Creating transformational change through innovation in risk management

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Risk Management Research and Practice: An Educational Perspective, Welsh Risk Pool and University of Wales, Bangor, Trearddur Bay Hotel and Conference Centre, Holyhead, Anglesey, UK - March 30th & 31st 2006

1 Abstract

Usually risk management aims to prevent bad things from happening – accidents, diseases, etc. The drivers are often that if the bad things happen, other bad things follow – namely costs, legal problems and moral pain. This is sensible – but limiting. These motivations are not enough to drive excellence. If they were taken away, what motivation would be left? A risk management approach concludes with application of a creative problem solving model. The "hierarchy of control" begins with "eliminate" the hazard and includes other thought provoking creative prompts aimed at encouraging a re-examination of how processes are performed. The direct aim is the improvement of safety. The first priority - "eliminate" the hazard – targets this very issue. Hazards can rarely be eliminated though without some thought given to process transformation. If this is achieved then it is not only safety that can benefit but the process outcomes in general. Application of this creative thinking process strikes some practical hurdles. One of which is victim-blaming. Why bother with process innovation if victims are to blame for their problems and should simply be more careful? Another hurdle is that those who face danger in the workplace are often individual employees, small workgroups or small businesses. They are small cogs in large processes; their sphere of influence is limited. Health care and construction are used as examples to emphasize the value of safety in driving process innovation and the need for leadership and action by those involved in each industry that have a broader sphere of influence such as governments, clients, designers, planners, etc.

2 Introduction

What drives safety? What drives risk management? Usually people respond with three motivations: money; law; and ethics. Does it follow that if compensation costs were eliminated, legal penalties were removed, and we stopped feeling bad if people were injured, there would be no point talking about risk management? This is hypothetical because money, law and ethics are real. But can safety do nothing more than avoid bad outcomes – can it really do nothing useful? This paper explores the role of risk management in driving innovation.

3 Risk management

Australian regulation of occupational health and safety largely mirrors that in the United Kingdom. In each Australian jurisdiction[1] the legislative approach generally follows that adopted in the United Kingdom following the 1972 Robens inquiry. The legislation therefore consists of an enabling statute that restates the common-law general duty of care. The enabling statute is supported by regulations that often follow a hazard theme (noise, manual handling, plant, asbestos, hazardous substances, etc). Advisory codes of practice are a third level in the schemes. Essentially the duty-holders are called upon to address risks with the best practicable solution given the circumstances. A risk management is usually required:

- hazard identification;
- risk assessment; and
- risk control.

This model can be found in statutory regulations and in quasi-regulatory instruments such as national standards. Each of the three steps is accompanied by requirements that set out good practice in how to conduct each step. For instance hazard identification is intended to involve a thorough examination of possible sources of danger. Regulations typically provide checklists of dangers that vary depending on the hazard type (manual handling, plant, etc). Risk assessment often involves the provision of a set of risk factors that should be considered. Finally at the control stage, the hierarchy of control model is usually presented as a problem solving and creative thinking tool.

4 The law promotes creative thinking

A problem solving tool known as the hierarchy of control appears in most occupational health and safety regulations throughout the Australian jurisdictions. The following is a typical example (*Occupational Health and Safety Regulation 2001*, NSW clause 5):

- elimination;
- substitution;
- isolation;
- engineering;
- administration; and lastly
- personal protective equipment.

[1] In Australia occupational health and safety is regulated by the states (Victoria, New South Wales, Queensland, Western Australia, Tasmania, South Australia), territories (Australian Capital Territory, Northern Territory) and by the Commonwealth in relation to its employees. The newly established Australian Safety and Compensation Council (encompassing the previous National Occupational Health and Safety Commission) provides a coordinating role at a national level (non-regulatory) including the development of national standards and codes that facilitate national consistency.

Comfort can be found in low order solutions such as add-on approaches like administrative solutions (rules and procedures) and personal protective equipment. These have no potential to generate anything particularly new or innovative or fundamentally change the work. This kind of solution is a reactive and rule-following approach. They are easy and this is probably appealing. A further appeal is that this kind of "solution" matches up with thinking about accidents that is often unhelpfully focused on the victim and the failures at the very end of the chain rather than the contributing circumstances.

In contrast, high-order solutions present a great opportunity. They demand a high level of thinking, but if applied have the power to drive creative thought and possibly arrive at not only a safer way, but a better way, of achieving a given outcome. This is very much a double-edged sword; on one hand helping to drive creativity; and on the other being too easily brushed aside as far fetched. Innovative thinking in safety therefore requires:

- shifting the victim-blaming model;
- recognizing broader spheres of influence; and
- making a creative effort.

