

less "solutions" such as expert systems, fuzzy logic, neural nets and the like. Decision makers in industry will be seduced by such "solutions" unless they hear of success stories involving statistical methods. We have found such anecdotal evidence very effective in convincing them that it is worth allocating the necessary resources. Through publications and talks at conferences, case studies will also serve to attract to the field students who might otherwise pursue careers in engineering.

3. EDUCATION AND TRAINING

There has been considerable discussion in various publications about what courses should be taught to engineers and quality practitioners in industry. A major reason for the ineffectiveness of academic training in industrial statistics is not so much *what* is taught, but *how* it is taught. In this regard, universities in Japan have been even less effective than those in the U.S. In fact, Japanese companies engage in massive (re)training of their employees in statistical methods for quality improvement (see Box et al., 1988).

There are a few things to be learned from the training methods used by Japanese industry. Industrial training in Japan is closely tied with product development and process design organizations, and there is exten-

sive use of case studies directly related to the students' work environment. Courses typically meet several days per month over a period of many months, so students can try out the ideas in job-related projects between class sessions. There is often a follow-up, with the instructor and the student's supervisor, to see how the student has been applying the methods learned in his/her real work environment. In contrast, many training programs in the U.S. are built around the short-course format, with students getting intensive training over a three- to five-day period, with little or no follow-up to consolidate the knowledge gained and to ensure that the methods are being used.

If universities are to respond adequately to the needs of industry in terms of education in industrial statistics, it is imperative that there is a partnership between both groups. Statisticians and others from industry should play an active role, as consultants/advisors, in the development of university curricula in industrial statistics. The faculty members, for their part, should be willing to forge relationships with industrial partners and obtain access to real data and practical experience working on real problems. A fuller appreciation for the context in which statistical methods are used in industry is crucial for developing and teaching courses in industrial statistics. Such experience will also help to shape the research directions.

Comment

T. J. Orchard

David Banks covers a lot of ground, mostly useful and all interesting. Any practicing or potential industrial statistician will benefit from reading and reflecting on the article, even those parts with which they disagree.

It has been a long time since I was in manufacturing industry and I am out of touch with the latest developments in statistical methods. In spite of that I know enough to accept the value of research in the proposed areas. I am now more concerned with management and so I concentrate my remarks on David Banks' thoughts about TQM.

The view seems to be presented that TQM is all very

easy and the concepts are just common sense which should be apparent to any high school student. This overlooks the need to sell the contribution that simple tools and statistical thinking can make in process and product improvement. Experts must be aware that what may be common sense to them may not be apparent to less experienced people. (Although my son can now look down to count the rapidly appearing grey hairs on my head, I can still remember his problems in learning to walk. As an expert I knew it was common sense to balance on one foot and move the other, but it was not immediately obvious to him!) If we statisticians are that clever and knowledgeable, we should have the common sense to listen and communicate with our customers in terms they understand. And our customers may be fellow employees needing a bit of advice and training.

In spite of the provocative remarks, I do not doubt David Banks' understanding of what makes a good

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