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Creative Thinking and OHS Committees in the NSW Construction Industry (1998/99)

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This report is submitted to complete the requirements for the subject EV840 Thesis of the Master of Applied Science (Occupational Health & Safety).

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Declaration:

I declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published (with the exception that a paper about this research has been submitted for consideration to the journal Safety Science) or written by another person nor material which has been accepted for the award of any degree or diploma of the University of Ballarat or other institute of higher learning, except where due acknowledgment is made in the text.

G.F.Ayers

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Abstract

Australian occupational health and safety law is based upon two important principles: firstly that workers are able to participate in the management of health and safety at their workplace; and secondly that workplaces engage in flexible problem-solving processes rather than simply following prescriptive rules and regulations.

In the state of New South Wales, worker participation is achieved by the establishment of joint worker / employer occupational health and safety (OHS) committees that are intended to function as consultative problem-solving forums. While much has been written about the benefits of creative thinking for business, the potential benefits that creative thinking approaches hold for OHS committees has not been widely explored. To test the potential effect of creative thinking on OHS committees, members of two OHS committees from two leading construction companies were trained in a combination of creative thinking and risk control concepts. Subjects were tested in their ability to generate solutions and to prioritise solutions about hazard control options. The trained subjects were compared with untrained subjects from two further OHS committees from the same organisations. The results showed that the trained subjects generated more OHS solutions and showed a greater affiliation towards the safe place philosophy as opposed to the untrained subjects.

Keywords: Occupational Health and Safety, Creative Thinking, Six Thinking Hats, OHS Committees, OHS Training, NSW Construction Industry Training, Problem Solving, Self-Regulation, Hierarchy of Control, Risk Control.

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1. Introduction

1.1 Self Regulation of Occupational Health and Safety

Australian workplace safety law follows the model of self-regulation outlined by the *Robens* investigation in the United Kingdom (Committee on Health and Safety at Work, 1972). It is based upon two important principles derived directly from the Robens model - these are that workers participate in the management of safety (p. 152); and the workplace safety statutes should pivot on a *"...clear statement of the basic principles of safety responsibility"* (p. 153).

The *Occupational Health and Safety Act 1983* (NSW) is an example of an Australian self-regulatory statute. The Act itself goes into little detail regarding specific safety measures, focusing instead on a simple statement of the employer's duty, which is by and large a restatement of the common law duty.

This 'general duty of care' is contained within Section 15 of the Act, and is a mandatory requirement. It states that *"Every employer shall ensure the health, safety and welfare at work of all the employer's employees."* (Occupational Health and Safety Act 1983 [NSW]).

The Act in NSW (like others in Australian occupational health and safety [OHS] law) is centrally a self-regulatory model that centres on this "general duty" statement. Nevertheless, the regulation system in NSW is not entirely self-regulatory. The achievement of attaining the right levels of safety at the workplace relies on a combination of three different types of standards:

1. *Prescriptive standards.* Prescriptive standards define a solution for a given problem. For example, *"Handrails shall be fixed at a height of 1m above the working platforms...and ...supported at points not further apart than 2.4 m"* [*Construction Safety Regulations 1950*, Reg. 154 (a)].

2. *Performance standards.* Performance standards define an end-point to be achieved without specifying the means of achieving that end point. For example, *"...a place of work is unsafe and a risk to health if any person is exposed there to noise levels (a) that exceed an 8-hour noise level equivalent on 85 dB(A)..."*) [*Noise Regulation 1996*, Clause 5].

3. *Process standards.* Process standards specify, usually, a problem-solving model. The most typical problem solving processes are the *risk management process* and the *hierarchy of risk controls* discussed as follows.

1.2 Problem Solving in the Self-Regulation Model

The move from prescriptive requirements to the problem-solving requirement was in part because prescriptive requirements could never be totally comprehensive and could not adapt to change. Prescriptive requirements were seen by the Robens committee as *"...outdated, over-complex and inadequate"* (Committee on Health and Safety at Work, 1972, p. 151). This view prevails today in Australia, with the Industry Commission noting that: *"Requirements that prescribe particular processes impose high compliance costs, stifle innovation, prevent the evolution of best practice and contradict the notion of continuous improvement"* (1995, vol. 2, p. 357).

While the regulations and codes of practice under the Act provide some detail in hazard specific areas, in general they consist of a problem solving process rather than a list of specific solutions for given problems (the draft *Occupational Health and Safety Regulation 2000* also follows this model). The problem solving process on the first level is that of risk management, which relies on the following principles:

1. Hazard identification
2. Risk assessment; and
3. Risk Control.

The second level of problem solving is known as the hierarchy of risk control and is mandated within the risk control stage. The following is an example taken from the recently published *Code of Practice: Formwork* (WorkCover NSW, 1998, pp. 15–16). It is stated that *"The control measures at level 1 give the best results and should be adopted. The measures at the lower levels are less effective and they require more frequent reviews...".*

Example of Hierarchy of Control

***(Code of Practice: Formwork* (WorkCover NSW, 1998, pp. 15–16)**

Eliminate the hazard (for example, discontinue the activity or not use the plant).

Minimise the risk, by:

- *substituting the system of work or plant (with something safer).*
- *modifying the system of work or plant (to make it safer).*
- *isolating the hazard (e.g. introduce restricted work area).*
- *introducing engineering control (e.g. guarding, fencing, safety screens, intermediate-working decks).*

Other controls:

- *adopting administrative controls and safe work practices (e.g. specific training and work instructions).*
- *using personal protective equipment (e.g. safety lines, eye protection, safety helmets).*

The success of the self-regulation model to overcome the problems of prescriptive standards would seem to be predicated on the ability of organisations to be innovative. The self-regulation model requires that employers apply the principles of the hierarchy of controls. To apply the hierarchy, controls that address the hazard source through elimination or substitution must be sought. It is not required that these controls be implemented if they are impracticable, but simply that these controls be sought and explored in the first instance. Culvenor and Else (1997, pp. 190–191) argued that creative thinking was implicit in this process. Their argument was based on the strong parallel between the principles of creative or divergent thinking and the need in safety to "think outside the square".

