

FIX THE PROCESS NOT JUST THE PRODUCT

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ABSTRACT

Understanding your process and how to minimize defects has always been important. Nowadays, its importance is increasing with the complexity of products and the customers demand for higher quality.

Quality Management Solutions (QMS) that integrate real-time test and inspection results with engineering and production data, can allow the optimization of the entire manufacturing process.

We will describe the cost and time benefits of a QMS system when integrated with engineering data and manufacturing processes. We will use real examples that can be derived from integrating this data. This paper also discusses the aspects of Quality Management Software that enables electronic manufacturers to efficiently deliver products while achieving higher quality, reduce manufacturing costs and cutting repair time.

Key words: Quality Management Software, ICT, Repair workstations, First Pass Yield, Pareto analysis, Flying Probe, QMS.

INTRODUCTION

By collecting, in a central relational database, test results from all aspects of test and inspection processes, failure and measurement data can be used to assess the efficiency of the production process, predict process issues and create detailed diagnostic information.

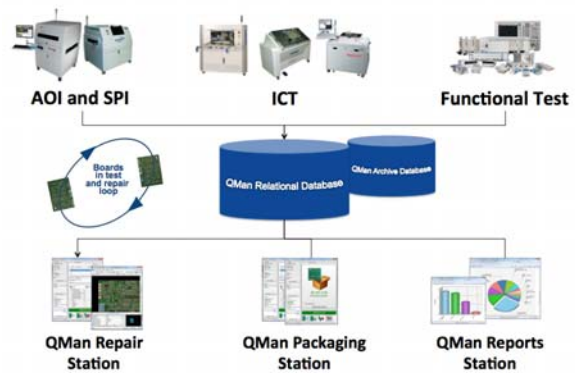


Figure 1. Quality Management System Overview

As detailed in many previous studies, defects increase costs and waste valuable resources. These costs increase the later in the process the defects were found, so tools that can identify the problems quickly and efficiently are critical to today's processes. [1]

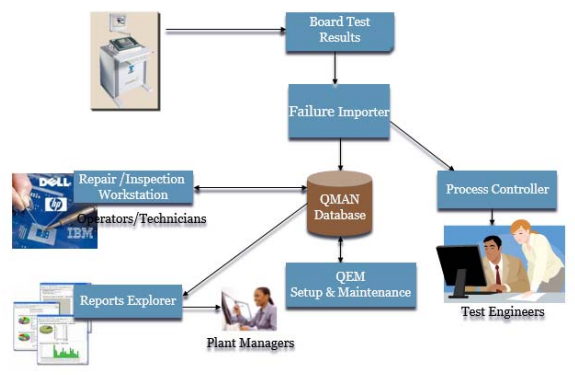


Figure 2. QMS Data Flow

Defects are not always visible during the manufacturing process so tools that allow defects to be correlated with their manufacturing processes are critical. Not only do

manufacturers need feedback from Inspection and In-Circuit Test, they would also like feedback from functional test. Accordingly, by continuously monitoring all aspects of Test and Inspection these goals can be achieved.

INTERNAL OR EXTERNAL QUALITY MANAGEMENT

At Pulse Communications, Quality Management tools have been deployed since the mid-nineties and focused at optimizing their processes. Over that time, the test processes have moved from an internal process to an external manufacturer. A quality management tool, like QMAN, also allows for a seamless migration of test and inspection data.

The test optimization practices at Pulse Communications include a continuous program review to ensure peak efficiency. These improvements are also fully portable and can be implemented on all systems across their standard network. The reason for continuous test optimization is to increase yields, reduce costs, reduce false calls and escapes, on all programs.

Table 1 details a typical report showing the Fault distribution across Functional and ICT at Pulse Communications’ manufacturing partner. This data can be produced using the time ranges you require and allows you to drill down to the exact cause of a defect.

Table 1. Table of Defect Causes

Fault Type	Fault Code	Total Frequency	Relative Frequency	
ABORTED TEST		202	47.53%	
Component Fault	NO DEFECT FOUND (Teradyne)	202	100.00%	29.41%
	NO DEFECT FOUND (Teradyne)	93	74.40%	
	INSTALLED WRONG	10	8.00%	
	DEFECTIVE PART	7	5.60%	
	MISSING SOLDER	6	4.80%	
	BROKEN / DAMAGED	3	2.40%	
	Z TEST	3	2.40%	
	WRONG PART	2	1.60%	
Open	SOLDER BRIDGE	1	0.80%	17.18%
	NO DEFECT FOUND (Teradyne)	63	86.30%	
	MISSING SOLDER	6	8.22%	
	INSTALLED WRONG	3	4.11%	
	OPERATOR PROBLEM	1	1.37%	
Short		25	5.88%	
	NO DEFECT FOUND (Teradyne)	15	60.00%	
	SOLDER BRIDGE	7	28.00%	
	BROKEN / DAMAGED	1	4.00%	
	PCB DEFECTIVE	1	4.00%	
	REFLOWED BGA	1	4.00%	



Figure 3. Defect Classifications across ICT and Functional Test

Pulse Communications work in a high mix environment and, since their implementation of a Quality Management System, they have been able to use the measurement data to improve the quality of their products. By providing real-time feedback to earlier process steps, QMAN has helped them increase their first pass yields to in excess of 96%. These tools have also allowed them to react quickly to problems by providing real-time trend alarms when issues are seen during production.

