Lateral Thinking and

Performance-Based Risk Control

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Performance-Based Risk Management

The Victorian *Occupational Health and Safety (Plant) Regulations 1995* are an example of what is known as performance-based legislation. The Regulations require those involved in plant (such as designers, employers, etcetera) to undertake a process of risk management. In general the Regulations require risk to be managed by a process of hazard identification, risk assessment and risk control. The philosophy of this approach is that it empowers those in control of plant to manage risk in innovative ways rather than be bound by prescribed systems. In this paper I am concerned about the *risk control* phase of the risk management process.

The Risk Control Phase

The Plant Regulations emphasise the elimination of risk associated with plant. If it is not practicable to eliminate the risk, then the risk must be reduced as far as practicable. The regulations define risk and hazard as follows.

- ***risk*** *means the likelihood of injury or illness arising from exposure to any hazard.*
- ***hazard*** *means the potential to cause injury or illness.*

In terms of reducing risk, beyond the aim of elimination, the Regulations refer to measures such as plant substitution, engineering controls and isolation in preference to administrative controls or personal protective equipment. The Code of Practice for Plant 1995, makes these priorities for risk control much clearer. In order of priority the Code of Practice lists;

1. Elimination
2. Substitution
3. Engineering Controls
4. Isolation
5. Administration
6. Personal Protective Equipment

(Health and Safety Organisation, Victoria 1995)

This philosophy of control is well-accepted in accident prevention and seems to originate in the work of Haddon (1963). Haddon defined hazards in terms of energy sources and suggested a standard hierarchy much like the one above.

1. Prevent marshalling of energy
2. Prevent or modify the release of energy
3. Remove the man from the vicinity of the energy
4. Impose a barrier

(Haddon 1963)

Haddon (1973) later expanded these countermeasures to a ten-point hierarchy that retained the focus on elimination of the source of damaging energy. Haddon's emphasis on controlling the source of the problems is evident in strategies adopted today such as by the new Plant Regulations and Code of Practice. The Regulations and Code of Practice make a clear distinction between controls that eliminate risk and those that rely on less effective means. The difficulty with this process of risk control 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 as usually the hazardous plant 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. A further obstacle to fluent use of the risk control processes suggested by the new legislation is a general misunderstanding of the accident process and a continued focus on blame and behavioural causes. In accident prevention we appreciate comments like; *'...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) and *'Accidents are due to human failing. This is not untrue, merely unhelpful.'* (Kletz 1985, p. 2). 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. I've undertaken some preliminary research in this area. This research revealed a strong acceptance of behavioural controls as the preferred risk control measures among senior managers at a large Australian engineering company. This research is only indicative at best but the indications show that low-order controls would be the most immediately appealing.

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 as the remainder of the paper is devoted to the challenges to thinking presented by contemporary risk control philosophies. The challenging nature of thinking process of achieving higher-order risk control lends itself well to a comparison with the process of lateral thinking.

Lateral Thinking

The term, *lateral thinking,* was coined by Edward de Bono around twenty-five years ago. Lateral thinking is a process to create ideas. De Bono created these methods to assist in moving thinking from a dominant current pattern to a new pattern or new concept; to think *outside the square*. The well-known nine dots problem is an example of the requirement to move thinking out of a boundary. The task is to connect the dots with a continuous line of no more than four straight sections.

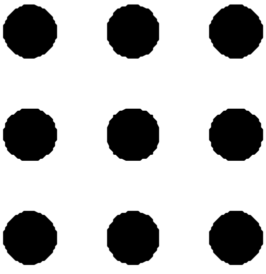

Figure 1. The Nine Dot Problem

The classic solution requires moving outside the 'box'. The nine dots problem becomes much easier once the assumed boundary is broken. (Note there are many other solutions to this problem, including some that only use one line.)

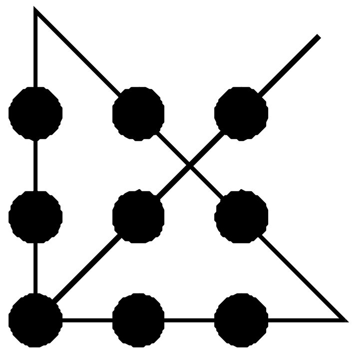

Figure 2. The Classic Nine Dot Solution

This breaking of assumed boundaries, or dominant paradigms, requires something to divert the thinking from the dominant paradigm. 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 in 1831 Faraday invented the electric dynamo, without realising the similarity between the dynamo and his earlier electric motor. The dynamo became very popular and was used to generate electricity from steam engines. In 1873 at an exhibition of improved versions of the dynamo, one of the technicians 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 became obvious that the motor and the dynamo were the reverse of each other but this was not obvious before, even to the inventor! The provocation in this case was provided by chance, but once provided the logic of the discovery was obvious. There are many instances of chance provocation providing valuable new ideas.

