Lessons from Occupational Safety for Work Related Road Safety

Mooren, L\textsuperscript{1}, Grzebieta, R.H.\textsuperscript{1}, Williamson, A.\textsuperscript{2}
\textsuperscript{1}Injury Risk Management Research Centre, University of New South Wales
\textsuperscript{2} Department of Aviation, University of New South Wales
Email lori.mooren@unsw.edu.au

Abstract

The field of occupational health and safety (OH&S) has recently embraced the implementation of a “Safety Management System” (SMS) as a productive approach to reducing workplace accidents. Hale and Hovden (1998) \cite{1} refer to the use of OH&S management systems as the “third age of safety.” This follows the “technical age” which prevailed from the start of the century to post World War II, and the “human factors” age that mostly characterised occupational safety until well into the 1980’s.

The technical age focused on the problems caused by industrialisation, and the need to make work tools and machines safer for workers to operate. Then the human factors approach rose to prominence as the focus was more strongly aimed at worker selection, procedures and training. While systems theory was beginning to be applied to OH&S in the 1960s, particularly in weapons and aerospace industries, the SMS approach did not gain much prevalence until the 1990’s \cite{2}. The relatively new systems approach is reflecting a greater understanding of complex and integrated nature of human interaction with the environments that they operate within. SMS typically includes: policies; strategies; practices; procedures; roles and functions associated with safety with the primary aim of reducing accidents, injury and exposure to risk.

Traditionally, road safety practitioners approach hazards as individual problems and have in general failed to acknowledge the dynamic interactions between them. Taking an SMS view, transport hazards are understood as a set of interacting variables that require interdependent actions to effectively respond to these risks instead of the traditional approach of a group of individual problems with sets of single interventions. This paper reviews the literature about SMS, safety culture, and lessons for effective safety management models for work related road safety. It argues that road safety needs to move beyond the static Haddon model \cite{3}. It further argues that a more holistic and dynamic model for risk analysis and intervention solutions is needed in order to boost reductions in fatalities and serious injuries.

Keywords

Safety management system, road safety, occupational safety, fleet safety

Introduction

Road safety gains resulting from traditional approaches of analysing and addressing the road trauma problem have reached a plateau in some countries, including Australia. Further reductions in road fatalities and serious injuries will require an elevated level of analysis and response.

This paper aims to challenge the road safety community’s traditional approach to defining the road injury problem and to the way in which safety solutions are developed. It does so, through a critical review of the limitations of Haddon’s \cite{3} injury epidemiology and an examination of risk and safety assessments used in fields outside of road safety.

The intention is to stimulate some new thinking about how road safety is managed. Through discussion and exploration, the methods of road safety work can be enriched and strengthened by learning and adapting injury analysis and management methods used in other spheres.

There is a particular focus on methods used in occupational safety and highlights the nexus between road safety and occupational safety especially in the heavy vehicle transport arena.

Injury factor analysis models

The idea that injury can be prevented relies on the premise that injury events can be predicted. This in turn relies on knowledge of injury causation and injury mechanisms. In the case of road safety, the data analysis methods typically used by practitioners are focused on identification of human, road and vehicle
factors contributing to road injury. Using the Haddon [3] epidemiological model (Figure 1), crash events are examined for contributing factors. The most common factors then become the focus of the investment of resources into road safety interventions to achieve best overall safety results.

<table>
<thead>
<tr>
<th>Human Factors</th>
<th>Pre-crash</th>
<th>Crash</th>
<th>Post-crash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 – Haddon Matrix

There are limited sources of information available for analysis of road traffic crashes. At a government jurisdictional level, mass crash data is available for crashes that are required to be reported to roads authorities. This data source assures some confidence in the identification of priority road injury factors, at least for more serious crashes. In New South Wales, although the Traffic Accident Data System (TADS) includes tow-away to fatal crashes, with approximately 50,000 crashes per year, much of the analysis conducted for road safety purposes focuses on fatalities and fatal crashes.

