When Statistical Techniques Won't Work, Problem Solving Methods for Low Volume Production and Field Returns.

Solutions to problems that intermittently occur in production or in the field are becoming harder and harder to diagnose as complexity of product and equipment increases. Despite the recent emphasis on statistical techniques, not all problems can be solved this way, particularly if you are like most companies, with smaller production runs and finite resources. The depth of experience needed to solve these problems has increased along with the complexity. Research & Design, Inc. can help you overcome these difficulties with proven problem solving techniques.

There are those today that would have you believe that the only acceptable way to solve conformance problems is by using statistical techniques. Quality texts often have more information on how to start a *movement*, than what kinds of problems are suitable to the technique. It is assumed that a "team" is required to solve a problem, and that statistical techniques *will* be used. Take for example the following description of the 'first step in improvement' (fixing the problem). "At this stage, we need to determine what we want to achieve by changing the process, who are the members of the team involved in the project, when we are planning to start and finish the project, what we need to accomplish the objective, what data are already available and what needs to be collected, in what format we want the data to be collected, what statistical tools will be used to organize and interpret the results, etc."[1] (Yes, that is *one* sentence!) Nothing is said about how the problem *should* be addressed, only *deriguerr* of statistics and teamwork. These methods are not applicable to situations where the production volume is insufficient to achieve statistical significance.

> ***"When all you have is a hammer, everything looks like a nail."***

Research & Design, Inc. uses all applicable methods to identify and solve problems no matter what the quantity. First, when identifying what process you will use don't set one course of action and determine *the* way you will solve *the* problem. This may lead to *a* solution, but not the *proper* one. This approach is best given in the adage "When all you have is a hammer everything looks like a nail." Be flexible. Ask yourself "What parts of this design or process *could* be producing the problem?" List them. Enlist the help of people closest to the problem, this includes design, production, field service, *and* the customer. In some cases this is as far as you will have to go. The solution will be obvious. If you were so lucky! Once you have identified what could be causing the problem then organize them in descending order, most likely to least likely. Then, for each, determine how you could prove it was or was not that item.

It is also a good idea to assess the economy of certain actions. Sometimes any solution *now* is better than the best solution *too late*. Or, investigation of one possibility would be very expensive, better to make sure it isn't something else *first*.

Now you have a plan, including methods. Assign competent people to the tasks. One by one eliminate the things that are not the problem. Usually you will find the solution in the first few "likely's." Sometimes it isn't so, and you can get hung up or deadlocked. Research & Design, Inc., with experience in solving a wide range of problems, can help you in fresh approaches and background, to ensure appropriate problem solving techniques are applied. (*See case histories on next page.*)

Whether your problem is threatening survival in the market, or just something that would make your life a lot easier, apply specific problem solving techniques for the best results.

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[1] Yefim Fasser, Donald Brettner, Process Improvement in the Electronics Industry, (New York:John Wiley & Sons, Inc.,1992), p. 5.

Case history: Excessive drift in magnetics part

A company had been contracted to design and develop an accelerated MTBF test system. At its heart was a custom magnetics module. Research & Design, Inc. was engaged to develop this module and other parts of the system. A prototype was designed, built, and extensively tested. Results showed the unit would perform within the specifications. A production run of 50 of the relatively expensive modules was made, and the rest of the design went on around these components. When the production units were tested however, the modules fell *far* outside the design limits. One individual on the customers design team attempted to determine the cause, and while examining the prototypes damaged them irreparably, leaving not a single conforming unit. The magic was gone. The deadline was approaching.

During a meeting with all involved parties a list of 25 or so possible causes were identified, including some seemingly superficial ones. Methods were decided to determine the culpability of each of these candidates. The list was systematically worked down, deadline ever nearer. Finally, down to the seemingly trivial, one of the differences noted between the prototype, which had worked, and the production units, which did not, was *color!* Upon investigation of this difference it was found; that to obtain an attractive finish, the vendor had heat-treated the cases in such a manner as to adversely affect their magnetic properties!

Immediately heat treatment specifications were drawn up and the parts sent out for re-treatment. When returned and reassembled, units all worked within specifications.

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Case history: Random field failures, but returns test good

Mysteriously, a percentage of this company's machines had failures of the control board. When returned either as warranty repair or for recondition, they showed *no* defects. Replaced back into the field, the same units worked properly. The cost of the problem was not high, but the damage to the company name and the perceived reliability of their products was deemed too great to tolerate.

Research & Design, Inc. was brought in to determine the source of the problem and to propose corrective action. From a list of symptoms the question was posed "What *could* cause this to happen?" The answer to which was "The microprocessor must be misinterpreting conditions." Which only led to the further question "How could it misinterpret conditions when the boards work fine on the bench?" So the problem was worked backwards.

The program was examined to see how it could *possibly* get into the state of inoperability (even the built in diagnostics would not work). The original software was written years ago and while helpful, the author had forgotten. Detailed inspection of the program revealed that, on power up, the processor sensed an impossible switch condition (i.e., a switch was ON *and* OFF at the same time). So it reset itself. Only to determine the impossible situation again... and forever loop. But how could a switch be ON and OFF at the same time???

This lead to the board. It worked. But it hadn't in the field. Inspection of the schematic provided a clue. In the interface logic there were short sections of CMOS input lines that were high impedance. Even a small resistance to ground (surface contamination) would cause false reading. A board was received and retrieved before testing (where it is *cleaned* first), it was found to have an 11 Ohm short on a line, causing the problem! When cleaned the short disappeared. Several recommendations were made to the customer from which spray coating of the board against surface contamination was implemented at relatively low cost.•