Taking the hierarchy cited above in the *Code of Practice: Formwork* as an example, the priority is to eliminate the hazards (for example, discontinue the activity or not use the plant). Eliminating hazards is a difficult task, because most of the "hazards" do some worthwhile job, and discontinuing the activity or not using the plant will often seem to be at odds with actually continuing to do whatever work is involved (Culvenor, 1997 b). However this is no excuse to simply ignore the approach.

Creative thinking techniques invariably involve some consideration of "impossibilities" and this it seems is vital in safety if the high-order controls such as elimination or even substitution are to be given a chance. This is the reason that Culvenor and Else (1997) pose for introducing creative problem solving techniques into safety training.

1.3 The Key Concepts of the "Safe Place" Approach

According to Culvenor (1997 a, p.71) "*...the concept of the hierarchy of control is now common and bears a strong relationship to the control at source models, emphasising elimination of the hazard, or passive control as a preference over measures relying on appropriate hazard avoidance behaviour.*"

Sundstom-Frisk (1999) also describes safe place control measures as passive control measures - those that are able to function regardless of the people involved. Passive control measures function regardless of the age, experience, alertness, sex, carefulness or any other factor that the person involved may happen to have or may not have. In other words, passive control measures operate regardless of the capacity and or risk perception of the individual/s.

The safe place philosophy relies upon hazard elimination or controls that do not (unduly) rely upon those individuals who are at risk behaving in an "appropriate" manner (Culvenor 1997 a, p.141).

The alternative approach, that is the safe person approach, is founded on the assumption that the individual can avoid accidents by taking or behaving in the so-called "appropriate" manner. While this approach may still have a certain appeal and varying support (based partly upon the work of Herbert W. Heinrich in the 1930s, 40's and 50's), the safety profession generally supports the concept of the safe place philosophy (Culvenor 1997 a).

In the words of the Industry Commission (1995, p.xx)

> *"...the key to controlling injury and disease at work is to be found in the design and control of the workplace and the activities conducted within it. Only very limited, if any, control is possible by focusing upon the behaviour of those who may be injured."*

1.4 The Role and the Training of the OHS Committee.

In Australia, worker involvement in occupational health and safety is usually brought about by way of health and safety representatives and/or committees. At present in New South Wales, Australia, where this research was conducted, the *Occupational Health and Safety Act 1983* provides for OHS committees but not for representatives. Therefore health and safety committees are the central way that workers participate in OHS decision making. Often the occupational health and safety committee is the sole means of directly involving workers in occupational health and safety at the workplace.

Wyatt and Sinclair (1998, p.92) summarise the statutory role of the OHS committee as

- helping develop OHS policies and programs for the workplace
- monitoring the effectiveness of the workplace OHS program, and
- making recommendations to the employer about protecting the health and safety of people at the workplace.

However it requires knowledge and expertise to take part in this process of managing OHS, and this requires effective training (De Roche, 1993).

It is argued that creativity is a natural partner to self-regulation (Culvenor 1997a, Culvenor and Else 1997, Pardy 1994). While much has been written about the benefits of creative thinking for business, there appears little documented evidence to directly link creative thinking to the effective operations of OHS committees, this is especially so in terms of OHS committees in the NSW construction industry. Existing opinion about the effectiveness of OHS committees' in general varies from poor (Mathews, 1985; Brooks, 1987; 1993) through to generally effective (WorkCover NSW, 1996; Creighton and Rozen, 1997). Such varied views reinforce the need for more comprehensive research to be conducted on OHS committees.

A particular concern raised by Glendon and Booth (1982) was that OHS committees tended to become stagnate and ineffective, with their members becoming despondent and disinterested because of a lack of impact. This view was also reflected by Wyatt and Sinclair (1998) who argued that part of the reason that OHS committees were severely constrained in their effectiveness, was due firstly to poor senior management commitment and participation in the committee, and secondly due to the quality of the training provided for the committee. According to research by Wyatt and Sinclair (1998) it is not only difficult to motivate senior management to sit on OHS committees but also to get them to attend OHS training programs.

Wyatt (1987) earlier argued that OHS committees do not exist in isolation, but rather reflect not only the organisation of which they are part of, but also the training and education they receive.

Given that the primary aim of training courses' for members of OHS committee's is to promote the effective operations of committees and produce effective committee members (CCH, 1998), the training of the OHS committee takes on great importance. Wyatt (1996, p.67) states that the aim of OHS committee training should be to:

> *"... train a group of adult individuals with diverse backgrounds to function as an effective, cohesive OHS committee within a particular working context".*

There are also legal obligations which require members of OHS committees to be provided with accredited OHS committee training as soon as practicable after being elected or appointed to the committee *(Committees in Workplaces Regulation 1984).* However merely having the committee trained because of legal requirements, does not necessarily mean that the OHS committee will make meaningful contributions to the OHS programs at the workplace (Wyatt and Sinclair, 1998). An effective OHS committee should be an active problem solving body (CCH, 1998), but as Filipczak (1997) argued, you need to firstly generate ideas to help solve the problems, and the competence and confidence of individual members of OHS committees to achieve this is dependent upon the quality of the training they receive (Wyatt and Sinclair, 1998, p.94).

With this is mind, this research project was developed.

