The Use of Creativity Techniques in OHS Risk Management

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Modern legislation governing the management of occupational health and safety is now often based on what is known as the *performance-based* approach. The performance-based approach mandates a problem-solving process known as risk management. The risk management models revolve around a method of injury prevention known often as the *hierarchy of control*. The first priority in the hierarchy is *elimination* of the hazard, while the least preferred methods rely on behavioural approaches or personal protective equipment. The high-order controls on the hierarchy require a rethinking of the system to make the workplace intrinsically safe. However, in practice, the implementation of this kind of thinking is conceptually very difficult. This paper explores these issues and suggests that the techniques of creative thinking have a logical and worthwhile role in the performance-based risk management model.

Introduction: Performance-Based Risk Management

The potential for accidents and ill-health is a continuing industrial problem. In the past, legislation governing the management of safety has been prescriptive in nature. That is, the requirements for workplace safety were specific. They indicated what to do about specific workplace problems. Given the wide range of circumstances found in modern workplaces, prescriptive legislation can be complex. In addition to this complexity, prescriptive legislation is sometimes seen to restrict the development of alternative ways to manage risk. There is now a move away from the prescriptive approach. In contrast modern legislation tends to be performance-based. The performance-based approach mandates not exactly what to do about a problem; but rather stipulates a problem-solving process known as *risk management*. Typically the risk management process involves the following steps.

1. Hazard identification (what is the problem)
2. Risk assessment (how big is the problem)
3. Risk control (what to do about the problem)

The philosophy of this approach is that it empowers those in control of an operation to manage risk in innovative ways rather than be bound by prescribed systems. While the risk management process is interesting in its entirety, in this paper I am concerned about Part 3; *risk control*.

Risk Control: The Hierarchy of Control

The control of safety problems has for some time been based on a methodology known as the *hierarchy of control*. The key to the hierarchy is *control at source*, rather than *control at the person*. The basic model arises most directly to the study of occupational hygiene, where the process was modelled as follows.

hazard source → pathway → person

It had been customary in occupational hygiene to view the source of contamination as the hazard and to regard the control of the problem source as a priority (Hamilton 1929). From this basic philosophy arose a hierarchical model of the priorities for preventative activities (Bloomfield 1936 Table 1; Brandt 1947 Table 1).

Established in occupational hygiene, the concept was extended into the area of injury prevention (NSC 1959; Table 2). This extension was facilitated to some degree by the definition of hazards likely to cause injury in terms of their *energy* type (Gibson 1961; Haddon 1963 Table 2). While the concept of

Table 1. Early Hierarchies for the Prevention of Occupational Diseases

Bloomfield (1936)	Brandt (1947)
1. **Substitution** of a non-toxic material for the toxic one.	1. **Eliminating** the sources of contamination or reducing the amount.
2. Isolation of the harmful process.	2. Prevention of contaminant dispersion.
3. Wet methods in the case of some dusty processes.	3. Protecting the worker.
4. Exhaust ventilation.	
5. Respiratory protection.	

energy analysis became popular, mainly through the work of Johnson (1973; 1980), the use of this model is not universal and many prefer subjective definitions of *hazard*, such as the *potential to cause injury or illness* (HSO 1995). While the exact definition of hazard varies, the importance of *control at source* rather than *control at person* via the hierarchy of control is widely acknowledged. For example, here in Victoria, Australia, *Occupational Health and Safety Act 1985* has as one of its objects:

> . . . *to* ***eliminate, at the source****, risks to the health, safety and welfare of persons at work.* (*Occupational Health and Safety Act 1985, p. 5, emphasis added*)

Focusing on blame

Clearly the elimination of a hazard is the most effective measure in prevention. From this point on, there are other worthwhile options such as to contain the hazard in a way that makes it intrinsically safe. Peripheral issues such as personal protection and safe behaviour are relegated to last resorts. The importance of addressing the sources of the problem is now recognised as the most effective way to improve safety and is emphasised by legislation. These legislative approaches make a clear distinction between controls that eliminate the hazard and those that rely on less effective means. They encourage an examination of the processes involving the hazard before consideration of other options.

