Problem Identification through Root Cause and Statistical Analysis

DESCRIPTION

A data collection (or failure reporting), analysis, and corrective action system provides a closed-loop process for identifying and tracking root failure causes. An effective data collection, analysis, and corrective action systems may use good engineering practices, reliability physics, or physics-of-failure methodology to evaluate the cause of each reported failure as appropriate (i.e., physical, chemical, and/or electrical failure analysis techniques). Root cause analysis goes beyond the symptomatic defect to isolate the fault to the discrete part or process step causing the problem. A number of sophisticated failure analysis techniques may be required in order to correctly determine solutions to a particular problem.

With the increasing emphasis on identifying the root source of a problem to ensure that the failure mode is eliminated, the failure analysis definition can be expanded to include failure prevention. Root cause analysis, properly applied, can identify corrective action for many problems (i.e., a failed semiconductor device, a low yield machine operation and a non-robust process). Common root cause analysis techniques include: optical microscopy, verification tests, internal visual examination, photographic documentation, and formal laboratory failure analysis.

Every process has some variation in its output. The greater the variation, the less often the customer will be satisfied. Quality measures like physical, performance, failure-related, cycle time, and cost parameters most impact the customer's satisfaction. Statistical process control can be used to examine these parameters, as it follows the premise that as long as the process is stable random samples of the output will measure values randomly distributed in a defined range. The central limit theorem states that the sample measurements will be normally distributed about the process mean and their variation will be related to the process variation. As long as the sample values vary randomly within the accepted range, the process is "in-control" and should not be adjusted. If a non-random pattern (i.e., a series of consecutive points constantly rising) or values outside the accepted range are detected, there is some (usually undesirable) factor at work which must be identified and corrected to restore the expected variation.

If a process is in control, the only way to improve it (if it is not yielding desired results) is to change it. The change may be the creation of a new process, but, more often, the parameters of the process are changed. To most efficiently find desired improvements and examine the interactions of factors statistical design of experiments (DOE) can be conducted. DOE can be used to find the optimum process parameters for a defined use environment or adapt it to find a robust design (i.e., one well-suited for a range of use environments). The significance of these results can then be evaluated using tools from a family of methods called analysis of variance (ANOVA). ANOVA provides a means to separate the influences of many different factors on a parameter of interest.

The Alion SRC staff has a proven ability to rapidly and effectively perform root cause failure analysis on electrical, mechanical, and electromechanical components. Alion has several laboratories, both in-house and external, that the SRC staff can utilize when formal laboratory analysis is required to identify the root cause of a customer's problem. The skilled engineering staff at the Alion SRC routinely collaborates with our statisticians to provide a comprehensive failure analysis solution. The variability of the process can be measured using statistical process control and if improvements are needed Alion's statisticians can apply the design of experiments principles with analysis of variance methods to effectively improve the parameter of interest.