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RISK CONTROL SYSTEMS IN ROAD SAFETY - RELEVANT APPLICATIONS FOR THE PREVENTION OF OCCUPATIONAL TRAUMA

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Abstract - At a broad level the key elements of successful injury prevention strategies could be considered as universal, irrespective of the area of interest - be it unintentional or intentional injury. Therefore there can be significant value in comparison between various seemingly unrelated injury areas. This paper considers the key elements of the successful programs developed in road safety and proposes that in comparison, many OH&S programs do not have the necessary ingredients for successful outcomes. By assimilating the lessons learnt in Road Safety, OH&S programs would have significantly increased effectiveness and improved outcomes.

INTRODUCTION

In terms of injury prevention in the Community, the successful strategies used to achieve the major reduction in the road toll over the last 20 years, provide an important benchmark for comparison with OHS programs.

The common question that immediately arises is how can these quite different environments be usefully compared? The argument put by some experienced OH&S practitioners is that the road system appears to be very uniform in comparison to the diversity of the workplace, and hence comparisons are not useful. However the real question is what can we learn from the successes in road safety and what can be adapted into the work safety environment. Such comparisons highlight significant areas of improvement needed in OH&S prevention strategies.

A UNIFIED INJURY PREVENTION PARADIGM

At a broad level the key elements of successful injury prevention strategies could be considered as universal, irrespective of the area of interest.

This is well presented by Berger and Mohan in their text on "Injury Control - A Global View" (1996). Significantly, Claude Romer[1] in his introduction to this text, notes that though injuries can range from unintentional (sport, domestic, transport, occupational etc); intentional (from suicide to homicide and spouse violence); politically sponsored (civil strife to warfare) or from natural disasters - *the principles of injury analysis and control apply to all injuries.*

In considering a universal prevention paradigm, Haddon's matrix and ten strategies provide a powerful and useful analysis tool. "**Haddon's Matrix**" looks at injuries in three phases and three factors, as set out in the following table:

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[1] Chief, Injury Prevention Program, World Health Organisation

		FACTORS		
		HUMAN	VEHICLE & EQUIPMENT	ENVIRONMENT
PHASES	PRECRASH			
	CRASH			
	POST CRASH			

Berger and Mohan note that "*Any type of injury can be analysed by this model. Furthermore the model can be used for analysing both risk factors and possible interventions*" (1996).

Haddon also presented a systematic view of injury prevention and control by means of his *ten technological strategies*. These ten strategies provide a systematic approach to preventing or controlling the potentially damaging energy[2]. Importantly Berger and Mohan provide examples to show how Haddon's ten strategies can be used to analyse diverse case involving *injury to motor vehicle occupants*, injury *to football players*, and injury *by handguns*.

The second element of a unified injury prevention strategy recognises that injuries arise from a '**causal chain-of-events**'. This chain-of-events encompasses pre-crash, crash and post- crash activities and factors: "*Each link in the chain is a potential point for injury prevention or control*" (ibid, p159). This view is in contrast to the simplistic and more common view that tries to assign single causal factors, often associated with blaming the victim (also see Wigglesworth, 1978).

The third element of a unified injury prevention strategy recognises the **4E's in Injury Control.** Although Berger and Mohan regard Haddon's ten strategies as essentially engineering or technology related, a broader view could readily encompass both behavioural aspects including the need for education and enforcement[3]. Thus the elements of a full injury prevention strategy would encompass:

- Engineering
- Environment
- Education
- Enforcement

Education provides the means to direct behaviour, but in many cases both enforcement of laws and regulations is required to assure compliance. Berger and Mohan note that: "*The most effective regulations are those based on environmental and engineering approaches that have demonstrated value, but which might not be voluntarily implemented because of cost or inconvenience*" (1996).

Thus from the preceding analysis, it is argued that at a strategic level, not only can comparisons of injury prevention programs be made within similar categories (eg. within unintentional: road safety vs work safety) but such comparisons can be usefully made across seemingly unrelated areas (eg. unintentional vs intentional). The key in such comparisons is not to be absorbed and distracted too early by the detail and differences[4], but rather to focus on the successful principles and how these might be able to be *adapted* to the area of interest.

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[2] Injury is the outcome of energy release beyond human tolerance levels

[3] Waller (1994) highlights Haddon's major contributions - "*Haddon's models now serve as a sound scientific basis for CDC activities*"- but he also notes that "*...several authors have focussed as well on understanding the socio-political factors that have either supported or undermined safety efforts*".

