MONASH University

ACCIDENT RESEARCH CENTRE

# Development of a systems thinking investigation tool for light vehicle work-related incidents

REPORT PREPARED FOR WORKSAFE VICTORIA

**October 2021**

**This project is funded by WorkSafe Victoria, through the Institute for Safety, Compensation and Recovery Research.**

# INTRODUCTION

Workers that drive light vehicles (e.g., passenger vehicles, utility vans) represent 30% of registered motor vehicles in Australia. Driving for these workers is often considered to be secondary to their primary job role (e.g., in-home nursing care, sales representatives; Newnam et al., 2012). Despite this, these workers have significant exposure to the inherent dangers of the road transport environment, with some workers reporting driving over 1,100 kilometres per week (NRSPP, 2015). In fact, it has been estimated that 33% of work fatalities occur while driving (Driscoll et al., 2005). Unlike the road freight transport industry, a Chain of Responsibility does not exist for managing the safety of individuals that operate a light vehicle. Thus, limited lessons have been learnt for preventing these incidents.

The lack of systematic and rigorous investigation of system and organisational-level circumstances of individual crash incidents involving light vehicles is an impediment to progressing the safety improvements needed to ensure worker and public safety on roads. We have learnt from other safety critical environments (e.g., healthcare; Newnam et al., 2020; 2021) that a systems thinking approach is required as a first step to better understand incidents, review and revise existing risk controls and to develop feasible and practicable control measures. The Monash University Accident Research Centre (MUARC) in collaboration with WorkSafe Victoria aimed to develop a prototype 'systems thinking' tool to review and revise control measures to prevent and manage light vehicle work-related driving incidents and near misses.

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**The end goals of the project were to:**

Provide a standardized process for reviewing and revising risk controls following the report of an incident or near miss involving a work-related light vehicle

Help WorkSafe Victoria to identify strategic interventions to drive systemic change required to prevent light vehicle work-related driving incidents and near misses

**The objectives of this proposed project were to:**

Develop a prototype 'systems thinking' tool for investigating light vehicle work-related incidents and near misses

Pilot the application of the tool for guiding a systems thinking investigation of light vehicle work-related driving incidents or near misses

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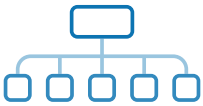
This report presents a brief summary of (i) the key findings of the stages of the project and (ii) the pilot application of the tool with three case studies involving light vehicle work-related vehicle incidents and near miss. A more detailed analysis of the findings will be presented in forthcoming peer review journal papers.

# **STAGE ONE:** DEVELOPMENT OF THE TOOL

The tool was developed through a co-design process with key representatives from MUARC, the Program Director of the National Road Safety Partnership Program (NRSPP) and WorkSafe Victoria. Three stages were involved in the development of the tool including:

A systematic review of the literature to identify factors associated with work-related driving crashes

A workshop with representatives from MUARC, WorkSafe Victoria, industry and the Program Director of the NRSPP



Development of a classification scheme that represented the factors contributing to crashes