The Difficulties with the Hierarchy of Control

Use of the risk control processes as suggested by the new legislation is obstructed by a general misunderstanding of the accident process and a continued popular focus on blame and behavioural features of accidents. Accident prevention specialists have long recognised that the common apportioning of blame to victims has little to do with prevention; for instance:

> . . . *to say that an accident was caused by inattentiveness gives us no clue whatsoever about how we could have prevented it* (*Chapanis 1965, p. 8*)

> *Accidents are due to human failing. This is not untrue, merely unhelpful.* (*Kletz 1985, p. 2*)

Table 2. Hierarchies for the Prevention of Occupational Injury

NSC (1959) (Historical)	Haddon (1963) (Historical)	HSO (1995) (Recent Example)
1. Eliminate hazard	1. Prevent marshalling of energy	1. Elimination
2. Minimise hazard source/ prevent release	2. Prevent or modify the release of energy	2. Substitution
3. PPE	3. Remove the man from the vicinity of the energy	3. Engineering controls
	4. Impose a barrier	4. Isolation
		5. Administration
		6. PPE

However, it seems socially and industrially ingrained that faulty human behaviour is the cause of most accidents and that it follows that behavioural prevention strategies are appropriate. This belief will be an obstruction to the development and implementation of high-order controls. A number of studies have shown that the 'careless worker' myth is alive and well (Else and Cowley 1987; Biggins and Phillips 1991; Gaines and Biggins 1992). My own research (1997) indicates that victim-blaming remains a strong feature of the culture surrounding accident analysis and prevention.

A further practical difficulty with employing the hierarchy of control process is that the elimination step is easily by-passed. It's fairly easy to say, *"We can't eliminate this"*, and subsequently adopt one of the least preferred options. The path of least resistance is to move through the hierarchy to lower order strategies. The elimination stage is conceptually very challenging. Usually the hazardous equipment, process, substance, etcetera, was put in place for a good reason and serves some purpose. The ideal of elimination is easily resisted because it challenges the decisions of the past. The ideal of elimination is threatening as it directs the thinking into uncharted water; unfamiliar, and uncomfortable, territory. In summary, there seems to be two main difficulties with achieving high-order risk controls:

1. The obstructing nature of victim-blaming paradigms
2 The challenging nature of the high-order mandates (such as 'elimination')

The first issue is worthy of discussion. However it is not addressed further here. The remainder of the paper is devoted to the challenges to thinking presented by contemporary risk control philosophies and the relationship to creative thinking.

The Relationship to Creative Thinking

The challenging nature of the thinking process of achieving high-order risk control lends itself well to a comparison with the process of creative thinking. The history of inventions is saturated with regularly cited examples of events that diverted thinking from the dominant paradigm of the time. For instance in 1821 Michael Faraday invented the electric motor and made a simple working model, however the invention attracted little interest. Ten years later Faraday invented the electric dynamo without realising its similarity to earlier electric motor. The dynamo became very popular and was used to generate electricity from steam engines. In 1873 a technician mistakenly connected a second dynamo to one already being driven by a steam engine. The second dynamo sprung into life and the electric motor was reborn; fifty years after its invention!

In hindsight it was obvious that the motor and the dynamo were the reverse of each other but this was not obvious before, even to the inventor. The diversion in this case was provided by chance, but once provided the logic of the discovery was obvious. There are many instances of chance diversion providing valuable new ideas.

Role of chance diversion

- Faraday's dynamo was mistakenly joined to another.
- Fleming happened across penicillin by observing mould on a culture plate.
- Archimedes' discovery of the theory of displacement is attributed to some time spent in the bath.

These famous examples indicate a process in creative thinking.

1. Involvement and understanding in an area of study.
2. An event that diverts thinking.
3. An effort to make sense of the diversion.

While being involved in an area of study is straight-forward, how do we arrange the diversions in our thinking? When should we resort to climbing into a bath? To inject some certainty into this uncertain process of creative thinking, creative thinking and problem-solving have been the subject of much discussion and research.

The general problem solving process of preparation, illumination, and verification was outlined many years ago (for example Ribot 1906; Wallas 1926). However the processes of getting the illumination, of changing the paradigm, is the difficult part. Even knowing about the importance of changing out of a dominant way of thinking only goes part of the way to actually making it happen. From this need for deliberate techniques for creative thinking, we now have a number of common methods. Many years ago, Ribot (1906), and similarly Spearman (1930), suggested the use of analogies as a way to create links between the operation of one idea that might be applied to another idea. More recently, around the 1950s and 1960s, discussion of ways to provoke thinking became very popular and included the techniques of; *random combinations* (Mednick 1962); *analogy* (Ribot 1906; Gibson and Phillips 1958; Gordon

1961; Koestler 1969); *morphology* (Allen 1962; Zwicky 1969) and the *focusing verbs*, such as *reverse* and *magnify* (Osborn 1948). These techniques remain popular today and are all ways to generate a diversion of thinking from a dominant paradigm. The basic process can be summarised as:

1. Identifying an area of interest
2. Thinking diversion techniques (such as *magnify*)
3. Making sense of this diversion.