This analysis of data forms the basis of the current strategic approach to road safety management. The Haddon approach enables road safety practitioners to identify clusters of road injury factors within the matrix that can then be investigated further with social, behavioral and engineering research methods. One such illustration of this is a project carried out in Queensland [4]. This project, conceptualised safety issues and strategies in an expanded Haddon Matrix, adding a column entitled, Socioeconomic Environment. The researchers thought that this better enabled both a systematic process of analysis as well as the ability to consider feasibility and logistical concerns, by those involved in recommending school bus safety improvements. While the study authors advised that the use of the Haddon Matrix was a helpful research tool, they did indicate that it is limited in that the model is “primarily descriptive”.

For employers, data may be available on crashes occurring while driving for work through workers compensation, and company medical records. In these work-related datasets, serious injury crashes are likely to be few in number, so safety practitioners and researchers must either extrapolate from general road safety knowledge, analysis of available industry data, or using the risk assessment approach make subjective judgments about likeliness and severity of injury events in work related motor vehicle use.

In occupational safety, where datasets are smaller, some safety analysts have come to use a pyramid or “iceberg” model. Although Heinrich’s [5] “common cause hypothesis” is still debated by some researchers [6], a common practice in occupational safety is to assume that the causes of minor and no injury incidents are similar enough to causes of major injury incidents to enable some confidence about addressing the most important risk factors identified across all incidents. So, as there is often a volume of minor crashes involving employees in organisations, it is believed that the capture of information about these can also be instructive.

Wright et al [7] found some support for using this approach in the UK railway domain. They found that using the Confidential Incident Reporting and Analysis System, or CIRAS, [8] model of macro coding of causes, there are similar sets of individual causes of incidents whether serious or not serious. The macro-codes include technical (mechanical), proximal (preparation, supervision, awareness), intermediate (job, staff, plant), and distal (resources, culture).

This enables railway operators to learn about the most critical areas requiring remedial action from a larger body of data. Adapting and applying these kinds of analyses to, for example, heavy vehicle road transport could be useful to test the efficacy of this approach for road safety.

As road fatalities are diminishing to levels that may not provide enough data for road safety authorities to be confident about capturing the most important injury factors, perhaps more attention to injury data

1 Note: it is important to distinguish between systematic and systemic analyses. Systematic means doing things in an organised way, whereas systemic means addressing the roots of issues. Borys believes that the confusion over the use of these terms has resulted in less than optimal risk control in organisations [2].

Peer-reviewed full paper

2009 Australasian Road Safety Research, Policing and Education Conference © 2009 L. Mooren et al
10 –13 November 2009, Sydney, New South Wales

537
(notwithstanding the problems with the risk of incomplete or inconsistent data sets between the health and road sectors.) It may be useful to test the common cause hypothesis in the road injury data to ensure that there are similar causal foundations to fatal and non-fatal crashes.

A traditional approach using Haddon’s matrix requires substantial quantum of injury crash data in order to identify any conclusive trends in particular road safety problems. In other words, it relies on data clustering to highlight any issues that could be addressed. Moreover, the Haddon model does not enable ready analysis of the combined effects of road safety countermeasures being implemented simultaneously (which is often the case in jurisdictions with active road safety programs.) Elvik [9] concluded that “there is a need for more research in this area in order to develop more sophisticated models for estimating the combined effects of road safety measures.”

In the case of work related driving incidents, there is an opportunity to find out more about circumstances that preceded crash events. These antecedents may have involved human errors that extend some months or years prior to the events that created riskier circumstances for work related drivers. This will be discussed later in the paper.

Currently, road safety and fleet safety research still largely concentrates on the Haddon type of analysis of road injury causation factors.

The first international conference on “Road Safety at Work” hosted by the National Institute of Occupational Safety and Health brought together road safety and fleet safety practitioners. The conference ‘white paper” concludes that “Overall, the Haddon Matrix …. provides an all-encompassing systems-based framework that incorporates all the good practice identified in the report, and is supported by a small, but increasing body of published evaluation data, and many as yet unpublished outcomes.” [10]

Murray’s modified Haddon Matrix diagram in Figure 2 below is a depiction of the corporate interventions that are fitted with the usual cells used in road safety, addressing people, road and vehicle before, during and after a crash, plus some additional columns for management culture, journey and external conditions. He advises, “The percentage figures in the headings are shown for discussion purposes, and represent a best estimate of the relative importance of each factor from a good practice perspective.” Thus, the chart indicates where an organisation should devote resources, programs or actions.