The project is an extension of Culvenor's work (1997 a) that explored the relationship between creative thinking methods and accident prevention concepts. That research, reported in part by Culvenor & Else (1997), tested the effect of training in creative thinking methods (specifically deBono's (1985) *Six Thinking Hats* method) on OHS problem solving ability. Culvenor's study employed control and experimental groups with various types of subjects. The intervention was tested with a series of problem-based exercises developed specifically for the study. The exercises were used to evaluate the ability to generate solutions to safety problems and rank given safety solutions according to their theoretical effectiveness. The evaluations were also conducted in teams of three.

The training in creative thinking did not include any information about safety and so the study tested the subjects' ability to transfer the general creative thinking skills to the safety problems. The results showed that this transfer was effectively made with trained subjects outperforming untrained subjects by 20 to 150% both individually and in teams. This increase in the number

of solutions was accompanied by no change in the quality of ideas. In terms of prioritising solutions, the study showed a trend that subjects favoured safe place solutions. Although evident, this effect did not seem to be as pronounced as the improvement in the generation of solutions.

In the recommendations following from the research Culvenor stated that:

> *"Creative thinking training proved to have a positive effect on a test of safety design. The research showed a wider transfer of skills than has been shown in many other studies. However taking the transfer of skills to the logical next step, research is indicated to determine the effect of such training in an applied setting"* (1997a, p. 231).

1.5 Aim

The aim of this project was to determine what effect training in creative thinking and risk control concepts had upon members of two OHS committees in the NSW construction industry compared with members of two similar OHS committees who had not undergone such training.

1.6 Objectives

- Define and describe Edward de Bono's Six Thinking Hat technique in creative thinking, and explain why this method was chosen as the "model" of creative thinking for this project.

- Conduct a one-day training session combining both the Edward de Bono Six Thinking Hat technique and risk control concepts for members of two NSW construction industry OHS committees.

- In regards to their ability to both generate and prioritize solutions about hazard control options, compare the members of two OHS committees who participated in the one day training session (experimental group) with members of two similar OHS committees who did not undergo such training (control group) via four hypothetical OHS case studies.

- Subjectively determine if participants of the one-day training session have used, or will use the creative thinking technique in their committee meetings, and whether or not they believed the technique to be beneficial to their OHS committees.

2 Methodology

The project included a review of the relevant literature and legislation regarding creative thinking (in particular the six thinking hats program) and OHS committees (predominantly in the NSW construction industry). Such literature was located using both manual and computerised retrieval search systems at the following institutions:

- University of Ballarat, Victoria;
- Sydney University, NSW;
- University of NSW, Sydney;
- University of Technology, Sydney;
- State Library of NSW, Sydney;
- National Occupational Health and Safety Commission Library, Sydney.

Keywords used in the searches included: *Creative Thinking, Six Thinking Hats, OHS Committees, OHS Training, NSW Construction Industry Training, Problem Solving, Self Regulation, Hierarchy of Control, Risk Control.*

Computerised searches were also conducted using electronic databases including

- AUSTROM

  AGIS: Attorney Generals Information Service
- OHSROM

  NIOSHTIC: National Institute for Occupational Health and Safety US,

  HSELINE: Health and Safety Executive, UK.

  CISDOC: International Labour Organisation.
- ACEL

  OHS Plus - Occupational Health and Safety Index
- ENGINEERING AND APPLIED SCIENCE

  BUILD-Australian Building, Construction and Engineering.

Discussions were also held with personnel with experience in both training and working with OHS committees in the NSW construction industry including WorkCover NSW, the Construction Forestry Mining and Energy Union (NSW Construction Division), COMET Training (NSW), the Master Builders Association (NSW), Australian Industry Group (NSW) and the Civil Contractors Federation (NSW).

2.1 Subjects

Four occupational health and safety (OHS) committees from two major companies in the NSW construction industry participated in the project. Each of the four committees consisted of eight male members. Each committee had equal number of employee and management representatives. All members of all the four OHS committees had previously undertaken the WorkCover NSW accredited OHS Committee Training Course.

Twelve of the 16 members of the two-trained committees attended the training (six from each committee). Of the twelve participants, eight were employee representatives and four were management representatives.

2.2 Intervention Program: Combined Creativity & OHS Training

The main intervention program was a one day creative thinking training session in the Edward de Bono *"Six Thinking Hats"* combined with training on risk control concepts.

Two of the four OHS committees (one from each organisation) were randomly chosen to take part in the one day training session. The training session was conducted by John Culvenor. The six thinking hats (see below) training materials were donated by Advanced Practical Thinking Training (De Moines, Iowa, USA).

2.2.1 Creativity Training Component

The six thinking hat technique was chosen because it is a simple method to use and was a successful intervention in a similar project (Culvenor, 1997a).

Culvenor (1997a, p.99) argued that there needs to be "methods" that are able to provoke thinking out of the "*traditional boundaries*", and to also be sympathetic to what he terms "*seemingly illogical*" ideas. The six hats are able to do this by providing a tangible way of translating intention into performance (de Bono 1985, p 19).

The six hats are not descriptions of thinkers or categories of thinkers. The method is simply designed to create a framework for thinking, thus representing directions to think, rather than placing specific labels on the thinking process.

Each of the coloured hats represents a different element or type of thinking. The neutrality of colour is used to allow the hats to be used without embarrassment and is designed so that thinking becomes a game with defined rules, as opposed to a process of simple exhortation and condemnation (de Bono 1985, p.33). The following is a summary of what each of the coloured hats represents by way of the "thinking process".

The White Hat:

The white hat is primarily used as a way to ask for information; in effect the absence of colour (ie white) symbolises neutrality and objectivity (de Bono 1985, p.53).

The Red Hat:

Emotions and feelings are often dismissed simply because they are illogical, however emotions are, whether we like it or not part of the thinking process, and must be acknowledged as such, because they will not go away. The red hat gives emotions and feelings the right to be heard and expressed. The red hat legitimizes them as important elements of the thinking process (de Bono 1985).