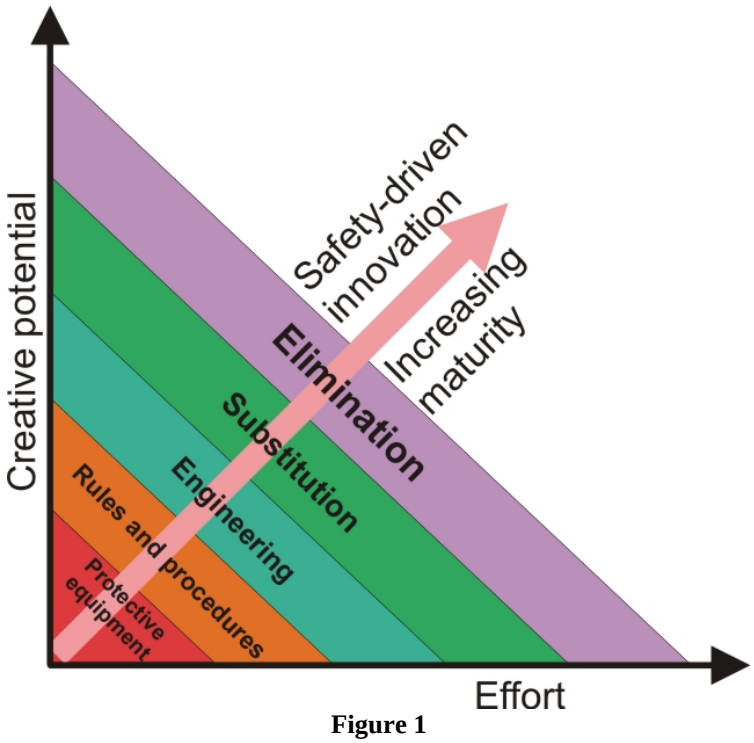

Figure 1

5 Escaping from victim blaming

Victim blaming is a barrier to engaging in high-order thinking- creative thinking. The logic is that if victims are at fault for their injuries, then why bother with system-changing initiatives? On first appearances accidents can be attributed to the mistakes of operators or other people involved at the immediate time. Herbert Heinrich remains a reference today for those seeking to blame victims for accidents. In a review of insurance claims Heinrich arrived at his now well-quoted statistic that 88% of accidents were attributable to unsafe acts (1941). But this limited view places the microscope only on the final links in the chain. Many would argue today that *every* accident is caused by the unsafe acts of somebody - but who had the greatest power to prevent the accident – the victim or someone upstream? It is no surprise that persons most nearby to the accident (often the victim) have the most responsibility attached to them. But it is of little use in changing the situation. The failure to look further back in the lifecycle could stifle efforts to find much more effective upstream solutions:

'Accident statistics compiled by insurance companies on home, street, railway and industry accidents are full of causes such as carelessness, faulty attitude, and inattention. Although labels such as these appear to tell us something, they really don't. Everyone is inattentive at some time or other, and to say that an accident was caused by inattentiveness gives us no clue whatsoever about how we could have prevented it.' (Chapanis 1965, p. 9)

Some schools of thought have blamed victims ever since accidents and diseases have been studied. These views continue in some circles today. If accepted it means that accidents were mostly due to the carelessness in the past and it is still true today. This would imply that radical changes in design (cars for example) were of no purpose. After all, if accidents and disease were the responsibility of the victim's behavior then quite plainly changing the design would serve no purpose. If that was true then it should be possible to rewind all design changes that have occurred since and return to working, driving, and living with the equipment, vehicles, structures, layouts, and substances of the past without any increase in injury or disease. It should be plain that we could not return to those situations without causing large increases in accidents and disease. We could not agree that a return to asbestos construction material, lead paint, spear-like car steering columns, highly flammable children's clothing, and so on could occur without increases in injury and disease. Therefore, despite findings that victim behaviour was the cause of accidents, it has been safe design that has provided our progress.

6 A broader view – spheres of influence

In the understanding of injuries, the physical accident sequence too often is as far as the analysis proceeds and too often as a result the final link in the chain, often the victim, wears most of the blame. This ignores the establishment of the precursor conditions. In 1998 an explosion occurred at the Longford gas plant in Victoria killing two workers. Several other workers were injured, the plant remained on fire for several days and gas supply to most of the state was essentially non-existent for several weeks. A Royal Commission, prosecution under occupational health and safety law, and a coronial inquiry followed. A summary can be found on the Victorian State Coroner's website[2]. In reflecting on the explosion and the development of the circumstances, Hopkins' (2000) proposed several levels to the incident:

1. Physical accident sequence
2. Organisation factors;

[2] www.coronerscourt.vic.gov.au/CA256902000FE154/Lookup/Coronial_Findings_of_Importance/$file/LONGFORD.pdf

3. Company level factors;
4. Government/regulatory factors; and
5. Societal factors.

This model of thinking could apply to most injury circumstances. Another way of capturing this idea would be in a model such as that shown in Figure 2. Individual workers influence a limited area of work. Their workgroup or small business organization influences a little more; and so on.

