Training for Six Sigma

An Integrated Approach

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The Six Sigma Enigma:

The Six Sigma Enigma was first advanced by Motorola around 1986. The rigorous training provided managers with specialised measurement and statistical tools to help reduce defects in products and processes and to cut costs. To date in excess of 50,000 people have been trained in the approach in America, Europe and Asia.

Six Sigma training is a program designed to increase process yields, reduce the cost of poor quality, and to increase capacity through the use of statistical tools. It is usually delivered by a group of consultants with the objectives to train people to support major process improvement projects and to become proficient in basic and advanced Total Quality Management (TQM) tools.

The Six Sigma approach extends beyond the narrow process control focus to encompass the broader issues of product and process design, and process management. Process capability is assessed, factors that are crucial determinants of quality are identified, and the full cost of poor quality is determined. Improvements are designed and implemented and outcomes are rigorously monitored and evaluated. It is "an information driven methodology for reducing waste, increasing customer satisfaction, and improving processes, with a focus on financially measurable results." (Keeping TAB, Nov 1999, No. 31)

Six Sigma Training – Definition:

The following basic training model features in the growing number of Six Sigma success stories around the globe. Generally it involves a team of instructors working closely in conjunction with senior and middle management, as well as the trainees. A typical deployment involves:

Champion Training: This is a two day workshop, for senior and middle management. The purpose of the training is to provide an overview of Six Sigma and the role of management in its successful implementation.

Project Selection: This is a one day workshop to review and select potential Black Belt projects which impact Cost of Poor Quality (COPQ).

Blackbelt Training: Usually this is on the job training for selected trainees, working over a 16 week period. Trainees are guided through the theory and practical application of Six Sigma methodologies, preferably in an activity-based program. The schedule includes 4x5 days of classroom training and 4x5 days of on-site support (40 days total).

Training Materials: These are generally provided by the trainers and may or may not include relevant computer software. A selection of useful reference texts usually accompanies the training notes.

Certification: Black Belt certification is awarded upon the successful completion of training projects. A formal ceremony is usually conducted for this purpose.

As a training program the Six Sigma model closes the loop in that it is project based and results focused. The success of the program is measured by the robustness of any fixes put in place. However, Six Sigma goes far beyond training. It represents a philosophy of manufacturing, the core of which is informed data driven decision making.

Reasons for Success:

There are probably many reasons for the current successes being reported around the world, resulting from Six Sigma training programs. The implications for how and what we currently teach in our undergraduate courses at University level should not escape our attention. I feel there are four major reasons for the successes reported. The first has to do with the power of the statistical content while the second concerns the learning model embodied in the structure of the training program. Other reasons have to do with company commitment and the suitability of the program participants.

i) *Statistical Content:*

The statistical tool bag opens with process characterisation tools such as process maps, and cause and effect diagrams, before introducing some basic descriptive statistical procedures involving both summary and graphical representations. Measurement and Capability analysis are then introduced into the training, followed by multi-variable analyses, inferential techniques and an introduction to various experimental designs. The Design of Experiment (DOE) techniques provide opportunities to further refine lists of significant variables and to focus upon an optimal operating window within which process yields and capacity can be maximised, and the costs of poor quality reduced. The statistical content is not new, rather it is the context and the packaging of these tools that reflects a new and creative form of statistical thinking.

Certainly a major focal point of the content is the use of carefully designed experiments where *multi-variable testing* techniques allow experimenters to change many variables simultaneously. This is a significant departure from the traditional practice by engineers of methodically changing one factor at a time and analysing the results. Such a procedure has been shown to be both inefficient and costly in terms of resources and time, as well as being incapable of detecting interactions between variables that can be primary causes of problems in manufacturing processes.

ii) The Training Program as a Model of Learning:

The successful training programs in America and Europe are based upon a common methodology involving the cycle *plan, train, apply* and *review*. This fits very nicely into what education theorists call the Action Research Spiral (see Fig.1 below) which can be described as following the path of *plan, act, observe, reflect, replan, …*

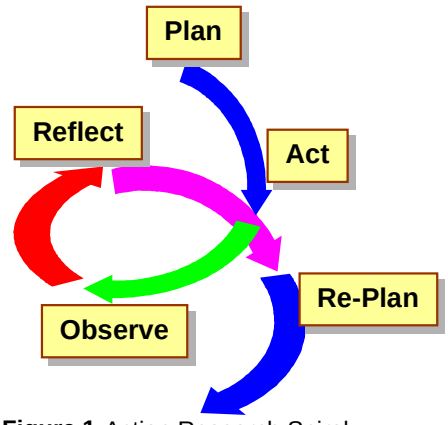

Figure 1:Action Research Spiral

The training program is designed to generate process improvement experts who learn by doing (the heart of the training program involves a project directly related to processes in current operation). Once trained these *experts* are expected to share their training with fellow employees, to continue the cycle anew, and so beginning the development of a culture leaning towards what Oakland would call total quality management.