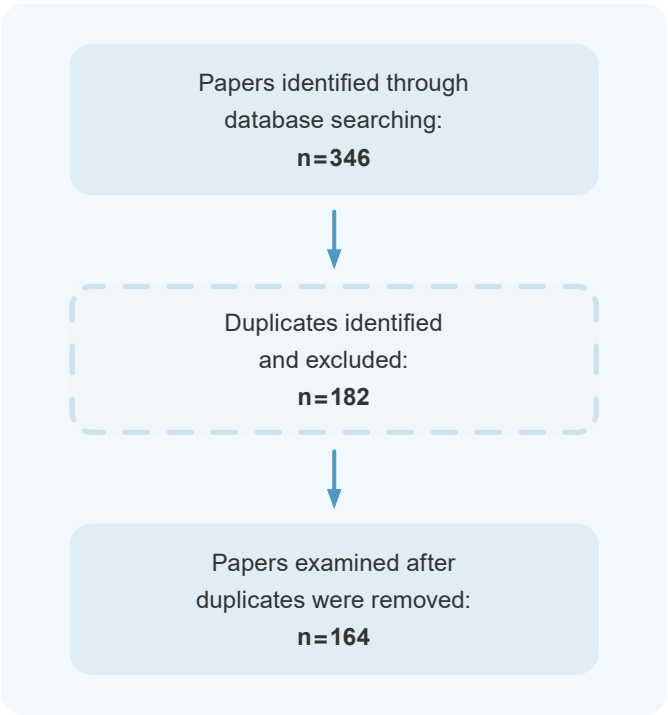



***Figure 1:*** *Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow chart of systematic search*

The framework underpinning the classification scheme was based on a systems thinking accident analysis method, Rasmussen's (1997) Accimap technique, as well as WorkSafe Victoria's guidance material on risk controls relevant to work-related driving. The project adopted key methodological and theoretical components of the successful 'Patient Handling Injury Review of Systems' (PHIRES) project to improve the efficiency of the prototype development stage. The following describes each of the stages involved in the development of the tool.

## SYSTEMATIC REVIEW

A systematic review of the literature was undertaken to identify factors contributing to work-related driving crashes. The systematic review search terms covered concepts ranging from, but not limited to 'workplace'; work-related'; 'safety'; 'risk'; 'crash'; 'accident'; 'ticket'; 'penalty'; 'risk factor'. The search was restricted to papers published from 2010 – present. Six databases were used to conduct the search (Medline, PubMed, AMED, Scopus, PsychINFO and Web of Science). Figure 1 illustrates the stages of the systematic review. Studies that identified the relationship between work-related driving crashes for both light and heavy vehicles were included to expand the scope of knowledge.

Each individual risk factor identified in the systematic review was mapped onto the relevant level of an adapted version of Rasmussen's risk management framework (Rasmussen, 1997). Figure 2 shows that the highest proportion of risk factors were identified at the Drivers and Other Road Users level (n=83, 47.7%). No risk factors were identified at the regulatory and government bodies levels of the framework.

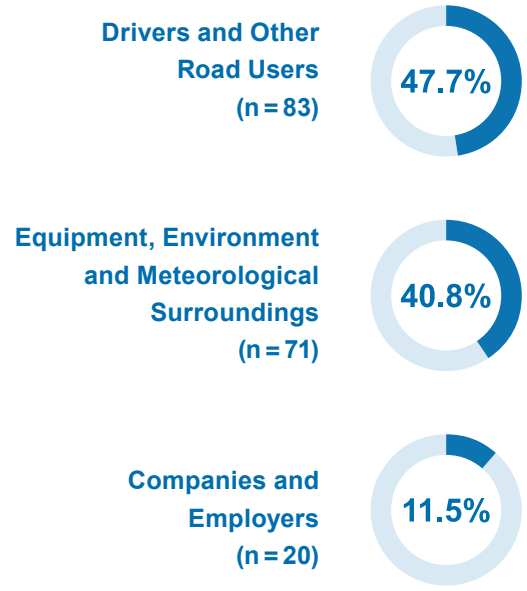



***Figure 2:*** *Percentage of risk factors identified by the systematic review at the 3 lower levels of an adapted version of Rasmussen's risk management framework*

A description of the risk factors identified at the three lower levels of a system are described, below.

TABLE 1: The risk factors identified at the Equipment, Environment and Meteorological Surroundings Level (n=71)

| Level of system | Risk factors | |
|---|---|---|
| **Equipment (16 articles)** | Warning signals (2 articles)<br>In-vehicle technology (1 article)<br>Vehicle specifications (2 articles)<br>Design of vehicle (2 articles) | Maintenance (1 article)<br>Road signage (4 articles)<br>Load/storage (3 articles)<br>Personal protective equipment (1 article) |
| **Environment (42 articles)** | Road surface conditions (6 articles)<br>Urban/rural (5 articles)<br>Road furniture (2 articles)<br>Time of day/week (8 articles) | Traffic congestion (2 articles)<br>Season of year (2 articles)<br>Road design (13 articles)<br>Speed limit (4 articles) |
| **Meteorological conditions (13 articles)** | Lighting (4 articles)<br>Weather conditions (8 articles)<br>Visibility (1 article) | |