![Murray’s Haddon Matrix for Fleet Safety](image)

A number of organisations have used this framework to guide them in determining what specific aspects of safety management would need to be addressed to assure good control and mitigation of fleet related occupational risk [10]. These case studies demonstrate how the Haddon Matrix has been applied to help audit safety performance, identify gaps, develop business cases and programs, evaluate performance and...
structure investigations after major collisions [11]. However in examining the case studies it is unclear how the Haddon based tool has played a part in safety improvement achievements. Murray’s use of the Haddon Matrix for indicating management actions pre-crash, during crash and post-crash, is a way of conveying things that could be done to better prepare organisations to manage work related driving risk. But these actions are based on subjective judgment about the things that should be logically done, rather than an analysis of how to best intervene systematically in the process of injury causation. Indeed, eliminating a problem at the start of the event chain has no relationship with the end event in the Haddon model.

Increasingly researchers are identifying limitations in the utility of Haddon. Runyan [12] has examined this problem finding that, “Once both dimensions of the matrix have been carefully defined, individual or group brainstorming is useful to generate ideas about interventions in each of the cells.” But beyond listing a number of options that relate to the injury factors in the matrix, the process of determining the best actions to take are not guided by this tool. Her answer is to add another dimension to the Haddon Matrix. This third dimension proscribes a range of decision-making criteria. These include effectiveness, cost, degree of freedom acceptable to motor vehicle users, equity of interventions on users, whether interventions will stigmatise some groups unfairly, preferences of the group affected, feasibility of implementation, and other relevant criteria for decision-making. See Figure 3 for a description of Runyan’s 3-dimensional Haddon Matrix.

Adding this dimension to a static model of injury causation factor categorisation, adds more boxes to work within, giving suggestions of the intervention decision-making criteria to apply. But it does not fix the inherent limitations of the model itself as an injury intervention tool. In addition it seems to add a complexity that may be too cumbersome to use as a tool for planning and programming safety interventions.

That is, taking a snapshot of the contributing human, vehicle, road and social factors, then coming up with ideas about what actions might best fit as controls for these factors, albeit through an organisational decision-making process, still only takes a piecemeal approach to interventions. So perhaps Runyan was half right. The Haddon Matrix is limited to identifying placing injury factors into categories to determine contributing factor prevalence. But adding more boxes for decision-making factors falls short of facilitating sound decision-making about ways to intervene in the injury causation process. That is, the 3-dimensional model is still a static piecemeal approach to injury prevention.

**Beyond Haddon to root causes**

Taking a different perspective, the work by James Reason [13, 14, 15] and others have examined the problem of injury causation in terms of human errors or decisions that occur in various phases of time leading to the injury event in such a way that recognises the compounding process that in its entirety results in injury outcomes. Reason speaks of *active failures* and *latent conditions* (caused by human decisions prior to the event). In this way, injury events are understood as inadequate injury defenses against human errors in a system or process.

While Haddon speaks to three phases of injury causation and a multiplicity of contributing factors, his model doesn’t recognise the dynamic and compounding nature of injury causation process; nor does it convey the interrelationships between the cells of the matrix. Instead injury factors appear in the Matrix as discrete occurrences. Individual road crashes may be reported with detailed chronology of events, particularly fatalities, but the data is then dissected and filed in categories where groupings of contributing factors are aggregated in human, road and vehicle sections. Moreover, the chronology of...
events is usually limited to what the road crash investigator can find at the scene of the crash. It is rare, for example, that Police collect data regarding purpose of journey.

By conducting thorough investigations into all relevant factors present leading up to the time of the road injury event, organisations can find systemic and individual factors involved in crashes. This process can take a number forms. Sklet [16] (2004) reviewed fourteen different methods for this kind of accident investigation. He concludes that “major accidents almost never result from one single cause, but most accidents involve multiple, interrelated causal factors.”