Six Sigma training, as a model, promotes a deep approach to learning, similar to that espoused by Ramsden (1992) and Biggs and Moore (1993), by typically placing considerable emphasis on the following points throughout training.

- relating existing knowledge to the project in hand;
- drawing on knowledge from as many sources as possible via project teams;
- placing theoretical statistical ideas into the realm of shop-floor experience;
- relating and distinguishing between evidence and argument - *no data = no argument*.

The deep learning is further enhanced by a strong activity-based teaching program which I believe is the core element in the success stories reported from America, Europe and Asia.

Characteristics of Adult Learning: An important 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. Each of these characteristics are readily identifiable in genuine Six Sigma training programs. Table 1 below shows a summary of Rogers' characteristics, with brief explanations of how each may be apparent in typical Six Sigma training programs.

Table 1: Characteristics Typifying Adult Learning (Rogers)

Learning is usually episodic rather than continuous;	*The structure of the training program should be such that it takes place in concentrated bursts - train for a week, work with it for 3 weeks, train for a week, work with it for 3 weeks.*
Learning is generally aimed at the solution of immediate specific problems of a concrete rather than theoretical nature;	*At all stages of the training examples relate directly to the situation at hand. Identification of projects (key point of the training) focuses upon impactful issues using specific problems that currently exist.*
Learning is rarely pursued in a systematic way;	*This is more subtle to detect, and may become apparent by observing how participants work towards solving the problems associated with their particular projects.*
Knowledge from many sources is usually used to solve particular problem (not confined to specific discipline areas);	*The emphasis placed upon establishing effective teams is both strong and consistent. A good team is one that represents all layers of personnel associated with the particular process. Successful projects are often associated with effective teams.*
As material is mastered it is applied immediately	*The structure of the training program ensures this will occur using the one week to learn the material and three weeks to apply the knowledge before the next learning episode.*

iii) *Commitment of Company Management:*

Undoubtedly an important factor in the success of such training programs is the degree of commitment shown by senior management. The Bulletin (July 16 1996) quotes Mikel Harry (founder of the Six-Sigma Academy) as saying the "key to the process is a company that is prepared to accept change and devote its entire thinking to quality control at every step of production". The most notable successful programs (GE., Allied Signal) have required this commitment to quality at all levels, and particularly at the senior levels. Dransfield, Fisher and Vogel (1999) discuss the need for statistical thinking in helping managers measure, monitor and improve all aspects of organisational performance. They promote a measurement-based approach to improving organisational performance and rue the fact that statisticians and statistical thinking have generally failed to engage the attention of top management on an on-going basis.

Total Quality Management: The structure of a genuine Six Sigma training program is such that it brings together the essential elements of total quality management, which according to Oakland (1993) and Caulcutt (1995), include *commitment, culture, communication and co-operation.* A slight modification of Oakland's model of total quality management is shown in Figure 2 below.

The ***Process*** at the centre of Oakland's model (Figure 2 below) links together complex chains of customers and suppliers. Successful training programs emphasise this and in particular continually stress the importance of appreciating and understanding the concept of the *internal customer*. Deming himself placed a great emphasis upon cooperation, and Caulcutt (1995) argues that the health of a company culture can be measured by the extent of cooperation that exists. Whether it be between departments or between people at different levels, both are indicative of an open culture with a true customer focus, claims Caulcutt (1995).

