Potentially Capable but not Actual

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1. Introduction

Many service courses in statistics, in my experience, have degenerated into the presentation of a set of recipes. The prevailing situation extant in many courses was summed up recently by my son, himself a trainee engineer, when he said, "I learn the recipes to pass the exam but I don't really understand the material". In fact the rapidity with which the material in his course has been presented would defy understanding by the most statistically astute. Ironically, if past form is anything to go by, he'll do exceptionally well!

With many manufacturing organisations pursuing quality improvement programmes, I've had numerous opportunities over recent years to teach practicing engineers the intricacies of statistical process control. This has often been done in their workplace using material that is directly relevant to them and their work environment. Generally, I have been surprised by how little they understood about the true nature of statistics and the potential benefits that a statistical approach could offer them. I appreciate that practicing engineers who may not have graduated in recent years or who have reached their current positions by working up from the shop-floor, will have had little or no formal statistical training. All recent engineering graduates, however, will almost certainly have endured some compulsory statistics course as part of their training. The disarming fact, however, is that neither by virtue of previous training nor through interaction with those who have been so trained have they come to see the benefits or relevance of statistical techniques. One must, therefore, reasonably ask what has gone wrong? Is the fault with them, with the courses they have pursued, a combination of both, or something else altogether?

With the current surge of interest in statistical techniques engendered by the "quality" push, many design, maintenance and process engineers are being forced to embrace ideas that many have met before but haven't mastered.

2. Statistical process control

I was recently discussing the problems of teaching statistics to undergraduate engineers with a bright young graduate chemical engineer who had a far greater appreciation of statistical methods than (in my experience) most with his background. He lamented the fact that he wasn't taught the techniques of statistical process control during his tertiary studies. I suggest that statistical process control should feature much more prominently in engineering courses than it does currently. It is even feasible to build statistical ideas around the fundamentals of statistical process control since this material embraces the ideas of point and interval estimation, hypothesis testing and a detailed study of normality and its properties. It would be possible to bring in the elements of independence and correlation, the study of non-normal distributions and even introduce some non-parametric statistical tests, as well. Transformation techniques for handling non-normal distributions could feature, with emphasis on the importance of sound data integrated into quality management principles. Of course, these techniques have a much more general relevance than merely for process control, but at least to aspiring process engineers such an approach has much to commend it. There is, in addition, the whole area of reliability, a "smattering" of which also could also be covered in such a course.

"Statistics" is peculiar in that most people using statistics in practice are not statisticians! It seems that in order to be deemed respectable any piece of research or investigative work must be accompanied by a statistical analysis - right or wrong does not always seem to matter too much. Respectability is gained by the statistical analysis, thus many non-statisticians have been drawn into the statistical arena. So it is in the manufacturing industry, many of those overseeing the use of statistical techniques aren't statisticians, many are engineers. Given that there are engineers with the background and perceptions alluded to previously, there is obvious potential for misunderstandings to "creep in".

Introductory plant training in statistical techniques, when given, is often appended to training in quality management and appears under the heading of "Tools of T.Q.M.". Often this material is presented by trainers who themselves are inadequately trained or are so severely limited by time constraints that it is not possible to really do justice to the techniques they are expounding.

When one today examines certain commonly used procedures in statistical process control there is an undeniable focus on point estimation. This pre-occupation is to the point (pardon the pun!) that undue credence is given to estimates as reliable determinants of process parameters. Although fundamental to statistical reasoning, the notion that processes are perceived through the "key-hole" of a sample or samples is often not fully grasped. As a consequence of viewing the process through samples, judgements made about the process are susceptible to error. The degree of this uncertainty is vital knowledge if we are to make far reaching and expensive changes based on these judgements. It is one thing to obtain a point estimate of process variability and yet another to gauge its reliability. The time honoured manner in which this is done is by obtaining appropriate confidence intervals. Failure to do this or to run some appropriate simulations or repetitions, can give us a false sense of knowing which can further lead to all manner of unreasonable practices and claims. If it is to be engineers and non-statisticians who are to be the main users of statistical process control