ACHIEVING SUCCESS IN INDUSTRIAL TRAINING

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The teaching of statistical techniques to people in industry, as part of quality control or process improvement programs, can be a rewarding but somewhat daunting process for academics. Whilst the spin-offs for undergraduate teaching are numerous, and will be explored in a future paper, the biggest gains include the co-operation between the specific industry and the academic institution concerned. This paper explores some of the requirements and conditions that go towards enhancing successful industrial consultancies involving statistically based training programs provided by academics.

INTRODUCTION

Successful industrial training involving statistical techniques depends primarily upon targeting the right people at the right time, and providing appropriate content. As Morgan and Deutschmann (2003) claim, getting the right "who" trained in the right "what" is crucial. These authors claim that it is not enough to ask senior managers what they think their staff should know. Attention needs to be paid to matching worker competencies with the organisational needs. As well as using training methods that are likely to be effective, promoting long lasting learning, allowance needs to be made for the evaluation of both the training program and its outcomes in terms of the objectives of the organisation. The new knowledge and the skills imparted by the training program must relate to real workplace needs.

BACKGROUND

Anxiety levels of those involved in such training programs need careful consideration, for as Pretty *et al*. (1995) stated, "adults learn best when their own motivation is supported, their active participation is encouraged, their experience is valued and the content is relevant to their daily work." Thus, in such programs, the emphasis needs to be on the participant's learning rather than on the trainer's teaching (Werner, 1995).

Research shows that many people involved in teaching tend to teach in a manner that reflects their own preferred learning styles (Stitt-Gohdes, 2001). However, those with knowledge of adult learning principles, and theories about student-centered learning and constructivism, are more likely to be more comfortable in focusing upon the participant's learning. Such people tend to use self-directed learning opportunities and interactive learning environments rather than the traditional lecture. They also make use of varied resources to create personally meaningful educational experiences (Glenn, 2000).

Historically as teachers of statistics we have taught students to test whether or not something is significantly different from something else. Box (1996) believes that we need to teach our students to be innovative, and that statisticians must move out of their "test-oriented mind-sets and take up a critical catalytic role in the process of discovery and development." What better way to do this than to become actively involved in an industrial training program, trusting and utilizing the very skills and tools we have been trying to pass on to student for decades.

Industrial training generally differs significantly from school or university teaching. The primary purpose of an educational institution such as a school or university is to *educate*, which according to dictionary definitions implies the bringing out or developing of qualities or capacities latent in the individual, or regarded as essential to his position in life. Whilst an industrial training program is also about educating, the usual focus is to provide training in *immediately useful skills*. This is clearly evidenced in quality control, or process improvement training programs such as those offered by providers of Six Sigma training. Such programs typically involve training in skills that are used immediately in projects designed to optimize processes by reducing scrap rates, downtime, and so on. Industrial training almost invariably suggests a distinct end or aim which guides the facilitators and instructors. Also industrial

training programs are paid for by industries willing to train their employees, whereas university students typically pay for their own courses.

Whereas training emphasizes the effective use of certain techniques and materials in order to answer immediate needs, it usually fails to meet the requirements of long-range professional development, which is one of the goals of an educational institution (Azevedo, 1990). It is in this context then that *training* may be considered different to *education*.

From an educational perspective, what is it that makes an industrial training program successful? According to Ramsden (1992) and Biggs and Moore (1993), successful training programs invariably promote a deep approach to learning. Typically this involves relating existing knowledge to a project in hand, and drawing on knowledge from as many sources as possible via project teams. These authors also argue that deep learning will be enhanced by placing theoretical statistical ideas into the realm of shop-floor experience. When statistical ideas are transformed into real world examples, meaningful context is established for the user thereby enabling better understanding and appreciation of a situation. The importance of meaningful context in interpreting graphical information, for example, has been argued by various researchers (Makar and Confrey, 2002; Wild and Pfannkuch, 1998; Roth and Bowen, 2001).

CHARACTERISTICS OF A SUCCESSFUL TRAINING PROGRAM

The statistical tools we keep putting before university students, particularly those associated with exploratory data analysis, can be invaluable in industry. Typically the industrial training programs in which I have been involved focus upon training the participants in the use of statistical procedures (tools) so that they might be used to help solve problems identified as important to the particular industry. This might involve increasing process yields, reducing costs, or to increase capacity in some way. The objectives of such a program are for the participants to become proficient in relevant statistical and problem solving tools, thus enabling them to support major process improvement projects.

Properly defined projects should meet certain criteria. They should have clearly defined deliverables, and be approved by management. They should not be so small as to be trivial, nor should they be so large as to be unmanageable. Finally, all projects should be directly related to the stated mission of the organisation.

Projects should address three different areas of potential improvement, including *quality*, *cost* and *schedule*. Additionally, they should be undertaken by teams led by those with a good knowledge of the appropriate technical, analytical and statistical tools.