[4] In this regard the 'expert' could be at a distinct disadvantage by 'knowing' too much about the area and being too aware of detail differences.

WHAT HAVE WE LEARNT THAT WORKS IN ROAD SAFETY?

The major features of effective road safety strategies have been:

1. A scientific approach, using a strong research base to underpin incident and injury reduction activities
2. A strategic perspective with use of combined agency resources in concert, focussing on identified priority areas
3. Address each key aspect of the incident/ injury causal chain

In an analysis of the reduction of the Victorian Road fatalities from 776 in 1989 to 378 in 1994 by Vulcan et al (1995) attributed a significant proportion of this reduction to two major road safety programs *random breath testing* (RBT) program and the *speed camera* program. The RBT program, for example was aimed at reducing drink-driving and involved high levels of enforcement with conspicuous publicity. Increased Police resources including 13 specially designed 'booze buses' were made available, with RBT increasing from 0.5 million in 1989 to over 1.1 million tests carried out in 1991 and 1992. These enforcement activities were supported by a major statewide multi-million dollar publicity campaign "*If you drink then drive - you're a bloody idiot*"), which commenced in December 1989. Vulcan et al conclude that "*..it appears that the major road safety programs combing Police enforcement and mass media publicity have contributed most to the reduction (in 1990-1992)*" and "*..are estimated to have contributed reductions in serious casualty crashes of 26% -29% during these three years*".

It is also instructive to look at Victoria's current Road Safety Strategy for 1995-2000 "Safety First": The main elements are listed in the table below:

Research	♦ To improved the understanding of road crashes ♦ To develop countermeasures ♦ To evaluate effectiveness
Education	♦ To teach children and adults about safe road use through schools and community groups
Enforcement	♦ To deter risky behavior through an integrated system of road laws, penalties and detection methods
Promotion	♦ To make the community more aware of high risk behavior and to highlight and support enforcement efforts
Engineering	♦ To ensure all vehicles are roadworthy and to make new vehicles safer for occupants through better design ♦ To identify and address accident blackspots and enhance the safety of new road projects
Coordination	♦ To ensure all agencies work together in terms of planning, priority setting and actions. ♦ To build on related Victorian and national strategies.

The program then goes on to identify specific **primary** issues and the strategies to address each of these: *drink driving; speeding; fatigue; restraint wearing; road quality; drivers in high risk age groups; motorcycle safety; bicycle and pedestrian safety; heavy vehicle safety; drugs and driving; occupant protection*.

The strategy document notes that "*The approach to these priority issues is underpinned by research and evaluation. Integrated education, enforcement, promotion and engineering strategies will be applied to issues as appropriate. Co-ordination will be a feature of the management of road safety*".

Queensland has recently released its Road Safety Action Plan 1998-1999. Queenslands approach is interesting in a number of aspects. Firstly the Action Plan is developed by "*a range of government departments and other organisations' work closely to devise effective road safety strategies for Queensland.*

Queensland's thorough and consultative approach to road safety has made it a pioneer in this field". It notes that its approach is to apply a suite of integrated measures, with two main thrusts involving engineering measures and methods to achieve behaviour change. The engineering measures include road engineering as well as vehicle engineering for increased vehicle crashworthiness as well as crash avoidance measures. Behaviour change measures '..*typically involve publicity, education and enforcement*'. Importantly the plan notes that '..*research has shown that these measures work better when applied together rather than in isolation*".

It is useful to contemplate, in comparing OH&S activities, what the state of road safety would be without clear specific road rules and the high levels of enforcement. How many people would obey the road rules if the threat of a fine or license loss were not a clear and likely consequence of non-compliance.

In a dramatic development in Road Safety philosophy, Sweden's 'Vision Zero' offers a significant new paradigm for injury prevention (Tingvall, 1998). Tingvall argues that though significant reductions have occurred in the road toll, the toll is still at a level where some 650,000 people are killed per annum, presenting a major public health problem. To achieve a radically safer transport system, a new approach is required - hence 'Vision Zero'. The underlying premise for 'Vision Zero' is that "*no foreseeable accident should be more severe than the tolerance of the human in order not to receive an injury that causes long term health loss*". Adoption of this philosophy, as has occurred in 1997 by the Swedish Parliament, clearly has far reaching ramifications in terms of system design requirements. It moves totally away from the 'blame the victim' viewpoint and explicitly recognises that responsibility for safety is shared by the system designers and the road users. It sets out three principles in this regard, the first of which is:

> '*The designers of the system are ultimately responsible for the design, operation and use of the road transport system and thereby responsible for the level of safety within the entire system*'.