- 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.
- Röntgen noticed by chance that a paper screen covered in barium platinocyanide became fluorescent while he had a cathode ray tube operating *inside* a black cardboard box. At the time it was thought no radiation could penetrate this type of

box. Röntgen soon discovered that these rays could also penetrate human flesh and reveal an outline of the skeleton; he named these *X-rays*.

These famous examples indicate a process in creative thinking.

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

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, de Bono (1977) developed the lateral thinking model. Lateral thinking addresses two problems, the problem of how to provide provocations, and secondly how to cope with the challenges of these provocations. To achieve this the main features of lateral thinking are;

1. Provocation techniques like the random word tool and the challenge tool
2. A new word '*PO'*, as a way to facilitate considering possibilities that appear unreasonable; for handling the challenging, unfamiliar and threatening 'uncharted waters' that the provocation techniques provide.

The random word technique connects the problem or main topic area with a random word. The random word is a provocation to create a shift in perception about the problem or topic. However the *challenge* tool is the technique that most closely parallels contemporary risk control philosophies such as the 'elimination' ideal. The purpose of lateral thinking is to inject movement and provocation into thinking. The challenge is the art of challenging anything with the aim of improvement from the current state. It makes no statement about the current state. This is quite different to many problem solving strategies that usually rely on identifying a weakness. The challenge tool of lateral thinking is not bound by this. All that needs to be identified is a focus area and then to challenge any feature of the area of interest.

Lateral thinking is a process to achieve a shift in the dominant thinking. Lateral thinking is not an outcome. In this way, lateral thinking is *performance-based* thinking as it specifies a thinking process. Lateral thinking means to use a technique to drive the thinking out of dominant concepts. However provocation like "eliminate the hazard" does not suit our thinking; it directs us into uncomfortable territory. Provocation also suggests things that appear immediately illogical. PO is a word invented by Dr de Bono to assist the process of lateral thinking and ease the process of navigating the uncharted waters where the provocation techniques have sent our thinking. PO is an alternative to YES and NO. PO is a cue; a way to signal to others that this absurd idea like elimination is just a suggestion to be used as a stepping stone. PO suggests "lets consider this for a while even though it seems like nonsense". PO is a way of exploring ideas without offence and to avoid early criticism. PO allows anyone to signal that an idea is a provocation, not a plan, it's an idea to consider rather than a definite decision. PO is a tool that allows exploration of logic impossibility. It is used as a stepping stone to a new idea or solution.

The general model of the lateral thinking is characterised by de Bono's diagram (1992) (Figure 3.). The lateral thinking model applied to Faraday's experience with the dynamos is shown in Figure 4. The creative leap in the electric motor story was joining the dynamos together by chance and seeing one work as a motor. The theory of why it happened was logical in hindsight.

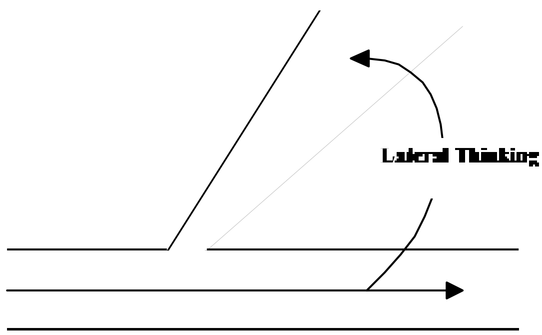

Figure 3. Lateral Thinking (de Bono 1992)

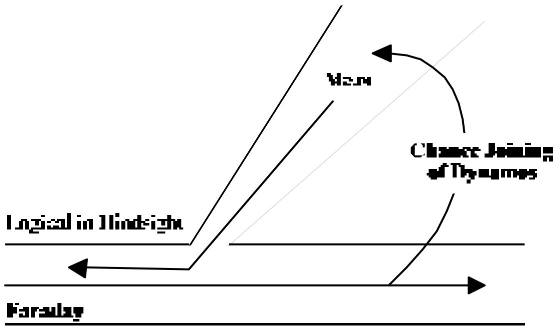

Figure 4. Faraday's 'Chance' Re-invention of the Electric Motor

Like the general model in Figure 3., when travelling along the main path there is no reason to move from the main path to the minor path. However if we do move by chance, or deliberately using lateral thinking, then sometimes the move appears logical in hindsight and we see a new path just as wide and valid as the one we normally travel.

The Relationship between Risk Control and Lateral Thinking

The lateral thinking challenge process in risk control is as follows.