In the occupational health and safety approach, the interrelatedness of causal factors is the crux of the need for a systemic response to crash and road injury risk. This in-depth, or root cause analysis process almost invariably finds a string or series of strings of factors that lead to the injury event. Some models, such as the Tripod Beta method (Figure 4), are based on the idea that all accidents are caused by organisational failings [16].

![Figure 4 – TRIPOD Beta accident causation model](image)

Organisations that undertake root cause analyses of injury incidents can identify individual (active failures) and systemic (latent failures) risks. By looking at injury causation as management system failures, it is possible to devise organisational controls and defenses against active failures becoming injury events. This is important as it is recognised widely that humans are fallible. As Reason states, “We cannot change the human condition, but we can change the conditions under which humans work.” [15]

Safe systems require systemic injury data analyses

Root cause analysis is not new in occupational safety, medical safety and industrial safety. As mentioned above, there are a number of methods for this process. Most focus on chains of events and points of system or human failures, where controls or defenses could be erected to block the “accident trajectory” [13].

A newer model, developed by the Aeronautics and Astronautics Department of the Massachusetts Institute of Technology, has emerged taking into account the need for a more dynamic approach to accident analysis and control [17]. The Systems-Theoretic Accident Model and Process (STAMP) recognises that “accidents occur when external disturbances, component failures, or dysfunctional interactions among system components are not adequately handled by the control system.” This kind of systems based accident model has a stronger focus on understanding why the control system failed, than on the immediate human error factor(s). In other words, it asks how the conditions were developed such that an operator error could result in harm. The STAMP model, “systems are viewed as interrelated components that are kept in a state of equilibrium by feedback loops of information and control.” As such it is a dynamic continual process of examination of the operations of safety control systems and changing internal and external environments. Safety management is defined as a continuous adaptive control task.

Stuckey [18] (2007) determined that the traditional models used to date in road safety were not sufficient for the analysis of risks associated with occupational light vehicles (OLV) and developed an integrated systems model that recognises that road risks emerge within a complex system of interactions between individual “multiple levels of influence on outcomes” (crashes and injuries). As depicted in Figure 2, the individual road user (the “locus of injury”) is placed in the contexts of immediate and external environments (vehicles and roads), organisational environments (prescribing travel tasks), and broader social, legal and economic environments (ethical and regulatory). Recognising these environments provides for a systematic analysis of crash and injury determinants of risk exposure for occupational light vehicle risk.
In Stuckey’s model, the elements of road injury risk are understood within a framework of immediate and increasingly proximal factors. The human, vehicle and environment factors from the Haddon matrix are placed by Stuckey in a contextual depiction of a whole risk scenario. Thus they enable the spheres of risk to be understood as a more dynamic interaction of human errors in different stages of the road injury causation process.

This concept may be a useful one to consider in light of the current Safe System principle underpinning the Australian road safety strategy. The Safe System principle evolved from the Swedish Vision Zero in the mid-1990s that is premised on the principle that road systems should be managed such that human users cannot be harmed through the mistakes they might make in the road traffic environment. Vision Zero introduced the notion that it is unethical not to take all possible measures to safeguard human road users from becoming injured before taking steps to extend the road infrastructure/capacity.

This constituted a fresh way of thinking in road safety strategy. Unlike the traditional approaches to intervention programs for safer roads, safer vehicles and safer people to reduce the likeliness and severity of crashes, Vision Zero takes a more systems based approach. That is, it treats the road infrastructure the way workplaces are treated with the view to placing responsibility on vehicle and road designers and road and road traffic system managers for eliminating hazards that could cause serious harm to road users. However, the overarching system is still compartmentalised into road, vehicle and human elements, albeit shifting the onus more towards road and vehicle system management. When introducing this new law into the Swedish Parliament, the proponent advised, “It is true, that 95% of all crashes or collisions depend on human error, but according to Vision Zero philosophy, 95% of the solutions are in changing roads, streets or vehicles.” [19]

The Safe Systems principle that underpins the Australian Road Safety Strategy represents an evolution of this kind of thinking. This model is based on the idea that, achieving safer road travel, needs to encompass the principle that management systems should be designed around the problem of human tolerance to physical force. Moreover, it assumes that humans have a propensity to make errors and that the system should accommodate this reality.