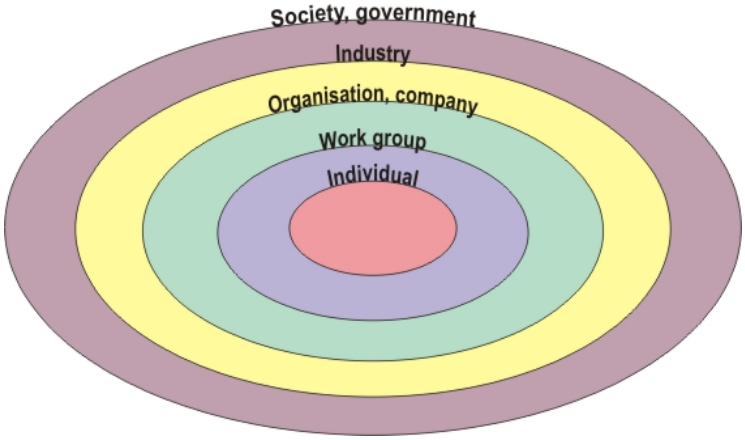

Figure 2 Spheres of influence - generic

7 Creating pathways to innovation through industry maturity

The model can be applied to any industry such as health care or construction (Figure 3). At each level we can expect diligent execution of good practice but too often we expect more. Too often blame is attributed to:

- motorists for car accidents on– and yet they do not influence the driving environment;
- nurses for back injuries – while they have limited capacity to fundamentally change the work;
- workers and small businesses in construction for accidents – and yet they have no control over the design of the construction methods, site organization, etc.

These principles apply to all industries including health care (of central interest to this conference) and others such as construction. Figure 3 shows a way of conceptualizing the relative influence of various decision makers in each industry. While they receive most of the blame, small businesses and workers in health care, construction or other industries, have the least opportunity to influence risk. The focus is disproportionate.

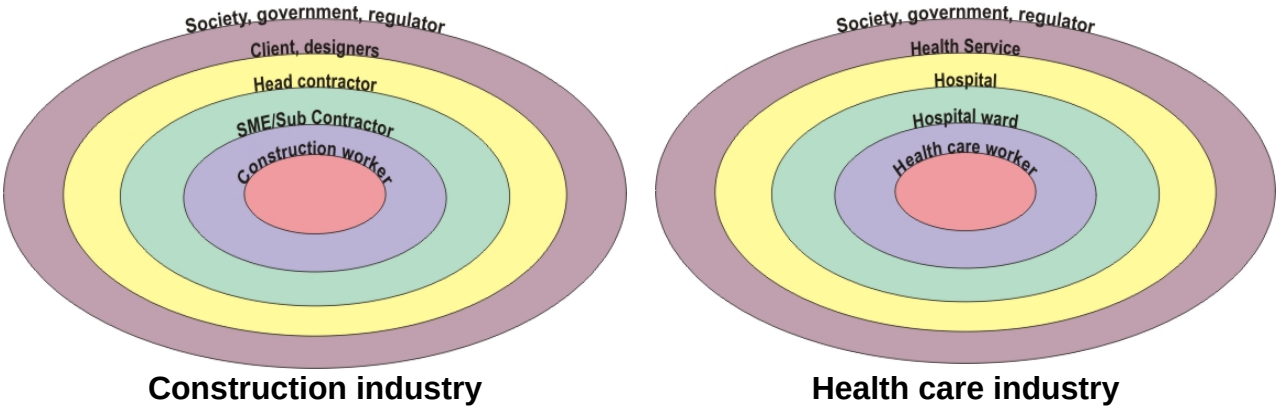

Figure 3 Spheres of influence – industry specific

The steps to creating pathways to innovation could be:

- identify the stakeholders;
- recognize the various spheres of influence;
- identify hazardous work;
- coordinate action to solve problems.