TABLE 2: The risk factors identified at the Drivers and Other Road Users Level (n=83)

| Level of system | Risk factors | |
|---|---|---|
| **Work design (5 articles)** | Job demands (4 articles)<br>Safety culture (1 article) | |
| **Drivers (76 articles)** | Aggression (3 articles)<br>Inattention/distractions (3 articles)<br>Alcohol/drugs (5 articles)<br>Personality traits (2 articles)<br>Safety attitudes (2 articles)<br>Physical/medical condition (8 articles)<br>Driving behaviour (9 articles)<br>Experience/competence (6 articles) | Hazard perception skill (2 articles)<br>Seat belt (4 articles)<br>Drugs/medication (2 articles)<br>Risk perceptions (3 articles)<br>Fatigue / Sleepiness (10 articles)<br>Traffic violations (10 articles)<br>Speed (5 articles)<br>Sleep quality (2 articles) |
| **Other drivers (2 articles)** | Behaviour: general (2 articles) | |

TABLE 3: The risk factors identified at the Companies and Employers Level (n=20)

| Level of system | Risk factors |
|---|---|
| **Leadership (3 articles)** | Mental health/wellbeing/OHS (2 articles)<br>Safety culture (1 article) |
| **Work scheduling (17 articles)** | Rostering (7 articles)<br>Shift work (4 articles)<br>Breaks (4 articles)<br>Workload (2 articles) |

## WORKSHOPS WITH KEY STAKEHOLDERS

One workshop was undertaken with MUARC and WorkSafe Victoria representatives, the Program Director of the NRSPP and an organisation that operates a light vehicle fleet. The purpose of the workshop was to:

Identify and refine risk factors relevant to light vehicle work-related driving incidents and near misses, beyond those already identified in the systematic review.

Contextualise the wording of the risk factors to ensure relevance to the work-related driving context.

The workshop generated significant discussion and resulted in several refinements to the list of risk factors identified in the systematic review.

## DEVELOPMENT OF THE CLASSIFICATION SCHEME

The risk factors identified in the systematic review and through consultation with key stakeholders in the workshop were consolidated and illustrated at each level of the adapted version of Rasmussen's risk management framework. The final product was a classification scheme of risk factors associated with light vehicle work-related driving incidents (see Appendix A).

# **STAGE TWO:** PILOT APPLICATION OF THE TOOL

Stage two involved piloting the application of the tool for guiding a systems thinking investigation of light vehicle work-related driving incidents and near misses. We recruited a private organisation to provide data to populate the case studies. MUARC and the NRSPP had an existing relationship with this organisation.

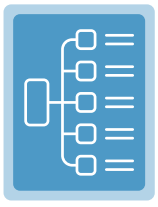
In this organisation, staff (i.e., Associates) are required to drive for work for multiple reasons including visiting customer premises, visiting various client locations and attending tradeshows or conferences. The nature and duration of driving varies dependent on the role of the Associate. For example, some Associates drive several hundred kilometres a week (e.g. field sales role) to only occasional driving (e.g. Associates undertaking incidental site visits). The overall responsibility to provide and manage safe workplaces whenever Associates use vehicles for work include vehicles owned, leased, or hired by the organisation as work vehicles.

The organisation has an ongoing partnership with leasing companies that provide a fleet of selected vehicles to ensure the Associates can undertake their scope of work. Field Sale Associates who drive to and from different locations for work purposes require a Tool of Trade Vehicle. All field sale Associates are based from their home, whereby their first and last trips are classified as work-related.

## CASE STUDIES

Two key modifications to the existing PHIRES tool were made to contextualise the tool for investigation of light vehicle work-related driving incidents and near misses. The two modifications involved:

The key stakeholder list at each level to align with names and relevant roles.



The classification scheme of risk factors associated with work-related driving incidents was used to guide the end-user in considering factors at each level of the system, relevant to the incident under investigation.