Conceiving of the problem in this way demands a more advanced model of analysis and intervention planning that recognises the inter-relationships between the various human, vehicle and infrastructure components.

For the Australian road and traffic authorities to truly embrace a Safe Systems approach, a new framework for safety intervention decision-making is needed. It is no longer sufficient to allocate resources to chip away at road injury factors that emerge from a Haddon-based analysis of crash data.
The analysis needs to take into account the relationships between factors, and to delve into root causes, thereby enabling injury countermeasure programs to address injury causation at the system level. More attention may be drawn to latent conditions, as well as active failures, that need to be addressed in a Safe Systems approach. Beyond this, drawing from developments in complex systems safety fields like aeronautics, a dynamic road injury analysis and control model could be pursued.

Root cause analysis and systemic safety approaches are most prevalent in the health care arena. McCarthy and Blumenthal [20] show examples of seemingly dramatic improvements in patient safety through applications of safety management systems that challenge the assumption that adverse events must be tolerated as an inevitable side effect of health care.

But these advances in medical error safety management have drawn from the experience in aviation safety. In fact, one study found that “Pilots were least likely to deny the effects of fatigue on performance (26% v 70% of consultant surgeons and 47% of consultant anaesthetists).” [21] Comparing the differences in safety management approaches in aeronautics versus medicine the researchers conclude that the airline industry has done more than the medical profession to investigate and address (flight) crew attitudes to stress, error and safety, since commercial jet travel was introduced in the 1950s.

Helmreich points out that recognition in the airline industry that human error is ubiquitous and needs to be managed has resulted in the industry’s concerted efforts to recognize and manage human error in a deliberate strategy to use data to inform ongoing efforts to improve flight crew assessment, risk education and other measures to ameliorate this risk [22].

Hierarchy of controls

In occupational safety the “hierarchy of controls” principle is well accepted as a method of controlling or preventing injury. First published by the American National Safety Council in its 1955 edition of the Accident Prevention Manual for Industrial Operations, this Hierarchy of Controls is conceived as a 4-level set of safety management decisions framework. It looks to establishing controls or defenses against injury in four ways. This is presented in graphic form in Figure 5 [23].

The Safe System model calls for the elimination of harm to road users. Elimination is becoming more possible with technologies being introduced that can refuse to allow vehicles to collide with other objects. The second tier of the hierarchy is to engineer the problem such that it will protect the human user from harm, if there is an incident. This is consistent with the Safe System principle of providing “forgiving road environments”.

Lessons from Occupational Safety for Work Related Road Safety

Peer-reviewed full paper
However, for the most part, approaches to safety and injury management have not been shared between OH&S and road safety sectors. For example, Knipling et al [25] examined commercial motor carrier safety management and found that SMS approaches developed and applied in occupational safety disciplines where a strong safety culture was created and existed at all levels of a company, were typically not being applied in transport management at any organisational level. This is despite the fact that OH&S approaches would be most applicable to the heavy vehicle sector because it involves fleets of working drivers.

### Safety management systems

Systemic safety management is still evolving in occupational safety. Indeed at this point in time, there is not a universally agreed definition of a safety management system (SMS). There are a number of conceptions of SMS. There are those that emphasise practices that impact on employee attitudes and behaviours, those that focus on standards and policies, and those that prescribe procedures and processes.

Roland and Moriarty [26] define the system safety concept as “the application of special technical and managerial skills to the systematic, forward-looking identification and control of hazards throughout the life cycle of a project, program or activity.” The emphasis is on the control of hazards from the very beginning or design phases of the system (any system) and for as long as the system operates.