1. Identify the hazard in the system
2. Challenge it's existence (eliminate)
3. Seek ways that the system can then work.

Part three of the process is probably the most difficult and where the ideal of elimination will be likely to fail. 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 (Figure 5.).

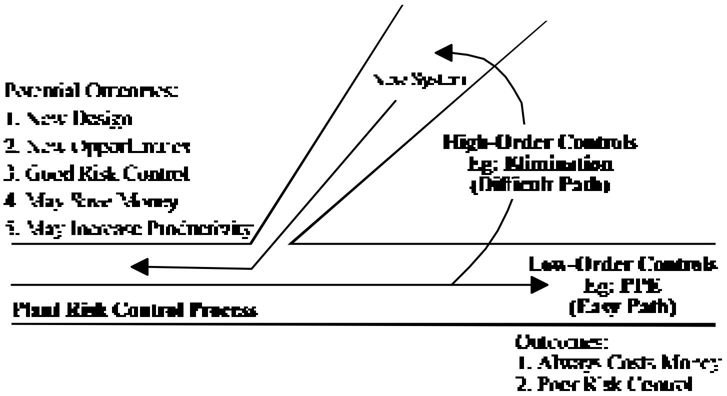

Figure 5. Lateral Thinking and High-Order Risk Control

Case Study Example

Some time ago the ABC screened a program about the safety of exercise cycles. Exercise cycles are not plant, however, the principle of risk control can be effectively illustrated by using an example familiar to most people. 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 though.

The television program is consistent with the approach of *Australian Standard 4092, Exercise Cycles - Safety Requirements*. The Australian Standard says that statistics show that there have been injuries to the fingers and hands of young children. These injuries occur sometimes while the cycle is being used by someone else and sometimes when the child themselves moves the cycle parts. The Standard says that injuries mainly involve *'...chains and sprockets, flywheel spokes and loading mechanisms, and loading mechanisms associated with solid flywheels'*. On this issue of guarding to prevent the 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)

This risk control process for exercise cycles can be summarised as follows;

1. Area of Interest: Exercise Cycle Safety
2. Problem: Injuries to children involving chains, sprockets and flywheels.
3. Solution: Guard the chains, sprockets and flywheels according to AS 4092-1993

However if we consider the process encouraged by the Plant Regulations, and relating this to the process of lateral thinking, we might move in a different direction.

1. Area of Interest: Exercise Cycle Safety
2. Hazard ('*potential to cause injury'* from Plant Regulations): Moving Parts
3. Provocation (from Plant Regulations): Eliminate Moving Parts
4. PO: Exercise cycles have no moving parts
5. Outcome: Redesign the exercise cycle to incorporate the necessary resistance into the pedal crankshaft and eliminate the chains and sprockets.

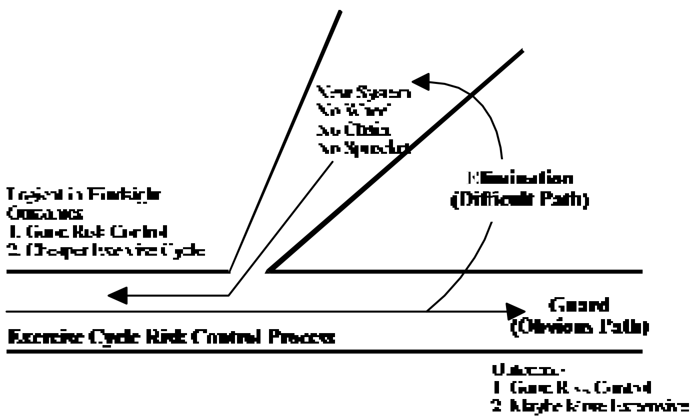

Figure 6. Exercise Cycles

This outcome from adopting the process outlined by the Regulations is completely logical in hindsight and would seem to have potential to lead to a cheaper and inherently safer exercise machine. The focus on high-order controls yielded improved safety along with simultaneous benefits such as cost savings. This contrasts with the lower-order risk control options that increased costs.

Conclusion: Achieving Synchronous Risk Control and Productivity Improvement

Risk control will always be a financial burden if the control measures lie near the lower-order priorities such as personal protective equipment. While the new Plant Regulations encourage elimination of hazards and other higher-order controls, the imperative for implementing these controls arises from the opportunity for synchronous improvements in other areas, such as productivity increases or cost reductions. Risk controls that seek elimination or substitution are provocative by their very nature. They seek to encourage a system-redesign. Within this redesign lies opportunities to generate *safety for free*. However there are two major obstacles to this happening. 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 creative thinking. The process suggested by the Plant Regulations shares a strong relationship with the process of lateral thinking. There are distinct opportunities here to make use of the techniques of lateral thinking to facilitate the process of change and overcome some of the common difficulties of creative thinking.

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