Pilot application of the tool was undertaken on three incidents, all of which were reported by Associates in the organisation. Three individuals that were involved in an incident (n=2) and reported a near miss (n=1) where interviewed about their experience and asked to provide details about the factors that contributed to the incident under investigation.

Figure 3 describes the six steps and associated data collection templates used in the investigations. Population of the tool was led by Associate Professor Sharon Newnam from MUARC and Jerome Carslake from the NRSPP, in partnership with the Associate and a member of the Risk Management and Safety team within the participating organisation.

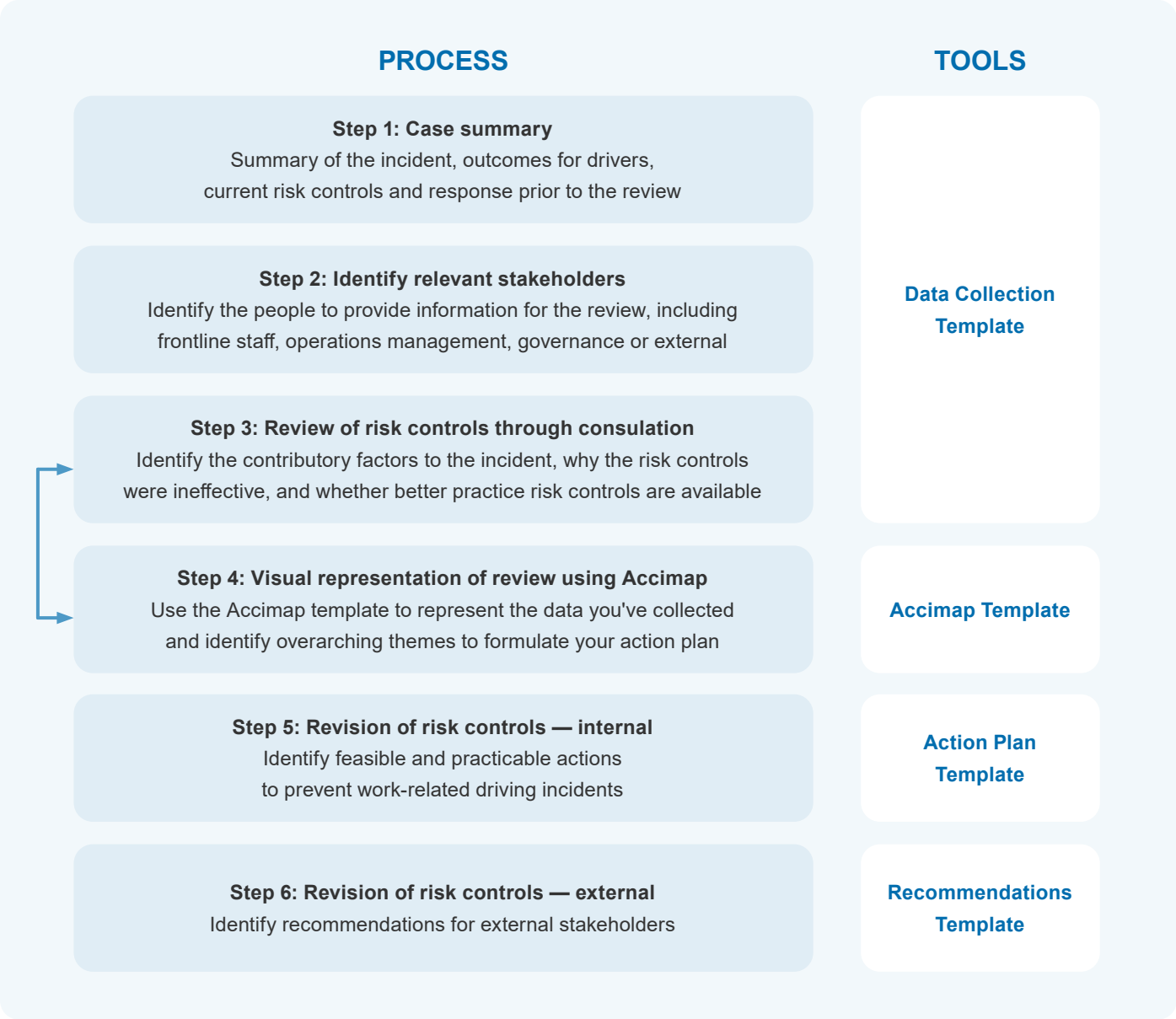



***Figure 3:*** *Overview of the work-related driving incident review process, including development of the Accimap (Step 4)*