Thus coordinated action is necessary. This could be termed a characteristic of a highly mature industry where those in the larger spheres take safe design action – and seek the input of those throughout the lifecycle including those in the smallest spheres – the people who eventually have to face the risks (e.g. see Westrum 1997) The understanding of safety culture is an emerging science (see Hale 2000) with the five level "maturity model" gaining considerable support as a framework for understanding the development of organisational safety culture (e.g. see Fleming 2001; Hudson 2003). The maturity model provides a conceptual outline for moving safety culture and performance from the transactional level through value added and planned approaches with increasing consistency, integration and commitment to highest level where the generative attributes will be exhibited. These attributes include a fast learning environment and system resilience. Validation studies are emerging. Lawrie, Parker & Hudson (2005a) describe 'a framework for understanding the development of organisational safety culture'. The framework, developed in the oil and gas industry, involves a matrix model consisting of 18 aspects across the 5 maturity levels and a set of descriptors in each cell. Lawrie, Parker and Hudson (2005b) then followed the development of the framework with a pilot survey and validation. Work is being conducted in Australia in a similar vein and Else and Terry (2004) propose a modified model of "organisational resilience" (Figure 4). This approach is the subject of research by Graeme Terrey which will add to the emerging research in the area.

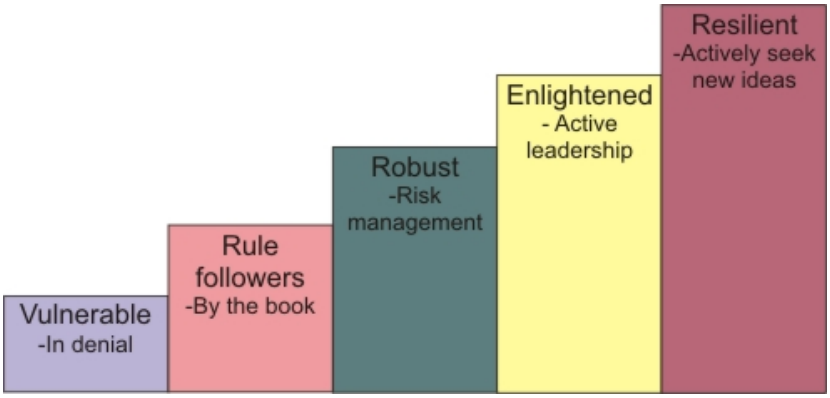

Figure 4 Levels of organisational resilience (adapted from Else & Terrey 2004)

8 Construction industry – example of action in the larger spheres

Construction is one of the most dangerous industries. The *Construction (Design and Management) Regulations 1994* in the United Kingdom are part of a Europe-wide effort to engage stakeholders in the upstream spheres in efforts to improve construction safety – typically these parties are clients, designers, project managers, etc.

European research in construction safety and productivity drew a parallel between the sources of construction fatalities and construction rework. The European Foundation for the Improvement of Living and Working Conditions (1991) summarized research concluding that over half of all construction accidents (63%) and most of structural damage and defects (80%) can be attributed to design and planning decisions. The Commission wrote that *'the [construction] site is where the dysfunctions created "upstream" converge. The accident at work is often the final indicator of dysfunctions revealing weak points in the management and general organisation of the project'*. Figure 5 summarises these data to show the sources of error leading to construction fatalities and rework.

The upstream functions in construction – design, organization and planning – are the sources of most fatalities and most rework. In contrast errors in implementation (e.g. site mistakes) lead to fewer problems. Solving the problem of construction fatalities then will require better upstream thinking – or high order controls. Given that construction defects or rework arise from the same source of error then it would be no surprise if upstream efforts in safety improvement also paid their way in terms of reducing rework. Better safety and better productivity should go hand in hand.

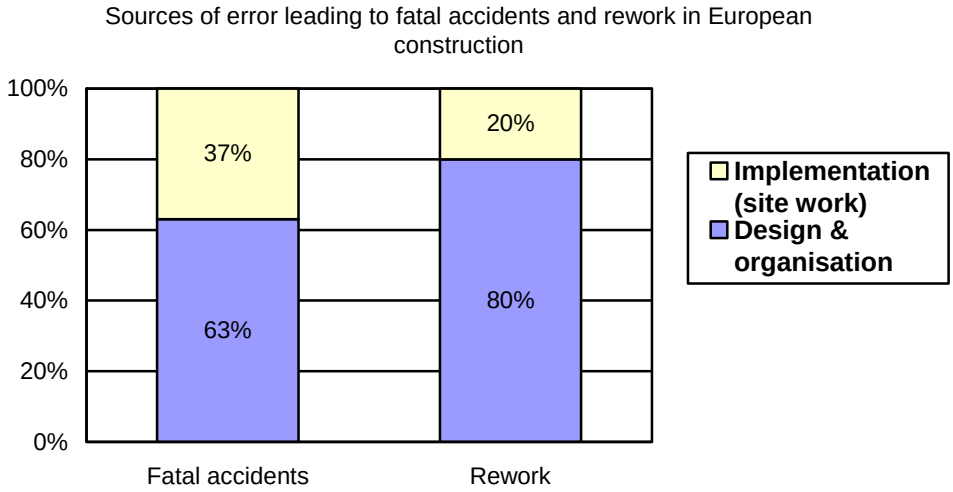

Figure 5 Sources of error in construction fatalities and rework (Source: Figure from Culvenor 2005 using data from: European Foundation for the Improvement of Living and Working Conditions 1991)

