The work has concentrated around Boundary Scan. There has been some work done on the Mixed-Signal Test Bus, and the evolution of the standard has been followed.

Four stand-alone B-Scan systems have been evaluated, and during spring 2000 evaluation has started on three in-circuit testers that accommodate B-Scan.

Boundary Scan is a well-established technology today, if only the designers would use it. A push in that direction would be for component producers to standardise prising. The same price with or without Boundary Scan would do the trick

3.4Diagnosis and repair

This subproject was intentionally focused on design for testability and built-in test. It required active participation by design and development teams, which turned out to be difficult to establish. Finally it was decided to use results experienced in the project, namely CIM tools that can merge CAD data and error data from a tester on to a repair station. Also it was found useful to have a database with statistics for the errors and faults that were discovered.

In this field there are lots of interesting topics that should trigger university and technical college students. Is there a lack of communication between the production companies and the universities?

4.Conclusion

The experiences from this project have demonstrated that to keep up the pace in production and testing of electronics circuit boards, companies not only have to invest in expensive equipment, they also need more experienced operators. In the '80s and '90s the objectives were to integrate development and production, and companies tried to tear down the wall between the two departments. A result of outsourcing is that the concrete wall is being raised again.

Research and development of ASICs are major topics at universities and technical colleges. The technological challenges of printed circuit boards are now approaching the levels of ASIC development, and where it is a demand for more research in this area.