> *If emotions and feelings are not permitted as inputs in the thinking process, they will lurk in the background and affect all the thinking in a hidden way. Emotions, feelings, hunches and intuitions are strong and real. The red hat acknowledges this"* (de Bono 1985, p.56).

The Black Hat:

The "western" method of thinking emphasises the use of argument and criticism (de Bono 1985). While black hat thinking is negative, it is important to note that it is based upon logic and relevance. While facts are provided under the white hat, they are in turn challenged under the black hat (de Bono 1985, p.91).

According to de Bono (1985, p.92) the intention of the black hat is to point out any weakness in an objective manner, rather than simply create doubt. While it is specifically concerned with negative assessment, it should also be seen as an objective attempt to have any negative elements raised and highlighted.

The Yellow Hat:

In contrast to the black hat, the yellow hat is concerned with both the generation and the positive assessment of the proposals (de Bono 1985). de Bono argues that while creativity is

often linked with change, innovation, new ideas and new alternatives, it is also concerned with the effective application of old ideas, and this is an important function of yellow hat thinking; *"effectiveness rather than novelty is what yellow hat thinking is all about"* (de Bono 1985, p.131).

de Bono (1985, p.133) goes on to describe yellow hat thinking as positive and constructive, to be used to explore the value and benefit of ideas and suggestions based upon logical support.

The Green Hat:

Green hat thinking is fundamentally about looking for alternatives. Merely because there may be an adequate way of doing something, does not necessarily mean that there cannot be a better way (de Bono 1985,p.155). The green hat is basically a creative hat.

The Blue Hat;

The blue hat thinker is the one who looks at, or oversees the thinking that is taking place (de Bono 1985, p.187). The blue hat thinker is described by de Bono (p.187) as *"the choreographer who designs the steps..."* and *"... the critic who watches what is happening..."*.

The blue hat thinker is often the chairperson of a meeting, however de Bono is at pains to emphasis that anyone at a meeting can "wear" or exercise a blue hat function. De Bono (1985, p.195) sees the blue hat as the control hat, with the blue hat thinker akin to the conductor of an orchestra.

There is quite a lot of overlap between the hats, and there is no need to be "pedantic" about precise applications and interpretations (de Bono 1985, p.191). The purpose of the technique is to try to unscramble the thinking process, to enable "thinkers" to use one mode at a time, rather than trying to do everything at once. De Bono (1985) insists that the method is designed to switch thinking away from the traditional argumentative style and steer it towards what he calls a mapmaking style of thinking.

In summary, the colours and their corresponding definitions, as defined by de Bono (1985) are shown in Table 1:

Table 1 Six Thinking Hats Definitions

Hat Colour	Definition
White Hat	Neutral and objective, concerned with facts and figures
Red Hat	Gives the emotional view.
Black Hat	Covers the negative aspects: why it can't be done.
Yellow Hat	The positive hat. Covers optimism and positive thinking.
Green Hat	Covers creativity and new ideas.
Blue Hat	Concerned with the control and the organisation of the thinking process.

2.2.2 Risk Control Concepts Component

As well as the creative thinking methods mentioned above the training also included the following topics:

1. the need for creative thinking in health and safety problem solving; and
2. the principles of accident prevention in terms of the control at source model and hierarchy of control model.

The inclusion of safety-specific material was a departure from the methods of Culvenor's study (1997 a) where health and safety theory was purposely excluded from the training. Culveror's study was based on the principle of finding creative solutions to workplace safety by encouraging collective creativity and by liberating blockages to new ideas caused by historic and present practice. That study found that the key to better performance in generating ideas to address particular industry safety problems lay in specific creative thinking training (Culvenor 1997a).

2.3 Limitations:

The most difficult part of any research design is the controlling of other or chance variables that may have some influence upon the project (Bouma 1996). The construction industry is very transient in nature with OHS committee membership constantly changing. Construction industry employees can and/or may be transferred to other construction sites at a day's notice (or whenever their contract of employment has been completed). Merely being elected to an OHS committee does not prevent such "movement" or transfer between sites. Members of OHS committees must simply be employed on the site at which the committee is established (*Committees in Workplaces Regulation 1984*).

This is the main reason why it was important to use only four committees, so as to try and keep the same membership component in terms of the same personal representatives, and minimise the chance of membership changes. However it is acknowledged that the findings may be somewhat limited by the small size of the study (Bouma 1996).

Senior management commitment was another factor that impacted upon the project. Their commitment was important in terms of allowing committee members (and themselves) the time to participate in the one-day training session and the subsequent training evaluation exercises.

The potential influence of the "Hawthorne Effect" (Ivancevich and Matteson, 1993), whereby the committees may inadvertently change their performance due to the unusual amount of attention given to them, was another factor that also required consideration. The six week delay between the training and the evaluation seemed to be the most practical way to account for this potential problem. A delay of any greater time was considered impractical, as a greater time would increase the possibility of changes in committee membership.

Another important factor in relation to the "control groups" and the "experimental groups" involved the issue of potential communication with and between the different committees. The possibility of contact with each other could not be totally ruled out, however given that the two experimental groups were unknown to the control groups, and vice - versa, it was considered highly unlikely that they would come into contact with each other, at least within the given time frame of the data collection process.

The participant's level or degrees of numeracy and literacy also needed to be considered when assessing the results of the case study exercises. Although it was assumed that all members of the four participating OHS committees had a basic level of numeracy and literacy (having previously undergone other types of training), the issues of proficiency and understanding of numeracy and literacy could not be totally discounted or ignored when analysing the data.