The hazards in the transport process are often complex factors that form interdependent process chains. An example of this is a truck fatality involving driver error due to fatigue – which in turn stems from lack of rest due to factors like long, irregular work hours, heavy workloads, poor scheduling, monotonous roads, difficult or rough vehicle to drive, and little opportunity for rest and recuperation between work shifts. The complexity of the influences on safety outcomes is exemplified in an analysis by Williamson [27], which showed that Australian heavy truck drivers were more likely to use stimulants while driving if they had difficulty managing fatigue, and if they were paid on an incentive basis that encouraged them to do more work. Such examples demonstrate that a number of interrelated risk factors occur at different points in the transport task and that there are a number of possible controls that can mitigate the hazards occurring at each of these points. Following this argument, the case of driver fatigue is likely to be overcome by better scheduling of work and rest time, but both fatigue and stimulant use are likely to be reduced by non-incentive based payment systems.

Given the discussion on the interrelatedness of road injury chains of factors described above, it is prudent to recognise this continuum of causation processes and to develop a framework that best addresses risk in

---

**Figure 5 - Hierarchy of Injury Controls [23]**

- **Elimination**: This means to design the hazard out of the process or to substitute an existing material or process with another that does not pose a hazard.

- **Engineering Controls**: If the hazard cannot be eliminated entirely, engineering measures are added to the process in order to provide protection from the hazard.

- **Training & Warnings**: The objective of training is to teach workers how to avoid a hazard(s). Warnings are means by which the existence of a hazard and how to avoid it are communicated to anyone who may be exposed to that hazard.

- **Personal Protective Equipment (PPE)**: This is apparatus worn on the exposed person’s body that places a barrier between the person and the hazard.
all its manifestations. The International Labour Office [28], defines SMS as a set of interrelated or interacting elements to establish safety policy and objectives, and to achieve those objectives. A SMS typically includes: policies; strategies; practices; procedures; roles and functions associated with safety [29] with the primary aim of reducing accidents, injury and exposure to risk.

There is growing belief that a SMS may be key to good safety outcomes as it has been introduced in a number of high hazard industries such as mining and aviation. However, evidence to support this belief is still fragmented [24, 29, 30]. For example, Bottani et al [24] compared companies that had implemented a SMS to their OH&S problems with those that had not and showed that SMS companies had better performance on a range of outcomes including the number of accidents. Fernandez-Muniz et al [31] in an OH&S study of 455 Spanish companies also showed that a good Safety Management System and safety practices permeating and enhancing safety culture, improve safety performance and reduce accident risk. While no one has yet applied SMS approach to road safety and validated that the method can reduce crashes and associated road trauma, there is reason to believe that this would be a worthwhile endeavor.

In recognition that injury events are usually preceded by a number of interacting processes and conditions, an approach to work related road injury prevention begs for a series of interacting management processes to ameliorate the injury hazard. Indeed the Chain of Responsibility (CoR) principle applied to transport and occupational safety regulation in Australia, recognises that there are a number of processes and entities involved that influence safety risks.

For example, in transport and logistic chain, consignors, contractors and consignees share responsibilities with the drivers and transport operators in controlling injury risk associated with heavy vehicle transport operations. Under transport laws premised on CoR, everyone in the supply chain has responsibilities to prevent driver fatigue and ensure drivers are able to comply with the legal work/rest hours. The actions, inactions or demands that cause or contribute to road safety breaches place legal accountability on:

- the employer of a driver;
- the prime contractor of a driver;
- the operator of a vehicle;
- the scheduler of goods or passengers for transport by the vehicle and the scheduler of its driver;
- both the consignor and consignee of the goods transported by the vehicle;
- the loading manager i.e. the person who supervises loading or unloading or manages premises where regular loading or unloading occurs; and
- the loader and unloader of the goods carried by the vehicle.

**Support and guidance for safety management systems**

With regard to applying occupational safety management practices to managing road safety at work (sometimes referred to as ‘fleet safety’), there have been some attempts to design safety management frameworks. An early attempt by the Federal Office of Road Safety together with the National Safety Council of Australia was the production of a Fleet Safety Manual [32]. This Manual provides tips for employers seeking to improve fleet safety in their organisation. Following this, a number of Australian State and Local Government agencies produced fleet safety management guides. Beyond Government efforts industry groups, insurance companies and consultants have developed fleet safety management system frameworks, policies and resources to guide good practice in improving work related road safety. [33]

The uptake on these resources is unknown. Moreover, they have not been independently evaluated for efficacy of their recommended practices. However, these efforts demonstrate the growing interest by employers to actively pursue good practice in managing safety risks related to work related driving.

