Using Test Strategies Simulation in the Test and Inspection Workflow

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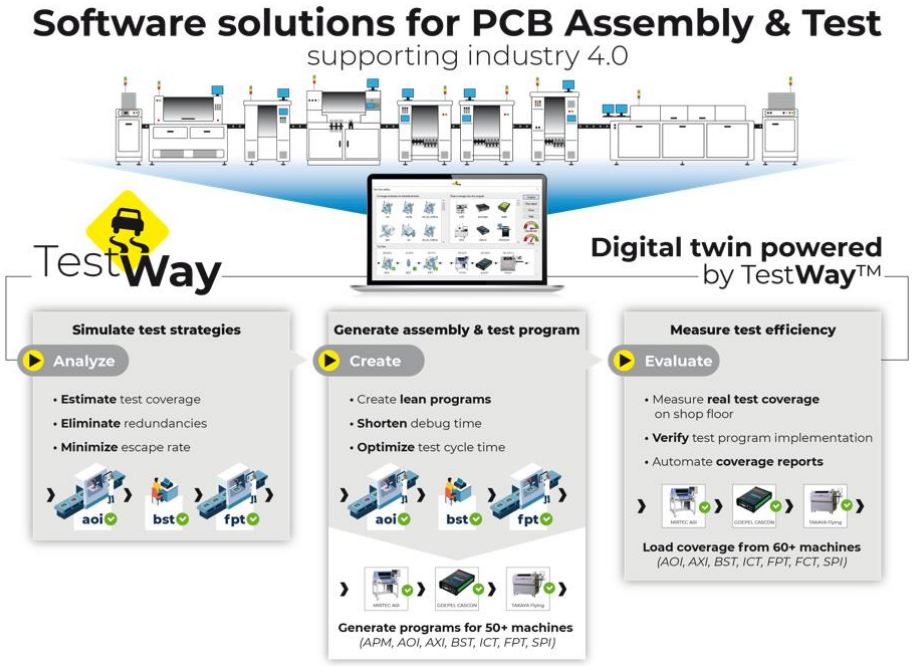
The question of applying test strategies simulation to the test and inspection workflow is something that everyone needs to be thinking about in the digital age, yet we notice that many engineers are still not applying this critical piece, to get the test and inspection workflow optimized.

In the past, test engineers tended to be focused on one piece of the test and inspection workflow; AOI, boundary scan, ICT, flying probe, functional test etc. In their focus on their particular strategy, they generally ignored the other test and inspection tests, and had little idea of what was covered and not covered by these other strategies. Essentially it is like a shot in the dark, applying the maximum coverage from their area of focus, or assuming what pieces may be covered from other strategies, without really knowing the facts.

The key to designing a good test and inspection process is to model that process before the start of producing test programs and see the coverage results reflected. Essentially, it's the concept of taking the digital twin of the test and inspection process to get the visibility that's needed to make important decisions.

The concept of the digital twin as it relates to the test and inspection workflow is to use data analytics or AI-driven simulation technology to create predictive models, which have been tuned, and can be continuously tuned based on real test results. Simulation models allow the user to determine the effectiveness of the test and inspection steps: Where are coverage duplications that are not needed? What components still have missing coverage or low coverage from the process, that need supplementation or more creative solutions to achieve the desired test coverage?



A good predictive model of a test strategy will allow a comprehensive report to be generated about the coverage as it applies to the board being examined. The simulation model for each test strategy needs to know the strategies capabilities. For example, if we look at AOI, what type of AOI machine will be used, 2D or 3D, will it have good camera resolution, will it have laser capability for planarity and tombstone components, with what effectiveness can solder joints be examined?

The model can then be tuned to reflect the machine to be used and predict the test coverage offered by the machine on the board. The same idea can be applied with other test strategies such as X-ray, ICT, Flying probe etc. Depending on the machine to be used, the model needs to understand the capabilities, the accessibility of the board, and the way some programing features will be used to again produce a report of comprehensive test coverage.

All of the planned or intended strategies need to be summed together to look at overall coverage of the test and inspection process. These simulation results then need to be analyzed to look at duplicate coverage and missing coverage. Duplication of coverage between test steps can be optimized to remove redundancies that will result in less test time and less development expense. In some cases, the results may show that a particular strategy or test and inspection step is not needed at all. An understanding of the results will also show where the lack of coverage is; what components are missing coverage or have low coverage that will result in test escapes.

A long-standing question that has always been asked of test engineers by layout engineers is: If accessibility could be improved where should the layout engineer concentrate on adding the test access? Are there some accesses that will be more beneficial than others? The answer is of course yes, but we need to understand where the most likely test escapes are. Predictive coverage simulation will show where the most benefit will be to add missing access if possible.

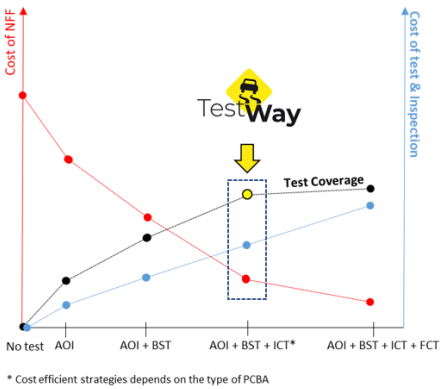
One of the concepts being applied with the simulation of structural test strategies is the idea of pushing “Test Left”. If good results can be achieved with the structural test strategies, then perhaps functional test can be reduced. Functional test has two significant issues that lead to difficulties, the cost of implementation of functional test can be high for complex boards, and the diagnostic resolution from functional test can be difficult which requires advanced training for technicians and can lead to bone piles of boards that can’t be diagnosed or fixed. If the majority of the coverage can be pushed “left” to the structural test where diagnostic resolution is better, then functional test can concentrate on only the areas where coverage just can’t be achieved with structural test. This will result in quicker functional test times, and less functional testers to be deployed. Also, the predictive coverage simulation will show what components are not able to be tested in structural testing, giving the technicians the knowledge of where to look for defects on the functionally failing boards.

As can be seen from the ideas presented above, if predictive models of the test strategies are performed, and continually tuned with available data, a thorough understanding can be gained of the coverage on the board, prior to implementation and development of the test programs.

Instead of driving for as much coverage as possible at each test strategy, a more intelligent method can be used which places the right coverage at the right strategy, substantially reducing wasted duplication, and therefore providing cost savings. We can then apply this idea to CAD conversion process for producing the test programs, and also performing real coverage measurement to evaluate the results and check that the results match the simulation.

All of this means a nice feedback loop in the process that allows tuning of the simulation models and the actual test process, so improvement is always being made. What better way to use the concept of the digital twin than to achieve real benefit in the test and inspection world where the results will be quickly evident.

How much ***test is needed*** to provide the ***maximum test efficiency*** for achieving the lowest ***cost of non-quality*** ?



The TestWay tool determines the ***test coverage*** of the SMT line, to find the balance of the right amount of ***test strategies***, in order to ***reduce the NFF (No Fault Found)*** as much as possible, without over testing.