2.4 Evaluation

The training was evaluated by comparing the performance of the trained subjects with that of the untrained subjects as per Culvenor's methods (1997a, p.150).

Six weeks after completion of the training, the members of all four committees completed an exercise comprising four hypothetical OHS case studies (briefly outlined in Table 2). The reasons for the delay were twofold:

- to counteract any potential 'Hawthorne Effect'; and

- to give the 'trained' individuals an opportunity to use and/or integrate the six thinking hats in their OHS committee's meetings/operations.

The first two case studies were specifically created for this project and respectively described a noise and chemical issue in a construction industry setting. In response to these case studies, subjects were required to generate as many potential solutions as possible in four minutes for each case study (the time requirement being an arbitrary limitation). The measure of success was the number of solutions generated for each case study, with the hypothesis being that the training would enhance the generation of solutions. A further measure of success was applied by looking at the 'quality' of the solutions in terms of what proportion of the solutions were either "safe place " or "safe person" solutions. Safe place being the preferred option.

The third and fourth case studies were drawn from Culvenor (1997a) and involved plant hazards in a non-construction setting. For both of these case studies there were six potential solutions proposed and subjects were required to rank these in order of effectiveness in the absence of considerations of practicalities such as cost. (A time limit of 3 minutes was allowed for each case study - the time requirement being an arbitrary limitation).

The case studies are shown in Appendix A.

Table 2 Evaluation Case Studies

Case Study	Task	Evaluation Measures
1. **Noise**	Generate solutions	Number of solutions & proportion of safe place solutions.
2. **Chemicals**	Generate solutions	Number of solutions & proportion of safe place solutions.
3. **Plant** [a]	Prioritise solutions	Correlation with optimum rank
4. **Plant** [a]	Prioritise solutions	Correlation with optimum rank

[a] Case study and analysis method from Culvenor (1997a)

2.5 *Data Analysis*

Except in the circumstances noted as follows, the data analysis method follows that described by Culvenor (1997a). In all cases the level of significance adopted was 5 per cent.

Generating Solutions

The number of solutions data are *count* type data ranging from zero upwards on a discrete ratio scale. The data were analysed using independent sample t-tests. One tail tests were used as it was expected that the training intervention would result in an improvement in the generation of ideas as per previous research (Culvenor, 1997a).

Quality of Solutions

The quality of solutions was measured by classifying each solution as either safe place or safe person and then calculating the proportion of safe place solutions. The distinction between these categories is somewhat arbitrary. The classification was standardized according to the list of potential solutions as shown in Appendix A. The hierarchy of control should ideally be used as a tool to guide controls towards a safe place solution (Culvenor 1997a). That is, it should be used to generate solutions rather than to classify solutions. Nevertheless some method was needed to classify the solutions. In thinking about the effectiveness of the hierarchy of control to define the effectiveness of solutions, Culvenor (1997 a, p.75) stated that:

> *"If the minimisation of risk is by a combination of [minimisation of] hazard exposure and the creation of an intrinsically safe, passive or ergonomic hazard control, then the hierarchy can be thought of as a two dimensional construct".*

By using this construct, Culvenor suggested that the safe place philosophy is not a one-dimensional approach as implied by the hierarchy of control, but rather a two dimensional continuum. To illustrate this, he used a Safe Place Matrix (Culvenor 1997 a, p.76) to create the link between the safe place and the safe person approach concentrating on:

1. a reduction in hazard exposure; and
2. improvements to the ergonomics of the hazard control option.

It is within this framework that the many alternative solutions, given by the participants to case studies one and two, were classified into their respective safe place and safe person categories.

The quality of solutions data are *proportions* data ranging from zero to one. The data were analysed using independent samples t-tests. Previous research by Culvenor (1997a) showed no change in quality of solutions following creative thinking training and therefore indicated the use of two-tail tests. However in this case one-tailed tests were used because the training in this case included risk control concepts and it was expected that this training would focus attention on the high-order controls.

Prioritization of Solutions

The prioritisation of solutions data in their raw form were ordinal (a ranking from one to six). The ordinal responses were correlated (Spearman) with a preferred order based upon the hierarchy of control principles in exactly the same manner as per Culvenor's study (1997a). These Spearman correlations were the variables analysed and they range from −1 to +1 on an *interval* scale. The analysis method reported by Culvenor (1997a), where the data was non-normal, was the non-parametric Mann-Whitney U test (this is different than the test as reported by Culvenor & Else (1997) where a parametric test was employed). One-tail tests were used in contrast to Culvenor's study. The reasoning was that the intervention here included training in risk control concepts. Therefore it was hypothesised that the intervention would lead to an improvement on the ability to prioritise solutions according to the hierarchy of control.

3 Results

3.1 Generating Solutions

Table 3 and Figure 1 show an increase of 20-40% in the number of solutions generated by those who undertook the training. The difference was significant for Case Study Two but not for Case Study One.

The indications of a greater number of solutions generated by the trained committee members shows a positive effect of the training in terms of empowering participants to generate and think about a number of alternate solutions to OHS problems. This preliminary result appears initially to be much less than that reported by Culvenor (1997a). The improvements in that study were in the order of 60-150% for undergraduate engineering and technology students but somewhat lower for industry and government safety advisers (20-50%). In that study, subjects experienced in occupational health and safety (industry and government safety advisers) seemed to respond less well to the training than those less well experienced (undergraduate students). And this was not because those experienced in OHS started at a much higher level, in fact there was no difference in the groups at an untrained level. Therefore, an improvement here of 20-40% is in order with the changes found for those subjects in Culvenor's study who were experienced in occupational health and safety.

Furthermore, the results here are even more noteworthy when considering that the subjects in Culvenor's study were evaluated immediately following the training and the subjects in this project were evaluated approximately six weeks after the training.