## DESCRIPTION OF THE CASE STUDIES

Case Study One was a near miss incident. The Associate was driving from one store to another and was being vigilant in the safety checks. The Associate looked in the rear-view mirror and noticed that the driver was being inattentive and did not notice the Associate's vehicle was stopping. To avoid a rear-end crash, the Associate pulled into the left-hand lane, as no vehicles were identified.

Case Study Two involved a rear-end crash. There was no injury to the Associate but damage to the bumper of the vehicle. The Associate had entered a short (50m) straight street, stopped at a give-way sign to turn left onto a main road when the vehicle behind rear ended the Associate's vehicle. The Associate did not see the vehicle behind as they were concentrating on giving way to traffic travelling along the main street.

Case Study Three involved an incident that resulted in damage to the vehicle. No injury was sustained by the Associate. The load in the vehicle in front of the Associate's vehicle was not secured and came loose. A large tub dropped out the vehicle and went under the Associate's vehicle. The side bumper of the Associate's vehicle came loose as a consequence.

**Pilot application of the tool for each of these three case studies is presented in Appendix B-D.*

## OVERVIEW OF THE FINDINGS OF THE CASE STUDIES

Pilot application of the tool provided evidence that the tool helped guide a systems thinking investigation of incidents. This conclusion was evidenced by the:

1. Risk and protective factors were identified within and across levels of the system. Each of the case studies identified factors contributing to the incidents and near miss across all five levels of the system. There was also a significant number of factors identified at the higher levels of the system. These factors would not have been identified using a traditional (i.e., linear) approach to investigations.

2. The Accimap method (Step four) illustrated the complex network of factors that contributed to the incidents and near miss under investigation. That is, relationships were identified between factors within and across levels of the system for all three reports.

3. Actions were generated that promoted the review and revision to risk controls and identified a role and responsibility for key stakeholders, both internal to the organisation (e.g., developing the skills of all levels of leaders in being proactive in their communication to promote workplace road safety) and external (e.g., development of accreditation standards to be developed to help guide employers in managing the risk associated with vehicle as a workplace). Several actors across the system were also identified in the responsibilities of actions (WorkSafe Victoria, Road Regulators, NRSPP).

Two aspects of the pilot application highlighted the versatility of the tool. First, the tool was successfully piloted on a near miss and incidents involving property damage. Investigation of near misses is a new form of investigation using this systems thinking approach to investigation. Second, the tool was used to identify both risk and protective factors. That is, factors that contributed to the risk of the incident as well as factors that protected the Associates from injury were identified using the tool. This aspect of the investigation process allowed us to identify risk controls that were effective in preventing injury as well as those risk controls in need of revision and the need for the development of new risk controls.

# CONCLUSION

This report presents the findings from the development and pilot application of a tool to investigate light vehicle work-related driving incidents and near misses. The tool was developed using an evidence-based approach for identifying risk factors contributing to work-related driving incidents and refined through consultation with the NRSPP, WorkSafe Victoria and a participating organisation that operates a light vehicle fleet. The data collected through the development stage (i.e., systematic review, workshop) were used to develop a classification scheme for risk factors associated with light vehicle work-related driving incidents. The classification scheme was subsequently used to help guide the investigation of risk factors as well as those factors that protected the worker from sustaining injury. The latter outcome was a novel application of the tool that highlights its versatility in mitigating against risks.

Pilot application of the tool illustrated that the tool helped guide a systems thinking approach to the investigation of light vehicle work-related driving incidents and a near miss. This conclusion was evidenced by the (i) factors identified within and across all levels of the system, (ii) complex network of relationships identified between factors and (iii) actions generated that identified the review and revision of risk controls and development of new risk mitigation strategies for internal (i.e., organisation) and external stakeholders.