This process accords with the earlier outline of many great creative achievements. However, unlike the stories of fortuitous thinking diversions, the process here relies on a deliberate attempt to force our thinking out of the current concept and into a new concept.

This model, now widely discussed in creative thinking closely parallels contemporary risk control philosophies that employ *thinking diversions* such as *elimination.* The purpose of the creative thinking tools is to inject diversions into thinking. However the immediate result is less likely to be enlightenment, and more likely to be nonsense. For instance, *eliminate the hazard* does not suit our thinking; it directs us into an area of unreasonable thinking; it often suggests the seemingly illogical and impossible. However difficult, if dominant paradigms are to be ever shifted there must be some effort to make sense of prompts, such as *eliminate the hazard.* The most fundamental mechanism is that judgement of ideas is deferred during the idea creating period. This principle was most widely promoted via the brainstorming model of Osborn (1948), that has been shown to be a worthwhile way of enhancing creative performance (Meadow and Parnes 1959; Meadow, Parnes and Reese 1959; Parnes and Meadow 1959; Weisskopf-Joelson and Eliseo 1961; Parloff and Hanson 1964; Reese and Parnes 1970; Baer 1988; Szymanski and Harkins 1992). Given the value of deferring judgement, others have suggested simple ways to facilitate the tendency we have toward this way of thinking. For instance, de Bono (1973) suggested that the word *PO* (neither yes nor no) could be a way to signal that an idea is not fully thought out and only intended as a possibility or maybe a stepping stone to a new idea. In a similar vein, Rickards (1988) suggested too often the response to a new idea is *yes, but . . .* The receiver of the idea immediately thinks of why the idea won't work, or is impractical, or too expensive, and so on. He suggested deliberately changing this habit to one of *yes, and . . .* to escape the trap of over zealous judgement. *PO* and *Yes, and . . .* represent ways to better employ the principle of deferring judgement, a long-standing element of effective creative thinking.

The Relationship between Risk Control and Creative Thinking

The creative thinking process in risk control is as follows.

1. Identify the hazard in the system
2. Challenge the current situation (using a diversion such as *eliminate*)
3. Seek ways that the system can then work (explore the idea; defer judgement)

Part one is straightforward and can employ techniques such as energy analysis. Part two however as mentioned above is generally absurd. Therefore part three of the process will not happen. It's difficult to see the sense in eliminating machinery, tools, substances and so on, that were put in place deliberately to do some particular job. This first priority for risk control is likely to be too-quickly overlooked. However if efforts in risk control are to be effective and reliable in reducing risk, and to also achieve simultaneous improvements on other measures, then low-order controls will not do. Only an effort to redesign the system along the lines of high-order controls has the potential to yield benefits like cost saving, or productivity, along with reliable risk control. A practical example of this is the recent change to the design of many exercise cycles.

Case Study in Risk Control: Exercise Cycles

Some time ago the ABC in Australia screened a program about the safety of exercise cycles. The main focus of the television program was the problem of children becoming caught in the moving parts. They investigated a number of exercise cycles and showed how the guarding of the wheel, chain, sprocket and so on, was often inadequate. The program pointed out common guarding problems like:

1. Guards that can be easily removed.
2. Guards that don't cover enough.
3. Guards that fingers can get through.

The relevant Australian Standard, *Australian Standard 4092, Exercise Cycles – Safety Requirements,* makes similar comments. The standard says that statistics show that there have been

injuries to the fingers and hands of young children. The Standard says that injuries mainly involve *'. . . chains and sprockets, flywheel spokes and loading mechanisms, and loading mechanisms associated with solid flywheels'.*

At this point we have identified a problem; that exercise cycles injure children's fingers. To solve the problem, there are two broad approaches that we could follow. The first is the *prescriptive* approach using the Standard; the standard tells us exactly what to do about the problem. The second approach is the *performance-based* approach that doesn't tell us what to do about the cycles but gives us a guide to the process of risk control.