Table 3 Number of Solutions Generated by Individual Members of Trained and Untrained Committees

Case Study	Untrained			Trained			t-test	
	N	Mean	SD	N	Mean	SD	T	P (one tail)
One	12	4.33	1.83	12	5.2	1.75	1.14	0.133
Two	12	3.58	1.08	12	4.92	1.68	-2.31	0.015

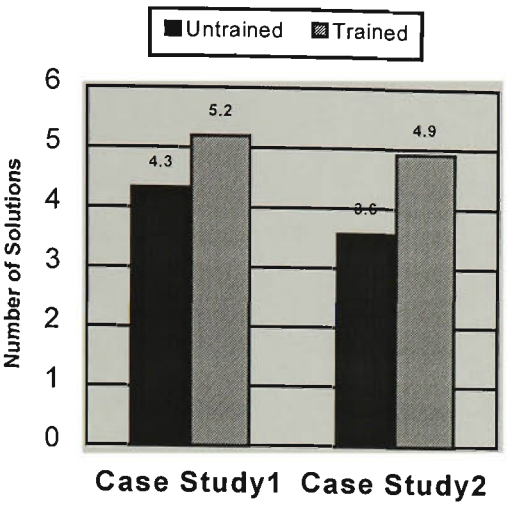

Figure 1 Number of Solutions Generated by Individual Members of Trained and Untrained Committees

3.2 Quality of Solutions

As shown in Table 4, the data indicate no significant difference in the quality of ideas between the trained and untrained group. Therefore the increase in the number of solutions noted above was made up of increases in ideas of both safe-place and safe-person nature which is in accordance with the results obtained by Culvenor (1997a) and Culvenor & Else (1997). However, in this case an improvement was expected due to the inclusion of risk control concepts information in the training. It appears as though this training did not focus the trend of solution generation toward the higher-order controls. The rationale explanation for this is perhaps beyond the scope of this project, however the following points are worthy of consideration:

- the restricted time frame of the training (one day) not being sufficient to allow a more comprehensive grasp of the fundamentals of the higher order control principles; and
- the proportions of good solutions were reasonably high in any case (~50-70%) and given we expect a range of solutions to any problem then there was not necessarily a great deal of room for improvement.

Table 4 Quality of Solutions Generated by Individual Members of Trained and Untrained Committees

Case Study	**Untrained**			**Trained**			**t-test**	
	N	Mean	SD	N	Mean	SD	T	P (two tail)
One	12	68%	13%	12	72%	16%	-.666	.256
Two	12	48%	11%	12	52%	20%	-.644	.263

3.3 Making Decisions about Risk Control

As shown in Table 5 and Figure 2 (page 27) the data reveal an encouraging trend insofar as the trained participants appear to show a greater understanding of the higher order control principles as opposed to the untrained participants. In Figure 2, the negative scores indicate solutions that are focused more upon a safe person approach (ie. solutions that are at the lower end of the hierarchy of control or lower order solutions such as PPE or behavioural solutions).
Conversely, the positive scores allocate solutions that are focused more upon the safe place approach (ie. solutions that are directed more towards the higher end of the hierarchy of controls or higher order solutions such as design and engineering solutions).

The trained participants seemed to score better, with their answers generally focusing more upon higher order control solutions as compared to the untrained participants; especially on Case Study Three where the difference was significant ($p=0.002$) - thereby showing a preference by the trained participants for safe place solutions. However this was not the case in Case Study Four, where there was no significant difference between the trained and untrained groups.

While the results were not outstanding in terms of any major paradigm shift, it was encouraging to see a trend that those who undertook the training began to show a greater appreciation towards the safe place philosophy that underpins the legislative approach to occupational health and safety in NSW.

In their report on *Health and Safety Representative Training in South Australia*, Culvenor et al. (1996) used the same method including the same case studies as was used in this project for Case Studies Three and Four. As well as comparing four levels of training by survey, they tested groups of participants undergoing basic level training before and after the training. Before the training, the mean scores of approximately 50 untrained health and safety representatives in three groups were -0.50 and -0.57 on the two case studies used in this research. Immediately following the training the mean scores had improved to -0.29 and -0.34 respectively. However, this effect was not sustained as shown by the survey where respondents who had completed basic training scored the same as respondents who had completed no training.

Therefore the untrained scores in this research are similar to the untrained scores of untrained health and safety representatives in South Australia (Culvenor et al., 1996). The post-training scores noted here seem somewhat better and this might be explained by the greater focus on the hierarchy of control issues in this research compared with the broader five-day health and safety

representative training in South Australia. Interestingly though, the improvement noted here was obtained with a test approximately six weeks after the training whereas as mentioned above, the immediate effect recorded in South Australian study did not seem to be sustained over time.

Table 5 Correlation of Ranking of Solutions by Individual Members of Trained and Untrained Committees

Case Study	Untrained			Trained			Mann-Whitney test	
	N	Mean	SD	N	Mean	SD	U	P (one tail)
Three	12	-.44	.47	12	.17	.44	20.0	0.002
Four	12	-.46	.57	12	-.29	.39	46.5	0.143