The end-goal of this project is to help WorkSafe Victoria and organisations operating light vehicle fleets identify strategic interventions to drive systemic change to prevent incidents.

The next steps in achieving this goal include:

1. Training in application of the tool across industries and government agencies who operate a light vehicle fleet. Opportunities for training could be identified through the NRSPP and their diverse range of program partners. Training could also be provided to WorkSafe Victoria inspectors to educate them on the system of factors contributing to light vehicle work-related driving incidents.

2. Evaluation of the short- (i.e., implementation and usability), medium- (e.g., change in awareness and culture relevant to workplace road safety) and long-term benefits (e.g., increased reporting of work-related driving incidents, reduction in light vehicle work-related driving incidents) of using the tool in mitigating against risk for organisations operating a light vehicle fleet.

# REFERENCES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# **APPENDIX A:** CLASSIFICATION SCHEME OF RISK FACTORS

## GOVERNMENT, REGULATORS AND EXTERNAL INFLUENCES

**Government & Regulations**
- Accreditation standards
- Funding and priorities
- Guidance material
- Legislation/regulation
- Political influence
- Communication
- Auditing
- Safety strategies

**Unions / Employer Associations / Peak Bodies**
- Support for OHS
- Political Agenda

**Suppliers**
- Expense/availability of equipment
- Equipment standards
- Training specialisation
- Maintenance schedules

**External Influencers**
- Reporting from media
- Social media
- Community attitudes
- Enforcement activities
- Social networks

## GOVERNANCE AND ADMINISTRATION

**Management Systems**
- Approval and change management
- Consultation
- Human resources
- Policies and procedures
- Risk management
- Safety monitoring
- In-vehicle technologies
- Incident reporting system
- Security systems
- Committees
- Recruitment protocols

**Resources**
- Funding
- Costs
- Time allocation to training
- Awareness campaigns
- Employment arrangements
- Mentoring
- Shared learnings

**Leadership**
- Safety culture
- Reporting culture
- Senior management commitment
- Communication
- KPIs
- Organisational change
- Priorities
- Strategies: safety/health/wellbeing

## OPERATIONS MANAGEMENT

**Supervisors**
- Communication
- Support from supervisors
- Co-operation between work areas
- Quality of supervision
- Priorities of supervisor

**Work Scheduling**
- Rostering
- Contingency planning
- Shift work
- Breaks
- Workload
- Time Pressure
- Time allocation for administration

**Work Systems**
- Budgets
- Equipment maintenance
- Equipment selection
- Skill-based training
- Education & development
- Role expectations
- Data analysis & feedback

## DRIVERS AND OTHER ROAD USERS

**Work Design**
- Job control
- Job demands
- Role conflict
- Work schedule leading up to incident

**Drivers**
- Aggression
- Inattention/distraction
- Alcohol/drugs
- Sleepiness
- Physical/medical condition
- Driving behaviour: general
- Seat belt
- Drugs/medication
- Mobile phone use
- Driving history
- Speed
- Sleep quality

**Other Drivers/Riders**
- Behaviour: general
- Decisions & actions
- Communication

## EQUIPMENT AND SURROUNDINGS

**Equipment**
- In-vehicle technology
- GPS systems
- Mobile phone
- Design
- Vehicle modifications
- Maintenance
- Fit for purpose
- Load/Storage
- PPE
- Vehicle specifications

**Environment**
- Urban/regional
- Weather conditions
- Lighting
- Visibility
- Time of day/week
- Traffic congestion
- Road design
- Road surface conditions
- Road furniture
- Warning signals
- Road signage
- Posted speed limit
- Incident response/ breakdowns
- Animals

## Further information

**Associate Professor Sharon Newnam**
Associate Director, Systems Safety Team

**Monash University**
Accident Research Centre

M: 0422 723 957
E: Sharon.newnam@monash.edu

CRICOS provider: Monash University 00008C