**Developing SMS for heavy vehicle transport safety**

The authors believe that independent pilot testing and research into important elements of fleet safety management will assist to refine approaches to road safety management and are developing a project to do this. The study will examine the safety systems in operation in transport companies with good outcomes and those with poor safety outcomes. Then a SMS will be prepared, based on learning from the literature as well as from examining practices and systems in a sample of transport companies. In a second phase of the study, a model safety management system will be piloted and evaluated.
What is different and innovative about this approach is the application, and in particular the validation, of a Safety Management System approach using the heavy vehicle transport safety as an exemplar. This SMS approach has not been applied or evaluated in any part of road transport.

Until now, the much of the fleet safety management intervention research are focus group studies and individual case study examinations [10, 34]. Only one sizeable quantitative comparative study of fleet safety interventions has been documented [35]. The novelty of the SMS approach for road safety is that it focuses on the wider context or system of road transport recognising that hazards or risk factors are interrelated and interdependent. By focusing only on discrete causes of crashes, the current approach in road safety may be failing to take into account pre-existing failures in the road safety system that have not been recognised as the root cause of the crash. Taking an SMS view, the study will conceptualise transport hazards as a set of interacting variables that require interdependent actions to effectively respond to these risks instead of the traditional approach of a group of individual problems with sets of single interventions.

This study promises to contribute significantly to road safety science by moving beyond the compartmentalised and static epidemiological Haddon model of identifying separate road, vehicle and human risk factors that has underpinned road safety in many countries since the 1970’s. Whilst the Haddon model has and continues to serve society well in addressing road safety risks, road casualties have reached a plateau over the past decade in Australia and in other countries. A recent report from the OECD International Transport Forum [36] stated: ‘…most countries have achieved significant improvements in road safety over many years, but many are finding further improvements progressively more difficult to achieve’.

Conclusions

This paper has reviewed and explored models and frameworks for managing road safety in the public arena and in the corporate driving arena. We have shown that while some of the traditional tools in road safety, particularly the Haddon Matrix, have served well to focus attention to the most important injury risk factors, there are still gaps in the tools road safety practitioners use to determine the best solutions to mitigating these risk factors. As Runyan has indicated, the Haddon Matrix is an insufficient tool for this. But the total answer is probably not to simply add a third dimension to the Matrix.

Instead of making injury factor analysis the central platform for the safety management system, this element of managing safety should be seen as one important element in the system. Safety management should begin with a policy framework. Road traffic system managers and corporate driving managers aspiring to a Safe System goal would ideally begin with a committed vision to achieving organisational objectives without harming people involved in the pursuit of these objectives.

In other words, instead of starting with a system that is driven solely by injury events, a safety management system framework would put in place elements that anticipate hazards and prevent injury events with ongoing processes and mechanisms embedded in the way the system is managed.

Future substantial reductions in road injury will require a multi-disciplinary and multi-sector systems approach to overcome the complexities of the dynamically interacting road safety variables. With a systems focus, as is the case for this proposed innovative study, the difference will be that, for example, speeding or driver fatigue will not be categorised simply as a behavioural risk. Rather, using a systems approach, they will be understood as management system problems that require a complex system-strengthening response involving policy development and enforcement, work and journey planning, safety risk management education and other systematic management actions.

A paradigm shift in road safety thinking is needed and an SMS approach provides that opportunity to think about the solution in a different, smarter way.
References:


Peer-reviewed full paper

2009 Australasian Road Safety Research, Policing and Education Conference © 2009 L. Mooren et al
10 –13 November 2009, Sydney, New South Wales 546
and aviation: cross sectional surveys’, BMJ Volume 320 18 March 2000


33. International Association of Oil and Gas Producers (OGP), Land transportation safety recommended practice, Report No 365, 2005


35. Gregerson NP, Brehmer B, Moren B, ‘Road safety improvement in large companies: an experimental comparison of different measures’, Accident Analysis and Prevention 28 (3), 297-396