A recent case study posted on the Health and Safety Executive website demonstrates that the theme of parallel success in health and safety and project outcomes generally also features in the private sector. Figure 6 shows a chart produced by the UK construction company Taylor Woodrow. The data shows the safety audit scores (Y-scale as a percentage) of 49 projects along with a category rating of how

successful the project was on other measures (green, orange and red). It is evident that good safety and good outcomes occur together.

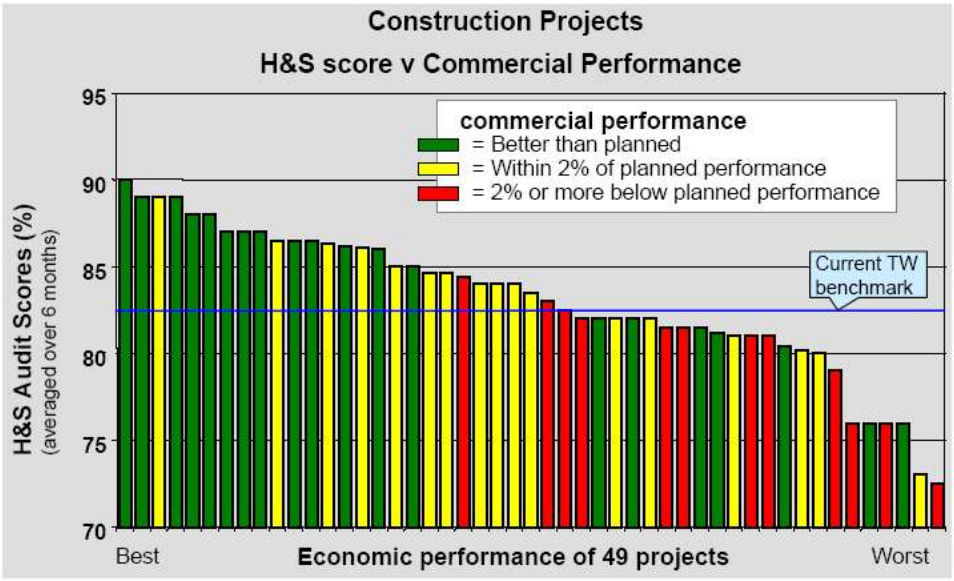

Figure 6 Correlation between health and safety audit scores and project outcomes (HSE c2005-06)

8.1 Large sphere action in UK construction

There are significant "large sphere" interventions in the United Kingdom that are beginning to drive construction safety. Among the initiatives of this kind are "government as client" programs that aim at construction safety. It is significant that the some programs of this type have not been prepared by a safety authority but by agencies such as the Office of Government Commerce (2004). This is evidence that safety is a mainstream construction outcome – not a related problem that must be dealt with separately. The desire for design-driven safety as evidenced by the *Design and Management* Regulations occurred at a similar time to the Office of Government Commerce administered Achieving Excellence initiative (launched in 1999) under which public sector clients commit to efficiency, effectiveness and value for money in the procurement of new works, maintenance and refurbishment. The program appears to be having a significant impact upon health and safety outcomes along with better general outcomes thus providing evidence of the benefit of engagement by those with large sphere influence; a recent (2005) evaluation of its effect in relation to the refurbishment of over 1000 Department of Work and Pensions job centre sites, estimates a saving in terms of injury costs of between £4.0M and £8.5M compared to typical results for construction activity.

8.2 Practical examples – actions by those in outer spheres affecting the inner spheres (workers and small business)

Figure 11 shows four construction examples that illustrate that:

- Decision makers in larger spheres (e.g. project manager, client, designer) affect those in smaller spheres (individual worker, small business); and
- Safety and productivity can go hand in hand.

These are practical interventions.