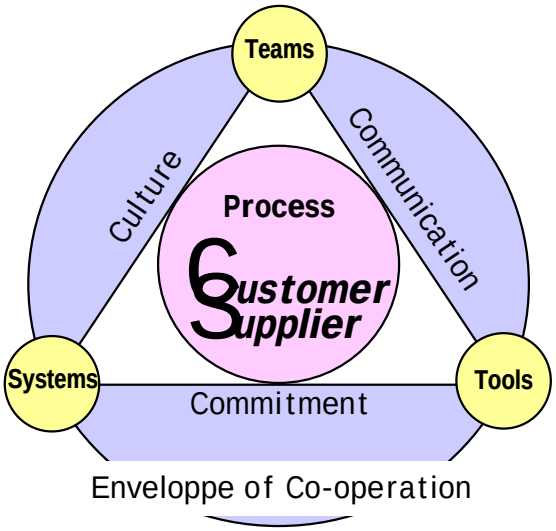

Figure 2: Model of Total Quality Management (After Oakland)

iv) *Program Participants:*

Six Sigma failure can be as disastrous as Six Sigma achievement is successful. The right people need to be chosen if the program is to succeed. Champions need to be selected by the Executive group and both Executives and Champions should undergo some form of training. A recent article on Six Sigma training in the Wall Street Journal claimed that upper management need to know enough to understand what the black belts are talking about. Project selection should be overseen by the Champions and vetted by the Executive. The Blackbelts themselves should represent the "best of the best" and be selected by the Champions and vetted by the Executive. The same Wall Street Journal article claimed that candidates need to be grounded in mathematics, statistics, data analysis, finance and computer skills, as well as interpersonal skills including team building, consulting and negotiating.

Each deployment should be pre-empted by a strong feeling of *anticipation* that this is something very special, and significant, and that it will work. Senior financial personnel need to be involved in project tracking and verification as they must endorse the financial impact of any project. According to A.B. Godfrey, chairman and CEO of the Juran Institute, "There is a heavy emphasis on measurement sciences, business analysis and achieving measurable bottom-line results".

A successful program requires the participants from every level to be innovative and to take up a "critical catalytic role in the process of discovery and development" (Box, 1996).

Providing an Integrated Approach:

The University of Ballarat (both TAFE and Higher Education sectors), in conjunction with personnel from Bendix Mintex (Ballarat) have developed a modularised training program that enables the combining of Six Sigma type training with accredited academic qualifications at both undergraduate and post graduate levels. The modular approach enables specific skill training to build into nationally recognised qualifications.

The Basic Certificate in Process Management is a Certificate III Award offered by the University of Ballarat TAFE division, requiring attendance at, and satisfactory completion of 5 training modules including Process Characterisation, Basic Statistics, Measurement Analysis, Capability and Control Charts. Training may be conducted by approved staff from Industry, and/or the University of Ballarat.

The Advanced Certificate in Process Management is a Certificate IV Award and requires attendance at, and satisfactory completion of a further 5 training modules involving Multi-Vari Studies, Statistical Inference and Experimental Design. Training is conducted by staff from the University of Ballarat.

The above two awards together are considered to be equivalent to what is known as Green Belt training, and involve around 40 hours of face-to-face instruction. Participants are expected to spend considerably more hours on reading, set assignments and project work directly related to their area of direct employment. Experience has shown that each participant should have an identified project before commencing training. Project selection and administration is the responsibility of the Industry concerned.

At the post graduate level *The Graduate Certificate of Statistical Process Management* may be awarded to those who successfully complete a Six Sigma Black Belt training program approved by the University. This award essentially comprises three units that dovetail into a standard Six Sigma program, and a fourth unit comprising a formal written report of the Black Belt project selected. Each Black Belt is appraised by staff from the University in conjunction with appropriate Six Sigma trainers and representatives from the Industry concerned.

Recognition for prior learning may be granted to those who have successfully completed the Certificate III and Certificate IV Awards comprising Green Belt Training as outlined above. In this case such trainees will be required to complete a further unit on experimental design as well as a major project report. It is anticipated that the report would be based upon the Blackbelt project used in the Six Sigma training program.

Conclusion:

As mentioned above, successful implementation of Six sigma programs probably depend upon many factors. I have highlighted those few that I feel are important. Many refer to Six Sigma as a driver for cultural change – from experiential decision making to data-driven decision making; from unquestioned acceptance to relentless questioning and impatience for change. The training model exists and there have been widely acclaimed, impressive results. Six Sigma black-belt training has been equated to 600 hours of commitment per trainee in the Post-Graduate Certificate award offered by the University of Ballarat. This equates to 40 hours per week for 15 weeks, and as such represents a major commitment by employer and employee. The desire to do Six Sigma must come from within. Those involved must be capable and prepared to learn the methods and tools, and be willing to put in many extra hours of practice. Above all they must be allowed to practice with adequate resources and appropriate coaching.

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