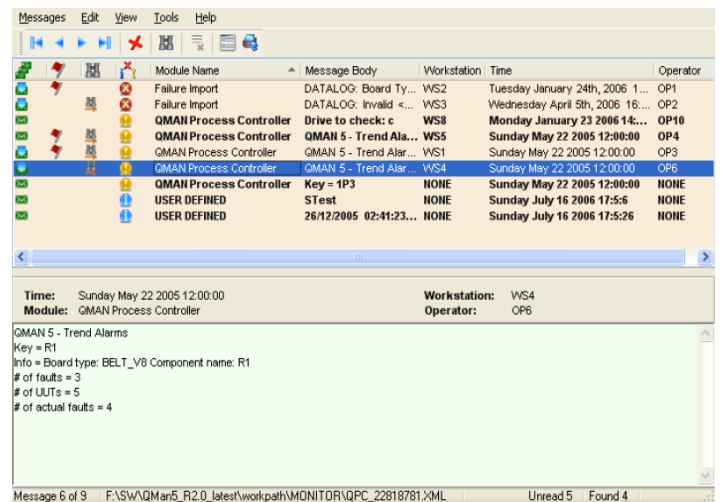


Figure 4. Real time trend alarms

DEFECT CLASSIFICATION ACROSS ALL TEST AND INSPECTION EQUIPMENT ALLOWS FOR CORRECT QUALITY DATA

In most Quality Management systems ICT, Functional Test and AOI are reviewed by different systems. This causes data inaccuracy. Also, these systems tend to only highlight defects. It takes diagnostics to determine the root cause of these failures. QMAN presents the test engineers with all the product data: it’s net list, it’s test results, possible short-circuit locations, board schematics and more.

Successful repair actions from all test and inspection processes can then be automatically added to the fault catalog. The Repair Workstation makes the Standard Repair

Actions available to optimize the repair time and to ensure high quality repairs.

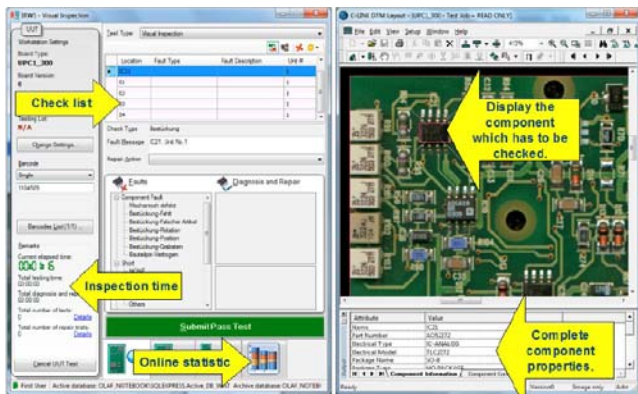


Figure 5. Repair workstation

To allow for inspection integration, the board image is merged with the board layout data. The use of resulting image/Layout offers the repair technician an indispensable tool to guarantee a successful repair decision, while reducing repair times.

In addition, the ability to link to the schematics help electronic engineers back track functional defects to their source. This data is tracked for every unit factory-wide, making this information available in real-time.

QMAN's repair tool also provides the ability to reduce operator training at the repair process for ICT and visual inspection. In a study compiled by Flextronics, there is a clear correlation between the skill level of a repair operator, the simplicity of the repair terminal, and the accuracy of the defect classifications. [2] The goal of a Quality Management System, is to provide actionable, understandable, defect information that the operator can determine with minimum training.

In addition, the Quality Management System needs to provide a detailed defect list containing status, part number, reference and connections.

When the unit is scanned by a repair workstation, the board image is displayed with clear indicators where failures are detected. Operators conduct their work and repair defects. No paper, no stickers or markers are needed. Everything is tracked, traced, and controlled to deliver analytical results.

MANAGEMENT REPORTS AND ALARMS.

We all need business reports and real time process control. The reports are provided by continuously monitoring the quality of the current production process and generating the report summaries and trend-alarms when production problems occur.