Who took action: **project manager** Who benefits: **subcontractor safety + project productivity**	**Fall protection for external trades:** Figure 7 shows a full scaffold on a residential project. This developer broke with tradition and purchased scaffold systems that now remain beyond the bricklaying phase of the project. This allows safe and convenient access for other external trades and sometimes even for those fitting security alarms, lighting and television aerials or dishes. The process also saved time from the construction schedule. This improvement to construction safety was put in place by the developer/project manager. The beneficiaries of the decision would be small trade contractors. Those small contractors who benefited were not in a position to put this improvement in place. However good their management system, however competent and conscientious of safety they were, their efforts within their work domain could never going to achieve this outcome.  Figure 7 Scaffolding remains in place beyond bricklaying (Photo © John

	Culvenor)
Who took action: **project manager** Who benefits: **subcontractor safety + project productivity**	**Access to second levels:** This example concerns work programming. Double storey houses are often plastered before the internal stairway is fitted. Achieving a tight fit of the stairway to the plaster is then possible for a neat finish. However this means that a ladder is often used to access the second level. Shown in Figure 8 (left) is a ladder used as access to the second level. The ladder access is far from ideal. Falls are one of the main causes of fatalities and other serious construction injuries. Figure 8 (right) shows a stairway installed in a domestic building prior to plastering. While this makes achieving a neat fit between the plaster and stairs somewhat more difficult to achieve, the upside is for safety as the stairs provide improved access to the upper level (compared to climbing a ladder, passing tools and materials through voids, etc). This enables workers to access and carry equipment and materials in a safer manner. Construction workers such as plasterers, electricians and insulation installers are not in control of construction programming decisions. However they benefit from decisions that are outside their work domain.   Figure 8 Access via a ladder (left) and via stairs (right) (Photos © John Culvenor)
Who took action: **project owner/client/designer** Who benefits: **Subcontractor safety + project productivity + waste reduction**	**Manual handling:** Block walls are used in apartment construction to divide apartments providing fire resistance and noise insulation. The construction of block walls however presents a manual handling hazard. Blocks can weigh 10-15kg. Blocklayers can handle 150-170 blocks per day, many in awkward postures some of which are caused by design of services such as ducting (Ayers and Mackenzie 2003). Ayers and McKenzie recommend a range of safe design solutions including specification of light-weight blocks by engineers and architects and better design of services and work programming. An alternative to making the blocks lighter – is to make them heavier! Figure 9 shows the use of prefabricated wall panels. This approach reduces repetitive manual handling, reduces mess on site through reduced use of mortar, reduces contact with mortar, and provides the strength of a joint less profile from floor to ceiling and reduces installation time. **Productivity and safety achieved jointly!**   Figure 9 Prefabricated wall panel (Photos © John Culvenor)

Who took action: **industry** Who benefits: **Subcontractor safety + project productivity**	**Manual handling and falls:** Figure 10 shows a worker finishing a plaster ceiling with a hand trowel. Work in this area is the topic subject of an ongoing Australian project funded by the Victorian WorkCover Authority led by VIOSH Australia, University of Ballarat. The hand toweling method is the traditional approach. Hand toweling involves: repetitive movement of one arm with the hand raised above the head; the back and neck in extended postures; and working on a trestle involving hazards of stepping up and down and falling from the trestle. The box trowel method removes most of the repetitive arm actions and eliminates the need for the trestle but retains hazards such as; holding one hand above head height; extension of the spine; and introduces the need for a very clear floor space to avoid tripping. The potential for reduced injuries owing to a reduction in trestle use could be a key advantage of the box trowel method, however the evaluation remains ongoing.   Figure 10 Plastering with a hand trowel (left) and box trowel (right) (Photos © John Culvenor)

Figure 11 Construction innovation examples

9 Health care industry – example of action in the larger spheres

The Victorian state government in Australia and public hospitals within the state spent $24M since 1998 to transform patient handling methods in order to drive a step change in nurse injuries: the *Victoria Victorian Nurses Back Injury Prevention Project.* The vision was to eliminate lifting of patients by nurses - an idea transported from the UK and a radical vision given that nursing injuries had been in the "too hard" basket for many years. The approach is perfectly aligned with the “hazard elimination” target set out by the occupational health and safety legislation (e.g. hierarchy of control).
Funding was provided to public health care facilities to initiate and accelerate implementation of nurse back injury prevention programs. The project was overseen jointly by government, union and employer representatives. The safe design of many things is needed to achieve better safety in nursing:

- the workspace including circulation space, overhead fixtures, suitable flooring, etc;
- the equipment including lifting equipment, beds, etc; and
- the work systems including work procedures, training, etc.