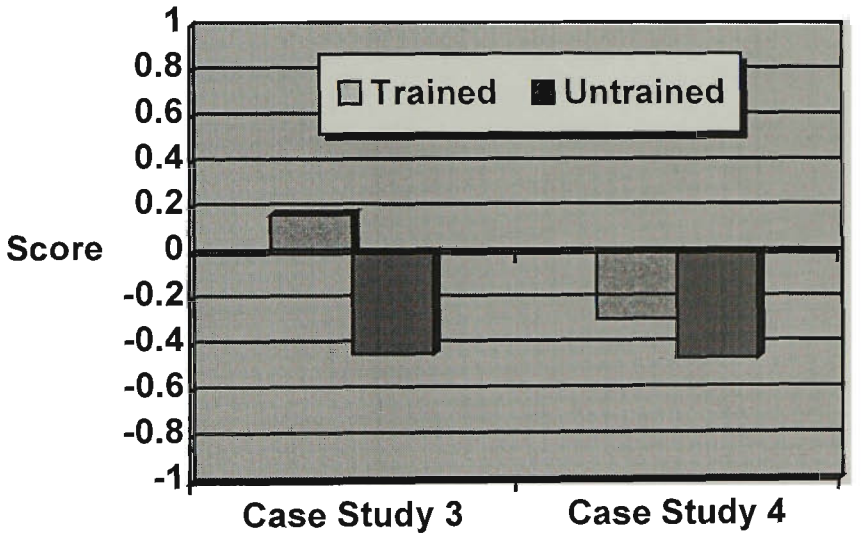

Figure 2 Correlation of Ranking of Solutions by Individual Members of Trained and Untrained Committees

3.4 Perceptions of the Training

The participants of the training were also asked (both individually - via three separate questions attached to their case study exercises, and as a group - via an informal discussion held after completing their case study exercises) about the relevance of the training, and whether their committee had used, or in their opinion were ever be likely to use the six thinking hats technique in their committee meetings.

The majority of the participants indicated that while they had not yet been able to fully implement the technique in their OHS committee meetings, they were still hopeful of using the six thinking hats process in a more comprehensive manner in future meetings. While their answers did not represent a scientific profile of the perceived benefits of the training as such, their enthusiastic comments on the six thinking hats and risk control concepts reflected an energy and ebullience that so far, has arguably been absent from the so called traditional construction industry OHS committee training forums.

4 Discussion

The negative score by the untrained subjects on the prioritisation tasks should not be seen as a great surprise. It has been established via various surveys (Biggins & Phillips, 1991; Gaines & Biggins 1992; ANOP, 1995; 1996; 1998; Culvenor, Cowley & Else, 1996; Holmes, et al., 1997) that the careless worker/blame the worker way of thinking is common in Australia. A general belief in worker carelessness is an impediment to the application of higher-order hazard controls. This stereotypical way of thinking locks in a preference for behavioural controls based on the careless worker belief about causation. Therefore the improvement noted where the trained participants of the OHS committees were more likely to favour hazard controls higher on the hierarchy of control indicated their willingness to move toward an approach to hazard control that parallels the intention of NSW workplace safety law.

The positive effect of the training in terms of empowering those participants who underwent the training to generate and think about a large number of alternate solutions to OHS problems (as compared to those individuals who did not participate in the training) was also encouraging when taking into account earlier comments and findings that OHS committee members can easily become despondent, stagnate and ineffective (Glendon and Booth 1982, Wyatt and Sinclair 1998). This is even more encouraging when it is considered that the case studies were not completed until six weeks after the training.

These findings are also consistent with Blisset and McGrath (1984), who defined creativity training models as not only focusing on the enhancement of generating solutions, but also as a means of improving the quality of solutions.

All the participants who took part in the combined six thinking hats and risk control concept training had previously attended accredited OHS committee training. Despite this, the group during the training appeared to appreciate the discussions over risk control concepts and seemed to find these concepts to be useful grounding. This was supported by the data that showed an improvement in the risk control concepts exercises. Accredited OHS committee training covers substantial ground, however much attention is given to the particular legal roles and functions of the committee, as opposed to the principles of risk control, thus it is not surprising that what might otherwise be viewed as "core" material is not well established in the minds of people who have completed committee training. And yet in the self-regulatory model, with a large reliance on process standards, knowledge of these concepts is central and one would think vital to good application of the standards. One could argue that there is a need for greater emphasis of these principles, which is much like the conclusion arrived at with regard health and safety representative training in South Australia (Culvenor et al., 1996).

It was earlier referenced that not all members of the two (randomly selected) committees attended the combined creative thinking and risk control concept-training program. Although it had little impact upon the study itself, it is disappointing when realised that it was senior management representatives from both committees who did not attend. It is worth noting the findings that Wyatt (1996) made in her study of effectiveness and training of OHS committees in NSW. She argued that the training of OHS committees should be seen as an investment in the effectiveness of the committee, and that if the training is blocked and/or attendance by senior management is not forthcoming, management's responsibility to the OHS committee will be questioned. Indeed, Wyatt identified that the effectiveness of OHS committees is heavily dependent upon management style and the extent and nature of the resources invested in the committee. It is important to note that such resources include both the training and the time to participate in it.

5 Conclusion

In terms of the application of creativity skills in safety, Culvenor (1997 a, p. 212) commented that little attention has been paid to creative thinking skills and concluded that creative thinking skills *"... were an effective way to improve the generation of solutions to safety problems"*. This project extended Culvenor's study and the results indicate a similarly encouraging outcome.

The combined six thinking hats and risk control concepts training lead to the following outcomes:

- an increase in the generation of solutions to OHS problems; and
- a shift in paradigm toward the safe place concept of risk control.

The improvement in both the generation and prioritization of solutions is important because it indicates that those subjects who undertook the training:

1. considered "solutions" to OHS problems that may otherwise normally be dismissed or rejected; and
2. began to support and appreciate the safe place philosophy.

Although not all members of the two committees who undertook the combined creative thinking and risk control concept-training participated in the training program, this did not affect the study because most of the measures related to individuals. The incomplete training of committee members did however affect the introduction of the six thinking hats technique into the OHS committee and thus impacted upon this part of the evaluation. However, the incomplete training represents a realistic test as one cannot always be assured of complete involvement in any training activity.