1. *Prescriptive Method of Risk Control*

The prescriptive method relies on *Australian Standard 4092*. On the issue of preventing injuries, the Standard says:

> *Guards shall be provided to protect dangerous parts at all locations which constitute shear, crushing, or drawing-in hazards, giving particular attention to the following:*
> *(a) The flywheel*
> *(b) The drive train*
> *(c) The flywheel loading mechanism. (AS 4092-1993)*

To reduce risk according to the *prescriptive* approach is then simple. Guard the chains, sprockets and flywheels according to AS 4092-1993. This approach seems sensible and is indeed what has been done. Exercise cycles in the stores now would seem to be guarded according to the standard. A salesperson mentioned to me that the extra safety had a drawback; higher price. Maybe safety comes with a price tag?

2. *The Performance-Based Method of Risk Control*

Consider the *hierarchy of control* model and the first priority is the elimination of the hazard. The process of improving the safety of exercise cycles could then be as follows:

1. Hazard (*potential to cause injury*): Moving Parts
2. First Priority: Eliminate Moving Parts
3. *PO*: Exercise cycles have no moving parts
4. Risk Control: Redesign the exercise cycle eliminating the wheel, chain and sprockets.
5. Outcome: Simpler, lighter, cheaper and inherently safer exercise machine.

Performance-based risk control

In hindsight this is completely logical. The wheel serves no purpose. The necessary resistance could be built into the pedal crank. This machine would seem to have potential to be cheaper and *inherently safer*. This example shows the power of adopting the performance based risk-control processes. The focus on high-order *elimination* control yielded improved safety along with simultaneous benefits such as cost savings. This contrasts with the guarding options that lead to increased costs (Figure 1).

Conclusion: Risk Control and Productivity Improvement

Better safety will always be a financial burden if the risk control measures lie near the lower-order priorities such as personal protective equipment, or even machine guarding. While the performance-based risk management legislation encourage the elimination of hazards and other higher-order controls, the imperative for implementing these controls

Safety with a price tag

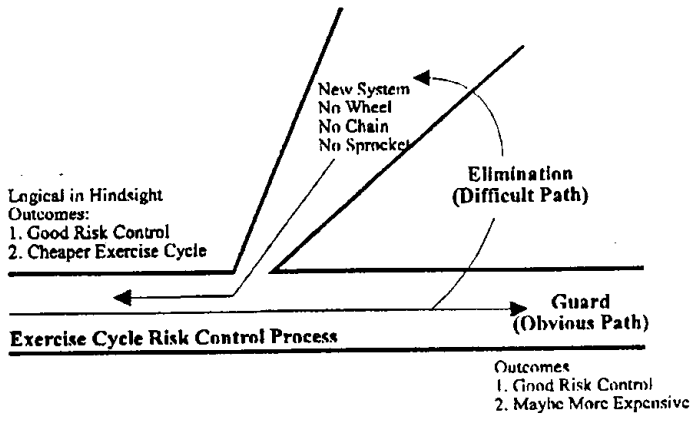

Figure 1. Lateral Thinking and Exercise Cycle Safety (model from: de Bono 1973)

arises not only from the legislation but from the opportunity for synchronous improvements in other areas, such as productivity increases or cost reductions.

There are two major obstacles to managers making use of the ideals of performance based risk control. The first is the difficulty of the popular attention given to victim blaming in the analysis of accidents. I've not explored this in detail here but it is a situation that will obstruct higher-order risk controls from the outset of the process, and one worthy of treatment in much greater detail.

The second problem is the psychological and social difficulty of the *thinking diversions* built into the hierarchy of control model. The redesign process suggested by the performance based approach is confronting and difficult to achieve. Immediately ideas suggested by the process, like *elimination*, don't make any sense. They suggest eliminating a feature that is in place around for a very good reason, something that's been put in place deliberately. Suggesting that a procedure, or a piece of equipment, or a process, be eliminated is absurd and tends to be insulting to those responsible for putting those processes in place. This difficulty is one of breaking paradigms. There is a large body of knowledge and techniques in creative thinking that address this issue. Breaking paradigms had been a major purpose of creative thinking techniques for some time. It follows then that many of the tools for creative thinking are useful in the management of risk. Employing the process of creative thinking won't guarantee a great success. However *not* going through the process guarantees a mediocre result. The only safety measures that cease to make safety a burden is those that examine the operation of the system; add-ons like personal protection only serve to increase costs. Use of the performance based approaches with an understanding of the techniques of creative thinking have the potential to improve risk control and simultaneously improve other goals like productivity.

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