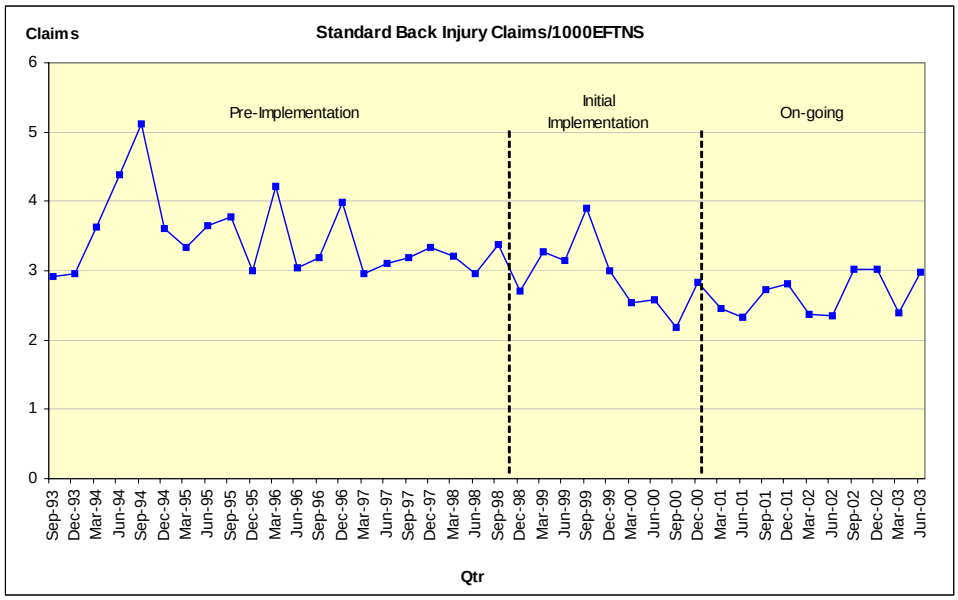

Figure 12 Nurse back injury claims (Martin and others 2004)

To date over $7 million seed funding has been provided with the aim of eliminating or minimizing manual handling required when moving patients (taken to $24M through internal additions by the individual hospitals). The need for good workspaces is known (e.g. WorkCover 1999) although in the case of this project the benefits were achieved through the provision of patient handling aids and equipment, raising the awareness of nurses, and encouraging nurses to be proactive in identifying hazards and reducing risks of injury in the workplace.

The project was evaluated in 2002 (DHS 2002) and more recently the Department of Human Services commissioned a further by University of Ballarat (Martin and others 2004). Figure 12 shows back injury claims over a ten year period (1993-2003). The analysis shows a statistically significant change in injury rates over the intervention period.

The Minister for Health in Victoria in his foreword to the report[3] stated that the evaluation demonstrated:

- 24% reduction in the rate of standard back injury claims by nurses in public health service agencies in Victoria;
- 41% reduction in the rate of working days lost associated with standard back injury claims by nurses in public health service agencies in Victoria;
- the cost savings to Victorian public health service agencies in the post-implementation period (Mar-01 – Jun-03) are estimated to be $6.4M per annum (Jun-03 dollars);
- the mean working days lost per claim was reduced from 100 days per claim in the pre-implementation period to 77 days in the post-implementation period, a reduction of 23%; and
- the assessed achievement of the cost recovery break even point is within five years of the commencement of the program. The reasonable presumption that there will be ongoing financial benefits and the acknowledged fact that there are many additional unmeasured benefits represents an excellent return on investment.

This program is an example of transformation driven by those with the largest sphere of influences and should represent a sustainable change (e.g. Figure 13). Importantly there will be greater benefits than those noted. No attempt was made to measure possible gains in areas such as patient health benefits and the retention of nurses.