It is acknowledged that this project is exploratory because of the small number of subjects. Furthermore, the project is limited in that no assessment of the committees' on-the-job effectiveness was undertaken. However, the results are still encouraging especially considering the favourable comments of the participants.

Taken in the broad context, it does appears that debate should at least commence about the future types of training for OHS committees in the NSW construction industry.

6 Recommendations

Clause 13B (4) of the *Committees in WorkPlaces Regulation 1984 (NSW)*, allows the OHS committee to determine which further and/or refresher training courses its members should attend to assist the committee in the carrying out and exercising of their roles and responsibilities.

- ***Recommended that the combined creative thinking training and risk control concept training be made available to NSW construction industry OHS committees.***

WorkCover NSW (1996) has acknowledged that there is a lack of training in hazard identification and control in OHS committee training.

- ***Recommended that the WorkCover NSW Accredited OHS Committee Training Courses include:***
  - ***I. a more comprehensive section on risk control concepts, and***
  - ***II. a component concentrating on creative thinking problem solving skills.***

WorkCover NSW (1996) has acknowledged that the lack of access and time to attend OHS committee training is a major area of concern. It also appears difficult to motivate senior management to not only sit on OHS committees, but to also get them to attend OHS committee training programs.

- ***Recommended that all senior management OHS committee members be obliged to participate in creative thinking problem solving skills training as referenced in recommendation above.***

Available research on both the effectiveness of OHS committees and the interaction between OHS committees and the use of creative thinking techniques is at best limited.

- ***Recommend that further research be conducted into the use of creative thinking techniques in OHS committees and the resulting impact upon the committees' effectiveness in terms of problem solving ability and performance.***

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Appendix A: Case Studies

Examples of case studies and classifications of solutions (Case Study 1 and Case Study 2), and options of solutions (Case Study 3 and Case Study 4).

A.1 Case Study 1: Noise (Generate Solutions)

Noise is a major hazard at the workplace. To carry out certain aspects of construction work, a mobile compressor is often used. These can be very noisy.

On this particular day, we find a compressor in the middle of about 20 construction workers, working on an unfinished floor of a small multi story building site. The compressor's noise output is about 100dB(A), far in advance of the legal requirement, which are 85dB(A).

Table 6 Classification of Solutions for Case Study 1

Safe-place Solutions	• Use electric tools • Stop compressor • Use electric compressor • Change compressor (less noise) • Set up compressor in another area (using longer hoses) • Build sand barriers/baffles around compressor. • Use acoustic panels around compressor. • Silencer on compressor • Insulate engine compartment • Service compressor to make quiet. • Stagger hours/out of hours work • Rotate workforce • Limit numbers of workers in area • Relocate workers away from compressor
Cut-off Point	
Safe-person Solutions	• Conduct noise monitoring • Isolate area using warning signage • Manage trades in area • Change work methods in area • Personal hearing protection (hearing plugs/muffs).

A.2 Case Study 2: Chemicals (Generate Solutions)

Toxic chemicals/glues are a hazardous part of many construction sites. Dave, a vinyl layer needs to use an extremely toxic epoxy mix to complete his job of finishing the vinyl floor.

While using this mixture on a vinyl floor in a small kitchen, Dave becomes very sick and collapses, and is rushed to hospital.

Dave's company has said that although the mixture is quite toxic, it is the best and most economical product for the job, and besides, they told Dave to use a respirator when using the product.

Table 7 Classification of Solutions for Case Study 2

Safe-place Solutions	• Use alternate floor type • Use another glue/product • Less hazardous epoxy • Isolate employee • Ventilation System • Extraction fans • Shorter shifts • Rotate workforce
Cut-off Point	
Safe-person Solutions	• Train worker in danger/use ppe/ safe work methods (SWM's) • Use of MSDS's • Work in pairs • Use of signage • Increase supervision • Warn other workers • Adhere to SWM's • Prosecute company • Sack worker and supervisor • Masks and breathing apparatus • Use of first aid equipment • Use of Radio/Phone for emergencies

A.3 Case Study 3: Plant (Rank Solutions)

Aircraft fitters inspect aircraft before each flight. To gain access for inspection Jim, an aircraft fitter, stood on a tug. A tug is a flat topped vehicle designed for towing aircraft and luggage trailers, etc. Jim was able to stand on the tug, inspect the aircraft and drive around underneath the aircraft by operating the controls away from the driver's seat.

Jim was moving the tug to a new inspection point when he collided with the aircraft. The collision trapped Jim between the tug and the aircraft fuselage. Jim received multiple fractures to his upper body. Company rules insist tugs are operated only if the driver is seated in the driver's seat.

Options:

- Reduce the height of aircraft landing gear
- Institute an employee incentive scheme promoting safe practices
- Provide a special motorised maintenance trolley
- Provide training to the fitters in safe equipment use
- Increase aircraft component reliability
- Increase supervision to ensure compliance with safety rules

A.4 Case Study 4: Plant (Rank Solutions)

Kelly is a gardener at a metropolitan hospital. Kelly was cleaning a 'gang' mower when she cut her foot. Kelly had seen other gardeners clean the mower by hosing the blades with water while operating them in reverse. Kelly was washing the mower in this way when her left foot touched the moving blades. The blades left deep cuts in her big toe and two adjacent toes.

There had been no verbal or written instruction about how to wash the mower safely. The hospital provides safety boots but Kelly was not wearing them at the time of the accident. Often outdoor workers wear their own shoes claiming that they are more comfortable. The hospital has now developed a code of practice for the safe operation of the gang mowers.

Options:

- Provide training in the new code of practice
- Remind all outdoor staff to wear safety boots
- Use sheep to graze the grass
- Purchase a self cleaning mower
- Re-sow the grass with a slower growing native variety
- Provide training away from the workplace in hazard recognition and reporting