The other important aspect of 'Vision Zero' is that it introduces '*ethical rules*' to guide the system designers. Tingvall sites two examples:

- '*Life and health can never be exchanged for other benefits within the society*'
- '*Whenever someone is killed or seriously injured, necessary steps must be taken to avoid similar events*'.

Vision Zero boldly moves away from the economic- rationalist 'cost-benefit' models which are used widely in many injury prevention arenas, to a humanistic (and more rational!) model. This is indeed, in my opinion, a move which should be much applauded.

A COMPARISON OF THE ROAD SAFETY AND OH&S MODELS

In comparison with the road safety area, it is becomes evident that for OH&S many elements required for an effective injury prevention strategy are either missing or implemented at a low level of activity.

The following table summarises and compares some of the major elements involved in road safety with those active in OH&S:

	ROAD SAFETY		OH&S
Vehicle Design	Mandated Rules for crashworthiness and other safety related criteria. Specific performance criteria; Full enforcement	**Plant design**	Low enforcement, Typically non -specific performance criteria
	Market competition helps product development		Little direct competition- except in opposite direction - reduce cost
	Major research, evaluation and rating programs on vehicle safety (by manufacturers, government agencies, research centres, etc)		Few sustained and well funded programs on work injury prevention research
Road system	Design by Govt. agencies Design standards	**Plant layout**	Few standards design by consultants or 'management'
	major research programs on road performance and safety University courses		Little research relating to safe systems for factories, plants in general
Operator (driver)	licence	**Operators**	no general proficiency requirements
	high & full enforcement, good detection		none or little enforcement, little detection
	-0,05BAC -speed cameras -Booze buses -red light cameras		
	-clear penalties		
	major research projects -Govt. agencies		Some Govt. research
Insurer	TAC ads -Black spot funding -major promotional campaigns school education	**Insurer**	some media some research
Federal Govt. Support	Federal Office of Road Safety -vehicle crashworthiness -research road funding driver research media campaigns		small support from WorkSafe Australia
Enforcement	High - Police/ courts/ culpable driving		Low level
Collaboration/ Networks	High levels of international collaboration		some collaboration

As a further comparison, Hopkins (1995) highlights that for an effective OH&S strategy, it is more effective to hold Management rather than workers responsible for illness and injury in the workplace. This is similar to a key principle in Tingvall's 'Zero Vision' in road safety that the designers are ultimately responsible for the level of safety within the entire system. Hopkins notes that the central question then becomes one of - *how can we best get management to shoulder its responsibility*?

Hopkins concludes that the current economic rationalist thought as applied to OHS fail as an adequate policy on which to base OHS policy. In addition to any economic incentives to mangers constructed through the compensation system (indeed Hopkins notes the inadequacy of this system alone to encourage managers to attend to safety), there remains an important role for government in devising the most appropriate regulations, monitoring compliance with them and prosecuting violators.

EXAMPLES OF APPLICATIONS OF ROAD SAFETY MODELS TO OH&S

To help illustrate some of the actual and potential outcomes from using road safety models and applying these to road safety, the following examples are presented.

(i) Traffic management systems within plants (forklift and other industrial truck safety)

Forklift trucks have often been identified as major contributors to fatal and serious injury incidents in the workplace. Larsson and Rechnitzer (1994) in their study on forklift truck serious incidents identified that one of the key problem areas related to impacts with pedestrians. The study did draw on road safety experience, and identified that that industry and standards failed to categorizes and recognize forklifts as heavy goods vehicles. The consequence is that industrial facilities - be they manufacturing, warehouse or transport terminal, did not (and typically still do not) incorporate in their design and management appropriate traffic management plans. This left the emphasis and onus on forklift drivers to 'be careful', any incident being blamed on the driver's behavior, ignoring fundamental and *inherent* system design deficiencies. In this regard the study recommended the need to:

> *Recognise forklift trucks as a "heavy goods vehicle" which require appropriate facility design for their operation. Develop industry specific models for the layout of new facilities which incorporate the principles of effective traffic management and separation of forklifts, pedestrian and other traffic.*

This also leads to the notion that common guidelines are required for all of industry, setting out model and explicit traffic management requirements to be used in facility design or refurbishment. Using the road safety analogy, leaving such requirements optional or to each individual facility, is somewhat akin to having each road way intersection designed by independent owners.