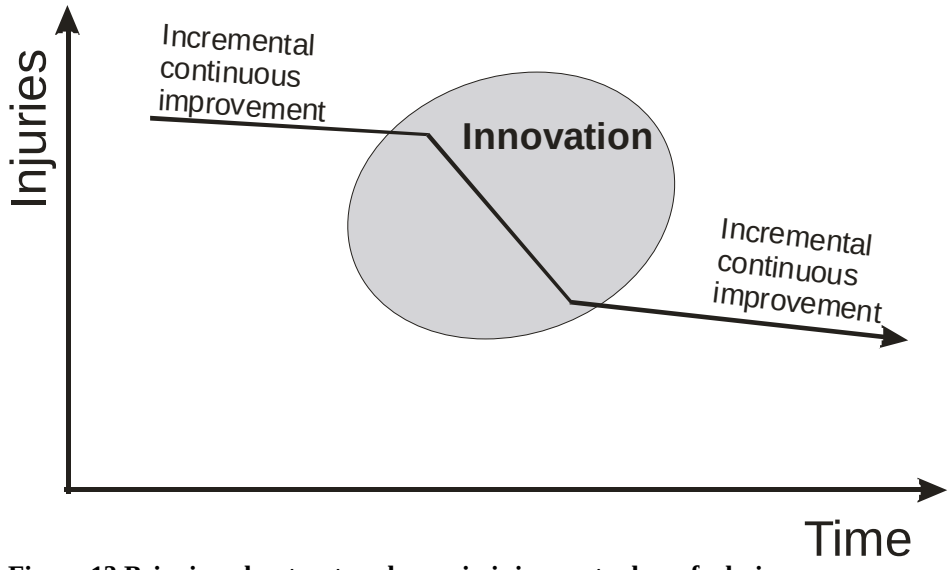

Figure 13 Bringing about a step change in injury rates by safe design

[3] http://www.nursing.vic.gov.au/downloads/vnbipp_report_dec_04.pdf

10 Conclusion: fitting creativity into the organizational maturity model

In Australia and the United Kingdom a risk management approach is a legal requirement for tacking occupational health and safety problems. Importantly the approach encourages creativity through the hierarchy of control model. The creative prompt "eliminate the hazard" is a tremendous conceptual challenge. Suggesting that hazards be eliminated will often appear counter to the purpose of the organization. Further, a tendency toward victim-blaming can steer safety solutions toward low-order interventions. The point of the high-order prompts is to encourage new ideas, because without new ideas, the problems do not fundamentally change and the outcomes both safety and otherwise, are unlikely to change. A significant hurdle in this regard is that in many cases those facing the hazards have a limited opportunity to transform their work – a small bricklaying contractor can't decide independently to use wall panels as the decision about materials was taken by others some time earlier – nurses in a hospital ward can't decide to eliminate manual patient lifting as the equipment, physical spaces, etc are designed by others. The "sphere" of influence of the individual or small business that faces most of the danger is reasonably small. They can not expect to transform how there work is done from within this sphere. High-order solutions require others in the supply chain to be involved. The kind of "step-change" in safety levels seen with safe design initiatives in nursing in Australia can not be achieved by those in the inner spheres – no matter how diligent their action in applying risk management principles. A number of Australian construction examples were discussed where the work of those in the smallest sphere was transformed by efforts of those with larger spheres of influence. In the United Kingdom at present there are a number of notable interventions where, through "government as client" initiatives, large-sphere stakeholders are engaging in the drive for improved safety. Perhaps the effects are only beginning to take shape but these actions represent a highly mature approach (Figure 14) to solving the problems of diseases and injuries in construction. A useful parallel may be drawn to health care or any industry and valuable lessons can probably be learnt.

In summary high-order safety efforts:

- **are about more than reducing risks – it is about transformational improvements in processes;**
- **can improve safety and other productive outcomes in parallel;**
- **aim at a step-change in exposure to hazards and consequently disease and injury outcomes;**
- **require creative skills;**
- **demand a break from victim-blaming;**
- **focus upstream in the lifecycle; and**
- **require leadership, engagement and action by stakeholders with broader spheres of influence**

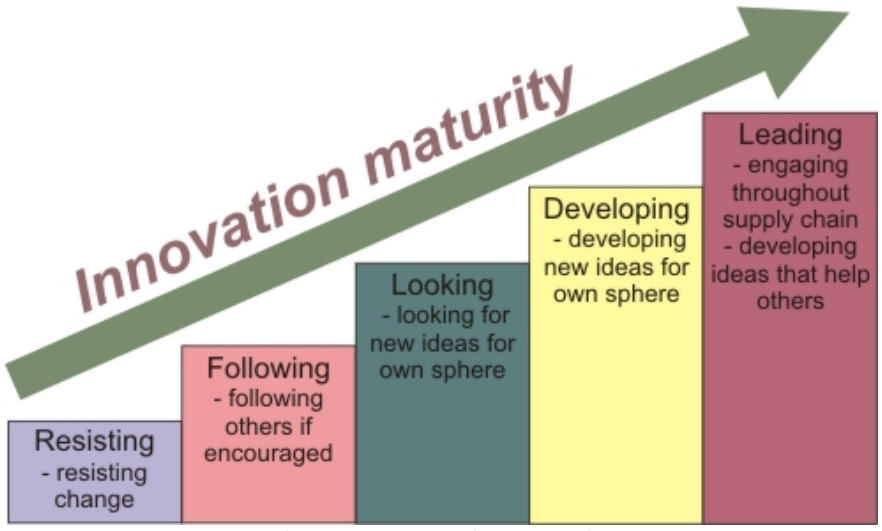

Figure 14 Innovation maturity

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