Many of the statistical tools that enable the participants to achieve the objectives and goals of the program are typically found in first and second level university courses. This material is often supplemented by total quality management (TQM) techniques. The power of modern computing software, particularly the associated statistical graphics capabilities, has undoubtedly added to the accessibility of the analytical possibilities.

Computers form an integral part of the training and are extensively used both during the training and for the analysis of project-related data. Each participant is required to have access to a computer and is expected to become proficient in *Word*, *Excel*, *PowerPoint* and *Minitab*. Work place projects should be clearly identified before training begins. In most cases these projects relate to scrap or defect problems resulting from current processes, cycle time issues, or cost of usage issues. The projects become the focal point of the training program, and provide the meaningful work-related context described above.

You do not have to be a super statistician to be an effective trainer. Rather, be prepared to listen, and continually ask questions. Usually the most difficult part is to get people to tell you precisely what it is they really want to know. Too often people collect data and then try and make it tell them what they want to know. As educators, facilitators or trainers we need to be active in teaching people to be doing just the opposite. Progression in this direction from knowledge to information to data will help to maximise the chance of success.

THE TRAINING PROGRAM AS A MODEL OF LEARNING

Typically the learning model involves lectures, course notes, materials and handouts, worked examples, practice examples, hands-on computations, case studies, self review,

simulations, application projects and presentations. The program is structured in such a way that in any 3 or 4 hour period most of the aspects mentioned above would be experienced. For instance, instead of participants completing a set of practice exercises by themselves, one exercise may be allocated to 2 participants who might then be required to work together as a team to solve the problem, usually based upon data collected on site. Solutions and explanations can then be presented to the whole group using *PowerPoint* with appropriate computer output as required. Questions and discussion from the participants are always expected.

A key factor contributing to the success of such training programs is that they account for the major characteristics that typify adult learning. Rogers (1986) identified five main characteristics of self-directed learning activities for adults. These are summarised in Table 1 below with a brief explanation of how each might appear in the training program.

Table 1: Characteristics Typifying Adult Learning (after Rogers)

Rogers' Characteristics of Adult Learning	Rogers' Characteristics in an Industrial Training Program
Learning is episodic rather than continuous;	*Successful training programs take place in concentrated bursts - train for half a day, practice the skills for 1-2 weeks, repeat, etc.*
Learning is generally aimed at the solution of immediate specific problems of a concrete rather than theoretical nature;	*Throughout the training site related data is used in all examples. Identification of projects (focal point of the training) is made using current on-site problems that require an immediate fix.*
Learning is rarely pursued in a systematic way;	*This can be more subtle to detect, however it becomes apparent by observing how participants work towards solving problems associated with their particular projects.*
Knowledge from many sources is usually used to solve a particular problem (not confined to specific discipline areas);	*The emphasis placed upon establishing an effective team is both strong and consistent. A good team is one that represents all key stakeholders associated with the particular process. Successful projects are often associated with effective teams.*
As material is mastered it is immediately applied	*Again, the structure of the training program ensures this will occur using the half day to learn the material and 1-2 weeks to apply the knowledge before the next learning episode.*

COMMITMENT OF COMPANY MANAGEMENT

Undoubtedly an important factor in the success of such training programs is the degree of commitment shown by senior management. Commitment at senior levels is always required and typically implies active and visible involvement in the

- initial development of the program (tailored to suit the goals and objectives of the business);
- selection of appropriate participants;
- selection of appropriate projects;
- overseeing of both the projects and the training program;
- protection of participants from negative criticism from others (most important).

According to Oakland (1993) and Caulcutt (1995), programs structured by involving management in such a way will bring together the essential elements of total quality management, which include culture, commitment, and communication. Caulcutt (1995) argues that the health of a company culture can be measured by the extent of co-operation that exists within. Whether it be between departments or between people at different levels, both are indicative of an open culture with a true customer focus (Caulcutt, 1995).

PROGRAM EVALUATION

Assessment of the training material for each training module requires participants to submit practical worksheets involving computer analysis of specific data sets, and to collect and analyse some data obtained from their particular work environment. This often involves individual and/or group presentations of analyses carried out during the training sessions, or more formal preparations of written reports based upon results of experimental studies carried out at the work-place. Assessment of the overall program is based upon the successful completion of the projects allocated at the commencement of the training, and in the savings or efficiencies gained

by the improvements made therein. Such successes are an important factor in the continuing successful application of the initial training received. Any researcher will be buoyed by initial success and will most likely be better equipped to continue with the experimental process.

CONCLUSION

In summary, a successful industrial training program may involve relatively advanced statistical analysis made accessible through computer software. These analytical tools are immediately applied to solving problems defined by projects directly related to the aims and objectives of the organisation. A training program that is based upon recognized adult learning characteristics will maximize the opportunity for achieving long lasting learning and success for both participants and the organization as a whole. With careful pre-planning and commitment from the senior levels of an organisation, the industrial training experience can be a rewarding experience for all concerned, not the least being the undergraduate students back at home base.

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