FIRST PASS YIELD REPORTS AND PARETO ANALYSIS CHARTS

The American Society For Quality (ASQ) definition for First Pass Yield: "First pass yield (FPY): Also referred to as the quality rate, the percentage of units that completes a process and meets quality guidelines without being scrapped, rerun, retested, returned or diverted into an offline repair area. FPY is calculated by dividing the units entering the process minus the defective units by the total number of units entering the process."

$$FPY = \frac{\text{number of tested boards} - \text{number of failed boards}}{\text{number of tested boards}} \times 100$$

Board Category : Production
Start Time : 1/9/2010 - 1:0:0
End Time : 31/8/2013 - 23:59:59

Lot ID	Test Name	Board Type	Qty Tested	Qty Failed	FPY
14688582	ICT	ICT PRD#1	221	32	85.52%
14764689	ICT	ICT PRD#1	374	62	83.42%
14835089	ICT	ICT PRD#1	300	33	89.00%
14851633	ICT	ICT PRD#1	238	18	92.44%
14895161	ICT	ICT PRD#1	241	16	93.36%
15131872	ICT	ICT PRD#1	247	41	83.40%

Figure 6. First Pass Yield report

In Pulse Communications case, first pass yield problems are quickly visible. We recently had an example where yields dropped below 50%. By being able to see the real-time alarms from our manufacturer and being able to drill down through the defect data, our Quality Management System allowed the issue with the screen printer to be correctly identified and corrected.

17743060	ICT	ICT PRD#1	50	26	48.00%
17750344	ICT	ICT PRD#1	56	31	44.64%
17756080	ICT	ICT PRD#1	46	18	60.87%

Figure 7. FPY in 40%-60% highlighting a problem

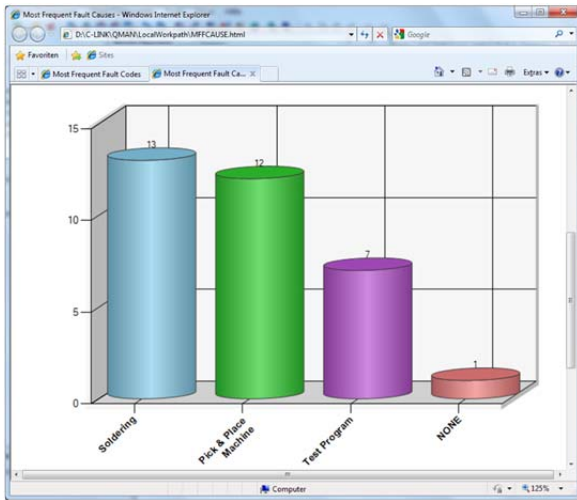


Figure 8. Pareto analysis chart of Defect Causes

The Pareto chart in Figure 8 shows the significance of various factors in declining order of columns. Pareto charts are frequently used in quality control to exhibit most common causes for failure or, product defects. The principle behind Pareto charts is called a Pareto 80-20 principle. The Pareto principle states that, for many events, roughly 80% of the most significant effects come from 20% of the reasons. [3]

WORK IN PROGRESS

Clear presentation of the production progress for various board lots is an indispensable tool for the managers to keep projects on time and satisfy their customers' demands.

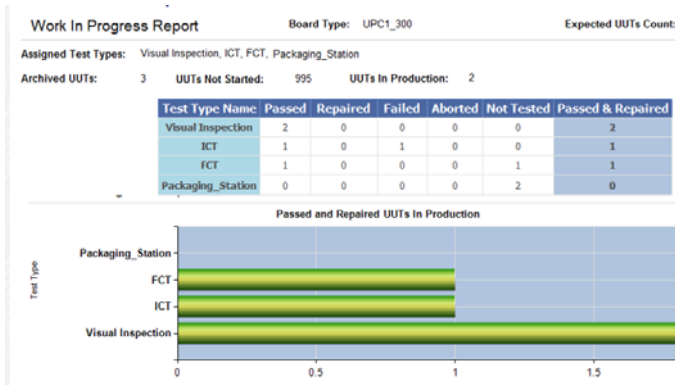


Figure 9. Work in Progress Report

SUMMARY

The greatest value of the Quality Management system is in the information it makes available.

Being able to get data from all test processes is invaluable. Combining data from Inspection, ICT, and functional test allows you to provide the data to drill down to the exact defect/process relationship; allowing you to quickly fix the process step that is causing the issue.

The flexibility of the Quality Management system is also important to the success of implementing a solution.

- Links to ICT
- Links to Functional Test
- Links to Inspection and AOI
- Provides Real-time information
- Links across multiple sites
- Provides statistical and analysis reports to evaluate production quality and frequent failure sources.

QMS tools can empower the people in operations to get manufacturing information in the hands of those who need it, while reducing costs and improving quality.

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