Other developments in forklift safety have included the ideas of 'crashworthiness', in that the design of the forklift can be modified to reduce severe injury risk should a pedestrian worker be struck. For example BHP has conducted experiments by adding guards to the wheels of forklifts and to the front and rear to cover open wheel surfaces to prevent pedestrians being dragged under the wheels, and to push feet and legs away if struck. Similarly energy absorbing surfaces can be added to these types of vehicles to reduce the injury risk of any impacts with pedestrians workers.

(ii) Enforcement

In the road system, enforcement of road rules plays a key role in maintenance of system integrity. There are clearly designated rule enforcers (the Police) with clearly expressed penalties and consequences for violation. The level of publicity and enforcement on the road is such that pressure on conformance to road rules is significant. In comparison, in OH&S, the generalized Lord Robens style 'duty of care' legislation, though claiming to be *performance* based, in fact provides vague and few actual performance criteria. Enforcement activity is undertaken by the Inspectorate, whose members typically have an inherent conflict in their roles being both advisory and compliance related - the so called 'white hat' 'black hat' dilemma. In addition, the actual level of compliance activity is very low when compared with the number of workplaces. These comparisons with the road safety model clearly suggest that:

- workplaces need to understand what levels of performance are required, rather than have this determined post incident, and
- have much higher levels of targeted enforcement activity by workplace 'compliance officers' (*the black hats*).
- have trained personnel to provide an advisory role to industry for workplace OH&S improvement needs (*the white hats*)

(iii) Market forces - Product evaluation and rating

Compared with passenger vehicles, there is currently little consumer based pressure or mechanisms in place to evaluate let alone improve the safety performance of equipment used in the workplace. This is true whether the equipment is a tractor or a delivery truck or a percussion drill. In road safety, considerable effort has gone in to developing publicly available consumer testing and evaluation of vehicle

crashworthiness. This includes the New Car Assessment Program (NCAP) supported by the major State Road Authorities and Motorist organizations, and Safety Ratings of Vehicles using statistical analysis of real world crash data. Such programs have had considerable impact on both car manufacturers in terms of improving vehicle design and on consumers in providing vehicle safety performance information.

What this comparison means for the workplace, is the need to set up an independent Ergonomic laboratory to test and evaluate equipment from a workplace safety /ergonomic basis and present these results to industry.

CONCLUSION

Overall, it needs to be recognized that successful major programs for injury prevention, as seen from the successful road safety programs, require long term commitment of resources with an on going research, education, engineering and enforcement program, and co-ordination of agencies and resources.

Although there are of course, areas of significant effort and good programs that are being undertaken in OH&S in various jurisdiction around Australia, in general current OHS activities lack many of the elements of the multi-layered safety program evident in road safety. Hence, due to these inadequacies, many of the OH&S programs *cannot* deliver in the levels of industry compliance and OH&S activity required for significant injury reduction in the workplace.

The corollary is that learning from the successful Roads Safety program, will help provide better planing, focus and implementation of the OH&S programs, and significantly increase the effectiveness and outcomes of these efforts.

REFERENCES

Berger LR & Mohan D., *Injury Control- a Global View*, Oxford University Press, Delhi, 1996.

Hopkins A., *Making Safety Work - Getting Management Commitment to OH&S,* Allen & Unwin, 1995.

Larsson T.J & Rechnitzer G. (1994) '*Forklift Trucks-Analysis of severe and fatal Occupational Injuries, Critical Incidents and priorities for Preve*ntion', *Safety Science 17*, Elsevier, p275-289.

Queensland Road Safety Action Plan 1998-1999, PBS 0290, Dec. 1998. Queensland Transport.

Safety First- Victoria's Road Safety Strategy 1995-2000; VicRoads, Transport Accident Commission, Victoria Police. September 1995.

Tingvall, C., *The Swedish 'Vision Zero' and how Parliamentary approval was obtained*. Paper presented to Road Safety Research - Policing- Education Conference. 1-17 November, 1998, Wellington, New Zealand.

Vulcan P, Cameron M & Newstead S., *Road trauma in perspective*. Paper Presented At Vehicle Accidents- Their Cause- Reconstruction Law Conference, Melbourne, 28-29 July 1995, Monash University Department of Civil Engineering.

Waller J.A. *The Reflections Of A Half Century Of Injury Control*; The American Journal of Public Health, V84, 1994. pp 664-670

Wigglesworth EC. *The Fault Doctrine And Injury Control*, The Journal of Trauma, V18, No,.12,1978, USA, pp789-794.